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INDEX TO VOLUME XXXVIII.

Owing to the large bulk of the present number, the Index for the volume just completed will be reserved for distribution in the issue of next week.

ELECTRIC LIGHTING IN NEW YORK.

The city of New York will always be historical ground for the electric lighting art, not only on account of the early work done here in commercial arc lighting, but because here a great many of the fundamental problems in incandescent lighting were first worked out in connection with the old Edison Pearl Street Station. Thirty years nearly of arc lighting and almost a quarter of a century in incandescent work have seen changes that can but be described as tremendous, yet as we describe this week the great Waterside station of the New York Edison Company, a continuity of influence and aim is felt and realized amid all the confusing technical, financial and industrial developments that have been crowded into the period. We can personally look back over the whole evolution, revolution and growth, and see in it but the promise of even greater results in the future. Out of a welter of systems, competitions, methods, voltages, apparatus, companies, has emerged one splendid comprehensive plan, one ideal, one leadership, directed specifically to the purpose of affording uniform service throughout the Island of Manhattan. This result had to be—it had to come, whatever the difficulties and obstacles—and now that it is here every citizen of New York, with all who are interested in the progress of electric lighting, is deeply concerned in what has happened.

This magnificent Waterside station represents a stage in the art. It is neither perfection nor finality, but it is a splendid realization of the best existing practice and the highest current theory, and deserves intimate study for its own sake. We illustrate and describe the plant just as it goes into service, and yet the demands for electricity in New York for light, power and heat increase so rapidly, the complete station which began its career this Christmas will have all it can do next Christmas to meet the call, with every unit going. In such conditions it is easy to see not alone the great future for electrical applications but the onerous problems to be met by the engineers and capitalists who propose to serve three million people.

ELECTRICAL PROGRESS DURING 1901.

Although the past year has not witnessed any startling electric novelty, yet it has fostered a remarkable development in many directions. Particularly active departments of electric industry have been electric railways, water power transmission, telephony and wireless telegraphy. In electric railways there has been a steady development of new lines, and of improved electric schedule times upon existing tracks. In water-power transmission systems there has been a steady increase in the powers utilized, and in the pressures employed, the existing limit being 60 kilovolts. Along with this development there is a greater confidence in the reliability and certainty of electric power transmssion under pressures that until recently have been considered as very high. In telephony there has been a very considerable extension of existing subscribers' systems, the gradual substitution of the central battery at exchanges, for the scattered batteries at subscribers' stations, and considerable improvement in exchange switchboard design and installation. By the principle of loading long aerial lines or cables with inductance at suitable intervals, the pre-existing limitations of long-distance telephony have been

greatly widened, and it would seem as though, eventually, commercial telephony might become possible across the length and breadth of the North American continent, and perhaps across the oceans.

Wireless telegraphy has made considerable progress over the ocean, and a number of ships, as well as shore stations, have adopted it. It seems to be only a question of time when every important lighthouse and signal station on the coast will be equipped with wireless apparatus, and every important vessel on the ocean will be likewise enabled to maintain communication for long distances at sea. Not only in the practical applications, but also in the knowledge of the science of electricity, a steady development has been and is taking place. A mere glance at the articles of technical journals, on the one hand, shows the steady gain and improvement of technical knowledge among specialists, while a glance at the nature and number of articles in semi-popular literature, shows how widespread is becoming the more general knowledge of the elements of electricity and magnetism among the masses of the people by comparison with the corresponding conditions a few years ago.

The amount of capital invested in electric industries continues steadily to increase, on the one hand, while, on the other hand, the applications of electricity are becoming more widely understood and more intelligently handled. Whereas only a few years ago it was difficult to find a workman who could look after electric motors properly without a special course of training, it is now becoming more frequently the rule to find experience in the care and application of electric motors and generators among comparatively unskilled workmen. In every direction electricity is becoming year by year of greater value and importance to the world.

Automobile Efficiencies.

Although the electric automobile has apparently been getting the worst of it in some quarters during the past twelve months, and some reforms and improvements over former defective constructions are needed, the outlook is by no means discouraging. As we have said before, the electric vehicle will win out in the end for city use. Abundant support for this opinion can be found. But this consolation lies not so much in what these vehicles have done as in what they have not done. If the art of electric vehicle building had reached the point where it was not easy to see directions in which improvements could easily be made and the results were no better than the average attained to-day, it would be discouraging indeed. But with such evident defects as are to be noted on so many of the earlier vehicles, the only wonder has been that the results are as good as they have been. That improvement is at hand is evident.

The shortcomings of the automobile storage battery have been too well debated to need recounting, the principal charges against it being its uncertain mileage due to deterioration and its high maintenance cost. It has commonly been assumed that the only weak point of the electric vehicle of whatever kind was in the battery, and that the electrical and mechanical efficiency left little room for improvement. How far from the truth this latter statement is, only those know who are intimately connected in a technical way with the electric vehicle business. When vehicles of the same weight and speed vary so widely in electrical and mechanical efficiency that one will require 50 to 75 per cent more energy than another, something is wrong. And yet this, we are informed by engineers who are in a position to make accurate observation, is a common occurrence. A battery manufacturer with a reputation for batteries of great mileage capacity per pound smiled knowingly the other day when the subject was broached, and remarked that batteries got both the blame and the credit for many things the battery maker has nothing to do with; that automobile builders would do well to look into the efficiencies of motors and running gears as well as search for better batteries. Coming from a battery maker, who might easily make temporary capital out of ignorance on the part of automobile builders and users as to some of the secrets of big mileage tests, the statement is significant.

This gentleman, however, took the broad-minded view that the more that is known about motor and running gear efficiencies, the better it will be for the battery maker in the end, even if he does have to divide the credit for large mileage on one charge with the vehicle maker. Hence we understand that he is about to proceed with a campaign of education and practical demonstration on efficiencies. It is, of course, true that the vehicle that will give the highest possible efficiency between the battery terminals and driving wheels will not be commercially practical because of structural weakness, but that there is a great deal of room to improve the average efficiency of electric vehicles as they have been commercially turned out there is little doubt. So far in these remarks we have dealt with the situation as it is, but obviously the availability of the Edison battery this year would in itself, while helping the art enormously, not cure any of the drawbacks due to the low efficiency of motors and gears.

The Metric System of Weights and Measures.

It will probably interest our readers to learn that two bills have been introduced within the last few weeks into the House of Representatives, for the adoption of the metric system of weights and measures in the United States. These bills are marked H. R. 123 and 2054, respectively, and have been referred to the Committee on Coinage, Weights and Measures. The bills are alike remarkable both for their brevity and for their comprehensiveness. Both propose (1) that after a certain date all the Government departments of the United States shall be required to employ the metric system of weights and measures exclusively in all departmental work, except in the survey of public lands; (2) that after a certain date the metric system of weights and measures shall be the legal standard of weights and measures in the United States. The only essential difference between the two bills is as regards the dates involved. One calls for the 1st of January, 1903, as the date of Government adoption, and the 1st of January, 1904, as the date of universal legalization. The other bill makes both these dates the 1st of July, 1902.

All those connected with electrical industries are specially interested in the general introduction of the metric system of weights and measures, for the reason that all the units employed in electrical engineering are based upon the metric system and are in conformity therewith. Electromagnetic units may be said to form an extension of the metric system in this direction. It is impossible to compare the barbarous and incoherent assortment of heterogeneous weights and measures in force in this country with the simple and connected system of metric weights and measures in force on the continent of Europe, without being impressed with the immense aggregate amount of unnecessary labor which is imposed upon the American people in learning to weigh, to measure, and to compare quantities; as well as the large amount of impediment that the existing ridiculous system introduces in the way of attaining all quantitative knowledge. Every reasonable person will admit the great advantage which the money decimal system of this country possesses over the money non-decimal system of Great Britain. The advantages of the metric system of measures over the non-metric system of measures is, however, still greater than that which exists in the case of moneys. It is a scandal that this country, in establishing good government in Cuba, Puerto Rico and the Philippines, should be instrumental in so far subverting the cause of education as comes through replacing in those

countries the pre-existing simple metric system by the ponderous system still existing here.

Consequently, while nearly every intelligent individual will naturally be in favor of introducing the metric system, which system is now in vogue through the entire scientific world, and in a large portion of the commercial world, the question arises as to how the change should be brought about, because the change necessarily involves labor and expense, and the injury inflicted upon the public by a sudden transition to the metric system might be much greater than the injury which exists in perpetuating the existing system. In the nature of things, a number of years must elapse before the existing system of measures can be entirely superseded by the international system. Under the new regime, however, education will be facilitated, statistics of all kinds simplified, foreign trade aided, and mental processes of all kinds abridged and clarified. It would seem that the first great step to be desired is the adoption of the metric system by all the United States Government departments. This change would involve a gradual adoption by the people without inflicting injury upon any industry. All persons having dealings with the Government would speedily become acquainted with the value and use of the metric system, and would in turn act as teachers of that system to those within their own sphere of influence. At some date after the exclusive adoption of the metric system by the Government, the system could be exclusively legalized, but it is more difficult to decide as to when this latter step could be taken without involving heavy expenditure upon the makers of tools and machinery. The introduction of the new system should be carried out in the country in such a manner that all new tools as needed should be made with a view to the metric system, without necessarily causing the existing tools and machines to be immediately abandoned.

THE FUTURE OF THE ELECTRIC RAILWAY.

The last two or three years have been rich in experience in electric railroading, and the most striking thing about it all is the almost entire lack of sensational features such as might not unnaturally have been expected. All the startling developments, such as get widely heralded in the daily press and promise to turn things topsy-turvy if they materialize, have been initiated on the other side of the water. Meanwhile, the progress here has been one of steady growth, each new road working with a little freer hand and on a little larger scale than its predecessors. By far the most interesting line of advance has been among our interurban roads of the larger class. Starting out as tramway extensions, electric interurban roads have by almost imperceptible degrees grown into a place which is in great measure unique. They run long and heavy cars quite comparable with ordinary passenger coaches, at speeds similar to those customarily employed in ordinary railroading, with an approximation more or less near, to every-day railway methods. The modern interurban road, therefore, occupies a somewhat anomalous position. It practically deals with the passenger traffic of an ordinary steam railroad, while in most instances it is ostensibly still a tramway using public roads and streets to a certain extent, having grade crossings without material restrictions, and in general enjoying the privileges and immunities of street railways while doing the work of a steam road so far as public convenience is concerned.

Utility is the strongest argument that can be brought to bear upon the public, and modifications in this simple but evidently temporary stage of growth have come spontaneously and from engineering considerations. It has not taken long to find out that when quick transit between two cities is established and long and heavy cars are operated, the track must be of a correspondingly solid and reliable character. So it has come to pass that the average new interurban line uses a heavier rail and a more substantial roadbed than is ordinarily found on anything but important lines of steam railroads. By reason of this and of using wheels to match, the question of suitable arrangements within the urban termini has risen to great importance. The situation has been widely discussed among the street railway men, and opinion seems to be divided as to whether Mahomet should come to the mountain or the mountain to Mahomet—whether urban roads should prepare for the extra strains of interurban rolling stock or whether a line should be drawn between urban and interurban traffic and a change of cars enforced at the city limits. On broad general principles a change of cars is always and everywhere a nuisance to be averted; but while urban systems might reasonably be expected and required to permit cars similar to their own to use their tracks they can hardly be forced to change their rails and roadbeds because an outlying line happens to be running extra large cars that require such a change. Thus it happens that a natural process of differentiation is tending to separate the larger interurban roads from urban precedents, and when this becomes more complete we may fairly expect some developments in the line of speed that will be well worth seeing. Instead of getting the high speed electric road at a leap, as would have been the case had the late Dr. Adams succeeded in putting through his St. Louis-Chicago line, we are likely to get it by a process of evolution, perhaps with a hearty lift from our friends at Zossen.

The requirements of heavier cars and larger traffic have called steadily for more power, and the outcome has been distribution by polyphase current and new methods of arranging the working conductors. The third rail, tried at first with some misgivings, has worked its way into considerable use, and its bearing upon future work is one of the open questions of electric railway engineering. On elevated lines it appears to give excellent service, but on surface roads its merits are certainly open to question when long distances are attempted. It is too early to forecast its fate. It may be, as in the case of the electric slotted conduit, merely a question of reasonable care and expense. The third rail has never been, to our knowledge, tried with anything like proper precautions to prevent leakage and to render the system safe. There is much to learn here as there was in the case of the conduits. An adequately drained roadbed, a suitably insulated rail, and, above all, proper protection for the rail so as to lessen the danger to life which is now altogether too considerable—all these are necessary before the status of the third rail can be determined.

The experiments now being tried at Zossen are likely to have a very important bearing on long-distance and high-speed work of every kind, and if the requisite energy can readily be taken from overhead conductors and the motor regulation proves successful, a long step will have been taken toward clearing up some existing difficulties. If the interurban road were inseparable from the urban networks at the termini, then the engineering methods adapted for the one must be suitable for the other. When, however, interurban systems by the nature of their growth come to further and further separate themselves from tramway methods, they may thereby open the way for some very radical changes. The necessities of urban termini are as severe a drag on the full usefulness and development of fast interurban lines as the old scheme of pulling cars through the streets with mules was upon the early steam railroads. Both the steam and electric systems have escaped their difficulties by cutting loose from confining precedents. The interurban road is with us to stay, and it must, so to speak, stand upon its own legs. If we are to have fast electric intercommunication we must not try to compromise with ordinary street railway methods.

Nerve Phenomena and Electricity.

The newspapers of Jan. 1 contain a sensational account of some discoveries as to the phenomena of nerve action, alleged to have been made by two Chicago professors. In some of the accounts given, Dr. F. A. Mathews, of Chicago University, is stated to be the discoverer, and other accounts give the credit to Professor Jacques Loeb, of the same university. The name of Dr. Loeb appeared some months ago in connection with what was claimed to be a startling discovery concerning the physiological action of sodium, which discovery newspaper writers epitomized in the phrase "Sodium is Life."

According to the present discovery, electricity is the controlling factor in nerve action. It is stated that nerves consist of a colloidal solution, the colloidal particles of which carry positive electrical charges. The nerve is stimulated by the action of ions—defined as electrically charged atoms or groups of atoms, which bear negative charges—and the stimulating of any chemical compound depends upon these negative charges. Ions having one charge are less efficient than those having two or three charges. A one-charged ion, such as sodium, is less poisonous than a three-charged ion, such as iron. The colloidal particles of nerves are held in solution by positively charged ions. These facts, it is stated, show that chemical stimulation is identical with electrical. When in any part of a nerve negative charges are in excess, the nerve is stimulated, the stimulus always arising at the cathode or negative electrode. All positively charged ions diminish irritability, and negative ones increase it. This is claimed to explain electrotonus, as the irritability of the nerve is increased near the cathode and reduced near the anode.

The stimulating action of any ion or the poisonous action of any kation is stated to be a function, first, of the number of charges rotating about the atom; second, of the rate of the rotation of these charges, and, third, of the circumference of their orbits. It is stated that the electron rotates about a fluorine atom about twice as fast as about a chlorine atom. In conclusion, it is said that chemical stimulation is, by the electromagnetic theory of light, shown to be identical with the stimulation of light waves. The stimulation of any anion increases as the spectrum of that anion approaches the ultra-violet. The common light waves and heat waves are in their action like those of the positively charged ion.

It may be remarked that so far as the alleged discovery relates to electricity it rests upon a rather slender foundation. The ionic theory is so far from being established that it may be considered not much more than a working hypothesis, and the Chicago professors appear even to have taken unwarranted liberties with the hypothesis in their assumption as to charges rotating about atoms at different rates, of "one-charged" and multiple charged ions, and, in general, in assuming the existence of a definite ionic mechanism. Dr. H. P. Pratt, the X-ray expert, confirms the discovery, however, but claims that he also had been working along the same lines. Dr. Pratt further believes that the twentieth century will prove that electricity and not sodium is the real life-giving principle.

Electrical Engineers of the Day—XXVII.

FRANK P. COX.

Frank P. Cox was born Dec. 31, 1866, at Terre Haute, Ind. After completing the curriculum in the common schools of his native city he took a two years' preparatory course and entered the Rose Polytechnic Institute, whence he was graduated as a mechanical engineer in 1887. A post-graduate course in electrical subjects was afterward taken at Johns Hopkins University, of Baltimore, and in the latter part of 1888 Mr. Cox entered the employ of the Kester Electric Company in his native city. He remained there about one year, during which time he was engaged in the design and manufacture of small motors.

In October, 1889, Mr. Cox entered the testing department of the Thomson Electric Welding Company, where he remained until June, 1890. About this time the Thomson recording wattmeter, which heretofore had enjoyed only a rather limited sale, begun to be fully appreciated by central station managers, and orders commenced to flow in for them at a rapid rate. About 1000 had been built at this period, and the weekly production was from 50 to 75.

With the advent of increased business, the Thomson-Houston Company found it necessary to extend its facilities materially, and reorganized its meter manufacturing department. In July, 1890, Mr. Cox was employed to take charge of the meter-testing department of the Thomson-Houston Company. He continued to have charge of this department until the formation of the General Electric Company, and until 1894, when the business had grown to such an extent that another re-organization was necessitated on much broader lines. As a result of changes then made, Mr. Cox was appointed engineer of the meter department, and assumed, in a great measure, responsibility for the mechanical as well as for the electrical and magnetic features.

A few years later the manufacture of instruments was begun by the General Electric Company, and a large portion of the engineering work in connection with this was placed in Mr. Cox's hands. Mr. Cox has surrounded himself with a corps of efficient assistants, nearly all of whom have had their practical education under his training, and at the present time the details of the engineering work are largely in the hands of these assistants, thereby leaving Mr. Cox free to take a more active part in commercial engineering than he has heretofore been able to do. His position is a rather unique one, as such positions go, in that he has largely made it for himself and to suit himself.

Aside from the general factory supervision over the designing, manufacturing and testing of motors and instruments, Mr. Cox devotes a large amount of time in a semi-commercial and advisory capacity, in connection with the installation of large instrument and meter groups in central power and lighting stations.



Although Mr. Cox has contributed a few articles to the technical journals, and written one book on direct-current dynamos and motors, he has found little time in the press of his routine duties, to contribute much of that which he is so well qualified to write upon to the use of electrical readers. He has been obliged to undertake many extensive studies in the solution of intricate problems which have confronted the General Electric Company's engineers in the design and improvement of instruments and meters, one of the most notable being the investigation of the manufacture of permanent magnets on a commercial scale.

One of the fundamental necessities of the manufacture of the Thomson recording wattmeter is the maintenance of permanent and uniform damping magnets. To accomplish a means of attaining this end on a commercial scale required a vast amount of research, study and experimentation, all of which was successfully done, as is evidenced by nearly 500,000 meters now in use. Mr. Cox has been allowed a number of patents relating to various phases of meter and instrument design, and has introduced a great many methods of manufacture and manipulation, which, for obvious reasons, are unpatented.

Mr. Cox is married, has one daughter, and lives in Lynn, Mass. Although of a rather retiring disposition, Mr. Cox has a very wide circle of friends and acquaintances.

The Waterside Station of the New York Edison Company—I.

INTRODUCTION



FIG. 1.—DOORWAY, WATERSIDE STATION.

THE happy lot falls to us about once in every five years to chronicle the development and growth in the intervening period of the New York Edison Company—the greatest central station organization and enterprise in the world. Many of our readers will doubtless recall the comprehensive survey made in one of the constituent journals of ELECTRICAL WORLD AND ENGINEER, in 1896, and previous to that period our columns preserve the record of the technical and industrial advance which now finds its furthest present reach in the magnificent Waterside station to which this article will be more specifically devoted. It is a theme to which we return with more than usual pleasure, and from whose consideration more than ordinary instruction results. Around the career of the New York Edison Company cluster historical events, pioneer beginnings, daring experiments, personal anecdotes, continuous successes, technical evolutions, financial expansions and steady broadening of relationships of the most interesting character, full justice to which would demand not merely the occupation of a few score pages of this journal, but the compilation of a volume. We have in the growth of this great enterprise a review, not in miniature, but on the grand scale, of what the art of electric light and power has attempted and realized in America.

It is not intended in these introductory remarks to summarize the details treated in each of the sections of this article, but so important a theme is not without its opportunities for a more or less philosophical treatment. There is not much chance or need for "academic" discussion in the stern and sober record of the remarkable onward movement of this company, which grapples so closely with the necessities of a great modern city in matters of illumination, power and multitudinous conveniences, but it cannot be forgotten that the history of this company illustrates in itself at once the relation of electricity to modern life and all the other tendencies that are so profoundly influencing our civilization. Here is a system beginning with but one class of work, and within a very limited area, but now furnishing current for every purpose to which it can be applied, and covering the whole of Manhattan Island. Here is a system founded when the storage battery was a byword and the alternating current a dubious thing of deep suspicion, now using more batteries than any other plant in the world as reservoirs and equipping for alternating current generation the largest station that has ever been seen. Yet, on the other hand, as evidence of the persistence of methods that have approved themselves are still to be noted the practice of putting every wire underground, just as in the start nearly a quarter of a century ago, and, further, the steady maintenance at the consumption end of the system of direct-current methods, with low voltages. Such conditions in dealing with some of the most vital problems that can confront an electrical engineer imply, to say the least, great courage on the part of those who have had to deal with these questions and a capacity of intellectual grasp, which in turn promise a firm touch with all that the future can bring in the art. Last year, at the meeting and Congress in Paris, as this year before one of the most crowded gatherings the American Institute of Electrical Engineers has ever held, these very problems of transmission, distribution and utilization were the most pressing that could excite the interest of such bodies; but even while the discussions were going on, the New York Edison Company, with its fellows in the field of central station work, was attacking the problems and solving them, even if not with final wisdom, at least with the satisfaction of marking genuine progress. It is one thing to play the game of war with mathematical theories and dummy squadrons, and quite another to present the brave front and adopt the shrewd tactics that ensure victory in a hard-fought campaign. "Settle it as you go," is an ancient bit of advice, but surely its most modern application lies in central station work, where every question solved with pains to-night opens up a broader problem for swift determination on the morrow.

Running side by side with this insistent requirement for high engineering ability in dealing with these matters, and not simply incidental to it, has been the financial problem. The original central station idea was that of several main generating plants in any given city, each jealous of its own territory, but often limited sharply in its kind of service, and rarely able to give that service cheaply or



FIG. 2.—VIEW OF THE WATERSIDE STATION, SHOWING BOILER ROOM FRONT AND WEST FRONT.

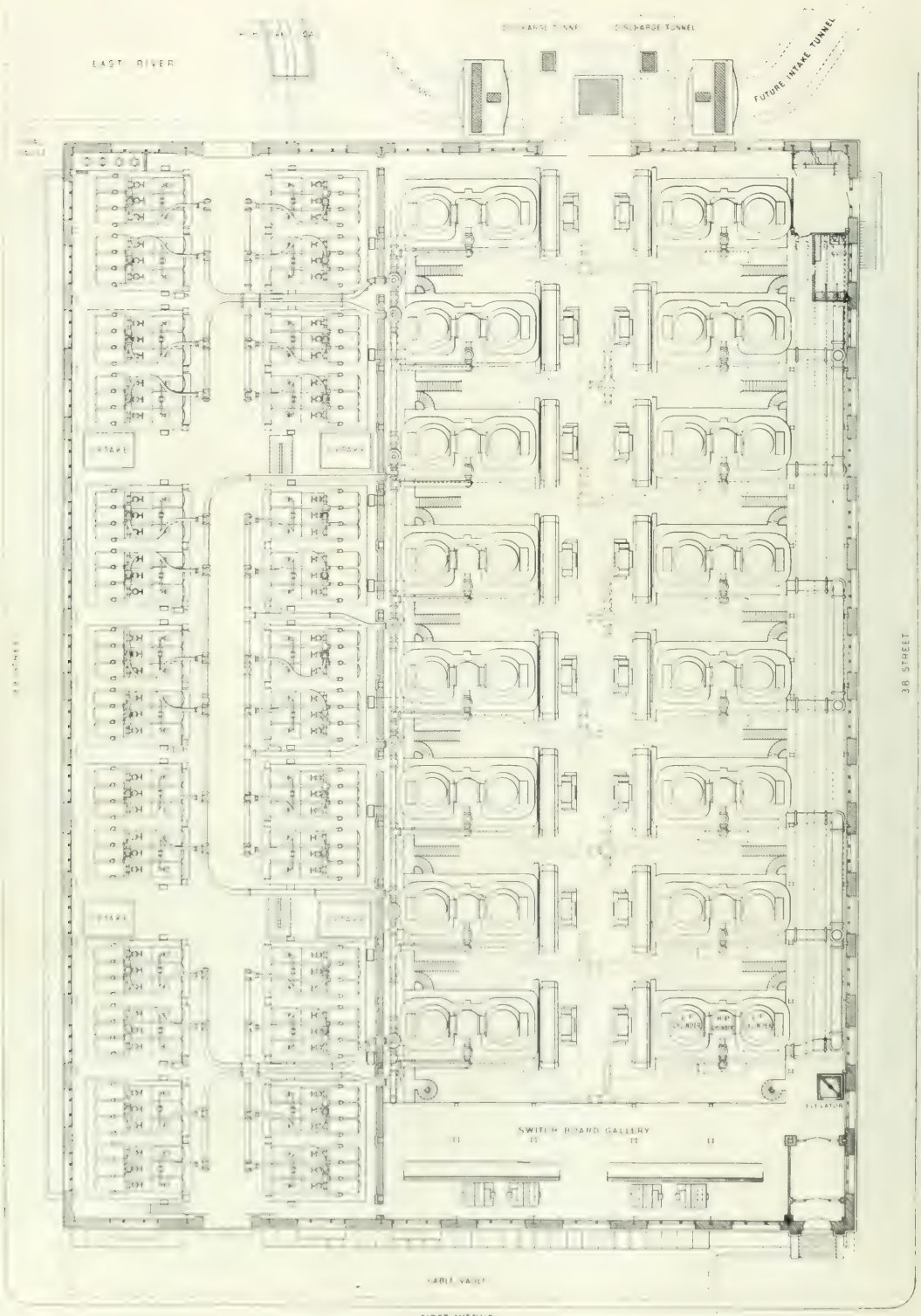


FIG. 3.—PLAN OF THE WATERSIDE STATION OF THE NEW YORK EDISON COMPANY.

efficiently. But that day has gone by, and with the development which has aimed at the generation of one universal type of current for use by apparatus of the widest individualization has had to come necessarily the welding together financially of the different interests concerned in the work. The tendency towards consolidation of productive and distributive agencies of all kinds is too much a commonplace nowadays to need noting with any emphasis here, but we cannot neglect the chance to express our belief that electric light, power and traction have afforded some of the best examples of the carrying out of this line of industrial evolution. Possibly, and doubtless, mistakes have been made in the execution of this inevitable process, but our conviction is deep that in the long run the programme will have justified itself in most cities and with most people. In the New York Edison Company, with the marvelous network of service that has been gathered together under that name, the conspicuous exponent of this policy has been Mr. A. N. Brady, whose striking appreciation of the broad principles involved in electrical application has been admirably evidenced by some of his recent utterances in leading organs of public opinion. For a man popularly credited with merely the "Wall Street view" of these topics, Mr. Brady has shown an insight and foresight that perhaps some did not expect. So far as we are concerned, dealing, as we do less with the financial aspects of the art than with its engineering side, we can only express our hearty admiration of the faith in electricity shown by such a boldness and vigor of financial enterprise as leads to the erection and equipment of plants like the Waterside station described below—enterprise based in turn upon the massing into one vast, comprehensive network of all the scattered, heterogeneous and unrelated projected which not long since were all that New York had to depend upon for its electric light and power. The greatest credit is, therefore, due to Mr. Brady for having early recognized the stupendous possibilities of such a situation, and for the courage and broad statesmanship which he has shown in bringing such a vast undertaking to a successful consummation. In like manner, this passing personal reference would not be complete without mention of the work of Mr. Thomas E. Murray, whose natural ability, tireless energy and sound engineering judgment have contributed so largely to the satisfactory carrying out on the practical side of this vast plan of consolidation and concentration.

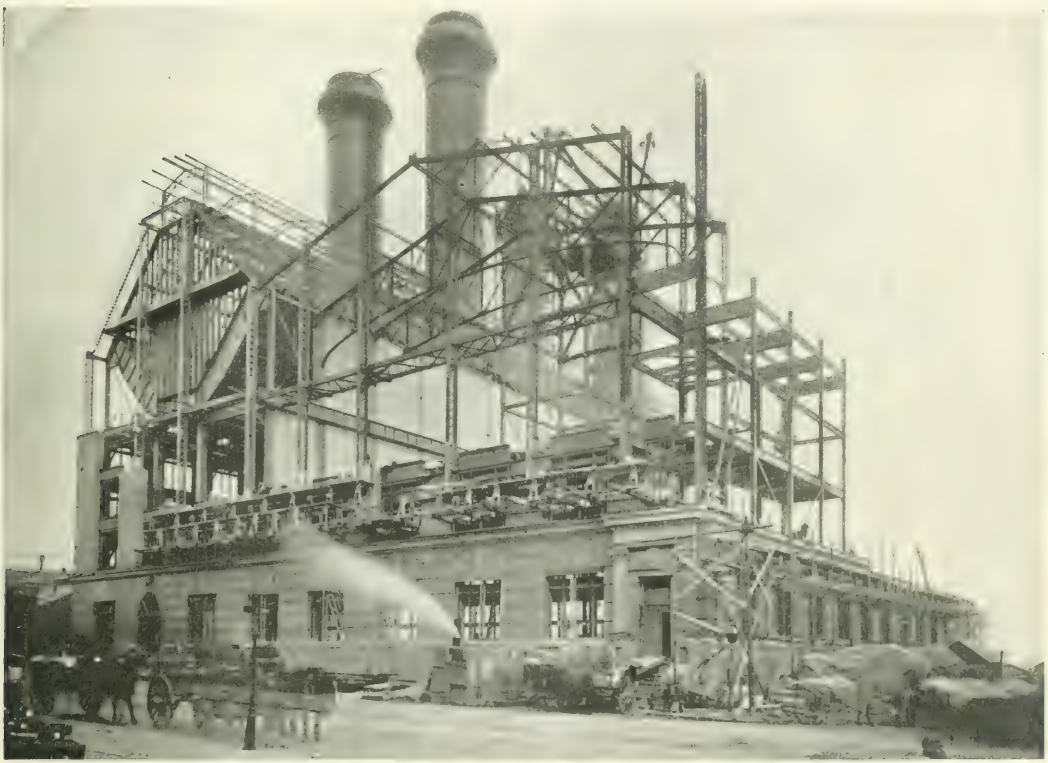


FIG. 4.—WATERSIDE STATION UNDER CONSTRUCTION. SHOWING STEEL FRAMEWORK.

THE PROBLEM OF CURRENT AND DISTRIBUTION.

The problem of furnishing light and power to a large city like New York involves the supplying of the densely populated business and southern district, and also requires that current be transmitted to a large outlying residence district covering many square miles in area and in the case of New York extending north 10 miles from the heart of the city.

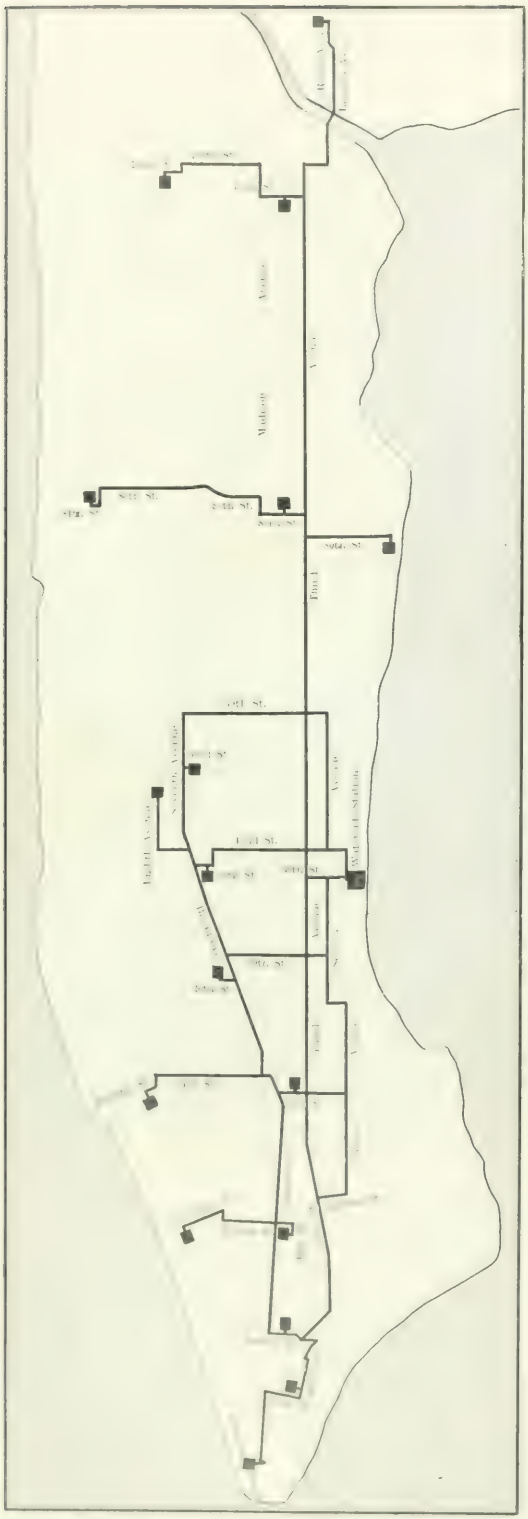
Numerous small stations distributed through this territory furnish a possible solution of the problem, but such a system lacks the well-known advantages and economy of a large central station. It being impossible to supply such an area with direct current from a single station it was decided to use a high-potential, alternating system of generation and transmission.

The question next arose, Shall the customer be supplied with alternating or direct current? It would be much simpler to supply alternating current through step-down transformers, but the question can only be answered by a consideration of the service required.

This is the supply of power for incandescent lights, arc lights and motors—the latter both for general power and elevator service.

Incandescent lights operate equally well upon direct or alternating current, provided the frequency is over 30 cycles per second. They require, however, a close voltage regulation, and where heavy currents are to be handled, as in the business district of a large city, this can be better secured by direct than by alternating current.

The arc lamp may be used upon direct or alternating circuits provided the frequency is not less than 40-50 cycles, and although the New York Edison Company has found that satisfactory commercial service can be obtained from alternating current arcs on



TENSION MAINS.

ordinary circuits, direct-current lamps are, considered on the whole, somewhat more efficient and reliable.

For general industrial use, the alternating-current motor, particularly that of the induction type, has reached a stage of perfection making it in every way the peer of the direct-current motor, the absence of commutator and brushes constituting a prime element of simplicity and ready maintenance, although involving a higher first cost.

Though constant speed motors may be designed to operate with satisfaction on alternating currents, yet the direct current motor is decidedly superior where intermittent service or variable speed is required. As a considerable part of the power used in large cities is required for elevators, and machinery running at variable speed, it becomes almost obligatory to furnish direct current to satisfy this demand.

After a careful consideration, therefore, of all the local conditions—the character of the large existing stations, sub-stations and underground system, the territory to be covered, the present and prospective business, the broadening nature of the electrical industry, and other features none the less perplexing, because less indefinite in engineering outline—it was decided to build a large central station generating high potential alternating current, transmission to sub-stations, and after passing through static transformers and rotary converters to be fed as direct current into the usual low-tension, three-wire network.

In deciding upon the location of such a central station the general rule that it shall be located as nearly as possible at the center of gravity of the system is often modified by the cost of land, availability of water supply, coaling facilities and various local considerations. The Waterside station of the New York Edison Company is admirably situated to satisfy all these requirements.

When we look back to 1882 and compare the Pearl Street station of the New York Edison Company and its six 125-hp "Jumbo" generators, with the new Waterside station of the same company, operating sixteen 5500-8000-hp generators, we are enabled to form some conception of the enormous growth of the business in the 19 years just past.

Between these two extremes we have the Duane Street station, erected in 1891, with the system of sub-stations, by which the city of New York has been supplied.

This station was erected before the era of high potential transmission in cities, and perforce was located near the "center of gravity" of the load. Real estate in the heart of the business center of New York City being very expensive, it was necessary to concentrate the power in the smallest space. This result was attained by the adoption of the vertical marine type of engine, which was modified to meet central station requirements by the company's engineering staff, cooperating with the engine builders.

The 2500-hp engines used in this station were the first vertical marine engines of any considerable size used in this country for central station work.

The form of switchboard, first installed in this station, and now in use there, and in the other sub-stations throughout the city, is remarkable for its space economy, and was also developed by the company's technical staff. In the Van Vleck "edgewise" system all instruments and regulating switches are read or handled on the edge of a quarter circle, instead of being moved around the face.

Owing to the fact that in New York and other large cities the heaviest load in the business section occurs at a different time from the peak load in the theater and residence section, it would evidently be a most desirable and economical arrangement to have the stations in these districts so connected that each could help the other, utilizing the capacity of the generating equipment to the best advantage. This result was attained before the completion of the Waterside station by installing rotary converters and static transformers in Duane Street and the various sub-stations. A net efficiency of over 82 per cent from direct current to direct current is obtained, and now that Waterside station is in operation the apparatus already installed in the sub-stations is used to transform from high-tension alternating to low-tension direct.

It became evident several years ago that even with this system of mutual help the time was soon coming when the full capacity of the various stations would be inadequate to supply the demands of a rapidly increasing number of consumers; and the multiplication of generating stations being undesirable, plans were drawn for a new station where practically all the current used by the company could be generated, the various stations throughout the city being re-

The Waterside station, equipped with the most modern and economical plant, will generate the bulk of the current used on the system, the larger Edison stations, Duane, Twelfth and Twenty-sixth streets, being used as distributing stations, and as supplementary generating stations during the period of heavy load in the winter months.

Some of the less important stations, Vandam, Thirty-ninth and Fifty-third streets, equipped with less economical generating apparatus, will have their generating equipment removed and will serve as distributing centers. Storage batteries located at all the important distributing centers, in addition to acting as a reserve, will also be used to eliminate the peaks from the local demand, so that the load on the Waterside station will be almost constant during the twenty-four hours. By utilizing the more important generating plants during the months of heavy demand, the larger generating apparatus already installed is used to advantage, additional new investment being saved, which would otherwise be necessary to take care of this capacity.



FIG. 6.—WATERSIDE STATION OF THE NEW YORK EDISON COMPANY FROM THE EAST RIVER.

THE BUILDING.

The Waterside station is located on First Avenue, covering the block between Thirty-eighth and Thirty-ninth streets, and running to the East River, an area of 272½ ft. by 197½ ft.

The bulkhead line will be 160 ft. distant from the east end of the station, and separated from it by a new marginal street 125 ft. wide, under which pass the condensing tunnels and coal conveyors. It is not until one sees a colossal operation of this kind that the extent to which the city is gaining territory along its eastern water front is realized. Such plants as the Waterside help in no small measure to what may be called the reclamation of this valuable waste territory.

The foundations for both engine and building are of concrete and rest directly upon bed rock, giving an exceptionally solid construction.

The building is of yellow brick, trimmed with red sandstone. The inside of the operating room is faced with pressed buff brick, with the exception of a wainscot of enamel faced brick, 14 ft. high, running around the entire room. The floor is of cast iron plates, and the roof, 116 ft. above, has a glass monitor giving abundant light.

The boiler room floor, with the exception of the cast iron plates along the boiler fronts, is of granolithic material.

The general layout of the building is shown in Fig. 3. The boiler room, a magnificent hall, is 76 ft. by 267 ft. 10 inches, separated by a massive brick wall from the main operating room, which is of the same length and no less than 115 ft. wide, presenting in its lofty pitch and harmonious porportions a strong resemblance to the main aisle of some grand and imposing cathedral.

The 16 General Electric dynamo-Westinghouse engine generating sets, included in the complete plan, as shown on the diagram, are placed each on its separate foundation, and each with its immediate and switching appurtenances constitutes a "cellular" unit, as though it alone were the generating heart of the station. The features of this interesting and important arrangement will be discussed later. The dynamos all face inward to the central passageway, their right and left-handed revolution corresponding to their

position on the north or south side. The storage battery room is in the basement on the Thirty-eighth Street side, south, as indicated. Locker rooms, lavatories, etc., are provided in liberal measure for the comfort of the employes. On the Thirty-eighth Street side, running the full length of the stately building, there are five galleries, the upper ones being used for storage, offices, etc., while the two lower ones afford ready access to the upper platforms of the engines. It is impossible not to be struck with the skillful manner in which the designers of this great station with its ultimate capacity of not less than 125,000 hp have pushed along practical lines, in these details, the analogy with marine engineering which underlies the ideal of modern central station work. A mere glance at the cross section view shows these galleries, just like the decks of a big steamship, surrounding the vast central well or hull within which the steam forces are at their work, while an inspection of the plant itself carries the parallel even further, for at the western end are the switchboard galleries, the full width of the dynamo room, corresponding in by no means a fanciful manner to the "quarter deck," whence command issues and through which all the functions of the system are set in motion and exercised.

This western end is, as will have been understood, the front of the building, where is found the handsome entrance from which our initial letter has been drawn. An electric elevator, built by the Marine Engine & Machine Company, and located just within the entrance lobby, gives quick access to all floors, supplementing the metal stairways which rise at both ends of the electrical galleries. The steel framework of the building was furnished by Milliken Brothers. Two electric cranes, one of 50 tons capacity, built by Pawling & Harnischfeger, of Milwaukee, and one of 25 tons, built by Alfred Box, of Philadelphia, span the engine room at the curve of the roof. The former has a high speed lift auxiliary hoist which enables the quick handling of light weights over the whole floor.

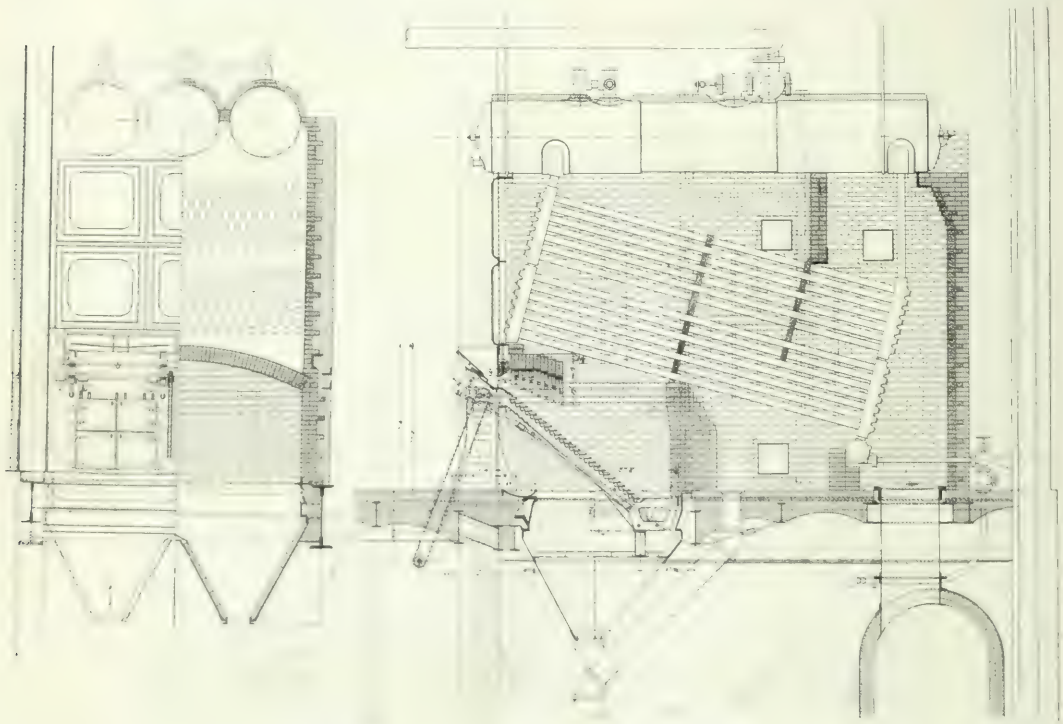


FIG. 7.—ELEVATION AND CROSS SECTION OF BOILERS AND STOKERS.

COAL-HANDLING EQUIPMENT.

Going now from the front of the station to the rear, we encounter, and begin naturally with, the coal-handling equipment. The coal will be received at the pier being built out into the river, 150 ft. beyond the bulkhead line. On this pier will be located the coal-receiving tower. It carries a bucket with a capacity of 1½ tons, which discharges into the hopper from which the coal descends into the crusher, passing thence into the bucket conveyor running along the pier and under the marginal street into a receiving vault at the northeast corner of the building. Here the coal is received into the weighing hoppers, and is then discharged by the automatic fillers into the vertical conveyors which elevate the coal to the monitor, where a horizontal conveyor finally distributes it into the bunker. This, as shown in the sectional view, is of solid steel construction, and has a capacity of 10,000 tons, sufficient for two weeks' supply. Coal chutes descend from the bunker, each chute feeding the stoker hoppers of two boilers, and each is equipped with a Clarke automatic coal weighing scale. The bunker is lined with concrete, no coal coming into contact with the iron, and a deflecting ridge along the bottom prevents the lodging of coal in dead pockets where it might take fire from spontaneous combustion. The entire coal-handling equipment was supplied under contract by the Exeter Machine Company.

THE BOILERS.

The boilers, whose construction and location are shown in Figs. 3, 7 and 11 were made by the Aultman & Taylor Manufacturing Company, of Mansfield, Ohio. They are arranged in two double-decked rows, one on each side of the boiler room, 14 in each row, 28 on a side, or 56 in all. They are each 18 ft. long, with 6250 sq. ft. of heating surface, and are rated at 650 hp each, on a 30-lb. basis; but as the engines used will require only about 12 lbs. of steam per I.H.P., the boilers will actually develop about 1625 hp each. When operated with forced draught, they can develop a much greater capacity.

The boilers are designed for a working pressure of 225 lbs., although 175 lbs. will be the pressure usually carried. They are equipped with Roney stokers and furnaces supplied by Westinghouse, Church, Kerr & Co. Sixteen fan blowers of large capacity will furnish the forced draught, so that the maximum capacity may be ob-

tained from the boilers, enabling also the use of steam sizes of anthracite coal in connection with the Roney stokers. It should be added that the Roney stokers have the greatest possible depth of



FIG. 8.—DETAILS OF BOILER ROOM WALL CONSTRUCTION.

grate in the available space to give the greatest feasible grate area, in view of the desirability of burning anthracite coal. It must be mentioned here also that provision has been made for the installation of superheaters on the boilers, proper fittings having been provided for connecting them, as the engines have been designed with an eye to the ultimate use of superheated steam.

Returning to the stokers, they in common with most of the other "auxiliaries" are driven by steam, these being operated in sections by sixteen 5-hp Westinghouse engines, and connected to the driving shafts in such a manner that the breakdown of any engine will not cripple any stoker. The furnaces discharge the products of combustion into four steel stacks, each 17 ft. in diameter, and rising 132 ft. above the roof, the tops being seen in our engravings and being plainly visible from a great distance along the river; the total height from the grates of the lower tier of boilers being very nearly 200 ft. The shell of the stacks is ⅝ inch thick for 44 ft., other sections of the same length being made up of ½ and 3/8-inch plate. The stacks are lined with 8 inches of firebrick for one-third of their height, the remainder being lined with red brick. The lining is carried upon rings of angle iron in independent sections of 20 ft., and air space of 4 inches being left between the lining and the stack. The ashes are discharged from the ash hoppers under the boilers into cars, which are to be hauled with small electric locomotives to the dock and the contents dumped into barges. Space has been provided in the basement for economizers in case it may be deemed desirable to install these before the completion of the station.

STEAM PIPING AND HEATERS.

The steam is delivered from each boiler through a 10-inch pipe into a 14-inch boiler room header, of which eight enter the engine room through openings in the fire wall from each deck of boilers, as indicated in various views herewith. The headers from the upper deck drop into steam separators connected in the main engine room header, from which steam pipes are taken to the northerly row of engines. Vertical risers drop from the engine room header and receive the steam supply from the headers of the lower tier of boilers, conveying the steam to separators in the basement, from which 14-inch mains carry it thence to the throttles of the southerly line of engines. Special fittings are connected to the cross-over pipe to each southerly engine, permitting their connection into a central tie header located under the center aisle. All joints are ground to a steam-tight fit, no gaskets being allowed in any of the high-pressure piping. The pipe, special fittings and flanges are of the maximum thickness specified for the highest class of high-pressure work. The feed water heaters are of the Wainwright type, 50-inch diam., 16 ft. long, containing 246 1½-inch tubes, giving a total heating surface in each heater of 1333 sq. ft. These heaters are inserted between the feed pumps and boilers, and receive the exhaust steam from the boiler feed pumps, stoker engines, and other auxiliaries. The feed water will be supplied for the city service in the beginning, although it is expected later to use the condensed steam from the engines as boiler feed after being purified. To this end four special storage and separating tanks have been installed in the basement under the boilers, provision being made in each tank for cartridge filters for removing the greater quantity of oil from the condensed steam. The more complete elimination of suspended oil to be affected in special purifying apparatus. The boiler feed pumps are of the Worthington type, steam driven.

CONDENSING WATER TUNNELS.

The condensing water is brought from the river through an intake tunnel, shown in Fig. 9, built by the General Tunnel Engineering Company, under the Landé patents. This interesting intake tunnel is composed of two ¼-inch steel shells with a space of



FIG. [illegible] GENERAL TUNNEL CO.'S FLIZABETHPORT INTAKE IN ITS WAY FOR THE STATION.

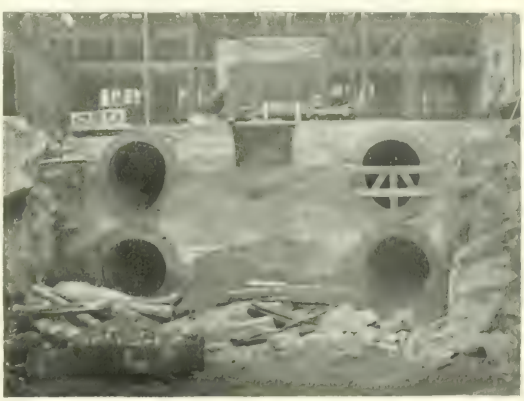


FIG. [illegible] OF BOILER ROOM IN COURSE OF ERECTION AND ONE OF THE GALLERY UNDER ENGINE ROOM.

15 inches between them filled with concrete. It was made in Elizabethport, and when finished was fitted with bow and stern and towed

to its present position. It extends from the east end of the station 230 ft. diagonally under the proposed marginal street along the river front out into the East River. Provision is made for connecting another similar tunnel, should it ever become necessary. Just outside the building the intake tunnel enters the screen wells and divides into two parts, circular in section and 7 ft. in diameter, one running under each row of engines. The discharge water from the condenser is returned to the river through two tunnels of an oval section 8 ft. high, running out on a higher level.

THE ENGINES.

The engines, 16 in number, are the product of the Westinghouse Machine Company. They are of the Marine type, vertical, three crank, with one high and two low-pressure cylinders, direct connected to 16 General Electric three-phase generators. The high pressure cylinder is 43½ inches in diameter, and each low-pressure cylinder 75½ inches in diameter, with a stroke of 5 ft. The low-pressure cylinders only are jacketed, and are provided with liners, the contemplated use of superheated steam rendering jackets for the high pressure cylinder unnecessary. With 175 lbs. steam pressure at the throttle and 27 inches vacuum, and while running at the normal speed of 75 r. p. m., the engines are to indicate 5200-5500 hp at most economical load; and will be capable of a sustained load of 8000 hp with an ultimate capacity at maximum cut-off (⅝ of stroke) of over 10,000 hp. The engine is guaranteed to develop its most economical load, 5200-5500 hp, at a steam consumption not to exceed 12½ lbs. of dry steam per I.H.P. per hour, including the steam used in reheater

The bed plate is made in three pieces with an extension for supporting the outboard bearing. The engine frames are of the A type of strong and massive yet graceful design, with a substantial bearing on the bed plate. The crank shaft is of the Bethlehem make, built up in three sections, with a 10-inch hole extending from end to end. The 26-inch shaft is supported in four bearings, the three main bearings each 60 inches long and the outbound bearing 48 inches long. The engine, having three cranks, set at the angles 101 degs., 133 degs., 126 degs., so as to give a uniform turning moment, does not require a heavy flywheel, a weight of 90,000 lbs. in the rim with an outside diameter of 23 ft. being sufficient to give the required steadiness of motion for parallel operating and avoiding any evidence of "beat" or pulsation in the electrical system.

The high-pressure cylinder is fitted with poppet valves, following European practice on engines of similar types using superheated steam. The low-pressure cylinders have valves of the double ported Corliss type. The valves are driven by eccentrics from a lay shaft receiving motion from the main engine shaft by means of helical gears, European practice again being followed in this respect also, although quite unfamiliar here. The governor is driven from the lay shaft and controls both the high and low-pressure valves, the latter being also detachable so as to be adjusted by hand.

The engine speed can be controlled by mechanical adjustment of the governor weights while in motion. To facilitate synchronizing the speed of the engine can also be varied from the electrical gallery by a pilot switch operating an electrical motor which shifts the weight on the governor arm.

An emergency steam-operated throttle is provided enabling steam to be shut off instantly, and this is connected to a centrifugal device in one of the crank cheeks, which in case the engine speed exceeds a certain limit engages a pawl admitting steam to the emergency throttle automatically, and cutting off steam. In passing from the high-pressure to the low-pressure cylinder the steam passes through the reheater with a capacity of 220 cubic feet.

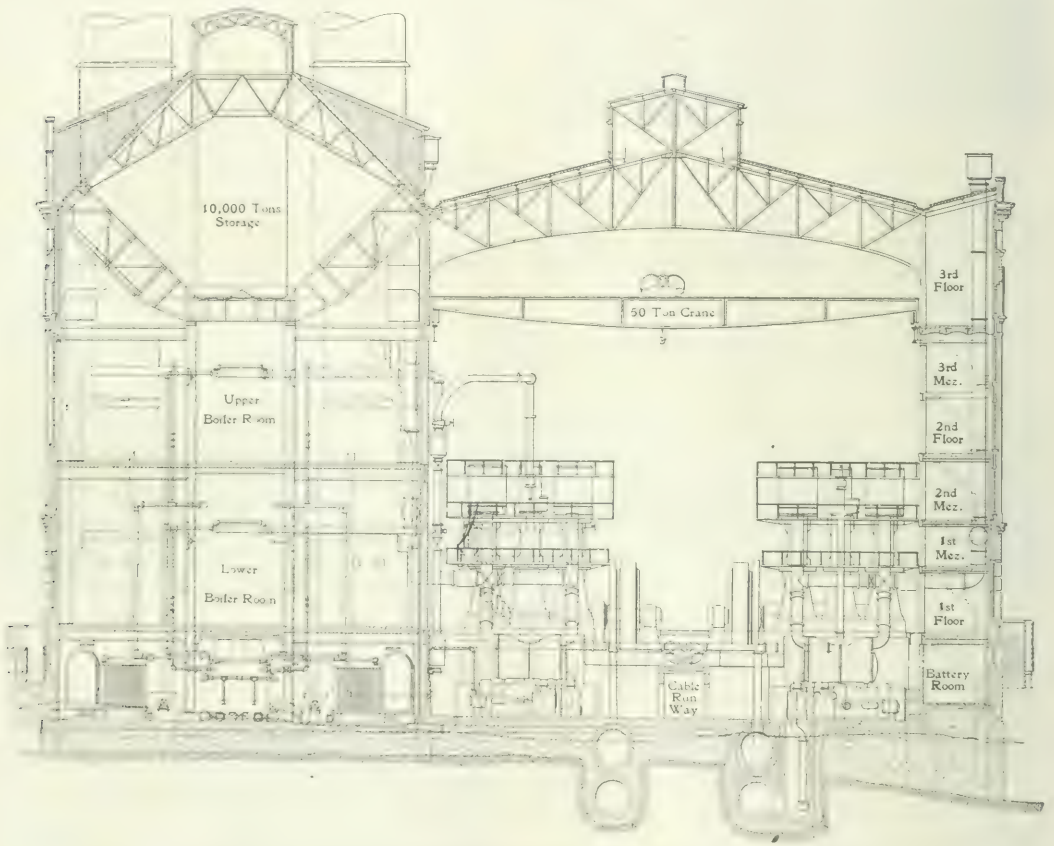


FIG. 11.—CROSS SECTION THROUGH BOILER AND DYNAMO ROOM OF WATERSIDE, NEW YORK EDISON, STATION.

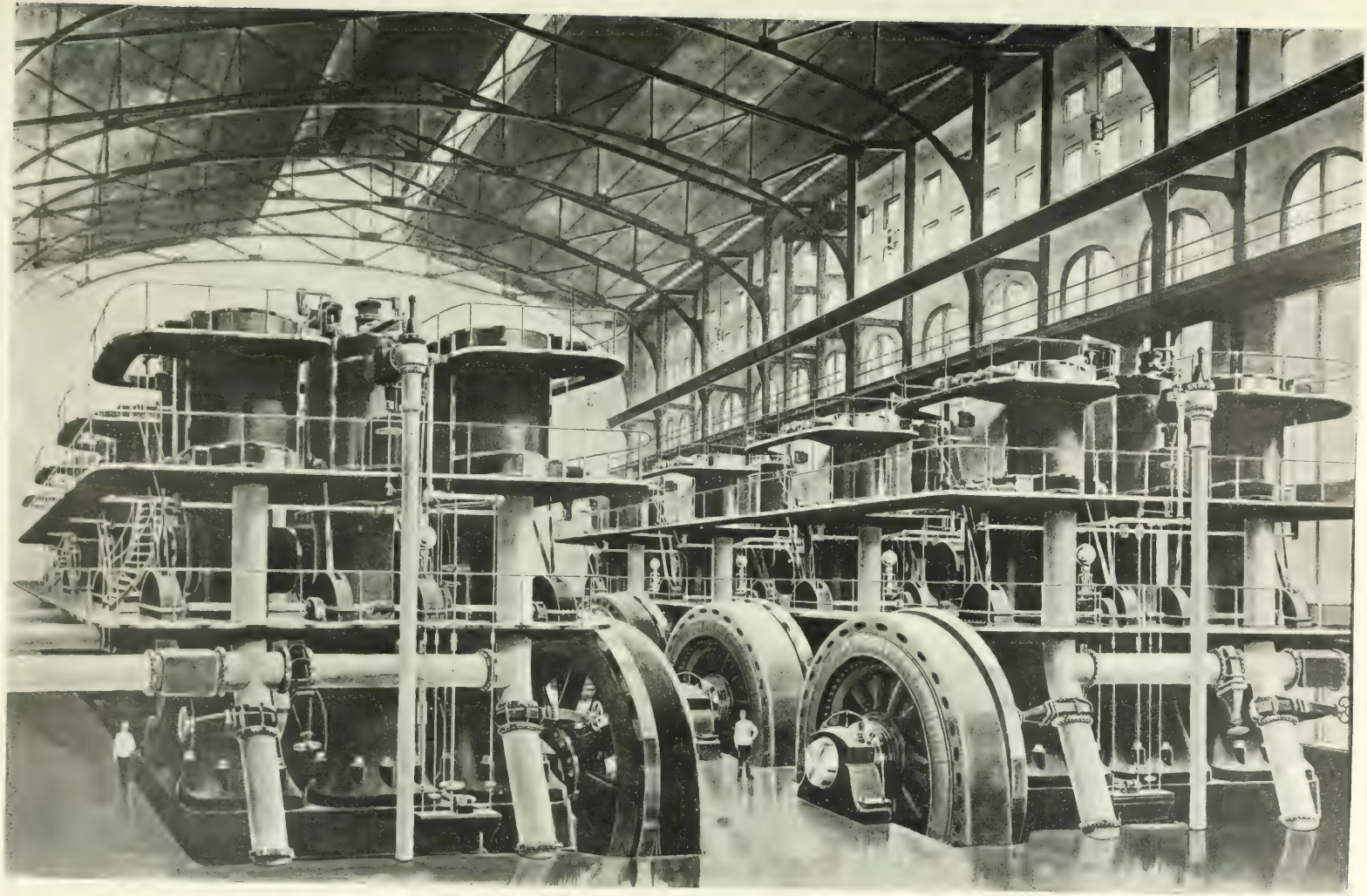


FIG. 12.—VISTA OF THE DYNAMO AND ENGINE ROOM, SHOWING ABOUT ONE HALF, AS SEEN FROM SWITCHBOARD GALLERIES.

THE WATERSIDE STATION OF THE NEW YORK EDISON COMPANY.

A complete oiling system is provided, the main bearings being fed with a gravity-pressure system, and the cylinders, cross-heads, etc., are lubricated from sight feed manifolds having pressure pumps driven from the valve motion. The oil is circulated by a special

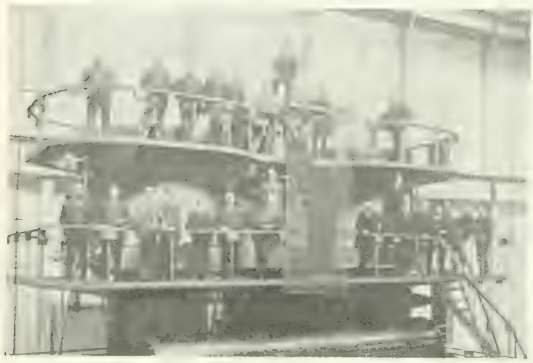


FIG. 13.—THE LOWER PLATFORMS OF ONE OF THE ENGINES.

force pump, with a system of tanks for its filtration. Each engine has an independent air and circulating pump driven by a separate engine with Corliss valve gear. The surface condensers are of the Worthington type, with a cooling surface of 9200 sq. ft. Each engine is provided with an automatic relief valve in the exhaust line, admitting to the 30-inch atmospheric exhaust riser, extending from each engine to the roof, where the riser is capped by an exhaust head.

Very complete platforms at three different heights are provided, giving ready access to all the working parts of the engine; and the two upper platforms have walkovers from engine to engine, facilitating efficient and economical supervision and oiling.

A flying bridge, which can be moved by the cranes, will span the aisle between the north and south row of engines. To borrow a scriptural idea, the engineer can literally "pick up his bridge and walk" without leaving it, and be carried from one end of the long hall to the other, with instantaneous access to any generating unit in either row. At the same time, when not in use, the flying bridge does not interfere in any way with the normal operation and em-

[concluded.]

Wireless Telegraphy Across the Channel.

The London, Brighton & South Coast Railway has entered into an arrangement with the Marconi Company for wireless telegraph stations at New Haven, England, and Dieppe, France, the distance between which places is 75 miles. The departure of boats will be signaled, with instructions as to the number of passengers, amount of luggage and other information. This service will also be a great convenience to the public, as the friends of passengers will not, as in the past, have to wait for hours at the other end when fog has delayed a boat starting.

Regulation of Automobile Matters in America.

Important developments will probably occur within the next month in regard to the plan proposed recently by the Automobile Club of America, to make that club the national organization of America, and all other automobile clubs affiliated members of the national body. The rough draft of the plan has been sent to all the leading clubs in the country, but considerable opposition has been encountered. The *New York Times* has an interesting review of the situation. In Boston and Chicago the idea has not been favorably received at all, the clubs there resenting the proposition to acknowledge the superiority of the Automobile Club of America in all law and racing matters. The Long Island Automobile Club, at its recent meeting, did not view the proposition favorably. Automobile clubs throughout the country generally recognize the importance of a national body, but no clear idea has yet been advanced as to how this will be formed or governed. The affiliated clubs all feel that they should have some voice in the matter, and some plan may be evolved whereby the clubs in the national organization may have a vote in the councils, according to their membership. The Boston automobilists have been particularly agitated over the subject, and the Automobile Club of Massachusetts, the leading one there, has practically refused to meet the request for affiliation with the New York club. It is said that the Boston men, as well as members of many other clubs, are willing to yield first place to the Automobile Club of America, in view of its priority in the field and the many good things it has accomplished for automobilism, but that these members resent hotly every suggestion of a dictatorial policy.

The Long Island Automobile Club plan for a national organization was to have it composed of delegates chosen from automobile clubs at large, and they would make rules binding on all of the clubs. The Automobile Club of America has advanced the idea that its rules should be accepted by all these other clubs without question, they being affiliated members and accepting all rules in the broader field of automobile interests made by the main organization. This, therefore, is where the hitch comes in. The Automobile Club of Bridgeport, which has 34 members, has accepted the plan of the Automobile Club of America to affiliate with it and be governed by its racing and other general rules.

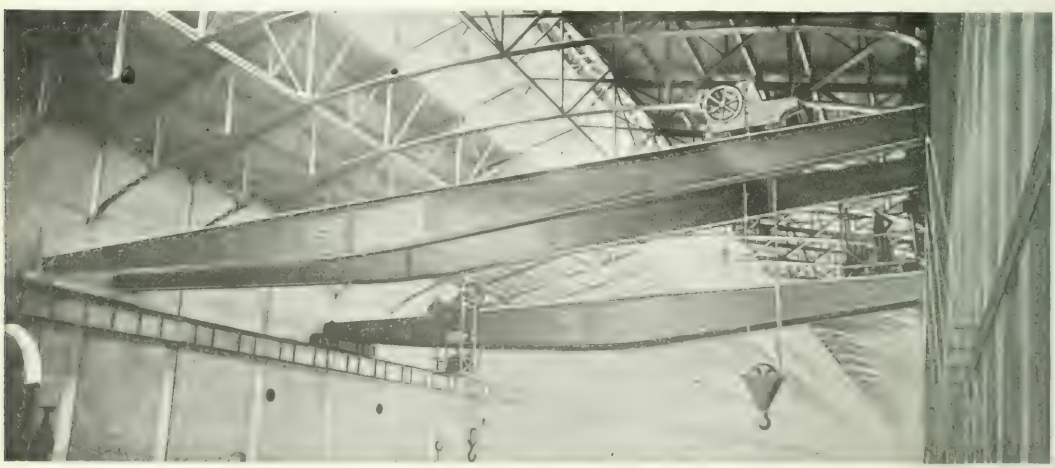


FIG. 14.—THE TWO ELECTRIC CRANES.

Two Recent British Electric Railways.

In the history of electric traction, Brighton, England, stands out as having been the possessor of one of the first electric roads—the electric marine railway of Magnus Volk. This road was discontinued many years ago, and it was not until November of last year that Brighton could again boast of an electric railway.

The present road has been built in the most substantial manner, the road-bed being laid on concrete and the feeders in underground conduits. The power house contains three Peebles-Willans units, one of 325 kw capacity and two of 175 kw; a motor-driven booster is provided for operation on the return circuit. Steam is furnished by Babcock & Wilcox boilers. The larger engine gives 467 brake horsepower at 320 r. p. m., and the other two engines each 250 brake horsepower at 350 r. p. m.

All of the engines are capable of giving 25 per cent overload for half an hour, and are fitted with automatic variable cut-off gear, and also by-pass valves, which enable the engines to give their full power with 150 lbs. steam pressure instead of the normal 175 lbs. The sets work without condensation.

The dynamos, which have been manufactured and supplied by Messrs. D. Bruce Peebles & Co., of Edinburgh, are of the multipolar flywheel type, compound wound for a pressure of 500 volts at no load, and 600 volts at full load. They are also designed to give an output of 25 per cent overload for half an hour, and 50 per cent momentarily without injury. In each case the armatures are of the slot-wound drum type, with ventilated cores, so that they will be suitable for running at full load for long periods, and the machines will run absolutely sparklessly at all loads from no load to over full load, without alteration in the position of the brushes. In the case of the small sets, the engines and dynamos are mounted on one combination base plate, whereas in the case of the larger dynamo, separate base plates for engine and dynamo are provided.

The motor-driven return circuit booster consists of two separate machines, direct-coupled end to end, and mounted on a combination base plate. The motor is a Bruce Peebles multipolar, shunt-wound, protected type, and is designed for an output of 40 hp when running at a speed of 800 r. p. m. It is designed to run off a 500-volt to 550-volt circuit, and will also give an output of 25 per cent over full load when required, and will run sparklessly under these conditions. The booster consists of one Bruce Peebles series-wound, multipolar machine, which is arranged to give an output of 1000 amperes at a pressure of 25 volts, varying down to 100 amperes at a pressure of 10 volts. The machine is provided with a suitable shunt across the series fields, to enable this regulation to be effected.

The switchboard comprises eight panels of polished white marble,

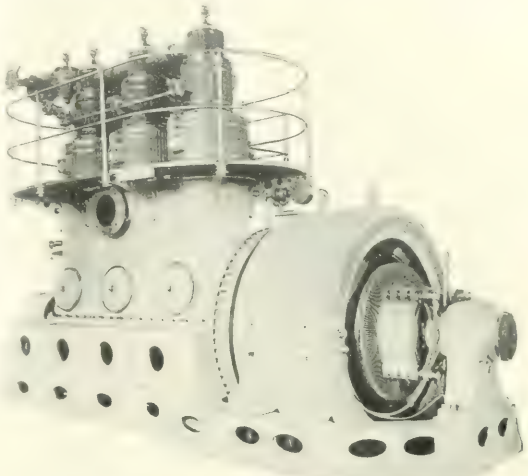


FIG. 2.—ONE OF THE GENERATING UNITS, BRIGHTON, ENGLAND.

consisting of three machine, three feeder, one booster and one Board of Trade panel.

Six and one-half miles of line have been laid, equivalent to 11½ miles of single track. Thirty cars are employed, all of which are equipped with British Westinghouse 49-B motors and No. 90 controllers. A system of electric signal bells has been provided in the cars, there being four pushes in the interior of the car and four on the roof for the convenience of outside passengers. In addition, a bell of distinct tone from the passengers' bell is employed on each platform for signaling between the conductor and driver.

The overhead construction was carried out by Robert W. Black-

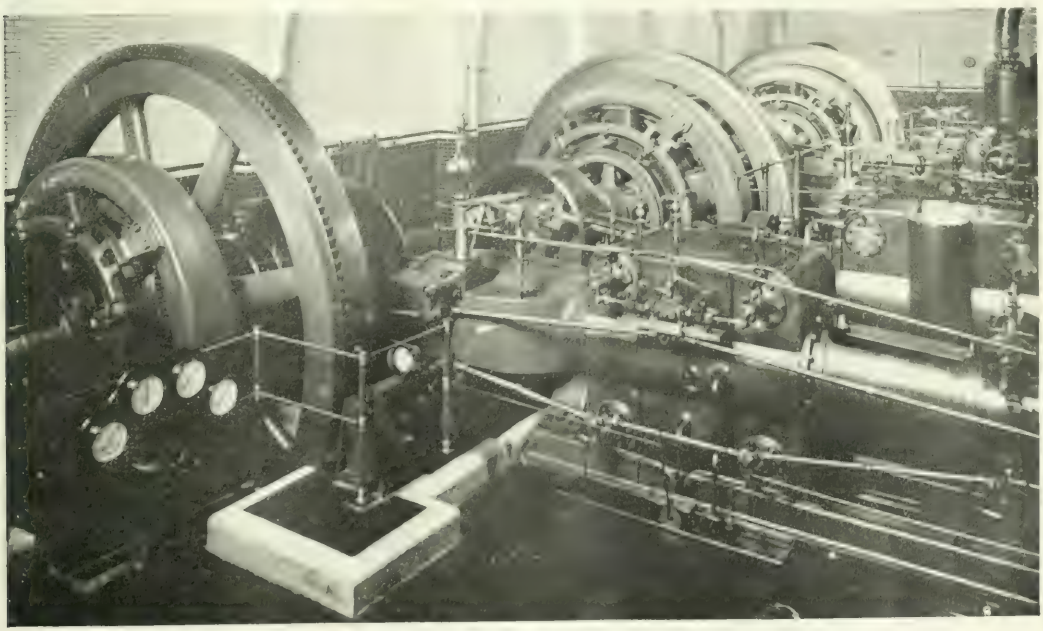


FIG. 1.—GENERAL VIEW OF ENGINE ROOM, PORTSMOUTH, ENGLAND.

well & Co. Brighton being a fashionable seaside resort, and as much of the route is through fashionable localities and along handsome parks, as great a regard as possible was paid to the asthetic point of view in constructing the trolley line. The trolley poles are drawn tubular steel, with bracket arms of steel tubing ornamented with wrought iron scroll work of elegant design. The road was

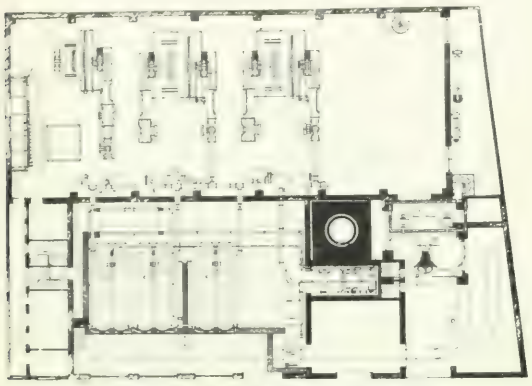


FIG. 3.—PLAN OF POWER STATION, PORTSMOUTH.

designed and installed under the supervision of Mr. Thomas B. Holliday.

Another recent English electric railway is that of Portsmouth, which is about being completed. The total length is approximately 14½ miles, there being 14 miles of double track and crossings, and ½ mile of single track.

The steam plant comprises three water-tube boilers and two horizontal cross-compound engines, each developing 640 hp under normal conditions, and having a capacity for a maximum of 900 hp. Also, a third engine of the horizontal tandem-compound Corliss type, which



FIG. 4.—SECTION VIEW OF POWER STATION, PORTSMOUTH.

develops 320 hp normally, and 450 hp overload, the revolutions in each case being from 90 to 100 at a pressure of 150 lbs. per square inch. There are three surface condensers of the Worthington Admiralty type, two of which are capable of condensing under normal working conditions, 12,000 lbs. of steam per hour, and the smaller 6000 lbs. of steam per hour. There are three sets of combined air and circulating pumps with compound steam cylinders, the pumps being independent and each connected to one condenser. A Green economizer is employed, the scrapers of which are driven by a 500-volt Lundell motor.

The rolling stock will consist of 80 double-deck single-truck cars

equipped electrically by the English Electrical Manufacturing Company.

The generators, which are three in number, are of the type generally supplied by Dick, Kerr & Co., and manufactured by the English Electric Manufacturing Company, with whom they are associated, and of which Professor S. H. Short is technical director. The output of the two larger ones is 400 kw, and that of the smaller one 200 kw when running at the rated speed under normal conditions. Each is provided with a long bearing surface to the shaft of the engine, to which it is to be fitted. It is bored accurately to a gauge supplied by the engine builder, and is made slightly smaller than the diameter of the shaft, so that it requires about 100 tons pressure to force it into position, it being then secured by means of two keys.

The switchboard is of the usual traction type, and is divided into panels, which are carried on vertical angle irons secured together with bolts, a suitable means being provided for fixing the angle irons to the floor and stays to support the board about 3 ft. clear of the wall. Automatic circuit breakers are provided on both generator and feed panels; all the instruments are of the usual type. There is a special panel provided to meet the requirements of the Board of Trade.

Plant of the Independent Electric Light and Power Company, San Francisco.

THE plant of the Independent Electric Light & Power Company, of San Francisco, is one recently built to compete with the company which formerly controlled the electric lighting business of that city. The engineers of the new company were given free hand to make the plant the very best possible for economical and reliable production of electrical energy. Mr. A. M. Hunt, consulting engineer, of San Francisco, and general manager of the company, has had full charge of the work.

In order to get a good location for the power house it was built on the Bay of San Francisco, some distance from the center of the city, and power is transmitted at 11,000 volts initial pressure to five sub-stations. One of these sub-stations supplies the San Francisco

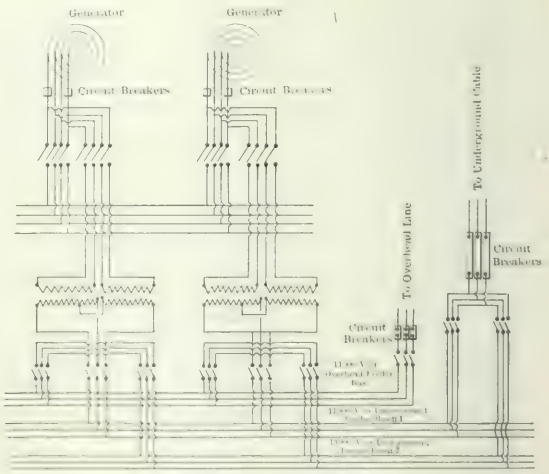


FIG. 1.—GENERAL SCHEME OF BUS-BARS, SAN FRANCISCO PLANT.

& San Mateo Electric Railway. Another sub-station is a combination from which both 500-volt direct current for the railway and 2000-volt alternating current for residence lighting are distributed. One sub-station supplies a 440-volt direct-current three-wire system, another one side of a 440-volt, three-wire system, and another 2000 volts alternating alone. The frequency is 60 cycles. The 440-volt, direct-current, three-wire system was selected for distribution in the downtown district, so that the company could bid for the business of many customers which had already purchased and installed 220-volt motors. In entering into a competition of this kind it was considered desirable to be able to connect with the motors already in place

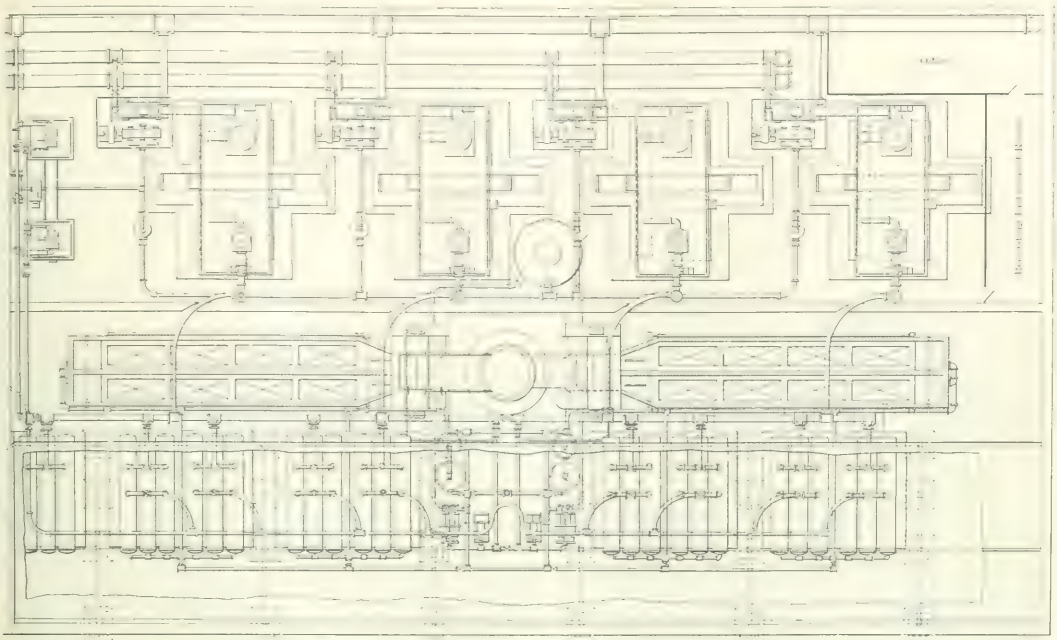


Fig. 2.—Plan of San Francisco Station.



Fig. 3.—One of the Units, San Francisco Plant.

INDEPENDENT ELECTRIC LIGHT & POWER COMPANY, SAN FRANCISCO

on customers' premises. The 10,000-volt distribution through the city is mainly by underground, lead-covered cables, with the three conductors in one sheath, though some of the outlying lines and the electric railway are supplied by overhead 10,000-volt lines.

Westinghouse electrical apparatus has been used almost entirely. The station has one 500-kw, two-phase Westinghouse generator and three 1500-kw generators direct connected to McIntosh & Seymour engines. These machines are the revolving armature type, with copper-sheathed pole tips. They generate at 550 volts, and each in ordinary operation is connected to its own pair of Scott-connected transformers for stepping up to 11,000 volts. The switchboard arrangement in this station has been the result of considerable study, and is worth noting. Fig. 1 shows the general plan of the station connections without going into unnecessary details, and without indicating the transformers. Then by closing the bus-bar switch connecting the generator with the bus-bars the generator can feed its neighbor's transformers by way of the bus-bars instead of feeding its own. There are five high-tension feeder panels, four of them for underground cables and one for the overhead circuits. These feeders are fused with long enclosed fuses mounted on a stick which can be removed to replace the fuse or to open the circuit by hand.

To synchronize a generator which has just been started up a small motor is mounted on the engine governor weight in the governor flywheel, and is controlled from the generator board. This motor acts to move the weight back and forth, and change the speed of the engine to bring it into exact synchronism with no load on. After synchronism has been attained and a new generator thrown in with those already working the motor is run back so as to move the gov-

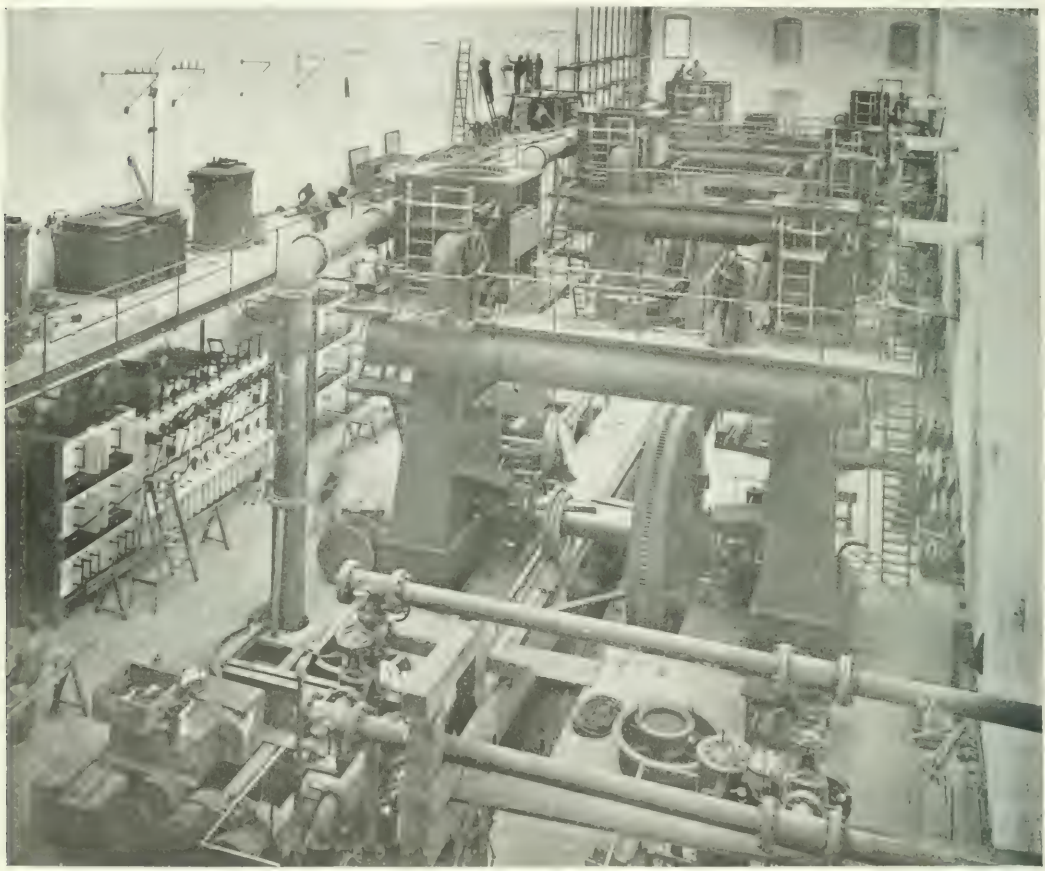


Fig. 1.—General View of Generating Plant, San Francisco.

full number of feeders and generators. From this it will be seen that each generator is provided with two four-pole single-throw switches, one of which connects it to the low-tension bus-bars, and the other to its own bank of transformers.

In ordinary operation the generator is connected to its bank of transformers, and feeds the high-tension bus-bars in this way. The high-tension side of each transformer bank can be connected with one or all of three sets of bus-bars. One of these sets of bus-bars is for the overhead high-tension lines. The other set is in duplicate for connecting to the underground high-tension lines. If it should ever become desirable to connect the bank of transformers belonging to one generator with some other generator, it can be done through the medium of the low-tension bus-bars by raising the brushes on the generator which is not to be run, and closing both the switch connecting it with the bus-bar and the switch connecting it with the ernor weights and make the engine take its own share of the load as shown by the generator wattmeter. Current is taken to the motor through collecting rings on the engine shaft. Each generator panel has two single-throw, four-pole knife switches, an indicating wattmeter, a Bristol recording voltmeter, an indicating ammeter and voltmeter, and a magnetic circuit breaker in one leg of each of the two circuits.

The engines are cross-compound, vertical, condensing with overhung cranks, as seen in Fig. 3. The three 1500-kw units have cylinders 28 and 58 inches in diameter by 48-inch stroke, and run at 116 r. p. m. When operated condensing at 165 lbs. steam pressure they are rated at 2400 ihp. The 500-kw generator is connected to an engine 17 and 36 inches by 30 inches stroke, running at 160 r. p. m. The guides and main bearing shells are made hollow so that water circulation can be used if desired. There is a complete oiling system for

each engine supplied from a tank located on the upper platform, from which a system of piping leads to each place requiring oil. The main bearings have an independent system, the waste oil being caught in basins at the base and from there taken by a pump on the valve gear and forced to the supply tank at each bearing.

Each of the generating units is provided with a hand-turned gear operating against the flywheel for turning the engine while being overhauled or adjusted. This gear, of course, is thrown out of action when the engine is running. The four main engines have separate steam and exhaust valves of the gridiron type, driven by a main gear as usually furnished by McIntosh & Seymour. Special care has been taken to reduce radiation. Besides the usual covering all steam chest covers and cylinder heads have been provided with non-conducting covering and false coverings. The high-pressure cylinders are steam jacketed, and there are reheaters between the high and low-pressure cylinders. A great deal of care has been taken to adapt the engines to the exacting requirements of operating alternating-current generators in parallel. The flywheels are very heavy to bring the deviation from uniform rotation within the limits allowable in such work.

As mentioned before, the governors are of the centrifugal shaft type, with a speed changing device driven by a small electric motor on the governor weight. This not only allows the speed to be changed for synchronizing purposes, but the load can be shifted from one engine to another while leaving the engine under the control of the governor at all times. The dash pots of the governors are of sufficient sluggishness to prevent the governor responding to quick changes in speed due to electrical disturbances, such as hunting or pumping of the generators. The generators run well in parallel even with no load. One of the large units working at full load only rose 4.5 per cent upon sudden removal of this load. The ordinary rise in speed between full load and no load of this engine is only .46 per cent. The two engines driving the exciters are the vertical positive-valve high-speed type with cylinders 11 and 19 inches diameter by 16 inches, and run at about 200 r. p. m. These engines are center crank, and each exciter is connected directly to the end of the engine shaft. A seven-hour economy test of one of the large units has shown the consumption of dry steam at 160 lbs. initial pressure, and at 26 inches vacuum to be 12.75 lbs. The combined efficiency of engine and generator or the ratio of electrical horse power at the switchboard to the ihp of the engine was 89.5 per cent at full load.

The main steam and exhaust piping about the plant was made by the National Tube Company, and fitted with Chapman valves. A 16-inch main is provided between the engines and boilers, and it is connected to the engines by large radius bends of extra heavy 12-inch pipe. This steam piping and all bends are tongued and grooved. Stratton receiver separators are placed in the steam branch of the engines close to the throttle valves.

The boilers are Babcock & Wilcox water tube, with Green fuel economizers, the arrangement of which can best be seen by the accompanying engraving of a photograph taken during construction. They were furnished under contract by Charles C. Moore & Co., of San Francisco, who also supplied much other apparatus about this plant. There are eight boilers at present in full operation, and four

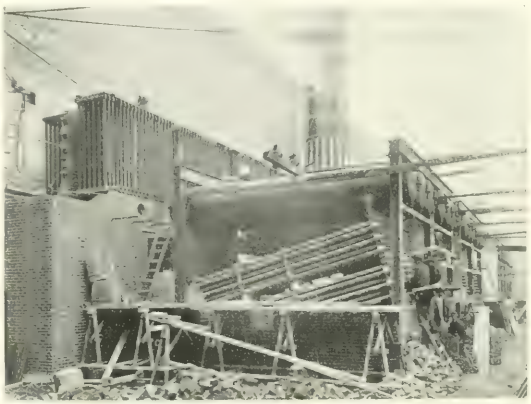


FIG. 6.—WATER-TUBE BOILERS IN COURSE OF CONSTRUCTION.

more in course of erection. These are of the largest size regularly built by the Babcock & Wilcox Company, and are equivalent in capacity to five return tubular boilers 6 ft. in diameter and 16 ft. long. The boilers are arranged in batteries of two each, with a heavy division wall separating the furnaces and passages on either side so that each boiler may be operated, inspected and cleaned entirely independent of the other. The furnaces have 252 tubes 4 inches in diameter and 18 ft. long, connected to three main steam and water drums by sinuous forged steel headers. The headers when placed in position form sectional water legs at each end of the drum.

The boilers can be run with the hot gases passing through the Green fuel economizers or directly to the stack. The boilers, economizers and induced-draft fans are arranged symmetrically on either side of a self-supporting steel stack 125 ft. high and 10 ft. inside diameter. The economizers are separated longitudinally by a division wall so that only half of the economizers on either side of the stack may be operated if desired. A pair of induced-draft fans is placed



FIG. 5.—CROSS SECTION, SAN FRANCISCO POWER STATION.

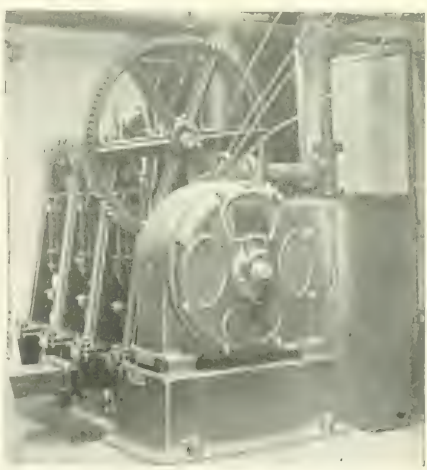


FIG. 7.—MOTOR-DRIVEN [illegible]

on either side of the chimney at its base. Each of these fans is 10 ft. in diameter, and operated by a horizontal direct-connected engine. Dampers and by-pass flues are so arranged that the gases from the boilers may pass either directly through to stack or through the economizers and fans. Feed water is pumped by three 2 by 6 by 10 Snow duplex outside center-packed feed pumps. The water passes from these through two large Goubert auxiliary feed-water heaters into which the exhaust steam is carried from all the auxiliary pumps. From these heaters the feed water goes to the boilers through the economizers. Each of the main engines, and the exciter engines exhaust into an independent condenser made by the Wheeler Condenser & Engineering Company.

The main condensing outfits consist of Wheeler Admiralty surface condensers and Edwards vertical triplex air pumps. The circulating water is supplied by an independent pumping station located at some distance from the power house at the water's edge, which supplies condensing water through a 30-inch main to all the condensers. Induction motors controlled from the power house drive centrifugal pumps for this purpose. Air pumps are also driven by 15-hp induction motors direct-geared to the crank shafts, as shown in Fig. 7. These air pumps have only one-third the number of pump valves ordinarily employed. From the fact that no induction valves are used either in suction connections or in pistons, this type is known as the "suction valveless" type. The only valves are in the discharge plates, which are easily accessible. A Quimby screw pump driven by direct-connected motors is used to pump the water for the transformer cooling. Part of the transformers, however, are oil cooled. The plant is operated by California fuel oil, the plentiful supply of which oil has caused it to be used almost exclusively for steam making purposes in the middle and southern portions of the State.

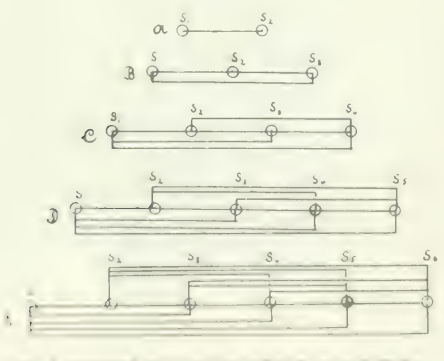
The Economic Design and Management of Telephone Exchanges—V.

By Arthur V. Abbott, C. E.

II. THE CENTRAL OFFICE SITE.

SLIGHT allusion has been made to the impossible complexity of a telephone plant devoid of a central office, but as even some telephonists rarely recognize the full significance of "Central," and as the general reader seldom thinks of it save to anathematize some unfortunate operator, it seems desirable to point out in detail the enormous economic value of this factor.

Consider Fig. 1, in which at *A*, *B*, *C*, *D* and *E*, five separate groups of sub-stations are shown as indicated by small circles. At *A* there



are two subscribers, at *B* there are three subscribers, at *C* four, at *D* five, and at *E* six subscribers. Imagine in each case that between the subscribers, taken in pairs, a wire is strung in such a manner as to give the least number of lines to enable each one to talk to all the others in both directions. Such wires are represented by the full black lines joining the circles. At *A* a single one joining 1 and 2 will suffice. At *B* there must be one line between 1 and 2, and one between 2 and 3 and one from 1 to 3. At *C* there must be one between 1 and 2, and one from 2 to 3, one between 3 and 4; also one each from 1 to 3, and from 1 to 4, and lastly one from 2 to 4. Continuing this reasoning it is easy to see that if there are m subscribers in any territory, and supposing them to be numbered from 1 to m, consecutively, then there will be $m-1$ lines from the first subscriber; $m-2$ from the second; $m-3$ from the third, etc., to one line between the $m-1$th subscriber and the mth subscriber. The total number of lines will evidently be the sum of all these, or $\Sigma\, m-1+m-2+m+3+$ etc. $+1$. This is the sum of an arithmetical progression, of which the first term is $m-1$, the last term 1 and the common difference 1. The familiar formula for the sum of a series is

$$S = \frac{n}{2}(c + a) \qquad (1)$$

in which S is the desired sum; n the number of terms; c the last term, and a the first term. In this case $n = m-1$; $a = m-1$; $c = 1$. Therefore,

$$S = \frac{m}{2}(m-1+1) = \frac{m^2}{2} - \frac{m}{2} \qquad (2)$$

In Table No. 1 the value of S is calculated for a few of the most commonly occurring groups of subscribers up to 5000, to illustrate the rapid increase in complexity that such a system would cause.

TABLE NO. 1

Showing relation between number of subscribers and number of lines needed with no central office.

Number of Subscribers	Number of Lines.
2	1
10	45
100	4,950
500	124,750
1,000	499,500
5,000	12,497,500

Cases where there are a thousand subscribers or more grouped together are numerous, needing, as shown by Table No. 1, nearly 500,000 lines. A 200-pair cable, the largest now commonly used, needs (including space for ducts) about 25 square inches, so the 500,000 lines, should they pass a single point, would need 2500 200-pair cables occupying 435 sq. ft. space in the street, taking in its most compact form, at least 20 ft. square. Even the astonishing maze of pipes and other underground structures of New York streets would fade into utter insignificance beside such a scheme. Nor is the resort to an aerial line conceivable. A line with ten cross-arms carrying ten wires each is considered the largest justified by good practice, hence 5000-pole lines would be needed for a petty exchange of a thousand subscribers. By similar reasoning, it is easy to see that the first subscriber must have 999 lines, requiring five 200-pair cables or ten-pole lines to care for his wire plant only. The perplexities are not yet exhausted. Supposing one new subscriber to be added to an exchange of a thousand, then a thousand new lines must be installed.

A similar huge plant outlay, and corresponding space at each substation, is needed to enable connections to be made between subscribers. As subscriber No. 1 has 999 lines, he must have the same number of terminals so placed that any one can be connected to each of the others. At present, the jack with its connecting cord and plug is the most compact known form of switching apparatus, but a thousand jacks with their companion appliances would require a switchboard as large as a folding bed, costing at least $3,000. To be sure, but one pair of cords and plugs would be needed, and no supervisory signals, but all other switchboard apparatus would be essential. On each subscriber would fall the burden of doing all the switch work necessary to carry on his telephonic correspondence, no light task for people telephonically busy, and then the switchboard and wire plant must be maintained and kept in good working condition, a matter needing expert knowledge and unremitting attention. So, from all standpoints, "Central" is shown to be a great economic factor in telephony, saving not only a vast investment over any other conceivable method of attaining the same result, but relieving the subscriber of an otherwise impossible quantity of irksome labor, accomplishing the desired end with, on the whole, wonderful speed, accuracy and economy, facts which it is well to bear in mind the next time the gentle "Hello Girl" is a second or two longer in getting a

desired party, gives, perchance, a wrong number, or cuts off in the midst of an important sentence.

If, then, the central office is admitted to be a necessity, the best situation therefor is an important consideration. Unlike other location problems in electrical engineering, there are no questions of fuel or water supply, and no attention need be devoted to electrical losses in the radiating lines, so consideration relieved of these details may be focused sharply on the pure cost of the necessary installation, including therein the factors of real estate (land and buildings) and electrical plant.

If the operating company buys real estate (land and buildings), or if it purchases land and builds, it must treat itself as a landlord and charge against operating expense a sufficient annual sum to cover real estate maintenance, namely, interest on investment in land, interest and depreciation on buildings, expense or janitor service, light, heat, general building maintenance, etc., for the same. If the company rents office quarters from other real estate owners, the annual rental therefor covers the same items, plus a probable profit to the owners, and must be charged against operating costs in the same manner. Thus, in so far as the actual annual operating expense is concerned, it matters little whether the company, or other parties, are the owners of the necessary real estate, except that if the company owns, it may save to itself the interest on the real estate investment, or any other expense in the nature of a profit on the real estate transaction, and charge against operating only such a sum as is actually needed to perpetually maintain the buildings in proper condition, leaving the general profits of the business to care for any desired profit on the real estate portion of the investment.

There are other and weightier reasons in favor of a telephone company owning its own offices. A central office of any magnitude is a large, complicated and expensive installation. The nature of the wire plant renders a removal very difficult, costly and exceedingly detrimental to the service, even if conducted with the greatest skill and care, so permanence in location is of vital importance. Ordinary buildings are ill adapted to the uses of a central office, and if adapted it must be at considerable sacrifice of economy in plant installation cost, or at an increase in operating expense. Further, telephone apparatus is peculiarly sensitive to injury by fire, as the most insignificant one may completely paralyze the service for a considerable period of time, so particular pains should be taken to protect therefrom. Central offices, therefore, are preferably located in buildings more than ordinarily fireproof, thus even the presence of other occupants courts a fire risk that it is well to avoid. It is, therefore, safe to assume that ownership by the telephone company of such real estate as shall be adequate for at least the more important offices, say, those of 800 lines or over, represents the best present practice.

The design of the central office, including therein the choice of the necessary site, will affect the cost of four items in the telephone plant, namely, the investment in real estate, in buildings, in switchboard and in wire plant. So far as a discussion of the best location is concerned, two of these, namely, the type of switchboard and building, will remain essentially constant. For all kinds of switchboard need about the same space and other requirements, and the cost of buildings at any given time will be essentially the same, whether placed on one site or another of a particular city, provided, of course, that there are no exceptional peculiarities in the locations considered. But it is very evident that the cost of land will vary very widely in the same town, sites in the business portion costing many fold the price of equivalent areas in the outskirts. It is also evident that there must be some point within every collection of subscribers, such as would be presented by the groups in every city or town, from which the expenditure of wire to reach all the subscribers will be a minimum. To locate the office at this point, generally called the "telephonic center," will certainly require the least wire plant investment, and involve the smallest annual charge for depreciation and maintenance, because both the quantity of plant and investment therein is a minimum. As the office is moved away from the telephonic center, the investment in wire plant increases in a manner easy to calculate, but the cost of real estate will also change in some manner to be ascertained only by inquiry on the ground. The problem presented to the telephone engineer is then this: Given the location of the subscribers and cost of various central office sites, to determine, first, the telephonic center; second, the rate of increase in investment and annual expense of the wire plant as the office recedes from the telephonic center, and, third, to select such a site as will make the sum of the investment in land and wire plant, and the sum of the annual charges on both these items, a minimum.

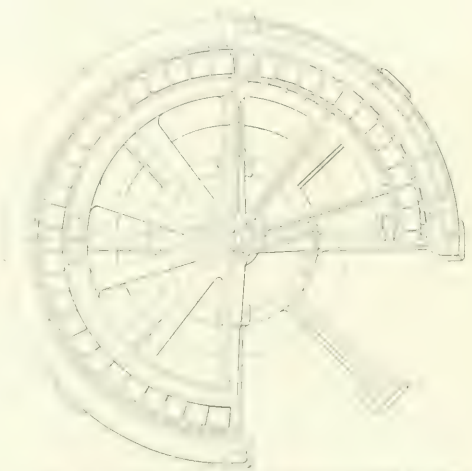
The Debt of Electrical Engineering to C. E. L. Brown VI.

By B. A. Behrend.

THE UMBRELLA TYPE.

THE great number of water powers in Switzerland of large volume and small head had early induced Mr. Brown to design generators with vertical shaft for direct connection to the turbines. We have referred to his designs for the Aluminum Works at Neuhausen, and more briefly to the 300-hp, low-tension, three-phase generators for the power transmission Bulach-Oerlikon. The very low speeds at which some of the turbines were operating demanded large diameters for the generators, and these large diameters would have made a top-bearing a clumsy construction. To this difficulty the "umbrella" type generator, so characteristic and typical of the





1200-HP, 1200 R. P. M. GENERATOR FOR LYONS, FRANCE.

leading Swiss and French electric power stations, most of which are built by Mr. Brown, owed its origin. Never addicted to stereotyping designs, Mr. Brown deemed it better from an engineering and economical point of view to adapt the generator to the prime mover. The "umbrella" magnet wheel of one of the eight 1200-hp, three-phase generators for Lyons, France, is well shown in Fig. 33, while a drawing of the machine, a performance curve of it, and a view of the station are shown in Figs. 30, 31 and 34.

The cuts being very good, little comment on this construction is necessary. The normal output of these machines is 3500 volts, 200 amperes, at 50 cycles and 120 revolutions. The power factor of the circuit is 75 per cent. The normal rating of these machines is, therefore, 1210 kilovolt-amperes. These machines were designed in 1897, and are very well proportioned. The rise in voltage is small, viz., 100 volts, or less than 3 per cent on a non-inductive load of 150 amperes, and 500 volts, or 14.3 per cent on an inductive load of 200 amperes and power factor 75 per cent.

The "umbrella" type is also used by Mr. Brown for high-speed



[illegible] Generators in Lyons Station.



[illegible] Plant

generators direct connected to the waterwheels. An early and typical installation of this kind is the plant on the Sihl near Waedensweil. The plant was constructed between 1893 and 1895. The design of the generators is shown in Fig. 35. They are rated to be capable of making the turbines take in 400 hp at 360 revolutions and 42 cycles, either on a two-phase motor load, or on a single-phase lighting load. The pressure per phase is 5500 volts, the maximum current being 50 amperes. Thus on a two-phase circuit the generators would be 550-kw generators, and they are very well capable of yielding 550 kw on a motor load.

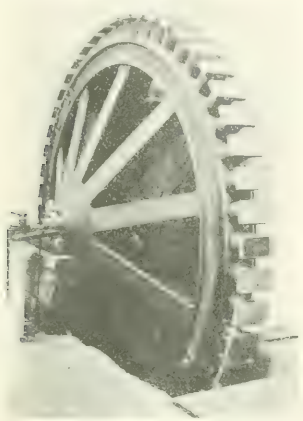


FIG. 33.—1200 HP REVOLVING FIELD UMBRELLA TYPE.

For the first time Mr. Brown used an extremely high surface speed in these machines, viz., 7500 ft. per minute. Professor Wyssling, the manager of the plant, told the writer some years ago that by accident one of the turbines had raced and ran at 600 revolutions, corresponding to a peripheral speed of 12,500 ft. per minute without in the least injuring the generator.

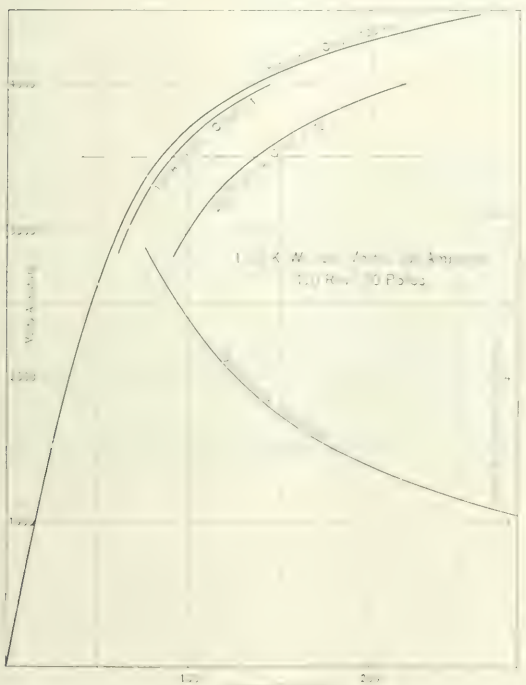


FIG. 34.—PERFORMANCE CURVES OF LYONS GENERATORS.

The poles are held to the steel rim in a very simple but strong way; the winding consists of copper on edge, and thus the magnet wheel is in the truest sense of the word a part of the machine. The armature has four circular holes per pole, the conductors consisting of flexible cable, being threaded through insulating tubes made of mica and paper. It is a very simple and brief operation to re-wind an armature coil in this machine, but it is very rarely necessary, as the machine frame is carefully insulated from the earth, as shown in Fig. 35 to protect the machine against lightning. The floor of the room is set on insulators to protect the attendants.

There are at present four generators in the station, all alike. We say "all alike," and we have no doubt that electrical engineers familiar with the work of the past ten years will understand the allusion. For it was not alloted to many designers of that time that they could make the second machine like the first. Nothing shows the real worth of the work of Brown so strikingly as the fact that with very few exceptions which we shall mention hereafter to disarm critics, he could make for one station all his machines alike, since the ones first installed had been designed rightly and required no changes. How many designers may say the same of their machines in the early half of the nineties?

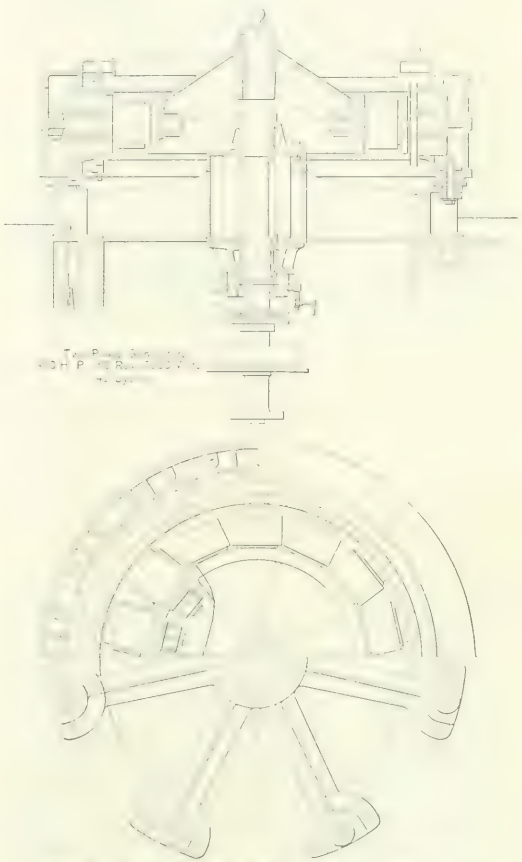


FIG. 35.—UMBRELLA TYPE GENERATORS AT WAEDENSWEIL.

Fig. 32 shows the generators in position in the station.

Cryptic "Contact."

The following cryptic, orphic dispatch of Dec. 24 hails from London: A new system of etheric telegraphy is being experimented with between Folkestone and Dungeness. The contact is said to be perfect.

Electric Generating Plant at Seoul, Corea.

Next to Thibet the most conservative country in the world has been Corea, which was only opened to the world in 1883. Up to that time but few Westerners, and then only at the risk of their lives, had seen the capital, Seoul. That Western ideas have been rapidly gaining ground, at least in the capital of the "Land of the Morning Calm," is made evident from the fact that the city now possesses an extensive electric railway system and an electric lighting plant.

The electric railway runs through the east and south gates, and a branch line through the west gate. The total length of the road is



FIG. 1.—CAR AT MAIN GATE, SEOUL.

10 miles, 5 miles of which are inside the city walls, and 5 miles outside. The terminus of the line outside the city is at the Han River, and recently an extension of 6 miles has been built to another point on the same river.

The prejudice of the people against the road was very strong at first on account of a superstitious belief that the power house was the cause of a dry season, which prejudice, however, is rapidly disappearing. When the line was first started two of the cars were [illegible] on account of the above-mentioned superstition, and partly on account of the accidental killing of a boy by one of the cars.

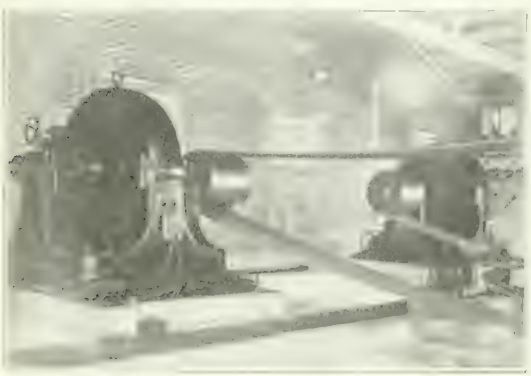


FIG. 2.—ONE OF THE GENERATORS, SEOUL.



FIG. 3.—VIEW OF ENGINE ROOM, SEOUL.

The accompanying illustrations show one of the cars near the main city gate, and views in the generating house. The electrical generators were furnished by the Westinghouse Company, there being two 120-kw double-current machines. The alternating-current side delivers two-phase currents at 60 cycles for lighting the city and palace, and the direct-current side delivers current at 550 volts for railway service. The plant has also recently purchased a 75-kw Westinghouse rotary converter.

[illegible] Company, of Erie, Pa., and consist of two tandem compound engines of 230 hp running at 240 r. p. m.

Transatlantic Wireless Telegraphy.

Marconi has now made a thorough examination of the eastern portion of Cape Breton, and has decided to erect a station there fore transatlantic wireless telegraphy. It is stated that the erection of a station will be commenced within a few weeks, and that three months after the work has begun he will make practical tests in transatlantic wireless telegraphy from a fully equipped station. The electrical power employed at Cape Breton will be double that now used at Cornwall, and the power at the latter place will also be doubled. Instead of temporary expedients such as were employed in Newfoundland the installation will have a permanent character. A dispatch from Sydney, N. S., states that Marconi also contemplates erecting a station at Cape Cod, Mass.

One objection applying to a station on Cape Breton is that the messages will have to pass over a part of Southern Newfoundland. Marconi stated, however, that the land distance can probably be overcome by increased power at the station. It is to be seen whether the Cable Company will make any protest on the score that the passage of electrical waves over Newfoundland will infringe its monopoly. Should the land prove an insuperable physical difficulty, Marconi says that he will place a way station on the Azores, the King of Portugal having invited him to do so.

The Cape Breton Railway has offered to give Marconi the site and all land required for a station, and the Dominion Coal Company has made the same offer. The Commercial Cable Company is also understood to have offered him facilities at Canso.

To a reporter of the *New York Sun* Marconi stated that a wire 200 ft. high elevated by a pole or other contrivance, is sufficient for his purpose. After that all that is required is abundant electrical power for the generation of electric waves. The curvature of the earth, he says, does not injuriously affect the transmission. The contrary was one time believed, but the Newfoundland experiment has offered the necessary disproof. A more serious difficulty is the nature of the ground where the station is located. Some geological formations assist the apparatus, others minimize its effect. It is possible in certain spots to communicate over 200 miles, and in others only over 100 miles. The presence of iron deposits is injurious.

Referring to the use of the letter "S" in the Newfoundland experiments, the manager of the Cornwall station said that the letter "s" is usually employed in test signaling, and it is used between certain of the European Marconi stations. For the transatlantic test, however, this letter was avoided as a signal might have been received from another station. The test letter is changed from week to week, and when the transatlantic message was received at Newfoundland it happened to be the turn to telegraph "S." The manager of the Cornwall station said that he is in daily communication with a station in Ireland 220 miles off.

Scientific Meetings.

The American Physical Society meeting last week in New York City elected the following officers and trustees: President, Prof. A. A. Nicholson, of the University of Chicago; vice-president, Prof. Arthur G. Webster, of Clark University; secretary, Prof. Ernest Merritt, of Cornell; treasurer, Prof. William Hallock, of Columbia; trustees, Prof. E. H. Hall, of Harvard; Prof. D. B. Brace, of the University of Nebraska, and Professor Carl Barus, of Brown. The officers were all re-elected. The American Mathematical Society, in session at Columbia University, elected the following officers for the ensuing year: Vice-presidents, Professor Maxine Bocher, of Harvard, and Professor Frank Morley, of Johns Hopkins; secretary, Professor F. N. Cole, of Columbia; treasurer, Dr. W. S. Bennett, of New York; librarian, Professor D. E. Smith, of Columbia; committee on publication, Professor F. N. Cole, of Columbia; Professor Alexander Ziwet, of the University of Michigan, and Professor F. Morley, of Johns Hopkins. The president, Professor E. H. Moore, of the University of Chicago, holds over until next year. Professor Pomeroy Ladue, of New York University; Professor G. A. Miller, of Leland Stanford University; Professor P. F. Smith, of Yale, and Professor E. B. Van Zleck, of Wesleyan, were elected members of the council for three years.

Electrical Transmission on the Pacific Coast.

No better illustration of the great feats in electrical transmission on the Pacific Coast, of which so much has been heard of late, can be given than by the map on page 26. While the course of the Bay Counties Company system has been shown before, this, we believe, is the first adequate representation to appear in public prints of the territory traversed by the two great systems with proper regard to their relative geographical location.

A review of some of the interesting features of the "California situation," together with recent data, for which the *Journal of Electricity, Power and Gas*, of San Francisco, as well as our own pages, are authority, makes interesting reading, with the map before the reader for reference.

Through its connections with the system of the Standard Electric Company, power from the Colgate power house of the Bay Counties Power Company is now distributed in every day, hard, commercial service at a distance in excess of 200 miles from its point of generation. The manager of the local company, which is making its distribution—himself one of the most exacting electric lighting and power managers in the West—after having sufficient experience to satisfy himself, says: "I want no better power; it's good enough for me."

There was a time, not so very many years ago, when a transmission of 200 miles was considered beyond the pale of commercial feasibility, and there was also a time, not so very many months ago, seemingly, when it was said that such a transmission, if attained, would be beset with such technical and engineering difficulties as to relegate it into the category of experimentalism. Now, the fact has been demonstrated and all fears of either nature have been found groundless.

Several years ago, before Californian transmission enterprises had struggled into eminence, a certain financier who had to do with a transmission project of moderate proportions, was so battle-dooredand-shuttle-cocked by the conflicting opinions thrust upon him, that finally he began to believe the possibilities of electrical transmission a myth. At last an agent of the Stanley interests came along, and without entering upon pros and cons gave satisfactory guarantees that his company would accomplish certain results at a stated cost under prescribed conditions. The sales agent got the contract, his company has fulfilled its agreement, and certain prophets against electricity have gone down in ignominy, while now far larger and bolder schemes have proved their feasibility.

If it be regarded from an engineering standpoint only it is not an unmixed blessing that circumstances have compelled the temporary tying-in of the Bay Counties and Standard companies' systems. Let us, even at the risk of repetition, review the situation, which is giving now a phenomenal transmission line of over 200 miles in length. From Colgate to Oakland, the distance, by way of the Bay Counties' line, is 152 miles. From Oakland to Redwood City, by way of the Standard Electric Company's line, is 49 miles, hence the distance from Colgate to Redwood City is 191 miles. From Redwood City the Bay Counties' power is continued, by means of the secondary distribution of the Consolidated Light & Power Company, northerly along the peninsular of San Francisco to Burlingame for a further distance of 11 miles, making the total length of line from Colgate to Burlingame to be 202 miles. During this present month the Standard Company's high-tension line will be completed into the Eighth Street sub-station of the Standard Electric Company in the city of San Francisco, some 20 miles further than Burlingame, and when this is done the Standard Electric Distribution Company will have at its disposal, for use in San Francisco, electric energy developed on the Yuba River, 222 miles distant. This extraordinary long transmission will exist until early in the Spring of 1902, when it is stated that the Standard Company's great station at Electra, in Amador County, will be placed in service.

From Oakland, where the Bay Counties' line ends, power is taken backward, so to speak, over the Standard Company's line to Mission San Jose, which is the Company's main switching station, 26¼ miles distant from Oakland. Back again over the Standard Company's line from Mission San Jose to Stockton is a further stretch of 49.6 miles; hence the Standard line from Oakland to Stockton has a length of 75.85 miles, which added to the length of the Bay Counties' line from Colgate to Oakland gives a transmission that is 218 miles in length. This line has already been placed in commercial service, and is delivering 1000 hp to the Sperry Mills, the Stockton Gas & Electric Company and other industries of Stockton.

The experience of the six months which have passed since the inauguration of the extreme long distance transmission service from Colgate was begun, is that no further question need be raised concerning the reliability of the service. This does not mean that transmission service is to be regarded as infallible, but it does mean that the experience of the last six months has demonstrated, in so far as six months' experience will demonstrate anything, that extremely long- distance, high-tension transmission is possessed of no materially great hazard because of its exceptionally long lines or because of its exceptionally high potential. In fact, there is room for the contention that the qualifying adverb "materially" is unnecessary to the truthfulness of the statement, for with a power house as perfect as the central station of any city, and with every function of the equipment in duplicate even to the pole line, it seems justifiable to contend that such plants are surrounded with every safeguard known to the the highest class of electric service.

With the advances made in electrical science, the distance of feasible electrical transmission goes onward as the voltage values go upward. Eight years ago the lines of the old Pomona plant, which carried 10,000 volts, were viewed with awe and almost reverence. Now the use of 40,000 volts is becoming commonplace in California at least, and another six months will see hundreds of miles of transmission lines in the Golden State operated at a potential of 60,000 volts. Indeed, the Standard Electric Company has already operated one of its lines experimentally in adverse weather for over two hours at the extreme potential of 80,000 volts, and this without experiencing any trouble whatever.

Of the financial considerations attending the completion of the Bay Counties Power Company, concerning which there has been doubt and trepidation in ill-informed quarters, a few authentic figures, taken from the balance sheets of the Bay Counties Power Company, point out the moral in their own irrefutable way. The cost of the completed property of the Bay Counties Power Company was considerably in excess of the amount originally estimated, but as the demand for its power was also much larger than anticipated, the result has not been displeasing to the owners. The assets of the company on Oct. 1, 1901, amounted to $6,339,442.05. Of this $2,250,000 came from the sale of first mortgage 5 per cent, 30-year sinking fund bonds, and $750,000 from second mortgage 6 per cent bonds. Of the authorized issue of $5,000,000 of stock, 14,000 shares remain in the treasury of the company, hence 36,000 shares are outstanding, with a market value of $60. The monthly fixed charges for interest on the first mortgage bonds is $9,375, on the second $3,750.

The earnings of the six months (up to September, 1901) show a steady increase:

1901.	Gross.	Expenses.	Net earnings.
April	$13,913.21	$4,466.35	$9,446.86
June	18,219.78	4,217.11	14,002.67
July	20,903.46	6,674.15	14,229.31
September	25,463.52	6,864.50	18,598.03

In addition to the above gross earnings, the Bay Counties Power

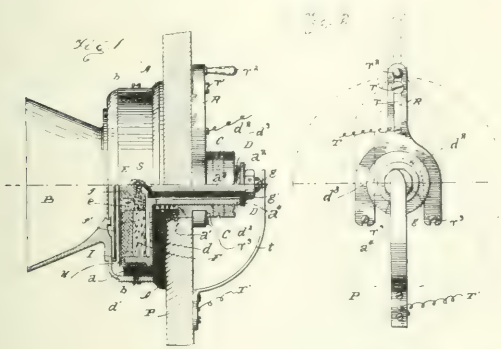

COLGATE P.H.
Nevada P.H.
Yuba P.H.
Browns Valley
Nevada City
Grass Valley
Smartsville
Yuba City
Marysville
Waldo
Wheatland
Lincoln
Oroville
Chico
Orland
Willows
Colusa
Woodland
Sacramento
Davisville
Dixon
Batavia
Elmira
Vacaville
Winters
Suisun
Fairfield
Vallejo
Benicia
Napa
Sonoma
Petaluma
Santa Rosa
Healdsburg
Cloverdale
Ukiah
Calistoga
St. Helena
Pennycove
San Rafael
Tiburon
Sausalito
Oakland
Piedmont
Alameda
San Francisco
San Leandro
Hayward
Livermore
Altamont
Niles
Mission San Jose
Alvisa
Redwood
Palo Alto
Santa Clara
San Jose
Stockton
Lathrop
Oakdale
Modesto
Turlock
Merced
Milton
Valley Springs
Jackson
Ione
Galt
Folsom
Placerville
Auburn
Grass Valley
Truckee
Marysville
Chester
Quincy
Susanville
Red Bluff
Shasta
Redding
Dunsmuir
Mount Shasta
Yreka
Weed
Alturas
Lassen
Plumas
Sierra
Nevada
Butte
Glenn
Colusa
Sutter
Yuba
Lake
Napa
Sonoma
Marin
Solano
Contra Costa
Alameda
Santa Clara
San Mateo
Santa Cruz
Monterey
San Benito
Fresno
Madera
Mariposa
Tuolumne
Calaveras
Amador
El Dorado
Placer
Nevada
Sierra
Plumas
Lassen
Modoc
Siskiyou
Humboldt
Mendocino
Lake
Trinity
Tehama
Shasta
Del Norte
Klamath
Curry
Coos
Douglas
Josephine
Jackson
Lane
Linn
Benton
Polk
Yamhill
Tillamook
Clatsop
Columbia
Multnomah
Clackamas
Marion
Lincoln
Wasco
Hood River
Sherman
Gilliam
Morrow
Umatilla
Union
Wallowa
Baker
Grant
Harney
Malheur
Lake
Deschutes
Crook
Jefferson
Wheeler
Klamath
Lake
Harney
Malheur
Owyhee
Elmore
Ada
Canyon
Payette
Washington
Adams
Idaho
Nez Perce
Lewis
Clearwater
Latah
Shoshone
Benewah
Kootenai
Bonner
Boundary
Pend Oreille
Stevens
Ferry
Okanogan
Chelan
Douglas
Kittitas
Yakima
Benton
Franklin
Walla Walla
Columbia
Garfield
Asotin
Whitman
Spokane
Lincoln
Adams
Grant
Okanogan
Ferry
Stevens
Pend Oreille
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Klamath
Jefferson
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Crook
Wheeler
Grant
Harney
Malheur

New Telephone Patents.

Telephony contributes but two patents to the issue of Dec. 24, the inventions originating from points as far apart as Los Angeles, Calif., and Rome, Italy. Giving Marconi's countryman the place of honor, Commander Alfonso M. Massari patents a transmitter of the granular carbon type, in which the principal novelty is a means of adjusting the transmitter without taking it apart.

Referring to the diagram, *A* is a plate of insulating material having a central opening therein and carrying sleeves *a* a^1. *B* is the mouthpiece attached to sleeve *a* by screws *b*. *C* is a hollow metal cylinder having an annular groove *c* on its outer periphery, and an internal recess at one end, which fits over and is secured to insulating sleeve a^1. *D* is a tube having its free end threaded, *d* is a disk or flat ring having a central opening, to which one end of the tube *D* is attached, and d^1 is a short hollow cylinder attached to the edge of *d*. The tube *D*, ring *d* and cylinder d^1 are of brass or other suitable metal, and may be integral. The tube *D* passes through the plate *A* and cylinder *C* and has its threaded end projecting beyond the latter. *S* is a coiled spring situated between the ring *d* and a shoulder formed by the recess in cylinder *C*. All these parts are mounted on the baseboard *P*. On the free end of *D* is a nut d^2, secured by a lock-nut d^3.

The cylinder d^1 contains a carbon block or cup *E*, situated opposite the central opening in the ring or disk *d*, and held in position and insulated by chalk *F*; *f* is a piece of cotton or felt placed in the cup *E*, *f'* is a ring of cotton and *e* is granulated carbon. *H* is the diaphragm of metal and *I* an elastic ring, which separates and insulates the diaphragm from the mouthpiece. In tube *D* is fitted an insulated sleeve



MASSARI'S GRANULAR CARBON TRANSMITTER.

a^2 having an annular flange a^4 at its outer end. A metal rod *g g* passes through the sleeve a^2 and bears against carbon cup *E*; *g* can be regulated by nut g^1. The transmitter is held in place by fork *R* which fits the groove in *c* and is secured by screws r^2 and r^1 passing through the slot *r*. One line wire *T* is attached to *R* and the other T^3 to a contact piece *t* which bears on rod *g*. The circuit is thus through R_1 C_1 D_1, ring *d* and cylinder d^1, and through rod *g*, carbon cup *E* and granulated carbon *e*, the diaphragm completing the circuit.

When the instrument is in use the diaphragm vibrates and so varies the pressure of contact with cylinder d^1. The spring *S* normally tends to press the cylinder d^1, ring *d* and tube *D* toward the diaphragm. The nut d^2 acts against this spring and bears against the free end of cylinder *C*. The transmission is regulated by adjusting the pressure on the diaphragm, and this is effected by screwing up or unscrewing the nut d^2 and its washer d^3, and thus decreasing on increasing the pressure on the diaphragm. By this means a very delicate adjustment can be effected.

If the granular carbon becomes displaced, as sometimes happens in transmitters of this type, the mouthpiece and diaphragm can easily be removed by unscrewing screws *b* and the carbon can be replaced with little trouble. By drawing *R* into the position shown in dotted lines in Fig. 2 contact between the terminal wire *T* and cylinder *C* is broken, and the instrument can then be withdrawn from the base *P*.

The construction of this transmitter is ingenious and the means devised for securing adjustment should be effective, but the multiplicity of parts would render it rather an expensive instrument to make and the absence of necessity for adjustment when once the instrument has been properly assembled, has always been considered one of the best features of the granular carbon transmitter.

Mr. Samuel Judson Ballard, of Los Angeles, patents an indicator for extension or party lines intended to show at each station, by means of a dial and pointer, whether the line is "busy" or clear. The instrument is a simple mechanical movement actuated by an electromagnet. As the electromagnet of the indicator at each station must be permanently in circuit (Mr. Ballard shows them in series on one leg of the line) and as, to indicate "busy," a permanent current strong enough to energize all the magnets must be kept to line it is apparent that the Ballard indicator would introduce difficulties greater than those it is designed to obviate.

American Electrical Trade Abroad.

Our own pages show weekly the extent and scope of electrical export trade. The *World's Work*, in its January issue, presents the same data in a rather more spectacular and sensational manner, as follows:

Punta Arenas in Tierra del Fuego is the southernmost continental spot on the globe, but the modern lighthouse on that lonely coast is equipped with electrical machinery made in Schenectady, N. Y. The firm that manufactured it has also pushed electricity farthest north by installing dynamos at Hammerfest, in Norway, and, though it is a far cry from the deepest drifts of the Calumet and Hecla mine to Yanteles, in the Andes, 14,000 ft. above the sea, two consignments recently left Schenectady, one for the deep mine, the other for the mountain.

By the very bedside of the Pope is placed every night an American apparatus in the form of a cylinder with an incandescent bulb in one end—in effect an electric candle. At Bagdad, Aladdin has been replaced by a New York concern. Lamps of fanciful patterns are sent from New York to a point on the Persian Gulf, and thence conveyed over some 300 miles of desert on camel back. They are then placed on rafts and towed 100 miles up the Euphrates, and again loaded on camels and carried to their destination 200 miles from the river. These lamps decorate the palaces of the Sultan of Morocco, the Prince of Siam and several rajahs in British India, and they are also popular in Jerusalem.

From the Falls of the Couvery, one of the sacred rivers of India, to Kolar in Mysore, American electrical engineers have recently set up an American transmission plant under somewhat remarkable circumstances. There are still wild elephants in Mysore, and there will always be white ants. But as a white ant will venture not more than 5 or 6 ft. up a pole in search of edible wood, the steamer from New York carried out to India iron post-sockets 7 ft. high in which to set the poles—to the discomfiture of the ants. To disconcert the elephants and prevent grounding of the current through any behemoth that might venture to test the wires with his trunk, the engineers, after careful measurements, strung the wires just beyond reach of the biggest possible elephant standing on hind legs and groping.

Telephones in Chicago Restaurants.

The Chicago Telephone Company has inaugurated a novel class of service by placing telephone facilities within reach of the customers of several of the largest restaurants of that city. The restaurant is wired so that the telephone instrument can be plugged in at the various tables. It is then only necessary for a customer to ask for a telephone instrument if he wishes to carry on conversation with some outside party during mealtime. Kinsley's, the Bismarck, Mandels', Rector's and the Edelweiss have put in this service, and it is being extended to other restaurants. In the restaurants just named the charge per message is 10 cents, and is put on the customer's check along with the other items. In the Boston oyster house a different plan is employed. The telephone instrument in this case has a prepayment coin apparatus attached so that payment is made by dropping money in the slot instead of having it charged on the customer's bill. The plan seems to be a popular one, as some restaurants have as much as 15 to 20 calls a day for a telephone instrument from customers, even though the service is not as yet well known. The fact that the service exists is announced by neat placards at various places around the restaurant. The wording varies according to the idea of the restaurant manager, but in all cases the announcement is made that the waiter will furnish telephone instruments upon request.

Marconi on Wireless Telegraphy.

The *New York Journal* prints in its issue of last Sunday an article signed by Marconi under the head "Wireless Telegraphy in 1901." The article was evidently written some time ago, for the following passage—curious, in the light of recent events—occurs in connection with transatlantic transmission:

"I do not give any countenance to the suggestion of bridging over the Atlantic. The time for that is not ripe. At the present time it would necessitate the stationing of 10 ships. That would entail a very large expenditure. Then there is the question of the numerous re-transmissions which would be difficult in practice and be in no way an improvement either in cost or in time on the present cable system. I do not say that the idea is absurd, or unattainable, but its realization is out of the question for some time to come."

As to land telegraphy, Marconi says that nothing has as yet been attempted in exclusively land wireless communication. In England he does not see that it would act very well. Apart from the question of getting a license to do so, which, under existing circumstances would in itself be rather difficult, the present system of telegraphing could not be materially improved upon except for very long distances, and, he says, that he does not know that for that alone it would be a paying business speculation. In America the possibilities are greater, because of the larger areas and more open country. It is a question for the future. Meantime sea telegraphy is the great thing, and progress in this direction is more to be desired.

Referring to marine applications, he says that Great Britain has already 38 battleships fitted up with his system, Italy has 10, and Germany and France a dozen between them. But perhaps the greatest development that 1901 has witnessed in connection with wireless telegraphy has been its extension to the general shipping. There are at present four Cunard liners, four Norddeutscher liners, two Belgian Royal packet steamers carrying installation, and a number of other companies have fitted up the instruments as an experiment in one of their vessels.

As to syntonic telegraphy, Marconi says it is now possible to tune a message so that it shall go only to the ship or the object for which it is intended. This has been brought about by an alteration in the transmitters and receivers, and has resulted in a concentration of the electrical oscillations of each frequency. The improvement has been effected within the last year, but even yet when any reference is made to wireless telegraphy the erroneous impression, he says, is put abroad that the oscillations disturb other frequencies and so give to all the installations in the vicinity the message that was intended only for one. This new working has not yet been generally applied because in the generality of cases the old arrangement answered well enough, but wherever concentration is necessary the old instruments can be adapted to the improvements with very little difficulty and in a very short time. In other directions changes that have been for the good of the system have been carried out. Originally a very much higher pole was necessary. Every 30 miles required a pole 100 ft. in height. Now the same distance may be covered with a 10-ft. pole.

Government Telegraph Bills.

Postmaster General Payne, in his letter to us, noted last week, has formally and positively denied the rumors as to administration measures for securing control of the telegraph and his own share in them. But there are plenty of "private" bills from Congressmen. Congressman Brownlow, one of the Republican members of the Appropriations Committee of the House, in an interview, says, regarding the purchase of the telegraph lines by the Government: "I think the question will come before Congress this winter, and it is my opinion that some measure looking toward the purchase of the existing telegraph companies will pass the House by a pronounced majority. The telegraph is simply a quicker means than the mails for the transmission of intelligence, and it should be a part of our postal system. I am thoroughly in favor of the plan."

Representative W. A. Smith, of Michigan, who is the chairman of one of the important committees of the House, besides being a member of the Foreign Affairs Committee, is also strongly in favor of the purchase of the telegraphs, and says that it will probably be done through the issuance of 2 per cent bonds, which can be used by the national banks as a basis for their circulation.

Representative Pearre, of Maryland, who is also a Republican of some influence in the House, is preparing a bill, which he will introduce as soon as Congress reassembles, providing that the Government shall purchase the stock of the two telegraph companies, paying therefor bonds to the par value of the property and placing the telegraph business under the control of the Post Office Department.

Congressman Jackson has received promise of support from many members of Congress to his proposition for the government ownership of telegraph lines. He believes that the cost of transmission would be greatly reduced, even a 10-cent or a 5-cent minimum being possible.

It may not be generally known that every telegraph company that was in existence in 1866, and every telegraph company that has been organized since that time has filed with the Postmaster General of the United States its written acceptance under seal of the terms of the Act of Congress of July 24, 1866, agreeing thereby, in consideration of the right of way over post roads and through Government lands and under or across navigable waters, to transmit Government messages at rates to be fixed annually by the Postmaster General, and to sell its lines to the United States at a price to be fixed by arbitrators, one to be appointed by the Postmaster General, one by the company, and the third by these two. Mr. Payne's denial shows, however, that the Government has no intention of supporting any of these schemes.

Reorganization of Erie Bell Telephone.

The reorganization plan of the Erie Telephone Company, just announced officially, provides for the formation of a new company to acquire substantially all the assets of the Erie Telephone & Telegraph Company, which new company is to have a capital of $16,000,000 6 per cent preferred stock and $16,000,000 common stock, subject only to an indebtedness of $10,000,000 gold bonds. It has already been outlined in these pages. The $9,000,000 notes of the present Erie Company are to be paid. The 1928 and 1929 bondholders of the present Erie Company will be offered $800 5 per cent bonds of the new company, due in 1932, and two shares of preferred stock for each $1,000 bond. The 1909 and 1926 bondholders of the Erie Company are to be offered $1,050 5 per cent bonds of the new company due in 1932 for each $1,000 bond.

The holders of Erie Company stock will be given the opportunity to purchase the preferred and common stock of the new company upon the payment by them to Kidder, Peabody & Co., of $25 per share for each share of the present stock, each holder of four shares of Erie stock to be entitled to receive upon such payment one share of preferred stock, and three shares of common stock in the new company. Kidder, Peabody & Co., from the balance of the securities of the new company, are to sell a majority of both preferred and common stocks to the American Telephone & Telegraph Company, and are to buy and cancel the outstanding $9,000,000 notes of the present company and to pay into the treasury of the new company for the improvement of the plants of the subsidiary companies $6,000,000 in cash, which amount, it is estimated, it will be necessary to expend in the near future.

The bonds of the new company will be secured by all the securities now behind the several issues of debenture bonds and behind the $9,000,000 of notes, except so far as there may be an exchange of stock for notes of the subsidiary companies and except the shares and notes of the Michigan company. The preferred stock of the new company is to be 6 per cent, cumulative after two years from issue, and to have preference in liquidation. The portion of the stock issue of the new company which is to be offered the holders of the present Erie Telephone & Telegraph Company has been underwritten.

Automobilism in France.

It is announced from Paris that the Automobile Show closed on Christmas night after 15 days of unprecedented success. The final scene was the drawing of tickets of the free lottery, for which the best prizes were two automobiles. The estimated profits are from 80,000 to 100,000 francs, which will be evenly distributed between the exhibitors and the Automobile Club. A banquet to M. Rives, commissioner general of the exhibition, was given at the Automobile Club.

Charron, Girardot and Voigt announce the formation of a Franco-American automobile company, $1,000,000 being offered by American

capitalists and about $500,000 by French ones. The plan is to manufacture according to M. Charron's new models, which met with success at the Automobile show.

Messrs. Robert and Walden Shaw, of Chicago, accompanied by their wives, are ready to start on their automobile tour of Europe. Mr. Walden Shaw has chosen a French machine for his trip.

Coming Lecture on Nernst Lamp in Chicago.

Alexander J. Wurts, manager of the Nernst Lamp Company, of Pittsburg, will give a lecture upon and demonstration of the Nernst lamp at the laboratory of the Lewis Institute, Chicago, Friday evening, Jan. 10, 1902. This lecture was to have been one of the regular Chicago Electrical Association lectures, but owing to the difficulty of arranging for the lecture at the regular place and time of the meetings of that organization, Professor Woodworth, of Lewis Institute, arranged for the lecture to be held where the laboratory facilities of the Institute would be at command, and to invite the Chicago Electrical Association as a body to attend the lecture. Any other electrical men interested in the development of the Nernst lamp will also be welcome. This lecture will be the same as that already delivered by Mr. Wurts at Boston, Philadelphia and Cleveland, but will embody in addition some interesting new experiments, and will no doubt be largely attended, as it will be the first public opportunity offered the electrical men of Chicago and vicinity to investigate the Nernst lamp as a new factor in the lighting art.

German Appliances in England.

The *New York Times* is publishing with the *London Times* some very instructive articles on the industrial situation in England. In comments on foreign competition the following occurs: Though the foreign competition may not yet be extremely serious, it is undoubtedly severe, and the manufacturer to-day must be content with a very small profit on individual articles, depending for his gain on the possibility of turning out very large quantities. In the trade in electrical accessories, for instance, prices are cut so fine that there is hardly any profit at all. The development of the electric light has attained to so much greater proportions in Germany than in Great Britain that the makers of accessories in the former country have a distinct advantage over those in the latter. The German manufacturer will buy English china, mount his own brass work thereon, and send the complete article here, beating the English maker in his own market. A leading manufacturer says that when he has told his men of such things as this and shown them the foreign-made articles, the men have simply given him an incredulous smile, without in any way realizing the gravity of the position. Then there is the case of the electric light lamp holder, which is to the electric light what the burner is to the gas bracket. At one time the manufacture was protected in this country by a patent, and the holder sold for 1s. 8d. But the patent was not in force in Germany, and, as soon as it expired here, the German makers so flooded the English markets with their holders that the price was at once reduced from 1s. 8d. (40 cents) to 4d. (8 cents).

Franchises in the Philippines.

Among the recommendations of the Philippines Commission to the President in its annual report are the following:

7. That the commission be given power to grant street railway, electric light, telephone and other municipal franchises.

11. That the commission be given power to pass a law for the conducting of legitimate business of corporations.

There is nothing in the treaty between this country and Spain to prohibit the granting of franchises by the United States in the Philippines. Existing franchises are, however, protected by the following clause of the treaty: "The rights and property secured by copyrights and patents acquired by Spaniards in the Philippines and other ceded territories, at the time of the exchange of the ratifications of this treaty, shall continue to be respected."

Congress, on Feb. 26 of the present year did, however, as an amendment to the then pending army appropriation bill, adopt stringent regulations against the granting of any franchises in those islands. The language of the amendment follows: "Provided, That no sale, or lease, or other disposition of the public lands or the timber thereon, or the mining rights therein, shall be made; and, provided further, that no franchise shall be granted which is not approved by the President of the United States and is not in his judgment clearly necessary for the immediate government of the islands and indispensable for the interest of the people thereof, and which cannot, without great public mischief, be postponed until the establishment of permanent civil government; and all such franchises shall terminate one year after the establishment of such permanent civil government."

The Philippines Commission, of which Judge Taft is the head, in its report, now recommends that these restrictions upon the issuance of franchises be removed. Its recommendations have been approved by both the President and the Secretary of War, and it is confidently believed that Congress will adopt the necessary legislation asked for by the commission during the present session.

Preparing for the Commercial Pacific Cable.

Early during the present year Congress is expected to pay some attention to the question of an American Pacific cable, there being before it, as already noted in these pages, several bills proposing various schemes. Mr. George G. Ward, vice-president of the Commercial Cable Company, intimates that these measures will make no difference in the plans of his corporation. In an interview last week he said: "It would be inadvisable for the Government to undertake to construct a cable. In the first place, there is the matter of expense, not only of laying the cable, but also of keeping it in repair. It is doubtful if the Government could make as complete working arrangements with connecting lines so as to give complete service, as could a private enterprise, for diplomatic and business difficulties would quite naturally surround such a project if undertaken by the Government. It should be borne in mind that the Pacific Cable Company will be obliged to make arrangements with existing companies for business between various points in the Orient and Europe. This country could hardly expect to secure landing privileges or concessions where exclusive grants have already been given in foreign countries, notably Japan, to cable companies now in operation, and it is doubtful if a working arrangement could be made with such companies by this Government looking to any division of the business that these foreign companies now enjoy. No diplomatic difficulties, however, would be in the way of a private corporation making such arrangements. The Pacific Cable Company assumes all responsibility in the construction and maintenance of the new cable, thereby relieving the Government of any expense whatever, either for construction or operation."

The Silvertown Cable Manufacturing Company, of London, to which the contract for building and laying the Pacific cable was awarded a short time ago, has completed about 100 miles of the cable, and the remainder is expected to be finished in about eight months, when the cable will be shipped in special vessels around the Horn and the actual work of laying it begun. The section from San Francisco to the Hawaiian Islands is to be finished and in operation in some 9 or 10 months. The company will then proceed at once to complete the cable to Manila. This section will require a much longer time before it is finished, both on account of the greater distance and also because of the fact that the company will have to take soundings for the route. All the necessary soundings on the route from the Pacific coast to Honolulu were made some time ago by the Government. The total length of the cable from San Francisco to Manila will be between 7000 and 8000 miles.

Illustrious Electrical People.

Note has been made recently by our English contemporaries of a volume entitled "Lives of the 'Lustrious," which contains biographies of interest to Americans published in London. In November last Lord Rosebery, in one of his speeches, called biography "by far the most fascinating form of literature that exists," but he deplored the great abundance of bad biography. "It is in order to supply good biography, whose lack Lord Rosebery thus deplored, that the present monumental work has been undertaken." It is edited by Sidney Stephen and Leslie Lee. "Each of the editors makes it a personal request that all celebrities with a grievance will call on the other." We give below two of the biographies, one of Mr. J. P.

Morgan, and the other of Mr. Yerkes. We may premise that Mr. Morgan presented not long ago an electric lighting plant to St. Paul's Cathedral:

"Morgan, John Pierpont, Electrician to St. Paul's Cathedral, was born in 1837, with a golden spoon in his mouth. For many years he worked at the tiresome routine of monopolist, and only in 1901 reached his true vocation, the lighting of St. Paul's. Mr. Morgan has not yet decided whether to provide the motive power from Niagara Falls, or whether to buy up Buckingham Palace and place his engines there. In filling up a confession album in the house of one of our more affable Duchesses, Mr. Morgan stated Trust to be his favorite quality, and Steele his favorite author. Mr. Morgan's favorite game is Puss in the Corner, and his favorite song 'Johnny Morgan Lit the Organ.'"

"Yerkes, Edison Volta, Tubular Millionaire, was born in the Catacombs in 1841, and has been described by an enthusiastic Irishman as a 'rail gintleman.' Mr. Yerkes, after squandering upon America his lusty youth, descended upon the shores of this island a little while since, and by raising Tubal Cain, gave our railway system shocks. By passing an electric current along the metals, he claims to be able to stimulate porters to civility, station masters to humility, engine drivers to punctuality, and directors to decency. His name, which is usually pronounced as if it rhymed with that of his colleague, Mr. Perks, is rightfully a dissyllable, thus providing a much-needed rhyme to 'circus' and (at a very long distance) to 'work us.' Mr. Yerkes, who, as becomes one who has so many irons in the fire, is a great poker player, finds a Home from Ohm in the spacious hotel built on the Embankment by Lord Hugh Cecil, to accommodate the members of the Cabinet in consequence of their aversion to Downing Street. His motto: 'Tube be, or not tube be.'"

CURRENT NEWS AND NOTES.

WIRELESS IN KOREA.—The Japanese Minister at Seoul has notified the Korean Government that Japan has begun the erection of wireless telegraph stations along the Korean coast.

LONDON—BRIGHTON.—A new electric railway project is announced which is to have a line doing the 47 miles (we thought it was more) between London and Brighton in 30 minutes. Why not?

CANADIAN TELEGRAPHERS.—The federated railway telegraphers of the Dominion are feeling their way to the making of a demand for higher wages from the three great railway systems of Canada—the Candian Pacific, the Grand Trunk and the Canada Atlantic systems.

KANSAS TELEPHONY.—The Northern Kansas Telephone Association will hold a meeting at Concordia, Kan., on Jan. 6, when a number of papers and questions dealing with the problems of telephone service will be presented and discussed. This is the second semi-annual meeting of the Association. The president is Mr. T. M. Dolan, of Clifton, and the secretary is Mr. F. A. Daugherty, of Concordia.

GERMAN BEER AND ELECTRICITY.—The connection between lightning and lager is rather remote, but the *New York Evening Post* notes it as follows: So serious has the drawback of beer-drinking workingmen in Germany become, and so thoroughly is it recognized, that a movement has been started to exclude the drink from the factory premises. It has been not uncommon for a man to consume 10 pints a day in his shop, while the average is put at not much below a gallon per day, excess being especially marked among moulders. Several experiments have already been made in educating workingmen to dispense with the morning and afternoon recesses for beer, and one firm making electrical apparatus in Berlin has found an increase of 10 per cent in product per man since the change was made.

ELECTRICAL ENTERPRISE IN ENGLAND.—A cable dispatch from London of Dec. 28 to the *New York Times* says: There are signs that the district railways are about to push their contemplated improvements vigorously and intend, it is said, to oppose the projected branch of the existing electric line of the Central London to Hammersmith. Statements have been published this week that Mr. Yerkes is now likely to gain control of the Metropolitan, but though this is not believed, there is no doubt that the Metropolitan will now work harmoniously with the District. A cock-and-bull story was floating around this week to the effect that a new American syndicate had been buying canals on the Continent and trying to buy them in England, intending to introduce a new system of electric propulsion. The story was not credited.

DATA OF ILLUMINANTS.—In a paper recently read by Mr. Douglass Burnett before the Brooklyn Institute of Arts and Sciences the following comparative data of illuminants are given. The following figures refer to the intrinsic brilliancy or candle-power per square centimeter of various sources of light: Argand gas burner, at 1800 degs. C., 0.3; Siemens regenerative burner (one of the brightest gas lamps), 0.38 to 0.6; electric incandescent lamp, 40; Nernst electric lamp, 100; crater of an open arc lamp, at 3500 degs. C., 6400. For ordinary cases a square inch of gas flame emits 4 cp, whereas for the crater of an arc lamp the pro rata figure is 42,600 cp. The figures below refer to the optical efficiency, or the ratio of the light energy to the entire energy supplied: Argand oil lamp, 2½ per cent; naked gas flame, 5 per cent; electric incandescent lamp, 6⅓ per cent at 3 watts per candle; Nernst electric lamp, 13 per cent at 1 watt per candle; burning magnesium, 15 per cent; 5000-cp arc lamp, 25 per cent; sunlight, 25 per cent; the light of Geissler tubes, 33 per cent.

WIRELESS TELEGRAPHY IN U. S. NAVY.—The Navy Department has taken the initial steps toward the adoption of wireless telegraphy as a means of signaling between warships at sea. Admiral Bradford, of the Bureau of Equipment, has asked that the armored cruisers of the "Pennsylvania" class have their masts and rigging so arranged that the wireless system can be introduced. This will necessitate the lengthening of the masts of the ships and the insulation of the metal rigging by the use of hemp covering for halyards. It is intended to get test sets of instruments of the various wireless systems now being operated. These include the Marconi system. Thus far, however, the Navy Department has not adopted definitely any system, but the construction of the new ships is regarded as a preliminary to the adoption of a system whenever its practicability is established fully. The Navy Department has also decided to establish wireless telegraph plants at the Washington Navy Yard and at Annapolis. The plans for the necessary equipment of the two stations are being worked out under the direction of Admiral Bradford. Experiments will be under way soon. At each point a tall mast is to be erected for the purpose of receiving and transmitting signals. Small buildings are to be erected for the installation of the instruments, etc.

SIR WILLIAM PREECE.—With regard to wireless telegraphy the *New York Tribune* has the following appreciative item: There was something rather exceptional in the encouragement given by Sir William Preece to Signor Marconi when the latter first arrived in England, his adopted home, in 1896. The young Italian had only attained his majority at that time, and was practically without friends. The experiments which he had previously tried on his father's estate near Bologna had satisfied him that the principle involved was sound, but they were of a rudimentary character. In order to develop the system sufficiently to interest capital, more elaborate and costly tests were requisite. Sir William, then at the head of the British telegraph service, soon heard of the newcomer. But he had himself been working for ten years on another scheme which dispensed with wires, and with a moderate degree of success. Under the circumstances it would have been only human to ignore Marconi, if not to put obstacles in his way. Instead, he offered a helping hand, though he quickly discovered that the new system was superior to his own. Before the close of 1897 Marconi had shown that Hertz waves would penetrate the solid masonry of city buildings, and on an open plain like that of Salisbury travel for miles. A year later communication was opened up between the mainland and the East Goodwin Lightship, and also between the Isle of Wight and Bournemouth, and early in 1899 the English Channel was crossed. But it is doubtful whether any of these achievements would have been recorded so soon, if at all, had it not been for Sir William Preece's generosity.

AFGHANISTAN AGAINST ANYTHING.—At a great durbar held at Cabul recently the new Ameer, Habib Ullah Khan, addressing the assembled chieftains, promised to maintain the policy of his father, the late Ameer, in guarding Afghanistan against foreign aggression, and in preventing the introduction of railroads, telegraphs, European trade and education by missionaries.

NEW HAVEN THIRD RAIL.—Work is beginning on the New York, New Haven & Hartford Railroad Company's improvements of the third-rail system between Hartford and Bristol, about 19 miles. Higher voltage alternating dynamos are to be placed in the Berlin power house, heavier copper wire installed, and at Hartford, New Britain and Bristol will be placed sub-stations with transformers. The third rail is to be improved, the outer rails rebonded, and the cars geared for higher speed. A uniform voltage for all service is to be established. A more frequent express service between Hartford and Bristol is another feature of the plan.

THE LONGEST TROLLEY YET.—A report has been current in Indianapolis that Hugh J. McGowan, president of the Indianapolis Street Railway Company, is prominent among the men who are behind plans for a trolley system to connect New York and St. Louis. The scheme, it is reported, is even broader in scope than that of the great Everett-Moore syndicate, whose system is being extended to connect all of the principal cities on the Great Lakes. The Murdocks, of Lafayette, and Frank De Haas Robison, of Cleveland, are said to be associated with Mr. McGowan, and the plan is supposed to have been well developed during the recent visit of Mr. McGowan to New York.

TRANSMISSION IN ITALY.—A newspaper correspondent who visited Italy recently writes: The industries of Italy show a remarkable advance. This is largely owing to the development of electricity as a motive power. I was lately in the valley of the Nerina, where are the Marmore Falls, formed by the plunge which the River Velino takes over a precipice, 600 ft. high, into the River Nera below. Around the falls manufactories of all kinds are springing up, while down the united streams as far as Terni there are nothing but huge factories at work or in process of construction. What has taken place at Terni and in the Valnerina has taken place on a smaller scale wherever good water power for the development of electricity exists. It is proposed to light Rome from the Marmore Falls, from which it is distant 70 miles.

A COMMERCIAL CABLE DINNER.—So great a success was the first dinner of the New York staff of the Commercial Cable Company, which took place on Dec. 28, at the Pierrepont Assembly Rooms, Brooklyn, that a motion to make it an annual custom was carried by acclamation. Nearly 100 persons attended, and Mr. John Shea was chairman. Among those present were G. G. Ward, vice-president of the company; George Clapperton, traffic manager; J. H. Smart, superintendent; C. E. Merritt, assistant treasurer; Charles Cuttriss, electrician; S. F. Austin, assistant superintendent; F. H. Dennis, superintendent of the clearing house; Albert Beck, secretary, and W. G. Wenman and T. E. Hurdus, supervisors. John W. Mackay, president, sent a congratulatory message from California. Musical and dramatic selections were contributed by the "talent" of the company.

LIVERPOOL ELEVATED DISASTER.—An accident of serious nature occurred on Dec. 23 on the Liverpool elevated electric road. A dispatch from Liverpool of Dec. 24 says: Six bodies have been recovered from the Dingle Station tunnel. These apparently represent the total number of deaths resulting from the burning of the electric train yesterday on the overhead railroad. An explosion in a fuse box set fire to a train on the electric railway at Dingle Station, Liverpool, last evening, and the burning train entered a tunnel containing stacks of creosoted railroad sleepers. These were also set on fire, and the tunnel became a blazing furnace. It was at first reported that many lives were lost, but it was subsequently ascertained that many of the passengers had got out at the preceding station, and the others had escaped by jumping from the train, or were dragged out by their fellow passengers. The persons who perished were all employes.

ELECTROLYTIC INTERRUPTER.—A patent granted Dec. 24 to Thomas W. Topham describes an electrolytic interrupter of the Caldwell type. A glass jar is contained within a larger glass jar, the first-mentioned being submerged in a liquid. Near the bottom of the smaller glass jar are a number of equidistant holes of small caliber, and in the interior opposite each hole is a point, the several points being fixed to an inner electrode. The other electrode is on the exterior of the small jar, and consists of a rod with a sharp point located exactly opposite to one of the holes in the glass. Two or more of outer electrodes may be used. In action the liquid within the hole is vaporized, due to the heat generated by the current, and the small bubble of liquid thus formed breaks the current within the hole. As soon as the circuit is broken the source of heat is stopped and the surrounding body of cool liquid causes the bubble to be condensed and the circuit is restored by the inflow of the liquid.

NEW TYPE OF ROTARY CONVERTER.—A patent issued Dec. 24 to Raymond Rouge and George Faget, of Paris, France, describes a rotary transformer in which only the brushes revolve. A comparison may be made with the ordinary type of transformer if we imagine the armature to be stationary, the fields supplied with alternating instead of direct current, and the brushes run at synchronous speed. In the actual machine it is necessary to provide arrangements for giving a definite polarity to the direct current produced, as otherwise in starting up the polarity at a given binding post might be either plus or minus. The apparatus may be applied to the transformation of single or polyphase currents into direct current, or inversely. The specifications go into great detail as to the various kinds of windings and dispositions that may be employed, and means are described for obviating sparking at the brushes. Among the advantages of the system are that the lead of the brushes is constant, no matter what may be the load on the working circuit supplied by the transformer; and the apparatus, whether for single or polyphase current, is self-starting.

GOVERNMENT TELEGRAPHS.—Senator W. E. Mason, the chairman of the Committee on Post Office and Post Roads of the Senate, before which committee the subject will have to be argued, is going to introduce a bill providing for the purchase of the existing telegraph lines by the Government and making them an adjunct of the Post Office Department. He says that there is a well-formulated plan in administration circles to effect the purchase, and he anticipates that it will be favorably acted upon at this session of Congress. The fact that he, as chairman of the committee, has taken the matter up is indicative of a purpose to carry the plan to a successful conclusion. His bill will provide for the issuance of bonds by the Government, bearing 2 per cent interest, to an amount sufficient to purchase the stock of the two existing companies. He says that the earnings of the lines under government management, even with the reduced rates that will be charged, will be more than sufficient to meet the interest on the bonds and create a sinking fund that will enable the Government to own, practically free of charge, the lines at the end of 20 or 25 years. Postmaster General Payne has specifically denied Senator Mason's statements as to the intentions of the Government, in our pages.

BRANLY ON MARCONI'S FEAT.—In an interview printed in the Paris *Figaro,* Professor Branly expresses surprise that Marconi should have at one stroke increased the distance of wireless telegraphy from 400 kilometers to 1800 miles. Such a feat, he said, however, was entirely possible. Formerly the curvature of the earth appeared to enter as a serious obstacle,, but the Marconi experiments between Antibe and Calvi had disposed of this point, since the aerial wires there used were completely masked from each other by the earth's curvature. This experiment definitely established that the waves followed the surface of the earth, and what was possible for a distance of a few hundred miles is possible for a greater distance, the only factor being the power of the apparatus. Nothing was, therefore, opposed to the success of Mr. Marconi, who is an ingenious, persevering experimenter, possessing a fertile mind—three elements which united go to make up scientific genius. Professor Branly, however, says that before arriving at a definite opinion it will be necessary to know exactly the conditions of the Newfoundland experiment, and to know if it was conducted in a rigorously scientific manner. For example, it should be definitely determined that there was no influence from submarine cables, which might be inductively affected by the transmission waves and thus have a part in transmitting the signals to the receiving station.

LONG WISCONSIN TROLLEY.—It is stated on reliable authority that there is on foot an electric railroad deal that is the most extensive ever contemplated in the State of Wisconsin, and which converges about the city of Oshkosh as a center.

BRITISH COLONIES.—It is stated that the telegraph lines in the British colonies have grown from 115,000 miles in 1889 to over 150,000 in 1899, and that the telephone lines in those colonies now aggregate more than 50,000 miles in length. The figures are those of the United States Treasury Bureau of Statistics, but it does not appear how many "colonies" are included.

YERKES' LONDON PLANS.—A cable dispatch from London of Dec. 23 says: At a meeting of the District Railway this afternoon, the chairman, R. W. Perks, announced that the electric power house to be erected by Charles T. Yerkes' syndicate would not only supply the underground railroads, but would also furnish power for the suburban services of several of the trunk lines, with which arrangements were now being made.

PAN-AMERICAN.—Some interesting figures are made public by the Pan-American officials regarding the receipts of the various concessions at the Exposition. The total amount collected by the Exposition as its share, usually 25 per cent of the gross receipts, was $1,332,109. The total of the receipts was $4,785,527.27. There were 25 concessions, whose gross receipts exceeded $51,500. Chicago did four times the business, according to the gross receipts, that Buffalo's concessions did, but Buffalo's were four times larger than those of Omaha. The electric tower elevators netted $83,212.

KELVIN AND CABLES.—The jubilee of the submarine cable, which occurred in 1901, recalls a little story of Lord Kelvin, whose inventions, the mirror galvanometer and siphon recorder, made "submarine telegraphy commercially practicable." At the time Professor Thomson, as he was then, was engaged on his deep-sea soundings work, he was one day discovered by a visitor experimenting with a long coil of wire. "What is that for?" inquired the visitor, pointing to the wire. "Making sounds," replied the professor. "Ah," said the guest jocularly, "what kind of note does it give off." "The deep C, of course," came the answer, like a shot, accompanied by the well-known twinkle in the professor's eye.

EXPOSITION AT LILLE, FRANCE.—Consul Atwell writes from Roubaix, Dec. 4, 1901: An international exposition will be held in Lille between the months of May and September, 1902. It will embrace the following classes: Instruction, works of art, liberal arts, general machinery, electricity, civil engineering, transportation, wheels, automobiles, sports, agriculture, horticulture, forestry, hunting, fishing, food stuffs, mines and metallurgy, decoration, household furniture and accessories, yarns, dress goods, clothing, varied industries, chemicals, sound economy, hygiene, colonization, material and export products, special application of alcohol as a motive force and for lighting and heating. The office of the exposition is No. 35 rue National, Lille.

N. Y. CENTRAL AND TROLLEYS.—An item from Boston says that the New York Central Railroad Company views with some apprehension the increasing number of trolley lines being built or already operating between the towns which are also served by the Boston & Albany line. Vice-President Van Etten, now in charge of the Albany system, is said to have inspected all of the electric roads along the line of the Boston & Albany with a view to meeting their competition more effectively. The Milford, Hollliston & Framingham Street Railway seems to have been selected by the New York Central people as the first trolley road against which its new policy will be tried and a brisk war in rates is in progress. The trolley road's earnings have been cut about one-third as a consequence. When the through electric line from Boston to Worcester is once in operation, if the steam road does not earlier block its projects, a continuation, in severer form, of this struggle is to be anticipated. It is certain that the present fare of $1 will not be cut until the Boston & Worcester is practically completed. It is almost certain that at that time there will be a rate war between the two. The proposed fare on the electric line will not be more than 50 cents, and perhaps considerably less.

LOCATING FAULTS IN CABLES.—Two patents issued Dec. 17 to T. W. Varley relate to means and apparatus for locating faults in cables, such as are used for lighting and power work. The method consists briefly in sending into the cable a direct current, which is interrupted for a definite period. For example, the current may flow during eight seconds and then be interrupted four seconds. As illustrated, one side of a source of direct current is connected to earth, and the other side connected through a choke coil to one leg of the cable circuit, which will usually be one carrying alternating currents. In the direct-current circuit there is also a rotating circuit closer by means of which the current is allowed to pass during a definite interval and is then interrupted for a definite interval. The cable supposed to be grounded is then explored with a compass needle, which, during the time the direct current is flowing, will point in one direction on one side of the fault, and the opposite direction on the opposite side of the fault. The interruption of the current will indicate that the pointing is not due to a local field. The circuit closer has two brushes. When the brushes both rest upon one contact segment, the direct current will be shunted from the cable, thus obviating any spark at the break. By this means another path to ground is also provided for the normal charging alternating current, thus preventing any disturbance to the ground on the mains.

ELECTROLYTIC CYANIDE VAT.—An apparatus designed to act in conjunction with a cyanide solution to continuously extract values from ores, patented recently to Albert I. Irwin, of Cripple Creek, Col., comprises a series of tanks to retain the solutions and provided with conveyors for passing the ores from end to end of the series. The several tanks are similar in form, shallow, and each formed with an inclined end from which it discharges into the next in series. The first tank contains a caustic soda solution, in traversing which the ores absorb sufficient alkali to counteract their acidity and to increase the electrical conductivity of the cyanide solution in which they are subsequently immersed. The last is a filter through which the exhausted solution is drawn for regeneration and return. The intermediate tanks are electrolytic vats. In these the conveyor becomes the anode, formed of a pair of endless chains moving upon guide rods in the sides of the tank and connected by metal bars to whose lower faces are attached wooden blocks, oppositely inclined on alternate bars, and serving to stir the ores and move them from side to side of the tank. Two cathodes are used, one being a plate resting upon the bottom of the tank, and the second parallel to the first and to the anode, a similar plate supported between the upper and lower stretches of the endless belt. The novelty of the apparatus lies in the structural details, for the plan of causing the material to be dissolved to pass through the electrolyte, and even of using the anode as a conveyor, dates from the early days of the art. In the present construction one of the cathodes is so placed as to be scoured by the moving sludge—a disposition most unfavorable to complete recovery of the precious metal.

LETTERS TO THE EDITORS.

Gold Leaf Electroscope Experiments.

To the Editors of Electrical World and Engineer:

Sirs.—Some observations I recently made with a gold leaf electroscope may be of interest to your readers. The electroscope was made out of a half-gallon chemical boiling flask—round pattern—and the brass rod on which the leaf was hung, had a cap of about 1½ inches in diameter. The rod was insulated by means of a rubber cork, and the flask contained in the bottom some sulphuric acid and pumice stone.

On placing the electroscope on a window-sill and attaching to the rod below the cap a strip of tinfoil three-eighths of an inch wide and about 15 ft. long (the foil thickness was such that 7000 square inches weighed 1 lb.), some interesting effects were noticed under certain conditions.

The experiments were made from about noon until 3 P. M. on a very cold day, the sun at times shining brightly. When the wind

carried the foil out in a direction either west or east no effect was visible. When the sun was not shining brightly, whatever the direction of the foil might be, there was a like absence of effect; but when the sun was shining brightly and the foil floated out towards it —north to south—then a divergence of the leaves took place equivalent to about 50 degs., if the foil was in vibration.

With about 30 ft. of foil floating out in rapid vibrations and the conditions similar to those last mentioned, a divergence of about 120 degs. resulted.

NEW YORK, N. Y. J. STANLEY RICHMOND.

Marconi and the Scoffers.

To the Editors of Electrical World and Engineer:

Sirs.—The feat that almost every experimenter in electricity since Lindsay's time dreamed of has been accomplished not by a dreamer but by that very matter-of-fact young man, William Marconi, and his statement that he has signaled across the Atlantic Ocean without metallic conductors has produced a profound and critical impression. The world—and this means the electrical expert as well as the layman—has not been so wrought up over a scientific achievement since the announcement by Professor Röntgen of his discovery of the X-rays.

From time immemorial there have been scoffers, but in the face of the fact of what is actually known of the new art and of the inventor of the system which bears his name, it seems to me an unprofessional procedure, to say the least, for those who are supposed to be versed on the subject to question the veracity of the statement that the signal was sent and received, and it should be stamped as absurd the inference that deciphering the signal was mere guesswork. Atmospheric disturbances are easily to be determined from the electric waves of an emitter by an expert, and Marconi would be, above all others, able to differentiate between them.

Atlantic cableless telegraphy has followed the other epoch makers in electrical science, i. e., the Bell telephone, the Field oceanic cable and the Morse telegraph. Each of these suffered at the hands of the doubting Thomases, who, like the Missourian, must needs be shown. So it is with the recent test which will develop into cableless telegraphy.

Another injustice, it seems to me, is the severe criticism Marconi has received in giving to the public at large the first news direct of the results instead of the nicer, perhaps more legitimate, method of reading a paper before some society. Had he done this the experiment would have remained unchanged. His word given to all men through the medium of the press is just as good as it would be to a chosen few from whom the information would have been disseminated. The course he pursued gave us the news at least two months earlier than possible by the latter method, and again what would he have to say to a scientific society? He has read papers on his inventions as he made improvements from time to time, his system is well known, and in this instance, notwithstanding the tremendous distance involved, is there anything new to tell? Only that an increase of power was used, a supersensitive receiver and 1800 miles spanned. That is the story.

It is hinted that the announcement was made from a purely commercial standpoint. There is no doubt that the price of Marconi stock will rise on the strength of it, but Marconi is a producer, and his company installs instruments, whereas stock-jobbing concerns are not capable of the former, and have no time for the latter. The cry has been loud and long about the letter "S" being chosen as the test signal instead of some other, but I am of the opinion that Marconi not only received the much-objected letter, but, what is more than likely, a complete message as well. The opposition of the Anglo-American Telegraph Company is well known in connection with the tests, and, while Marconi naturally would wish to announce as quickly as possible the first recorded signal without cable he would, knowing the attitude of the company, desire also to avoid trouble and so left the message out of the statements given to the press. In all events, Marconi has done what he has claimed he did.

What the world calls for and admires are producers, and Marconi is one of them. The scoffers we have with us always, but it is only once in a decade we are permitted to witness such a striking innovation of evolutionary progress in electrical science as that of signaling without cables across the trackless waters of the great Atlantic.

NARBERTH, PA. A. FREDERICK COLLINS.

Efficiency Tests of Direct-Current Generators and Motors.

To the Editors of Electrical World and Engineer:

Sirs.—In an editorial in your issue of Dec. 14 on efficiency tests of direct-current generators and motors it is stated that the efficiency as found by testing two like machines simultaneously according to the Hopkinson method is more reliable than the efficiency computed from the losses. It seems quite evident to me that the reverse is the case and below are the reasons for my belief.

First.—Unless the machines can be directly coupled there is a factor of considerable uncertainty in the belt loss. In case the machine under test is a generator it is necessary to drive the combination by a separate motor, thus introducing more difficulties in the way of belt losses and efficiency of the auxiliary machines.

Second.—In order to load up the machine under test the field of the other must be weakened or strengthened according as the former is a generator or motor. This change in field strength produces a change in core and field losses and thus leads to an error in the efficiency obtained.

The first objection is the more serious one, since the belt losses are practically unknown quantities. Moreover, there is liability of error due to measuring relatively larger quantities than are involved in the stray power measurements. The C^2R losses in switches, instruments, cables, etc., must also be negligible. The error due to change in core and field losses is not great, but is by no means negligible. Usually it would not affect the result by one per cent.

However, the stray power method has some objections. The most valid one is the error made by assuming the core losses the same at full load as at no load. It seems reasonable to suppose that the iron losses should increase somewhat with the load due to magnetization by the armature. The amount of increase could be readily found by experiment with a machine provided with Ryan balancing coils, tests being made for stray power without the coils, and with the coils in so as to give a field distortion such as would result when running the machine at full load without the coils.

MADISON, WIS. A. C. KING.

Hertzography.

To the Editors of Electrical World and Engineer:

Sirs.—Considering the great part which wireless telegraphy will probably play in the near future and the cumbrous and non-distinctive nature of the term, would it not be advantageous in the outset to give it short and distinguished name? I would beg to suggest the distinct appropriateness of the term "Hertzograph," "Hertzography" and "Hertzogram." The honor due to Hertz and the peculiar fitness and brevity of these terms will appeal to electricians the world over.

GREENCASTLE, IND. EWING MCLEAN.

Deterioration of Insulated Cables.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Nov. 23d, under the heading of "Resistance of Dielectric" in the Digest, is a statement that the deterioration of the insulating quality of rubber cables is due to the chemical action between the rubber and gases produced by the alternating stress on the air. Last August, in a conversation I had with Mr. Paul Lincoln, that gentleman mentioned a case of a cable that tested at the factory 70,000 volts, retested at Niagara power house at 50,000 volts, and which broke down at 17,000 volts after two weeks' service. He attributed the result to the ozone generated, and said he intended prosecuting the experiments further. I should very much like to hear whether any of your readers could meantime throw some light on the subject.

WILKESBARRE, PA. E. W. STEVENSON.

Italian Opportunities for Electrical Work.

To the Editors of Electrical World and Engineer:

Sirs.—Of late great activity has shown itself in railroad development in Italy, mostly in extending or building of subsidiary and local lines. Quite a number of new roads—steam or electric traction —are projected. Some of these are: In the province of Emilia, a line from Ceuto to St. Giovanni; in the province Lombardy, a line to connect Milan with Moltena on the Brianza Railroad; a line be-

tween Cremona, Bongo, St. Domino; in the Venetian province, a new line from Vicenza to Noveuta, and an electric road along the Garda Lake from Peschieva towards Riva; in the province of Piedmont, the line Turin to Torre Pellice is to be changed to electric traction, and a new steam railroad is projected to connect Turin with Oneglia via Ceva and Onmeo.

The long-entertained project of connecting Mestre (Venice) with Primolano via Castelfranco and Bassano now appears to become realized. Other new short connections with the Simplon line are planned.

In this period of activity in railroad construction our great American promoters and purveyors of railroad and electrical supplies ought to have able engineers and commercial representatives in Italy. Though business is good at home the manufacturers whose capacity for production is constantly increasing, should in time secure such foreign contracts and cultivate foreign fields, or they will find themselves idle and out of pocket later on when stagnation appears in the home market or home competition makes work profitless.

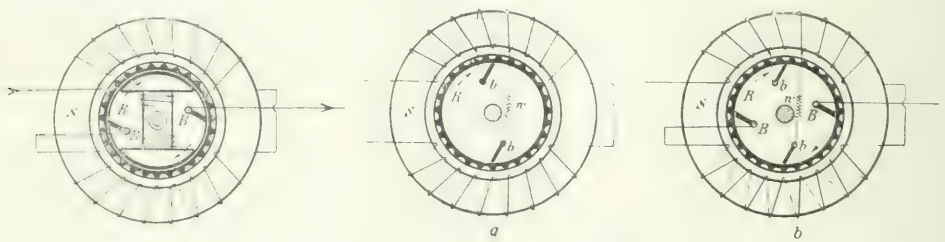
SIMON W. HANAUER.

U. S. CONSULATE, GENEVA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compounding of Alternators.—HEYLAND.—A long and very interesting article, illustrated by diagrams, in which he points out the great advantages which may be obtained with his "non-synchronous alternator," based upon the same principle as his induction motor with power factor equal to unity (Digest, Aug. 31, Oct. 19, Nov. 30, Dec. 14, 21; also ELECTRICAL WORLD AND ENGINEER, Sept. 28, p. 492). The first part of the present article deals with the compounding of the ordinary alternator. He thinks that the compounding devices of Leblanc and of Steinmetz are ingenious, but quite complicated, as they use a converter connected with the generator, and transforming a part of the armature current of the alternators into direct current, which is used for compounding. He describes the following method of compounding an ordinary alternator ("synchronous alternator"). Fig. 1 represents a two-pole synchronous alternator; *S* is the stator, but not the motor. In this case, a partial compounding of the motor may be suitable, which is explained diagrammatically. From the foregoing it is seen that this method of compounding requires a special winding on the revolving field system. This is not necessary with the Heyland "non-synchronous alternator," which is based upon the principle of his induction motor with a power factor equal to unity. All that is required in this case is another pair of brushes, through which the rotor is supplied with current from the armature. His non-compounded, non-synchronous alternator is shown in Fig. 2, while the same machine, when compounded, is illustrated in Fig. 3. The brushes *b b* are for excitation, the brushes *B B* for compounding. He treats this generator by the graphical methods and gets the important result that "the non-synchronous generator of the described form has no armature reaction for energy currents, but full armature reaction for wattless currents." This property of the



FIGS. 1, 2 AND 3.—COMPOUNDING OF ALTERNATORS.

the armature, in the windings of which the alternating current is generated. *R* is the rotor with two poles, in which a constant field is generated by direct current. This pole-wheel is also provided with a winding, uniformly distributed over the surface as in the Leblanc amortisseur, this winding is, however, not completely closed in itself, but is connected with a commutator, to which current is supplied through the brushes *B B*. If these brushes are connected in series with the main winding of the stator (the armature), the conditions can be arranged in such a way that this compound winding compounds the main winding of the stator. As this winding participates in the rotation of the field, there is no induction of e. m. f.'s, and the voltage between the brushes depends only on the resistance of the winding and is very small. He gives diagrams which show that the compounding can easily be accomplished by properly arranging the ratio of the compound windings to the armature windings and the position of the brushes. In designing, it is sufficient to calculate the conditions approximately. If the armature reaction or the straying should be smaller than had been expected, the exact compounding is obtained by a shunt in parallel to the compound winding, i. e., between the brushes *B B*. A single synchronous alternator should be compounded, when it supplies current to a network, but parallel operation of several compound alternators is not possible. With two machines in parallel, a "mutual" compounding may be used. When there are several alternators supplying a network, only one or two are compounded, the others are not. When a synchronous alternator supplies current to a synchronous motor, the motor is compounded, the generator is not, or the generator is compounded, non-synchronous alternator may be called the "natural compounding for energy currents," as it occurs automatically, without the supply of a compounding current, in contrast with the artificial compounding described above. This property of the non-synchronous machine is of essential importance. On the one hand, the armature reaction for wattless currents is absolutely necessary for operation in parallel and for power transmission. On the other hand, the armature reaction for energy currents is a necessary evil of the synchronous machine which one tries to avoid by various means. Large air space, high saturation of iron, and even high excitation, are all objectionable. The armature reaction limits the overload capacity of synchronous generators. It causes the motor to lag behind the generator by a certain angle, and when this angle gets to be 90 degs. (i. e., half the angle between two poles), the synchronous machine falls out of step. For the non-synchronous motor there is no such thing like this angle of lag. The load which causes the angle of lag for the synchronous machine, causes the slip in the non-synchronous machine. But the slip is not deleterious, on the contrary it is an elastic link in the chain of the transmission of power. The result is that with non-synchronous alternators operating in parallel, the degree of non-uniformity of the prime mover during one revolution, may not be smaller than with direct-current machines. Even operation in parallel with directly connected gas engines should be possible. This exposition shows that the advantages of the described non-synchronous alternator or motor over the synchronous machine are not only inherent in the non-synchronism of the machine, but in all the mechanical and electrical properties. There seems to be practically

no overload limit, the problem of the phase difference between current and e. m. f. finds a much better solution than is even imaginable for the synchronous machine, and the problem of the degree of non-uniformity of the prime mover may, in fact, be of no greater importance than for direct-current machines. Especially for large multipolar generators valuable practical success may be hoped for in this regard.—*Elek. Zeit.*, Dec. 12.

Periodic Variations in the Exciting Current of an Inductor Alternator.—DUDDELL and MARCHANT.—The last part of their illustrated paper. They reach the following conclusions. In any alternator in which the rotation of the moving part varies the number of lines of force threading the field coils, there is induced a periodic e. m. f. in the field coil which causes a periodic variation in the exciting current, and this effect may be considerable in the case of inductor alternators. The exciting current may be considered to consist of two parts, namely, a constant current, and a superimposed alternating current of twice the frequency of the armature e. m. f. The added alternating current is not symmetrical. The amplitude of this current is, owing to the high self-induction of the field coil, to a large extent independent of the resistance of the field circuit. When the machine is on open circuit, the maximum value of the exciting current occurs approximately at the same time that the armature e. m. f. has its greatest positive or negative value. When the machine is on open circuit, the amplitude of the exciting current wave is approximately proportional to the amplitude of the armature e. m. f. wave for constant speed. When the machine is on open circuit, the amplitude of the exciting current wave is practically independent of the speed for a constant mean exciting current. The amplitude of the superimposed alternating current in the field is reduced when the machine is loaded, and becomes very small when the machine is short-circuited. These variations in the exciting current tend to reduce the efficiency of the machine due to hysteresis and eddy current losses. The e. m. f. induced in the field coil may, under certain conditions, endanger its insulation and may produce disturbing effects in any other apparatus supplied with current coming from the same source as the field excitation, more especially if any of the apparatus behaves like a condenser.—Lond. *Elec.*, Dec. 13.

REFERENCES.

Eddy Currents in Pole Pieces.—An anonymous communication giving some mathematical notes on special points in the recent article of Picou, on the eddy currents in the pole pieces of direct-current dynamos.—*L'Ind. Elec.*, Nov. 25.

Artificial Loading of Alternating-Current Machinery.—GOLDSCHMIDT.—A translation, with illustrations, of the German article, recently abstracted in the Digest.—Lond. *Elec. Eng.*, Dec. 13.

LIGHTS AND LIGHTING.

Bang Electric Lamp.—A note on a new electric lamp constructed by the Danish physician Bang, which is likely to prove of great importance even outside of the field for which it is intended. In the ordinary arc lamp the carbons are heated to some 3000 degs. This is avoided in the new lamp by making the carbons hollow and letting a strong current of water run through them. The effect is that almost the whole of the energy of the electric current is removed to the light arc between the two electrodes, while the latter themselves remain so cool that one can touch them with one's finger while the lamp is burning. Besides, the carbons are consumed so slowly that the usual automatic adjustment can be dispensed with. "In science the new lamp will no doubt be invaluable. Its cold light is able to kill bacteria in one-eighteenth of the time required with the light of the ordinary arc lamp." The electrodes can be made from different substances, according to the use for which the lamp is intended. For medicinal purposes, carbon, silver and certain kinds of iron appear preferable.—Lond. *Eng'ing*, Dec. 13.

POWER.

Electric Driving in Sibley College.—A reprint of the report of the committee consisting of Professors Ryan, Morris and Barr, with recommendations upon the use of electric motors in the shops and laboratories of Sibley College. They recommend in all cases standard makes of slow-speed direct current, 500-volt motors, and to drive the tools in the various laboratories with individual motors. An installation of a variable speed motor drive by means of the multiple pressure system is also recommended. As there is no supply of alternating current at present available, no alternating-current motors are recommended.—*Sibley Jour. of Eng.*, Dec.

REFERENCES.

Electrically-Driven Winding Gear.—An illustrated description of an electric winding gear, used in a British colliery for winding from a "staple" about 100 yards deep. The gear is driven by a four-pole open type motor, capable of working up to 50 efficient horse-power at a speed of about 600 r. p. m.—Lond. *Elec.*, Dec. 13.

Transmission Plant in Mexico.—An article on the generation and transmission of electrical energy by the San Ildefonso Company, which has installed two hydro-electric plants for transmitting about 3600 hp to the City of Mexico, situated about 15½ miles distant. The voltage of the three-phase currents on the transmission line is 20,000. In the City of Mexico the current is transformed for distribution to 2600 volts.—*Eng. News*, Dec. 12.

Coal Conveying Plant.—An illustrated description of the automatic coal-conveyor plant at the Edinburgh electricity works.—Lond. *Elec.*, Dec. 13.

TRACTION.

Train Resistance.—ASPINALL.—An abstract of a paper read before the Brit. Inst. of Civil Eng. on experiments carried out with a dynamometer car on an English railway. Tests were made at speeds varying between 5 and 50 miles per hour on an almost straight line, having easy grade cuts. The mean result is embodied in the formula

$$R = 2.5 + \frac{V^2}{50.8 + 0.0278\,L}$$

in which R is the resistance in pounds per ton, V the velocity of the train in miles per hour, and L the length of the train, over coach bodies, in feet.—Lond. *Elec.*, Dec. 6.

REFERENCES.

Brighton.—An illustrated article on the Brighton Corporation electric tramway. The trolley system is used. The power house contains three generators of together 675 kw. The line has a length of 11.5 miles of single track.—Lond. *Elec.*, Dec. 6.

Electric Traction Service Without Track.—SCHIEMANN.—A translation with the illustrations, of the German article, recently abstracted in the Digest.—Lond. *Elec. Eng.*, Dec. 13.

Automobile.—DELASALLE.—The first part of a detailed and well illustrated description of the electric automobile Electricia, made by Contal.—*L'Elec.*, Nov. 30.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Traction and Lighting Plant.—The first part of a well illustrated description of the municipal plant of Salford. There are eight steam-driven generators. They supply current not only for the tramways, but also for the general lighting of the borough. It was, therefore, necessary to design the dynamos so that they could be run as compound-wound machines, giving 525 volts in the former case, and as shunt-wound machines giving 480 volts in the latter. The output of each dynamo is 775 kw, but each will carry an overload of 25 per cent, this bringing the capacity up to 1000 kw. For balancing the two sides of the three-wire system, three-direct current balancing rotary transformers are used, each consisting of two independent four-pole machines. The peculiarity in their construction is that both independent armatures of each set are mounted upon one and the same axle, so that only two bearings per set are required. The commutators are mounted on an extension of the core, so that either armature can be readily withdrawn from the shaft for repairs. The field magnets are compound, the shunt windings being separately excited while the series windings are connected in parallel with one another in such a way that the current in the middle wire passes through them to the two armatures. In this way the machine, which acts as generator at any particular time, has its field strengthened by the current in the middle wire, while the field of the motor is at the same time weakened. By this means a perfect balance of voltage is automatically obtained at all loads. Each balancer is capable of dealing with an out-of-balance current of 200 amperes in the middle wire. The efficiency of the balancer under full load is 80 per cent.—Lond. *Eng'ing*, Dec. 13.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Regulations.—A full account of the regulations for wiring in electric installations, as proposed by a committee appointed by the French Government.—*L'Elec.*, Nov. 23.

ELECTRO-PHYSICS AND MAGNETISM.

An Electromagnetic Anomaly.—BLONDLOT.—He recently showed that when a mass of air is made to move in a magnetic field at right angles to the lines of force, no electric displacement is produced in the mass of air. This fact implies another, viz., that a mass of air embodying an electric displacement does not undergo any action due to a magnetic field. The following experiment is considered: A rectangular open circuit *A B C D* (see the adjoining diagram) is



AN ELECTROMAGNETIC ANOMALY.

connected at *A* and *D* with the two armatures *A A*¹ and *D D*¹ of an air condenser, both armatures being normal to the plane of the paper and enclosed in a box of insulating material. Let this apparatus be placed in a uniform magnetic field normal to the paper, and let it be displaced along *A B*. A current will be induced in *B C*, and the Joulean heat, together with the increase of energy of the condenser, will form the equivalent of the work done by the agent, which has overcome the force, acting upon *B C*. There is no other external work, and, therefore, there is no electromagnetic action of the field upon the displacement current in the air condenser. If the principle of the equality of action and reaction is now applied, it must be concluded that a displacement current in air does not exert any magnetic action, and that, therefore, from the magnetic point of view, the charging current of the condenser is an "open current." This seems to bring Maxwell's electromagnetic theory into conflict with the law of action and reaction.—*Comptes Rendus,* Nov. 25; abstracted in Lond. *Elec.,* Dec. 13.

Induction Coil.—LORD RAYLEIGH.—A theoretical paper on the operation of an induction coil operating by means of a break in the primary circuit. The mathematical theory of the induction coil is given, and in the second part of the paper the action of the primary condenser is discussed. Theoretical arguments are advanced to show that the use of a condenser in the primary circuit should offer no advantage as compared with a sufficiently sudden simple break. He also describes some experiments which confirm this view and appear to show that the only use of a condenser, in conjunction with an ordinary break, is to quicken it by impeding the development of an arc, so that when a sufficient rapidity of break can be obtained by other means, the condenser is deleterious, operating, in fact, in the reverse direction, and prolonging the period of decay of the primary circuit. The first requirement of a well-designed induction coil is evidently the existence of sufficient energy at break, and this implies a considerable mass of iron, well magnetized, and not forming a circuit which is too nearly closed. The full utilization of this energy is impeded by a want of suddenness in the break, by eddy currents in the iron, and (in respect to spark-length) by the capacity in the secondary. It is to be presumed that in a well-designed coil these impediments should operate somewhat equally. It would be useless to sub-divide the iron, or to reduce the secondary capacity, below certain limits, unless at the same time the break could be made more sudden.—*Phil. Mag.,* Dec.

Length of the Break Spark in an Induction Circuit.—BEATTIE.—An account of a series of measurements of the length of the spark which appears on suddenly interrupting an inductive circuit. He investigated the influence of the current and of the material of the break poles upon the spark length. The results are given in diagrams exhibiting much diversity of shape, and indicating that the spark-length varies with the current in different ways for different materials, so that the material which gives the longest spark with a particular current does not necessarily give the longest spark with another current. Thus with a current of 15 amperes the spark is longest with carbon poles, shortest with platinum; but on reducing the current to 3 amperes the easily fusible metals, bismuth and lead, give the longest sparks. Perhaps the most interesting point brought out, however, is in connection with the behavior of different materials on reversal of the current. With the metals, iron, copper, tin, nickel, zinc, and with carbon, reversing the current produces no perceptible difference in the spark-length, but with lead, platinum and aluminum poles the spark-length for the larger currents is notably greater when the fixed pole is negative than when it is poistive.—*Phil. Mag.,* Dec.

Dielectric Strain.—MORE.—A dielectric placed in an electric field is subjected to a tension along the lines of force and a pressure at right angles to them, and it is expected that it will show an elongation in the direction of the force. Such an elongation has been found by Righi and Quincke, but it was much too large and probably not due to the dielectric stress at all. Cantone also obtained elongations, but they have been placed in doubt by the present author, who, with every precaution taken, obtained purely negative results.—*Phil. Mag.,* Nov.; abstracted in Lond. *Elec.,* Dec. 6.

Measuring Temperature with the Thermopile.—BECQUEREL.—The author's grandfather used the following methods for determining underground temperatures at the Natural History Museum of Paris: One terminal of an iron-copper couple was brought down to the level to be measured, the other was immersed in a bath whose temperature could be varried and accurately measured by means of the mercury thermometer; the temperature of the bath was so adjusted that the galvanometer deflection became zero; the temperature of the bath was then the same as the underground temperature to be measured. The present author uses a different method which he calls that of the sliding scale. If the junction in the laboratory is kept in ice, a galvanometer, such as that of Deprez d'Arsonval, will indicate the temperature of the other junction by its deflection, which is practically proportional to the difference of temperature. That being the case, he does not consider it necessary to keep the junction in ice. He simply leaves it at the ordinary temperature, and slides the scale of the galvanometer until the latter at its zero reading indicates the temperature of the room. On closing the circuit, the galvanometer gives directly the temperature of the other junction. A high resistance should be given to the galvanometer.—*Comptes Rendus,* Nov. 18; abstracted in Lond. *Elec.,* Dec. 6.

REFERENCE.

Cremieu's Experiments.—POINCARE.—A long article on Cremieu's well-known experiments, which, if they should prove to be correct, would revolutionize our electrodynamic theory. To show this would be the case, he gives a review of the theories of Ampere, Helmholtz, Maxwell and Lorentz, and of the contradicting experiments of Rowland and Cremieu. The criticisms against Cremieu's work are also noticed, and the great importance of the problem, which is at present an open question, is pointed out.—*Rev. Gen. des Sc.,* Nov. 30.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Dissociation Theory.—KAHLENBERG.—A long paper on "The theory of electrolytic dissociation as viewed in the light of facts recently ascertained." He gives an account of an experimental investigation made by him in co-operation with Koch and Hall. The paper is probably the strongest and ablest attack which has been made in recent years on the dissociation theory. He first gives a historical introduction and a summary of many facts from which he concludes that the dissociation theory is untenable in the case of non-aqueous solutions. His experimental investigation, however, deals with aqueous solutions, the general plan being to determine the boiling points of aqueous solutions of typical, common, chemical compounds from low to very high concentrations, in order to see how the molecular weight changes with the concentration, and at the same time to measure the electrical conductivities of such solutions at or near their boiling points. From the results of both measurements he calculates the degree of dissociation, according to the theory, and compares the values found in both ways. He also measured the conductivity at 0 deg. and made at the same time molecular weight determinations by the cryoscopic method and compared the degrees of dissociation found according to the two methods. The results of the very extended investigation is given in tables and diagrams. While in some cases the agreement between the results of the two methods is good for dilute solutions, it is poor in others, and for somewhat stronger solutions there is in general no agreement at all. There are solutions which are excellent electrical conductors, and yet the molecular weight determinations show a normal molecular weight of the dissolved substances. While in some cases the molecular weight increases with the concentration, thus according at least qualitatively with the theory, in other cases the molecular weight decreases with the increase of the concentration, finally be-

coming less than what it ought to be even on the assumption that electrolytic dissociation is complete. Again, in other cases the molecular weight at first increases with the concentration and then it diminishes as the concentration increases. And these phenomena are observed in solutions the conductivity of which steadily increases with the increase of the dilution. The principal conclusion drawn from his experiments is that there is no connection between the freezing points and boiling points of solutions on the one hand and their electrical conductivity on the other, as is claimed by Arrhenius' theory. In numerous cases not even a qualitative agreement exists. A number of agreements which have been made in favor of the dissociation theory are briefly discussed. Special stress is laid on the fact that "the attempts to harmonize the theory of electrolytic dissociation with the law of mass action, have signally failed in the case of the electrolysis par excellence" (Ostwald's law for the relation between conduction and dilution). The Thomson-Nernst rule for the relation between the dissociating power of a solvent, and the dielectric constant, is shown to be not generally correct. The dissociation theory is thought to be at present at its best in explaining the phenomena of actual electrolyis. But he claims that there are important phenomena of electrolysis which the theory does not explain satisfactorily. He says that in pressing the analogy between gases and solutions, it has often been forgotten that this is after all simply an analogy. The principal difficulty of the present theory of solution is said to be, that it neglects the all-important role of the solvent and that it fails to emphasize the fact that the process of solution takes place because of a mutual attraction between solvent and dissolved substance, and that this mutual attraction which is a function of the chemical nature of both solvent and dissolved substance, is the essence of the so-called osmotic pressure. "The dissociation theory has done much good in stimulating research in many lines. It has been fruitful in proportion to the amount of truth contained in it. Like other theories founded upon too narrow a basis of induction, it has gradually been outgrown—the facts are too much for it." The problem of solutions is pre-eminently one for the chemist and should begin with the most concentrated solutions. The behavior of the most dilute solutions will then appear as a limiting case, and then the present theory of solutions will be seen in its true relation to the facts.—*Jour. Phys. Chem.*, June; *Bull. Univ. of Wis.*, No. 47; *Science Series*, No. 5, p. 297.

Discharge Potentials of Ions.—COEHN.—An abstract of a paper read before the Association of German Naturalists and Physicians. The discharge potential of metallic ions can be diminished when the metal which is being discharged, forms an alloy with the metallic cathode. The tendency of the different metals for forming amalgams corresponds to the diminution of their discharge potential at a mercury cathode. The following series was found: Zinc, cadmium, silver, copper, iron. The discharge potential of hydrogen is diminished only at a palladium cathode, as an alloy is there formed. At other electrodes the hydrogen ion, to be discharged, requires a certain survoltage for each metal, in agreement with Caspari's measurements.—*Zeit. f. Elektrochemie*, Oct. 31.

Osmotic Pressure Observation.—OKER-BLOM.—A copper ferrocyanide membrane is permeable to sodium chloride, although impermeable to copper sulphate. He finds that when dilute copper sulphate is placed on one side of such a membrane, and a concentrated sodium chloride solution on the other, the pressure on the copper sulphate side first falls, owing to water passing from it through the membrane. Sodium chloride, however, gradually permeates the membrane until the pressure due to it is the same on both side, so that an excess of pressure is produced on the copper sulphate side.—*Zeit. f. Phys. Chem.*, July 12; abstracted in *Science Abstracts*, Nov.

Electrolytic Production of Chlorates.—J. B. C KERSHAW.—An illustrated article on the manufacture of chlorate of potash by the National Electrolytic Company, which has been carried on at Niagara Falls since 1898. The cell originally used was that patented by Franchot and Gibbs, its chief distinctive feature being the use of wire gauze cathodes covered with cuprous or cupric oxide. The cell yielded a good current efficiency, but the disadvantages attending the use of copper oxides as anode material, were found in practice to more than counterbalance the gains due to higher current efficiency, and the cell now used is a modification of the original form. Its construction is described from an English patent specification. The cathode is formed by a series of vertical copper wires. The anode is lead plate, covered with platinum foil. Some statements of the patent are criticised. It is said that it has been long known that working with a rapid flow minimizes losses, due to the fact that the chlorate formed participates in the electrolysis and is again decomposed. The real difficulty is to find the point at which the highest economy is possible. Solutions containing 10 per cent chlorate of potash will chrystallize on cooling without artificial aid. Solutions containing only 3 per cent will not. Under certain conditions of manufacture it may be more paying to work with weak solutions and to adopt refrigeration. The chief feature of the cell is the use of copper wire cathodes, in place of flat cathodes of platinum or other metal. The hydrogen gas liberated at the surface of these wires quickly detaches itself, owing to their rounded surface, and there is less trouble experienced from coating of the cathode with a film or with bubbles of hydrogen than with other forms of cathode. It is questioned, however, whether the use of copper as cathode material in a cell which necessarily contains hypochlorite as intermediate product of the electrolysis is wise, and probably still more satisfactory results would be obtained, if platinum alloy were substituted as cathode material. The original supply of the National Electrolytic Company at Niagara was 5000 amperes direct current at 175 volts. Early in 1901 the capacity and output of the works have been doubled. —Lond. *Elec.*, Dec. 13.

Calcium Carbide and Acetylene in Austria-Hungary.—A note stating that during the last year promising progress has been made in Austria-Hungary in the introduction of acetylene light. The State railways and other railway companies adopted it for their stations. Austria has five carbide plants. The aggregate power of these and others under construction being 80,000 hp. Three companies have formed a kind of trust, called the "cartell." Their carbide enjoys a good reputation and an acetylene generation of 280 liters per kilogram of carbide is guaranteed. Foreign competition is not feared in Austria, as there is a very high import duty on carbide.—Lond. *Eng'ing*, Dec. 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Frequency Meter.—MANZETTI.—A description of an instrument which has a moving system consisting of a copper disk and a parallelopiped of laminated iron, rigidly connected, one above the other, and suspended by a silk fiber. Each is acted upon by an independent pair of coils. The two pairs of coils are connected in parallel across the circuit with an adjustable resistance in series with one pair. The torque exerted on the iron is independent of the frequency, while that on the copper being due to Foucault currents, is a function of it. If then the two pairs of coils be so adjusted that for any given frequency the torques exerted by them are equal and opposite, there will be no deflection, but for a different value of the frequency a deflection will be produced which can be annulled by adjusting the resistance in series with one pair. The measurement of the frequency is reduced to a zero adjustment of the instrument, and a measurement of a resistance ratio. In tests made by the author the instrument proved correct within the limits of accuracy with which he was able to determine the frequency. The instrument can measure very low frequencies, but its readings might be falsified by self-induction at high ones.—*Acc. Lincei Atti*, 10, p. 157; abstracted in *Science Abstracts*, Nov.

Deformation of Alternating Current Curves.—WEBER.—An illustrated description of a new apparatus for exhibiting the deformations of the curves of alternating-current waves. It consists of a kind of combined telephone and sensitive flame apparatus. A polarized electromagnet is made of a steel magnet 25 cm. long, and a straight electromagnet in such a way that the wire of the latter overlaps the former, with the two axes coinciding. Facing the core of the electromagnet is a box, such as used by Koenig in his experiments on sound. The membrane which closes the box is provided with a small armature of soft iron, and the outer surface of the box is provided with the usual gas jet. An alternating current passing through the electromagnet produces vibrations of the armature and membrane, and makes the flame sing. The singing flame can be photographed in the ordinary manner, and the deformation of the current curve appear on the negative. He reproduces photographs obtained from currents with various capacities and inductances.—*Ann. der Physik.*, Nov. 11; abstracted in Lond. *Elec.*, Nov. 29.

REFERENCES.

Dynamometric Brakes.—GUILLAUME.—The conclusion of his illustrated article in which the dynamometric brakes of Feussner and of Ricter are described. He gives some theoretical notes on the action

of dynamometric and electromagnetic brakes. He notes that they can be used as hysteresis meters and describes the use of a Pasqualini brake for testing a dynamo.—*L'Eclairage Elec.*, Nov. 23.

Calorimetry.—HUBBARD.—A second article on this subject, the present one treating of the use of the separator calorimeter.—*Am. Elec.*, Dec.

TELEGRAPHY. TELEPHONY AND SIGNALS.

London.—The first part of a well illustrated description of the central exchange of the London Post Office telephones. The main features of the new service are: The adoption of the Western Electric common battery system; the use of underground conductors; provision for a toll rate of charging and intercommunication with the truck lines to provincial towns and other exchanges.—Lond. *Elec. Rev.*, Dec. 6.

Kensington.—The first part of an illustrated description of the new Kensington (England) exchange in the National Telephone Company's metropolitan area. The exchange is equipped with a luminous signal switchboard, embodying all the most recent developments of the central battery system, and the extremely simple method of operating is identical with that of the new exchange of the post office in London, but the actual details of the exchange equipment differ from the latter, as the company, while employing the Western Electric Company's central battery switchboard and accessories, has profited by its own experience in such matters as leading-in and the wiring of the switchboard.—Lond. *Elec.*, Dec. 6.

REFERENCE.

Telephony in the United States.—A statistical article on the present conditions of the telephone industry in the United States; an illustrated description of some typical telephone exchanges; also illustrated description of new telephone apparatus and appliances made by American manufacturers.—*Elec. Rev.*, Dec. 14.

MISCELLANEOUS.

Electric Arc Light for Treating Skin Diseases.—An illustrated article on the application in the London Hospital, of intensely actinic light to the cure of lupus and other skin diseases. The object attained is to enable the electric arc to be used within a short distance of the patient's skin. The effect is to increase the area treated and to shorten the time of application. Two different types of apparatus are described—the enclosed pattern and the open pattern.—Lond. *Elec.*, Dec. 13.

New Books.

DIE THEORIE DES BLEIACCUMULATORES. Von Dr. Friedrich Dolezalek. Halle: Wilhelm Knapp. 122 pages, 30 illustrations. Price, 6 marks.

This is one of the most creditable books in the rapidly growing literature on theoretical electro-chemistry. From the first to the last page it is limited to the discussion of the one subject—the theory of the lead accumulator. But notwithstanding this apparent limitation, the book really contains much more, as there is no volume of equal size known to the reviewer which gives an equally original and thorough exposition and demonstration of apparently all the numerous methods and principles involved in modern electro-chemistry and physical chemistry. The book is indeed the work of a master. It is also of great didactic value to engineers. There are several ways of learning a language, either by studying a grammar systematically, or through practice by listening and trying to speak, or by reading a good book and learning the grammatical rules while doing so, whenever occasion is offered. It is similar in studying electro-chemistry. The reviewer has the highest respect for the thick volumes of Ostwald's and Nernst's handbooks, and thinks that as reference books they have no equal; but he has always regarded them with the same reverence as he did his voluminous Greek and Latin grammars years ago. The engineer who, in his short leisure hours, attempts to study them thoroughly, must be courageous. It is a different thing with Dolezalek's little book. The lead storage cells is a thing which interests the engineer in itself. He is more or less familiar with its practical behavior and is naturally interested in understanding its theory. By studying Dolezalek's book he is led, step by step, to the different principles of modern physical chemistry. He sees that they are not only purely scientific speculations, but they can be applied to practical problems. He sees how they are applied, and gets in this way a working knowledge of the principles which may be of great value for him in the investigation of other problems.

The first chapter deals with the chemical reaction during charge and discharge of the lead storage battery, which is assumed to be a completely reversible cell in the sense of the sulphate theory, first brought forward by Gladstone and Tribe. The equations of this theory are given, together with a detailed review of the various experimental researches of different authors, which prove that the theory really accounts for the facts in so far as the consumption and formation of the materials in the cell during charge and discharge occur strictly in accordance with the equations of the sulphate theory. The diverging theories of Darrieus and Elbs are noticed and the points are shown where they fail. On pages 8 to 10 of this chapter, Caspari's hypothesis of the over-pressure or sur-voltage (Ueberspannung) is applied to the lead accumulator. This application (made in a paper of Nernst and Dolezalek in 1900) has been severely criticized by Mr. C. J. Reed in a paper in the January, 1901, issue of the *Journal of Physical Chemistry;* his criticism seems convincing, or at least it has not yet been refuted in the current literature.

The second chapter gives the thermodynamic proof of the sulphate theory. It is shown that the e. m. f. calculated on the basis of the sulphate theory by means of Helmholtz's formula (the modified Thomson rule) is in agreement with the facts. This proof is given for various densities of the acid.

The third chapter deals with the application of Nernst's osmotic theory of galvanic cells to the lead accumulator. As is well known, this theory is based on the hypothesis of a solution tension which between a reversible electrode and the electrolyte, acts in a precisely similar way as the vapor tension does between a liquid and its vapor. There are two different osmotic theories of the lead cell, one by Leblanc and the other by Liebenow. Both agree in the assumption that the lead electrode is reversible in regard to bivalent Pb ions, but they differ regarding the peroxide plate, which is assumed by Leblanc to be reversible in regard to four-valent positive Pb ions and by Liebenow in regard to bivalent negative lead peroxide ions. Both theories lead to the same final conclusions. The equations representing these theories are given and Nernst's formula for the e. m. f. at a reversible electrode is applied to Liebenow's theory. In the reviewer's opinion both these theories are certainly ingenious, but they appear to him to be somewhat artificial, and have not yielded any result which had not been obtained before in a different and less hypothetical way. Nevertheless, the theories are good examples to show how the Nernst theory can also be applied to cases where it does not seem to be applicable at first; for here we have not simply a metal in the solution of one of its salts, as in the ordinary applications of Nernst's formula.

The fourth chapter deals with the variation of the e. m. f. with the acid concentration. A summary is given of the experimental researches on this point, which is followed by a very interesting and ingenious thermodynamic calculation. Two storage batteries filled with acid of different densities are connected in series, but one against the other. The combination of these two cells is a source of electrical energy. The total result of the discharge is the transport of sulphuric acid from the more concentrated solution to the less concentrated solution, and of water from the latter to the former. The e. m. f. of the combination of the two cells is directly proportoinal to the change of the free energy in the system, which can be calculated in two different ways—either from the heat-toning of the transport of acid and water and from the temperature coefficient of the e. m. f. of the combination (Helmholtz's modification of Thomson's rule) or by the process of isothermic distillation with the aid of a method formerly used by Helmholtz for an analogous calculation. The e. m. f. of the combination of the two batteries can thus also be calculated in two different ways. It evidently represents the difference of the e' m. f.'s of the two cells with different acid concentration, or in other words, the variation of the e. m. f. with the acid concentration. The agreement between these calculations and measurements is excellent. While the calculations are generally valid, they can be greatly simplified for the special case of dilute solutions. This is done, and it is also shown that the simplified formula can also be obtained from Liebenow's theory and also directly from the law of chemical mass action. This simpler formula is also examined experimentally and found to be correct.

The fifth chapter deals with the variation of the potential differences at each electrode separately, with the acid concentration. The variation of the potential difference of each separate electrode against a

normal electrode, is investigated; as a normal electrode, the hydrogen electrode is usd first, and then the mercurous sulphate electrode; but the author correctly remarks that in this way he does not get the variation of the e. m. f. at the accumulator plate alone, which is what is wanted, but he gets it in combination with the variation of the e. m. f. at the normal electrode, which is not wanted. A somewhat better insight into the variation of the e. m. f. at each accumulator plate separately is obtained by the study of certain concentration cells, which is made. Again the special case of dilute solutions is taken up and the simple formula representing the same is directly developed from Nernst's theory of concentration cells. All these investigations are experimentally examined and confirmed.

The sixth chapter deals with the temperature coefficient of the e. m. f. of the accumulator. The interesting result is brought out that the temperature coefficient is negative for dilute acid, below a concentration of 0.7 grammolecule of acid per liter. At this concentration the temperature coefficient is zero, and above it positive, first increasing to a maximum and then decreasing again slowly. The seventh chapter deals with the influence of the pressure upon the e. m. f. A simple calculation (similar to that in the fourth chapter) is given, which shows that this influence is very small, and that when 8.8 per cent acid is used, there is a decrease of the e. m. f. by 0.0012 volt for an increase of the pressure to 100 atmospheres, in agreement with measurements.

The eighth and ninth chapters are of extreme importance, as a general discussion is given there of the influences to which the characteristic forms of the charge and discharge curves are due, together with a discussion of the important question of the full reversibility of the electro-chemical action of the cell. The main question is, Why is the average voltage at charging higher by several tenths of a volt than the average voltage at discharge? It is shown that it is impossible to explain this difference of the charge and discharge voltages as being due to the voltage lost in overcoming the ohmic resistance. It is convincingly shown that this difference is due to concentration changes of the electrolyte. The electro-chemical action during charge causes an increase of the concentration in the pores of both plates. During discharge both these concentrations decrease. Now, it is a fact that the e. m. f. increases with the concentration of the acid. At the usual current densities the average e. m. f. at charging is about 0.08 volt higher than corresponds to the acid density. During discharge it is lower by about the same amount. To explain this, it is only necessary to assume that the acid concentration in the pores of the plates during charge is higher by 10 per cent than in the space between the plates, and during discharge lower by the same amount; in fact, there are here also e. m. f.'s between the differently dense parts of the electrolyte, but the author is justified in neglecting them, as they are negligible against the e. m. f.'s at the electrodes. A critical analysis of the characteristic forms of the charge and discharge curves is given. Experimental facts are summed up which show that the electro-chemical action in the lead cell is fully reversible; i. e., that the chemical process during charge is represented by exactly the same equation as that during discharge, but goes on in the opposite direction; in fact, the lower the current density the more will the difference vanish between the e. m. f. of discharge and the counter e. m. f. of charge. It is shown that while both plates participate in the concentration changes causing the difference between the two e. m. f.'s, the peroxide plate predominates. On page 58, in calculating in detail the concentration change at the peroxide electrode, it is said that the increase by two molecules of water with a simultaneous decrease of 1.19 molecule of acid, is equivalent to a decrease of acid by 1.28 molecules of acid. It is evident that this cannot be a full equivalent. If it is meant that both changes would produce the same variation of concentration, it can be correct only for a certain amount of electrolyte in the pores of the plate, hence only for a special type and size of plate. The number 1.6, which the author derives, cannot, therefore, be used for general calculations.

In the tenth chapter the processes in the cell on open circuit are discussed—recovery, self-discharge at open circuit and sulphating. The eleventh chapter deals with experimental researches on the internal resistance, the twelfth with the ampere-hour capacity; various empirical formulas for the relation between capacity and current rate are noticed and a theoretical formula is developed which is at least correct for small currents. The influence of the thickness of the active mass of the plates, of the acid concentration, and of the temperature upon the capacity, is discussed. The last chapters deal with the efficiency, the processes in the cell during formation, and with methods of measurement. The book is concluded by Lunge and Isler's table of specific gravities and concentrations of aqueous solutions of sulphuric acid.

PARALLEL TABLES OF LOGARITHMS AND SQUARES. Feet, Inches and Fractions of a Foot Expressed in Decimals of a Foot and Advancing by One-thirty-second of an Inch. By Constantine Smoley, C. E. Cleveland, Ohio: Constantine Smoley. 212 pages. Price, $3.

This is a book of tables pure and simple, containing in parallel columns the square and the logarithms of dimensions from zero to 50 ft. expressed in feet, inches and fractions of inches, advancing by steps of 1-32 of an inch each. A table of five-place logarithms of numbers is bound in with the tables as are also a few pages of explanation and practical examples. Naturally such a volume is of little value to an electrical engineer, but architects and more particularly engineers engaged in structural problems should find it a great time saver. The author sets forth in his preface the method he has devised and employed for calculating the squares. It is too long to abstract here, but most interesting. From the description of the double checking by two other methods that was applied, it would seem that in all human probability the tables are errorless.

OUTLINES OF ELECTRO-CHEMISTRY. By Harry C. Jones. New York: Electrical Review Publishing Company. 106 pages, 13 illustrations. Price, $1.50.

A more appropriate title for this book would be "Outlines of Theoretical Electro-Chemistry," as the author refers briefly only once or twice to the application of electro-chemical methods in engineering practice. Nor does the book pretend to be a systematic treatise on theoretical electro-chemistry, as it deals only with several particularly interesting and important features but treats them more or less fully. After a brief historical introduction, the author discusses in the two first chapters the laws of the osmotic pressure and the theory of electrolytic dissociation. The first explanation of the term osmotic pressure is somewhat brief and could be extended to advantage, as the idea of osmotic pressure is really difficult to grasp by the beginner. In the description of the fundamental experiment proving the existence of osmotic pressure (page 7) it should have been explained that the difference of the pressures on the two sides of a semi-permeable diaphragm, measures the partial pressure of the substance to which the diaphragm is impermeable. The meaning of the experiment would thus become clearer. The significance of the analogy between osmotic pressure and gas pressure is well brought out by the author, as is also the line of argument which led Arrhenius to the dissociation theory.

In the third chapter the dissociation theory is applied to some interesting problems of a chemical nature. The fourth chapter gives a brief account of Faraday's law, a short review of the electro-chemical theories of Davy, Berzelius and Grotthus, and a detailed and clear review of the present views of the theory of ions with reference to the process of the elctrolysis of acids, bases and salts; the "primary" decomposition of water is explained according to Leblanc; the decomposition value of an electrolyte is discussed and a few notes are given on the electrolytic separation of metals. The fifth chapter deals with the determination of the relative and absolute velocities of the ions; the sixth and seventh with the conductivity of solution; Kohlrausch's law is given; the conductivity of electrolytes is shown to be a measure of their dissociation; the dissociating power of different solvents is discussed and the relation between the degree of dissociation and dilution; at the end of this chapter an instructive review is given of the different modes by which ions are formed. The last three chapters deal with the calculation of the e. m. f. of galvanic cells, and especially Nernst's theory of solution-tension; and outline his theory of concentration cells. It would have been better perhaps if in these three chapters less mathematics had been given, but it must be conceded that the author has endeavored to bring out the physical meaning of the equations.

At some parts of the book the author seems to presuppose more knowledge than beginners generally have. On page 43, for instance, he uses the law of chemical mass action which he has not explained. On page 79 he remarks that the charge of a univalent gramion is 96,540 coulombs; where this very important number comes from, should be clearly explained in connection with Faraday's law. The author's statement of Faraday's law is too qualitative. It should be

given in a strict numerical form, as it is in such a form that it is required in practice. But, on the whole, it must be said that the author understands how to treat his subject in an interesting and clear way. His book is easy reading, it is brief and covers only the principal points. These are properties which should recommend it especially to a busy electrical engineer. The author is right when he says in the preface that an engineer must be familiar with much which apparently belongs to pure science, in order to be able to see what can be put to practical use.

Electric Gas Lighting. By H. S. Norrie. New York: Spon & Chamberlain. 100 pages, 57 illustrations. Price, cloth, 50 cents.

This book consists primarily of descriptions of the different electric gas lighting attachments and other apparatus used in connection therewith, such as spark coils, batteries, etc., with some very elementary theoretical disquisitions. The descriptions are clear, and altogether the book is well written. The information, though elementary, is of a practical kind, and would enable a person of reasonable intelligence, who was unfamiliar with the subject to install a system of electric gas lighting.

There are six chapters in the book, entitled, respectively, "Introductory Remarks," "Multiple Gas Lighting," "Connections and Wiring," "Primary Coils and Safety Devices," "Lighting Large Buildings," and "How to Select Batteries for Gas Lighting."

A Manual of Laboratory Physics. By H. M. Tory, M. A., and F. H. Pitcher, M. Sc. New York: John Wiley & Sons. 288 pages, 63 illustrations. Price, $2.

Although there are a great number of standard works extant on the subject of laboratory physics, the book before us will prove extremely useful, and will surely hold its own among its rivals. It is written in a terse, concise manner, illustrated by simple well-drawn diagrams, and it shows a wise discretion in the amount of mathematics used in its pages.

The book is divided into five chapters, the briefest being devoted to sound, the longest to electricity. The three remaining chapters are devoted to light, heat and magnetism. References to standard works are freely given, and examples, with blanks to be filled in by the students, will prove extremely useful. This work can be heartily recommended.

Practical Marine Engineering. By William F. Durand. New York: *Marine Engineering,* Incorporated. 706 pages, illustrated. Price, $5.

The purpose of the author in the preparation of this book has been to serve operative marine engineers, especially those who have not had the advantages of higher engineering education. The work is hence, to a considerable extent, descriptive, although the greater part of it is devoted to the statement and explanation of the principles affecting the operation of marine machinery and of the problems which arise in its management, care and repair. The field covered is, therefore, the middle ground between that of the advanced textbooks used in technical schools and that of the handbooks which give information without explanation and leave the practical engineer, when his need does not fall exactly within their rules, adrift on a sea of uncertainty.

Beginning with the composition, physical properties and tests of materials of engineering, the author elaborates his subject through successive chapters upon fuels, boilers, engines and auxiliaries, the operation and management of marine machinery, valves and valve gears, the steam engine indicator, special topics and problems relating to the preceding, propulsion and powering, refrigeration and electricity on shipboard. A section giving the methods of computation in elementary problems in arithmetic, geometry, mensuration, physics and mechanics with a list of questions on the subject-matter, completes the work.

The treatment of this wide range of topics is marked by simplicity and directness, and, in not a few instances, by a fullness of information which would scarcely be expected in a work of this class. Thus, for example, the section relating to boilers is not only ample in description but gives much referring to design and to the cause and prevention of corrosion and scale. Again, under the heading of boiler and engine economy, much valuable information is given as to the economic regimen of marine machinery in service, with regard especially to evaporation, expansion, coal consumption and related problems. Under propulsion and powering the author handles topics which are unusual in text-books of a general character, such as the powering of ships, the reduction of power when towing and trial trips and their lessons.

Professor Durand's purpose in the preparation of this work has met, in its execution, a marked measure of success. He has given not only a fairly complete presentation of his subject from a practical viewpoint, but has discussed also, in clear and simple language a number of somewhat difficult problems which have been handled heretofore only by mathematical processes. The book is well printed on fair paper, the illustrations are ample and effective, but the binding is flimsy and unworthy.

BOOK NOTE.

The second edition of Steinmetz's "Alternating-Current Phenomena" has been translated into French by M. Mouzet. A French translation of the same author's "Theoretical Elements of Electrical Engineering" is now being made by M. Letheule. A French translation of Behrend's "Induction Motor" will also soon be issued.

BOOKS RECEIVED.

Elektro-Ingenieur Kalender, 1902. By Arthur H. Hirsch and Franz Wilking. Berlin: Oscar Coblentz. 209 pages, illustrated. Price, 2.50 marks.

Recherches Experimentales sur les Spectres D'Etincelles. By G. A. Hemsalech. Paris: A. Hermann. 138 pages, illustrated. Price, 6 francs.

Les Theories Electriques de J. Clerk Maxwell. By M. P. Duhem. Paris: A. Hermann. 228 pages. Price, 8 francs.

English Electric Locomotives.

We show herewith two types of English electric locomotives, both for railroad siding service and one employing a storage battery.

The locomotive shown in Fig. 1 was built by Thomas Parker, Limited, of Wolverhampton, and is similar in type to those made by the same company for the Waterloo & Baker Street underground line. It is of standard gauge, and will be employed for siding service. It has a capacity for hauling 45 tons on a grade of 1 per cent at about four or five miles per hour, and lighter loads up the same grade at speeds up to eight miles per hour. The motor can be lifted from its place for inspection or repair without resorting to the use of a crane. In the roof there is a ring fastened to one of the supports, to which a set of pulley blocks is attached, and the motor is suspended by means

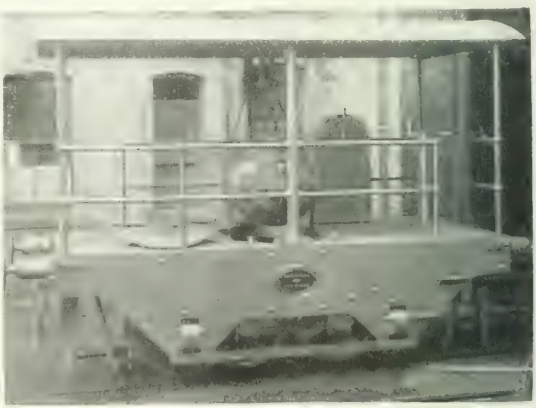


FIG. 1.—ENGLISH ELECTRIC LOCOMOTIVE.

of an eye-bolt on the top of the casing. When in its normal position the motor is below the footboard, and the whole is covered in with plates. The motor is of the four-pole, enclosed ironclad type, with carbon brushes. The armature winding is of the Eickemeyer type. The magnet yoke and the cover are cast together, with the division on the horizontal diameter. The motor develops from 40 to 50 brake horse-power when supplied with current at 200 volts. It is made both with water and dust-proof, but with lids arranged so that access may be obtained to the brushes.

The motor works through double reduction gear, with two countershafts, gearing at each end of the spindle into these countershafts, which are on the same horizontal line as the center line of the axles, so that the moving of the locomotive on the springs does not affect the teeth, which are in gear with the axle gear wheels. The controlling switches are placed in a box at one side and fastened to the hand railing. The starting, stopping, regulating and reversing switches are all operated by one handle. The brake handle is also within easy reach of the driver. The current is collected by a trolley arm, which



FIG. 2.—ENGLISH STORAGE BATTERY LOCOMOTIVE.

does not appear in our engraving. An ordinary tram car trolley base is fixed on the locomotive foot-plate, and rises through a hole in the roof. The complete weight of this locomotive is 12½ tons.

The locomotive shown in Fig. 2 was recently built at the works of Messrs. Tweedales & Smalley, of Castleton, near Manchester, to be used on their siding connected with the Lancashire & Yorkshire Railway. The locomotive is equipped with 60 Monobloc accumulators. These cells, for which Drake & Gorham, of London, are the selling agents, have a capacity of 525 ampere-hours, and are capable of charging or discharging at 105 amperes for 5 hours, 125 amperes for 3½ hours, or 390 amperes for 1 hour. It is claimed for these cells that vibration does not dislodge the active material, and that there is no buckling or breaking of the plates.

The block of the positive material is composed of punched sheets of lead, built up from the bottom of the cell, so as to form one homogeneous mass, which is cross-tied at all points to give the maximum mechanical strength. The holes punched in these horizontal sheets also form a casing and receptacle for the negative electrodes, which are in the form of vertical pencils. The positive block is formed by a special variation of the Plante process, which insures a dense and closely adherent coating that has been shown in actual practice on a large scale to resist the disintegrating effects of rapid discharges. Free circulation for the acid is provided at all points throughout the

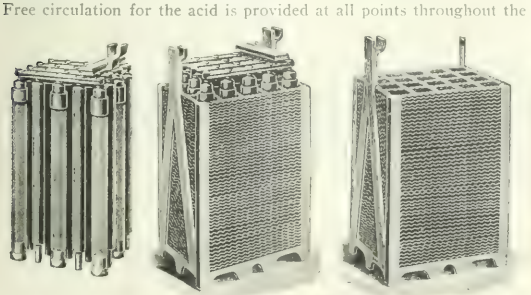


FIG. 3.—STORAGE BATTERY ELEMENT.

cell, and the arrangement also insures the even distribution of the electric current throughout the mass, which is essential in every well-designed accumulator.

The locomotive, which is capable of drawing 120 tons, is mounted on two axles, with four wheels 43 inches in diameter. Each axle is geared to an enclosed traction motor, supplied by the Electric Construction Company, of London & Wolverhampton, and geared to the axle by double-reduction, machine-cut spin gear, having a total ratio of 20 to 1. Each motor gives a horizontal effort at the tread of the wheels of 2500 lbs. The motors also give 1000 lbs. horizontal effort at from 3 to 4 miles per hour, with 68 amperes and 120 volts. They are specially designed to operate in conjunction with storage batteries.

The controller is of the series-parallel type, effecting these combinations on the motors, and not by manipulation of the battery. The locomotive is complete with instruments for registering charge and discharge of the battery, and controlling the locomotive from either end for shunting operations. The total weight, in running order, is 22 tons. At trials recently conducted, the locomotive started with ease under the maximum load required, and under perfect control. In shifting operations in connection with freight yards there is doubtless a considerable field for the electric locomotive, for not only is the risk of fire among timber and other inflammable goods avoided, but actual economy should result from the fact that the ordinary locomotive has to be kept under steam for many hours in order to be available for comparatively short periods of use. Apart from this, the labor required for the manipulation of an electric locomotive is considerably less than that which has to be provided for its rival, the steam locomotive.

Electric Cranes.

The accompanying illustrations refer to a type of electric crane recently placed on the market by the Case Manufacturing Company, of Columbus, Ohio. As will be seen, the girders are of the "fish-belly type," which lends grace to the appearance and reduces to a minimum the amount of unnecessary material to be moved back and forth, thus increasing the efficiency of the bridge movement. The girders are of box-section, which alone is conducive to lateral rigidity, but in addition to this I-beams are used for top and bottom cover plates. This makes the girders most rigid and permits operation if necessary at a high rate of speed.

These girders rest on top of the end trucks, thus placing the strain on the plates and angles used in the make-up of the girders, instead of on rivets or bolts. The end trucks are constructed of two steel channels of heavy section, and these are held rigidly together by heavy bolts and are stiffened by cast iron separators and truck castings, which in turn support the axles of the truck wheels. The wheel base is considerably wider than general practice, thus not only distributing the load economically on crane runways, but also reducing to a minimum the possibility of the girders getting out of square with the crane runways. The method of fastening girders to the end trucks also tends to eliminate this possibility, the results of which are occasionally noticed in the breaking of flanges on bridge truck

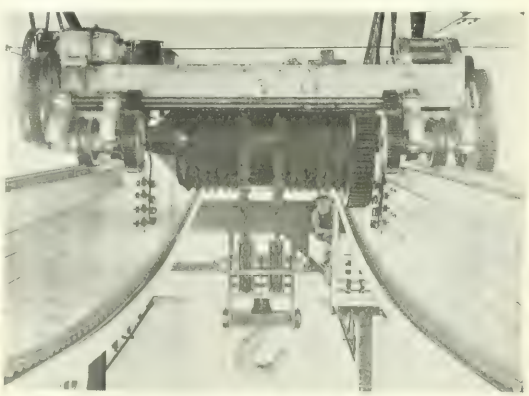


FIG. 1.—OPERATING OF ELECTRIC CRANE.

wheels or the necessity of frequently moving the crane to the end of the building in order to right it by running it against the buffers.

The bridge and trolley truck wheels are in all cases of cast steel. It has been found advisable to adopt this material for the reason that cast iron wheels with chilled treads are somewhat uncertain as far as the chill is concerned, this varying in thickness to such an extent that it cannot be relied upon. The flanges of these wheels are heavy enough to permit of long service before they are worn to the point where it is necessary to renew them.

The crane, as a whole, is driven by the application of power at the

center of the bridge, and the foot brake, which is controlled in the operator's cage, is applied at the same point. This prevents torsion of the propelling shafting, and the possibility of moving one end of the crane faster, or stopping it sooner, than the other.

The chief point of interest in connection with the trolley is its short wheel base, which affords the maximum travel of the hook; or, in other words, the near approach of the hook to the runway rails at either end of crane, in this way making the crane effectively cover a large area of floor space. The construction of the trolley furthermore makes it possible to raise the hook to an unusual height with respect to the top of the runway rails. The trolley frames are cast iron box section, and bearings are equipped with removable caps, which reduces to a minimum the time required for making repairs or fitting new parts.

The pinions are made of cast steel, and the gears of a superior quality of cast iron. They are of wide face and small pitch, which tend to eliminate noise during operation, and are machine-cut from the solid, with the exception of the main drum gear and its mating pinion. These latter are shrouded to the pitch line on both sides of the teeth, which insures perfect centers and great strength.

The mechanical brake, which is very generally conceded to be one of the most important points in design and construction of a traveling crane, is different from anything heretofore in use. The principle is similar to that of several brakes now on the market in so far as the method of application is concerned. The braking power or friction is obtained, however, by a quite radically different method. Where it is desired that the crane be equipped with an auxiliary hoist, this movement is, like the main hoist, equipped with both mechanical and electrical brakes; and in no case are less than two strands of chain or cable used to the hook, which insures a vertical lift which cannot be obtained where but one strand is used.

The motors used are of the series wound, reversible type, especially [illegible] and operate at exceptionally slow speeds.



tic. In a report of tests made with this lamp by Col. Holden, F. R. S., superintendent of the Royal Arsenal at Woolwich, it is stated that the initial watts were 2.53 per candle, 2.84 watts at the end of 500 hours and 3.35 watts at the end of 1000 hours. Colonel Holden commends the lamp highly, and expresses the opinion that it has reached the commercial stage of development. With more recent lamps it is stated that tests have shown an economy ranging from

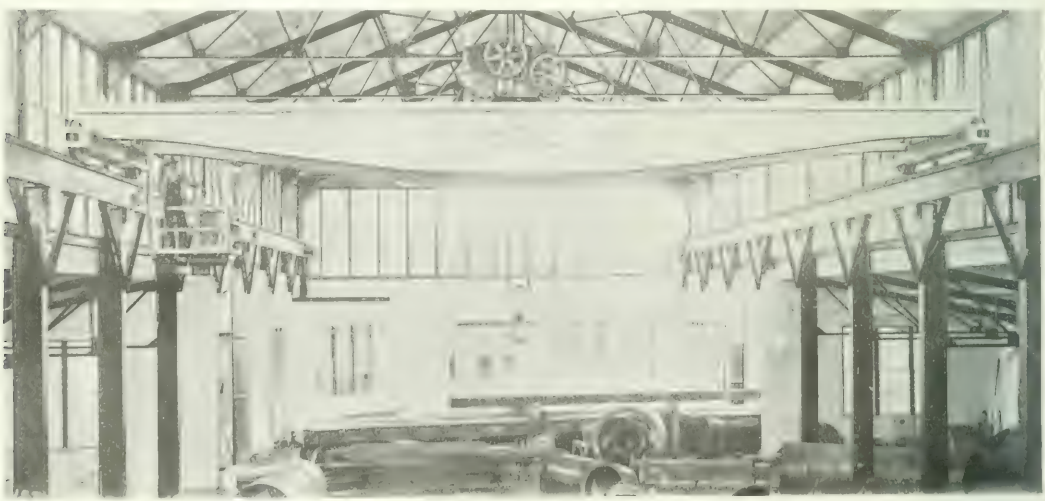


FIG. 2.—ELECTRIC CRANE.

This latter feature adds greatly to the efficiency [illegible] whole.

Titanium Incandescent Lamp.

[illegible] brought before the electrical public in England, known as the Crawford-Voelker lamp, the inventor of which, Mr. William Lawrence Voelker, is an American citizen. Not only is an entirely new filament employed, but the bulb represents a distinct new departure.

The material of the filament is carbide of titanium, and in its preparation the electric furnace is used. The inventor claims to have discovered a method of effecting a chemical union between several of the rare earths, thereby enabling him to produce for the first time a true carbide filament. In length the filament is much shorter than the corresponding carbon filament, and it is both tough and elas-

[illegible] carbon filament lamp, these results will be recognized as of striking significance. Another point claimed for the lamp is that there is practically no discoloration of the bulb during the life of the filament.

A filament of this material has been perfected for 500 volts, which marks a highly important advance in the art. This led to the design of a new type of bulb, which, however, has also important advantages for use with lower voltages. Various attempts have previously been made to do away with the danger of arcing or "washing" at the joints of high-voltage filaments. Edison carried out a number of experiments establishing the fact that a considerable current flows across from one joint to another of the filament and even succeeded in measuring it, but until the present it is stated that no successful means of preventing this arcing has been devised. At [illegible] high voltage filaments mounted in the ordinary

bulb are broken during the operation of pumping, owing to the current being turned on when there is still some air present in the bulb, the current thus being able to leap across from one joint to the other. This loss is stated to be entirely done away with by employing the bifurcated bulb illustrated herewith, in which the joints are separated by a double glass insulation. This involves a notable saving in manufacture, and in addition there is increased length of life of the filament due to the insulation of its joints.

In the case of high voltage lamps it is not sufficient to insulate the joints within the bulb alone, for it is important to continue this insulation in the socket itself. For this purpose the high-voltage sockets of the Crawford-Voelker lamp are made of porcelain or some suitable insulating material of that nature, with a division across into which the bifurcated end of the bulb fits and is secured with the minimum of cement necessary to obtain the requisite strength and firmness. Thus all danger of a "short" in the socket is obviated, nor can the socket absorb moisture as in the case where plaster is used. The sockets of the highest voltage lamps may, it is stated, be handled while the current is flowing through the lamp, without the slightest risk of getting a shock. As the sockets are indestructible they may be used over and over again.

Asphalt Conduits.

The accompanying illustrations show a system of asphalt conduit and troughing manufactured by the Howard Conduit Company, Limited, of Trafford Park, Manchester. Asphalt is particularly suitable for pipes or conduits, as it is impervious to water and air, resists wear and acids, is an electrical insulator and expels vermin. It is durable and easily repaired, and so ductile that it will yield to any ordinary pressure without cracking. It is unaffected by frost, and though softened by heat at about 125 degs. F. does not disintegrate even at 350 degs. F., and upon regaining its normal temperature has lost none of its desirable qualities.

Difficulties of manufacture have hitherto prevented the use of asphalt for pipes, but the Howard Company claims that it has overcome these. The process of manufacture consists in placing the hot asphalt in a sheet-iron pipe, which is revolved rapidly. Under the influence of the centrifugal force the asphalt spreads into a cylinder of uniform thickness, and is pressed into a solid mass. The heavier sediments are left on the outside of the pipe, forming a strong outer skin, and the lighter matter forms a smooth inner surface. The



FIG. 1.—LAYING ASPHALT CONDUITS.

pressure developed by centrifugal force in a 3-inch pipe revolving at 300 r. p. m. amounts to 10.6 lbs. per pound of asphalt. To prevent alteration of shape there is combined with the asphalt a spiral of galvanized iron, imbedded in the material and thus protected against oxidation.

The labor in making joints is naturally very slight. A cast iron block of suitable shape is heated in a portable fire and applied between the two ends to be joined. As soon as the asphalt is sufficiently warmed the two ends are pressed together firmly and left to cool, a thoroughly welded joint being thus produced.

Asphalt troughing for use on the solid system is made on the same principle as the conduit, but without the spiral, and is pressed into rectangular shape. The cable is laid directly in the bottom of the trough without supporting clips; a small quantity of bitumen is then flowed into the trough, which is sufficient to cover the cables. The remaining space is filled with asphalt rock, which can be arched, thus forming a cover sufficient to protect the cable from external damage.

In the accompanying illustration *D* represents an iron joint box lined with asphalt, connecting two lengths of lead-covered cable *B*

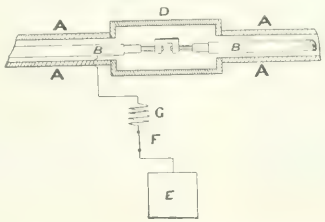


FIG. 2.—LONGITUDINAL SECTION OF CONDUIT.

laid in the asphalt trough *A*, the cable covering being connected to earth through the resistance *G* and the fuse *F*. In case of a failure of a cable causing a short circuit to the lead, and thus to the earth, the cable in the ordinary case is burned out, or the circuit breaker is opened, causing considerable trouble, especially in railway circuits. In the present system the fuse *F* in the section in which the fault occurs is blown and the lead covering is thus insulated from earth by the asphalt troughing. The cable can still be utilized until a convenient time for repairing the fault, the position of which is easily found by an inspection of the various fuse blocks. The resistance *G* is intended to prevent the flow of any electrolytic currents in sufficient strength to injure the lead.

New Fusible Switches.

A very satisfactory form of fused switch had been put on the market by the General Electric Company. It consists of a combination of the well-known punched clip spring switch with the Edison fuse plug, and is designed for 125 volts service. The use of this form of fuse has made the operation of re-fusing a switch a perfectly safe and simple matter which can be performed without tools. This feature combined with the protection which the Edison plug insures, makes this new switch desirable for use in many places where other forms

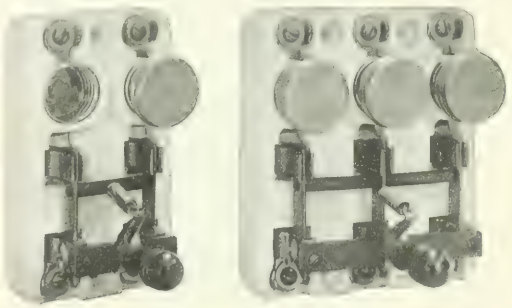


FIG. 1.—FUSIBLE SWITCHES.

of switches could not well be installed. This device will be found very useful in connection with small motors, arc and incandescent lighting circuits, etc.

The parts are mounted on a porcelain base, the entire construction being substantial and proportioned for severe usage. These are made with single-throw switches, either double or triple pole. The fuse plugs can be furnished with any capacity up to and including 30 amperes.

Blow-Off Valve.

Of all boiler fittings the blow-off valve is apt to give the most trouble, and necessarily so on account of being subjected to cutting action in passing scale and sediment, and the valve being forced to its seat with grit between. To overcome as far as possible trouble from these conditions, the Lunkenheimer Company has designed a new type of blow-off valve having a self-cleaning seat, and to which the trade name of "Duro" has been given.

Referring to the illustrations herewith it will be seen that the general form of the new valve is quite similar to the iron body angle blow-off valve which has been so extensively used for some years past. Heretofore in blow-off valves the seat has been so located that as the disk approached the same there would be an accumulation of scale and sediment, the effect which has been to cut out the bearing surfaces. In the "Duro" valve the plug fits snugly in a separate and easily removable bronze casing, which can be readily replaced when worn, and any accumulation of scale on the seat is prevented by a jet of steam blowing over the same.

It will be noticed, in referring to the illustrations, that there is a steam inlet, *A*, and on the sectional cut it will be seen that this connects with an annular passage *C*. The iron body of the valve has a brass casing, *D*, with circular slot, *J*, cut into the side of same just below the level of the seat, *E*. This casing, *D*, is held in place in the valve body by the seat ring, *E*, screwing over the same, both of which are removable at any time for repairs or replacement with new parts. The opening, *A*, is connected to the steam part of the boiler and a suitable valve interposed. The object of this steam inlet, *A*, is to admit steam to *C* and *J*, and in discharging from the latter it blows across the seat, thus cleaning off any scale or sediment that may have accumulated on it, so that the disk and seat bearing when in contact will be perfectly clean.

In operation, to close the valve the disk is screwed down in the usual manner. As it approaches the level of the inlet the edge of the disk passing the lower edge of the casing, *D*, cuts off a great deal of the flow of water, sediment, etc. At this time the valve in the steam pipe leading to inlet, *A*, should be opened and the steam admitted to the annular space, *C*, from whence it passes through slot, *J*, and carries over the entire surface of the seat, *E*. In the meantime, the disk is being screwed home to the seat, which also cuts off the flow of steam from the inlet, *A*, as well as the blow-off from the boiler.

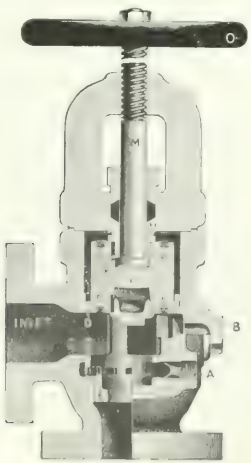


FIG. 1.—BLOW-OFF VALVE.

The valve in the pipe leading to the inlet, *A*, can be left open at all times, as the disk of the blow-off valve keeps outlet closed.

It will be seen that, by the time the seating is accomplished, all scale and sediment have been blown off the seat and the surface is clean; hence there is nothing present to cut the bearing surfaces. The disk, or plug, is reversible, having two valve or seating faces, which can be changed at will, thereby increasing the durability and efficiency of the valve considerably. These valve or seating faces in the disk consist of dovetailed slots, which are filled with Babbitt metal, and, when both are cut or worn out, the old Babbitt metal can be melted out and new metal poured into the slots, which, after facing off, renews this wearing part of the valve. The seat ring, *E*, and casing, *D*, are easily removable, and, as these are interchangeable, new ones can be supplied at small cost. There is also provided a plug, *B*, opposite the inlet, so that, if desired, this can be taken off and a rod run through the blow-off pipe to clean it out.

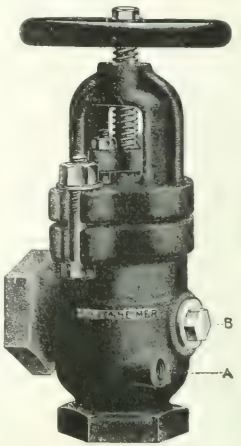


FIG. 2.—BLOW-OFF VALVE.

New International Telephone Apparatus.

The International Telephone Manufacturing Company, of Chicago, is just entering the field with a complete new line of telephone apparatus, which is especially notable for its substantial mechanical construction. While there are now no marked lines of difference, as a rule, between the telephone apparatus of the various

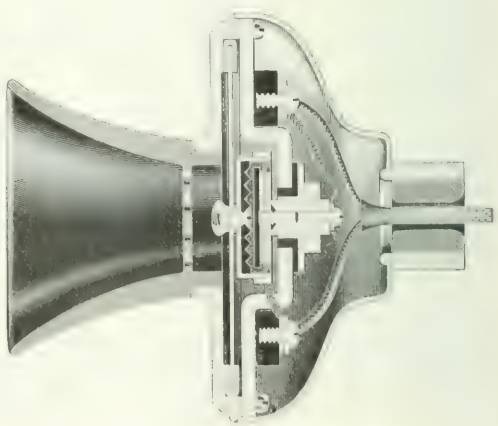


FIG. 1.—INTERNATIONAL TRANSMITTER.

[illegible] field, there is always considerable room for improvement in details, and it is in the perfection of details that the new apparatus here described is strong.

In the transmitter (Fig. 1) the cup, which holds the carbon, is a light metal receptacle, having its walls properly insulated and [illegible]

diaphragm. This contains the front electrode and forms the chamber of the granular carbon. The back electrode is supported by a bridge and so mounted that it can be readily adjusted. When set in its proper position, it is firmly clamped and locked by a screw in the collar at the center of the bridge. The granular carbon is held in its chamber by a small mica ring between the back electrode and the walls of the cap to which it is clamped by a small set rim, thereby avoiding the use of felt or plush or other material which compresses in time. The diaphragm and front electrode is insulated from the frame of the transmitter.

An insulated wire leading from the front electrode is terminated at a clip on a small rubber block mounted on one end of the bridge. A similar terminal is provided on the bridge for the back electrode. From these terminals the circuit is completed to the induction coil by a double conductor cord, thus avoiding the use of the transmitter arm and frame as one side of the circuit. The bridge and all working parts of the transmitter are mounted and securely fastened

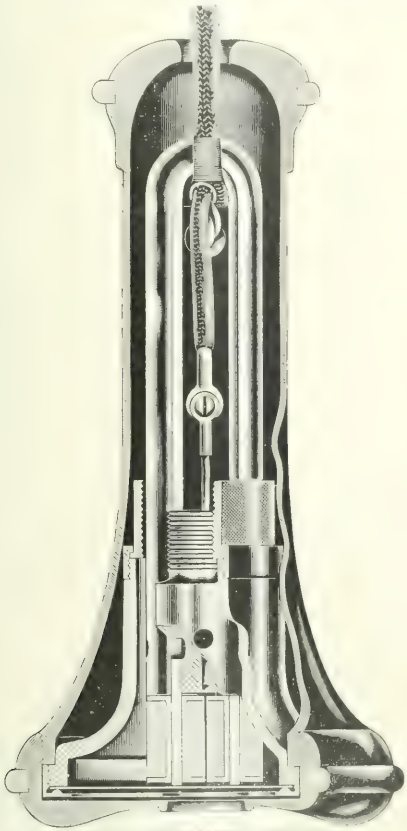


FIG. 2.—INTERNATIONAL PLATE.

on a strongly built cast front piece and are enclosed with a heavy stamped brass bell-shaped back piece.

The receiver, a cross section of which is shown in Fig. 2, is of the double-pole horseshoe magnet type, and is constructed so the magnets may be readily adjusted towards or from the diaphragm and so it can be conveniently locked or unlocked with a screwdriver at the set screws projecting through the side of the receiver head. The diaphragm is securely clamped to the head by a brass ring. This set ring is constructed with a disk or plate suspended in its center to form a protection to the diaphragm at the hole in the receiver cap. All metal parts of the receiver are strongly built and self-contained, and are completely enclosed in a hard-rubber shell and cap. The cord enters the top of the shell and is fastened inside, leaving no metal parts exposed.

Fig. 3 shows an individual generator call, local battery, toll line telephone. The transmitter arm is provided with a false base on which it is hinged, and is fastened with a lock and key. The induction coil and all its terminals are mounted on the false base, leaving all parts readily accessible for testing when open, and when the arm is closed no screws, terminals or wires are exposed. The arm is hollow, and through it pass the two conductor cords from the transmitter. It is made with a large surface hinge on its base for lowering and raising the arm, and is held in position by a heavy nickel plated brass bolt and nut, of neat design. The magneto box is pro-

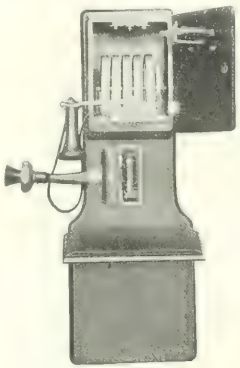


FIG. 3.—TOLL LINE TELEPHONE.

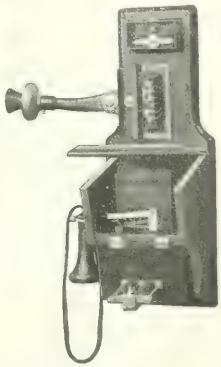


FIG. 4.—CENTRAL ENERGY TELEPHONE.

vided with a false removable bottom, on which are mounted the generator, switch and terminals. The switch is self-contained, with all springs provided with platinum points and with the hook formnig no part of the circuit. The generator crank shaft is constructed with an insulated head, perfectly insulating the crank from the generator. The polarized ringer is provided with an adjustment for the armature and also the bell hammer. The yoke to which the armature is pivoted is permanently held on one side and fastened between two adjustable thumb nuts at the other post so the armature may be readily adjusted. The bell hammer pin is fastened at the armature in a threaded stud, so the pin can be lengthened or shortened to correspond with the thickness of the board on which the ringer is mounted, so the ball may be adjusted to strike the bells properly to give the clearest tone.

The lightning arrester, a carbon disk protector with ground plate and the line terminals, is mounted at the top in the inside of the magneto box. The insulated line wires pass through the top of the magneto box and terminate at the line posts inside. In this telephone, as well as all of the company's wall and desk instruments for both generator call and central energy systems, there are no exposed metal parts that form any part of a circuit at any time. It is said that this feature has never before been so fully carried out.

Fig. 4 shows the regular public exchange central energy wall instrument. The carbon disk lightning arrester and line terminals



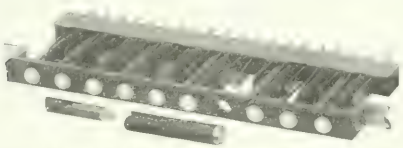
FIG. 5.—DESK TELEPHONE.

are mounted in a neat box at the top, which also serves as a holder for a card of directions and telephone number. The switch, ringer and condenser, are mounted under the shelf. This is so that when the shelf is raised the front with the ringer turns out on a pair of hinges and brings all parts in plain view for convenient inspection and testing.

The desk telephone shown in Fig. 5 is a strongly built instrument. Its pedestal and head is of heavily nickle-plated cast brass, making

it very rigid. The platinum contact switch springs are mounted in a hard rubber head, and with the hook-restoring spring are entirely enclosed. The induction coil and all connections are mounted in the base of the instrument.

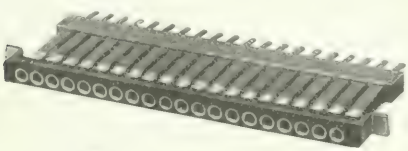
Fig. 6 shows a combined self-restoring drop and spring jack for generator call exchange switchboards. It is so constructed that the coil may be readily removed and replaced from the front of the board, being set into a socket forming a connection the same as a



plug and jack. Burned out coils can thus be removed with greatest facility. The night alarm springs are mounted on the rear of the drop and the circuit is closed when the shutter falls by a pin extending from the restoring latch. The night alarm contacts are provided with a point and plate connection, and form a slight sliding contact, making a good, reliable circuit. The drops are mounted singly from the front of the board in rows of 20.

Fig. 7 shows a bank of 10 lamp signals. The lamps are placed in an opaque tube, thus confining the light to the one signal only. An opalescence (glass) jewel is mounted at the end of the tube. The tube with lamp is inserted into the lamp jack from the front. The lamp jack is provided with a point contact to prevent corroding between the jack spring and lamp, and so the lamp may be easily removed without breaking.

Fig. 8 shows a strip of multiple springs jacks. The multiple jacks



are mounted ¾ inch centers (in strips of 20). The frame piece is of a veneer of a brass bar between two strips of insulating rubber, making the banks of jacks very strong and rigid. The brass bar is extended and forms a shoulder for fastening the banks to the iron switchboard frame. The springs are mounted flat upon a heavy rubber back piece, and are firmly clamped with the heavy rubber insulating bar between the tip and sleeve springs of each jack. The answering jacks for multiple boards and jacks for transfer switchboards are mounted in a similar manner with 10 on a strip.

The ringing and listening key, shown in Fig. 9, is constructed with one set of springs above the other, enabling the use of long springs and leaving the key short and compact. The cam lever is forked with one leg reaching to the first set of springs and arranged that the springs are opened from the front and with the other leg pass-



ing through to the second set of springs, which are so arranged that they are opened from the rear. The springs are of the best quality spring German silver, and are provided with platinum contact. The terminals of the springs are all at one end of the key, so it requires but one key cable in its wiring. The springs are mounted in a rubber block and firmly clamped to always hold them in their proper position. The block is securely fastened to a brass base for mounting

Electric Motor Controlling Devices.

A peculiar and indispensable feature of the art of transmitting power by means of electric motors is the absolute necessity of providing a device which shall constitute the connecting link between the electric motor and the particular machine which this motor is to drive. These connecting links, known as motor-controlling devices, are, as might be expected from the wide use of the electric motor, an important article of manufacture. A large line of such devices is produced by the Cutler-Hammer Manufacturing Company, of Milwaukee, the manufacture of which, indeed, constitutes its entire business. Below we give a brief account of the more interesting of the devices made by this company.

Broadly speaking, every direct-current motor must be provided with a device for gradually admitting current to the motor and thus smoothly accelerating its speed. In order to effectually protect the motor from abnormal currents it is necessary to so arrange the starting device that it will automatically open the motor circuit on failure of the current supply. Such devices are known as automatic motor-starting boxes, and the manufacture of this appliance forms an important part of the business of this company, as may be judged from their statement that during the year just ended approximately 25,000 were produced.

These automatic motor starters range in sizes from ¼ to 50 hp of the sliding contact type, and from 50 to 500 hp using a system of interlocking switches. As indicating the diversity of requirements which arise in motor work, the following list of types is given:

A line of reversible motor starters in capacities from ½ to 30 hp are arranged to start and operate a motor at full speed in either direction, and are adapted for the handling of motor-driven machine tools, etc., where speed regulation is not required. Starters provided with an overload attachment or circuit breaker range in sizes from ¼ to 500 hp. Speed regulators for controlling the speed of motor-driven fans range from ¼ to 50 hp. Motor speed regulators for controlling the speed of motors driving machinery, which necessitate practically a constant torque or turning effort at all speeds, and require the resistance to be constructed acordingly, range in size from ¼ to 50 hp, and the same is the case with speed regulators arranged both to decrease and increase the normal speed of shunt or compound motors, these also being in sizes from ¼ to 50 hp. For automatically operating motors driving bellows for supplying air for blowing church organs, a special regulator is made. For electric elevators there are reversible controllers, operated by a cable passing through the car and ranging from 5 to 50 hp. Also, reversible controllers, operated by a small electric switch in the car and connected by means of a flexible electric cable to a number of solenoid controlled switches, which make the necessary changes in the electrical circuits, these ranging in size from 5 to 150 hp.

Another long line consists of crane controllers with sliding contacts for controlling reversible series-wound motors driving traveling cranes, jib cranes, hoists, swinging bridges, railroad turntables, etc. An important application is for small printing presses, the device being arranged to control the speed by means of armature resistance, or with the addition of shunt field regulation. For newspaper printing presses, the controllers are arranged to give maximum speed by introducing shunt field resistance, and slow printing speeds by introducing armature resistance; very slow speeds are obtained by shunting resistance around the armature terminals, with all control from one handle and means for stopping a press controlled by push buttons. Another line of controllers, with or without push-button control, is necessary for very large newspaper presses utilizing two motors connected together with gearing and a clutch. The small motor is about one-eighth the size of the larger, and drives the larger at about one-twentieth the speed of the smaller to start the press and obtain the slow feeding-in speeds.

A type of reversible drum controllers is especially designed for heavy duty in controlling traveling cranes, rolling mill machinery, etc., as well as a similar smaller reversible type for printing presses. A line of self-starters ranging from 1 to 150 hp is adapted for starting a motor automatically from a distance, and are largely used in connection with motor-driven pumps, air compressors, electric elevators, etc. Finally, there are automatic pressure regulators and float switches for use in connection with self-starting devices controlling the starting and stopping of motor-driven pumps in accordance with variations in pressure or level, respectively.

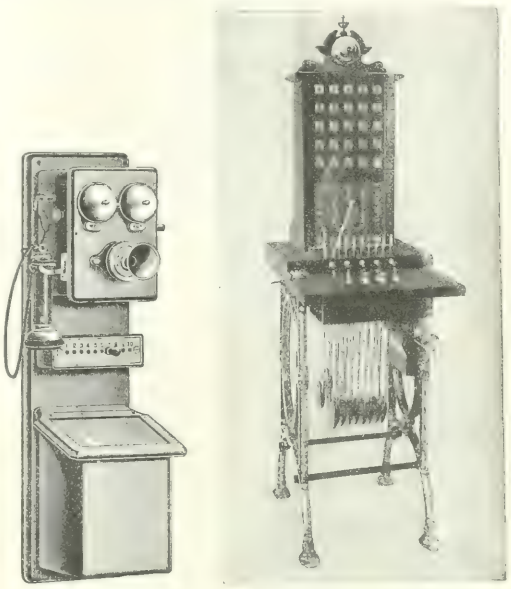
As the result of a thorough system of standardization of the vari-

ous parts which make up a complete controller, the Cutler-Hammer Company is enabled to make different combinations of standardized parts to produce the type of controller suitable for any requirements, thereby largely reducing the cost to the consumer.

Rontgen Ray Apparatus.

The accompanying illustrations show details of a Röntgen ray apparatus manufactured by Elmer G. Willyoung, which has been adopted for use in a large number of hospitals. Fig. 1 shows a hospital and office machine, which is made in sizes from 8 inches to 18 inches, inclusive. These machines are made for either battery or 110-volt circuits, and for direct or alternating currents. The same manufacturer makes a line of portable machines with extra short and very heavy cores. These portables may be run from battery or power circuits, as desired. Fig. 2 shows a Caldwell liquid interrupter, which attracted so much attention when it was invented two or three years ago. This interrupter consists essentially, it may be remembered, of a porcelain cup having a very small hole through the bottom, and a lead electrode within and one without the cup, the whole being immersed in dilute sulphuric acid. With voltages from 40 to 110 the largest coils may be run with this interrupter, the frequencies being 500 to 1000 per second, and the energy of discharge being very large.

In the illustration the curiously shaped jar is of lead, and constitutes one electrode of the combination. The radial flanges are for the purpose of increasing the radiating surface and thus keeping the apparatus cool. The same firm makes the Caldwell stereoscopic fluoroscope by means of which fluoroscopic images are seen in binocular effect. Also, the Cunningham mercury jet interrupter, which interrupter is more perfectly under control and is attracting a great deal of attention. Dr. Cunningham and the manufacturers are arranging this device to run with a synchronous motor, expecting to be able to clip off the tops of similarly directed alternating-current waves, and thus, for the first time, enable an induction coil to be satisfactorily run on such circuit.



FIGS. 1 AND 2.—ROENTGEN APPARATUS.

Factory Telephones.

The accompanying illustrations show details of the intercommunicating telephone system of the Ericsson Telephone Company, 296 Broadway, New York. The Ericsson intercommunicating system is especially adapted for factory use, since it allows instant communication between any two persons without the aid of a third party. This system is particularly applicable where 25 or 30 stations is to be the ultimate capacity of the plant, and where the buildings do not cover too much territory. A metallic circuit switch or plug board is employed, and each station is connected to the several plug boards by twisted pairs of wires. This allows any number of pairs of persons to converse at the same time, and if proper precautions are taken when installing to avoid the effects of dampness, not the slightest interference will be noticed between the different parties. Fig. 1 shows a type of instrument used on a system of this description.

In large systems and also those that cover considerable territory, the central switchboard system is preferable, as the extra size of the cable and large quantity of wire necessary to connect the different telephones would cost a sum equal to the time of an operator for several years. This system is very similar to the one used in small local telephone exchanges, the connections between different parties being made by an operator using an ordinary switchboard. (Fig. 2.)

The central call system is sometimes desirable. This system allows the central station to call the different stations and be called by them in return, but the several stations cannot call or converse with each other. The central calling instrument is equipped with either a lever switch (Fig. 3) or a button key of proper size.

In many factories a bell of special design is placed near each telephone and the several bells are rung simultaneously by a button generally located in the office. By means of signals, the superintendent or manager can be notified to step to the nearest telephone and call up the office, thus saving time and trouble.

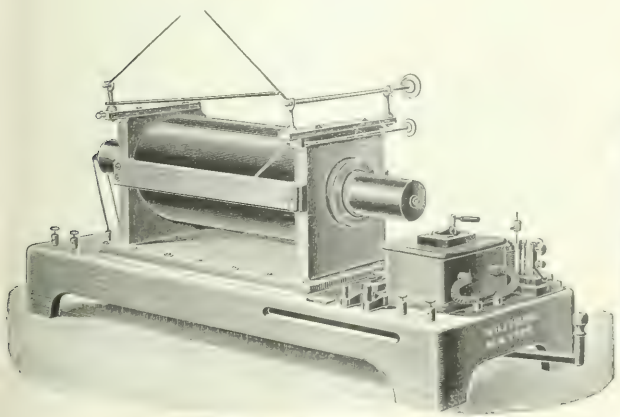


FIG. 1.—HOSPITAL AND OFFICE X-RAY MACHINE.



FIG. 2.—CALDWELL INTERRUPTER.

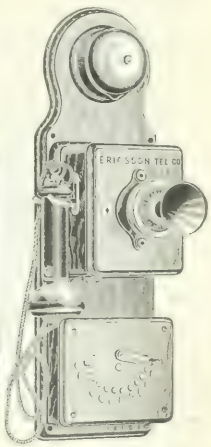


FIG. 3.—FACTORY TELEPHONE.

The Manufacture of Porter Storage Batteries.

The Porter Battery Company, of Chicago, has now put its factory at Waukegan in shape after the fire early in November, which destroyed a part of the building. It will have a more complete equipment than ever for turning out batteries. In this connection it is of interest to note that the Porter Battery Company is devoting all of its energy to the manufacture of automobile storage batteries, the demand for that class of battery being even greater than can be supplied, it is stated, though the output is in the neighborhood of $1,000 worth of batteries per day and 50 men are employed.

In the factory building, which is 260 by 60 ft., all different classes of work are separated into different rooms, so that there is a room for each department and a center hall running through the middle of the factory. The process of manufacture of the Porter batteries is very simple so far as construction of the plates goes. Cast grids of a lead antimony alloy are rapidly filled by hand with red lead moistened with sulphuric acid for the positive plates and litharge similarly moistened for the negative plates. This filling is done by laying the plates on a flat surface and rubbing the grooves full of active material with the aid of a putty knife. After the plates are dry they are assembled with three thicknesses of tar board between each plate and have a temporary cross connecting piece burned on with the aid of a oxy-hydrogen flame. They are then ready to put in the charging tanks. The tar board between the plates is taken out and wide rubber separators put in in its place. The separation between the plates is much greater during formation than after the cells are assembled for actual use. The forming solution has about half the quantity of sulphuric acid used in making a solution of full strength for regular use. The plates are formed at a low charging rate, and are then taken to another room for testing purposes. The defective plates are weeded out. When finally assembled for shipment the temporary cross connecting piece is taken off and a permanent one burned on in its place.

One notable thing in the policy of this company is the contract it makes for the maintenance of its batteries, which seems to be on a conservative and business-like basis. With each set of automobile batteries which it sells it is prepared to make a contract to maintain them for five years for 20 per cent of the first cost per annum. When such a contract is made the company insists on having the battery delivered at its factory or at one of its stations for overhauling and inspection every eight weeks, and, if desired, this maintenance charge will include keeping a battery through the winter. The contract for maintenance does not include damage due to accident to the vehicle nor disregard of instructions on the part of users.

The company now has a New York store, where batteries sold in that city are maintained. It has a station in the city of Chicago at the present writing, but will probably open up a more extensive store and maintenance depot the coming season. The remarkable mileage records made by a Baker vehicle with Porter batteries on one charge of battery last summer in Chicago have been noted in these columns in the past. H. C. Porter, superintendent of the company, is inclined to take the success of these batteries very modestly and gives due credit to the efficiency of the vehicle as well as to the capacity of the batteries per pound. Indeed, he has made many valuable suggestions to builders of vehicles looking toward better efficiency.

Electric Hoists.

The accompanying illustrations show several types of electric hoists made by the C. W. Hunt Company, West New Brighton, N. Y. The three essential parts of these hoists are the rope drum, the gearing and the electric motor. Each of these parts is made in a series of sizes. By a suitable combination of these parts, a hoist of any desired capacity and speed, within the limits of modern practice, may be built.

There are four factors that materially affect the size and cost of the hoist, namely, the load, the speed, the height to which the load is hoisted and the frequency of the trips. These factors affect the size, operation and cost in the following manner:

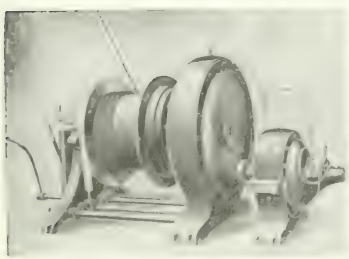
If the load is increased, the size, weight and strength of the mechanism will be increased—that is, a larger size must be used. If the velocity of hoisting is increased, the size and power of the motor will be increased, the other parts remaining the same. If the height to which the load is hoisted is increased, the drum must be increased to hold a longer rope, the motor remaining the same. If the frequency of the trips is increased, the size of the motor will be increased, the other parts remaining the same.

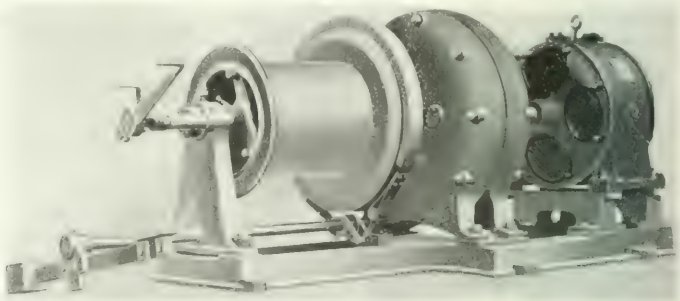
There are three methods of operating electric hoists: 1. Running the motor continuously, hoisting the load by throwing in a friction clutch and lowering by a band brake. This method is suitable either for alternating or direct-current motors. 2. Starting and stopping the motor for each lift, lowering by a band brake. This is better suited for direct current than alternating motors. 3. Running the motor forward to hoist and backward to lower. A direct-current motor with reversing switches is used for this work.

The mechanism of the Hunt hoist is so arranged that any size or make of motor may be used. The motor is connected to the hoist by a flexible coupling.

The great flexibility of electric transmission allows hoists to be installed to advantage in many situations where it is difficult or inexpedient to use steam-driven machinery. One of the great advantages is that the expense for power begins only when the hoist is started, and entirely ceases when the motor is stopped. The friction clutch for use on an electric hoist has far different work from one used for starting shafting, which is thrown in once or twice only each day.

The rope drums used in the Hunt Company's hoist vary in diameter from 12 inches to 60 inches. The drum barrel is sheet steel with cast iron flanges on each end. A suitable fastening is provided to secure the rope and a hole is arranged in the drum, through which the surplus rope is passed and coiled on the interior of the drum.





The necessary slipping of the friction surface generates heat that must be as rapidly dissipated or the friction surfaces would soon be destroyed. This is accomplished in these drums by making the spokes in the form of propeller blades, so that whenever the drum revolves in hoisting or lowering, they force a current of air over the heated surfaces. The part of the friction generating the heat is arranged to lie directly in the path of this current of air. A remarkable difference has been noticed in rapid work between a friction clutch with this cooling device and the ordinary arrangement.

One of the difficulties in applying electricity to hoisting machinery is the necessary reduction from the high rotative speed of the motor

armature to the comparatively slow speed of the winding drum. With these hoists, machine cut spur tooth gears are employed. They are hydraulically pressed on shafts that are ground true on dead centers. The gears are completely enclosed in an oil-tight and dust-proof iron case, which forms a reservoir for a bath of oil in which the gears run. Powerful band brakes are applied to the end of the drum

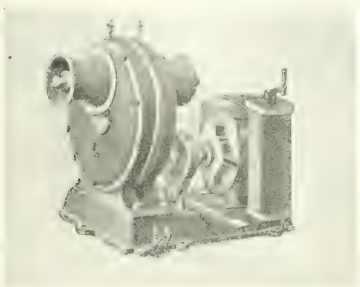


FIG. 3.—DOUBLE-SPOOL ELECTRIC WHARF WINCH.

opposite to the friction clutch so that the heat generated in one may not affect the accurate working of the other.

Improvements in Flashers.

The Reynolds Electric Company, Chicago, announce some very important improvements which they have recently made on their "Original Reyonlds Flasher," which, in reality, is a rotary jack-knife switch, having from three up to any desired number of switches working automatically as one, for giving the flashing or changeable effect to electric signs, flags and electrical displays of all kinds.

These latest improvements consist of a pin running through the spiral spring which raise the blades out of the fork contact, which acts as a guide and prevents the spring from bulging forward or to either side, making it impossible to break, and the blade cannot drop and cause short circuit or burn out. The contact forks are now made of phosphor bronze, shaped so that they are very flexible, and will take up all wear, thus insuring a perfect contact at all times. They are securely fastened to the bar which is bolted to the base, making it impossible for them to get out of alignment or for the blades to stick or the forks to burn out.

The segments are made with a groove in the center, which keeps the blade in exact line with the forks, always insuring an even and positive contact, and they are attached to the rim of the wheel with steel clamps, which prevents them from coming loose.

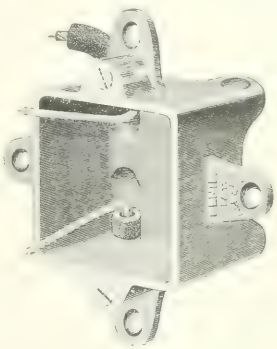
These improvements make this device a most practical, efficient and simple flasher, and should be of special interest to electric sign builders, electrical construction firms and central station people.

Universal Switch Box.

We illustrate herewith a switch box made for use in connection with porcelain knob and tube work. Ever since the introduction of flush switches, iron boxes or pockets for their installation have been furnished by the manufacturer. As the distance between the holes in the attaching ears and also the dimensions generally of the different makes of switches vary considerably, the box of one manufacturer might not fit the switch of any other. Supply houses were thus obliged to carry in stock as many different styles of switch boxes as they had makes of switches. For the same reason it was necessary for the contractor at the time of wiring, to decide on the particular make of switch he proposed to use when the job was finished possibly six months or a year later. The switch box illustrated, as the name implies, is made to take all the different makes of switches of the same style, equally well in the same box; that is, one style fitting all rotary flush switches and another style all push button switches and flush receptacles.

The adjustable feature is accomplished in a very ingenious and simple manner. The switches are attached to the box by means of long screws, the threaded portion of the screw hole being removed a considerable distance back from the front plane of the box. This arrangement allows ample adjustment in all directions and also affords a means of readily leveling the switch plate in case the switch box was not originally set plumb.

The flexible conduit enters the box by means of peculiarly constructed pockets instead of directly into the back or side of the box



SWITCH BOX.

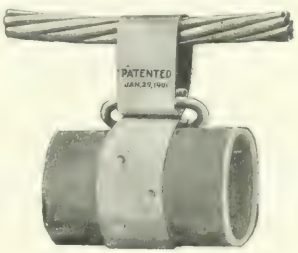
as has been the custom heretofore. This novel method of entering securely holds the flexible conduit, at the same time allowing the boxes to be used in much thinner partitions than would otherwise be possible and also effecting a considerable saving in both labor, conduit and wire. These boxes are being placed on the market by the Renim Specialty Company, Boston, Mass.

Aerial Cable Clip.

For many years a winding of marline was considered a proper method of suspending aerial cables from the supporting strand, but its rapid deterioration and unsightly appearance has created a demand for metallic clips for supporting the cable. We illustrate herewith a recent device of this sort, known as the Metropolitan clip, and manufactured by Yonkers Specialty Company, of Yonkers, N. Y. The clip is simple in construction, consisting of a strip of zinc with a galvanized wire loop at one end and a hook at the other, and can be quickly applied to the cable in the manner shown in the cut. This is usually done by a lineman from a chair, which runs trolly-fashion along the supporting strand, the cable having previously been run out on temporary hangers.

Owing to the dangers of storm and accident to which an aerial cable is subjected, it is essential that the supporting clips be strong, that they should be securely held in place and that they should be durable. These conditions seem to have been well met in the design of the Metropolitan clip.

The standard clip has a tensile strength of about 400 lbs., which should give an ample factor of safety for ordinary sizes of cable.



CABLE CLIP.

The closed loop over the supporting wire is securely locked, and is detached with difficulty. The tendency towards longitudinal displacement which may occur on steep grades or when the cable is run out with the clips permanently in place, is corrected by studs lightly impressed upon the portion of the zinc band encircling the cable.

The manufacturers claim that this clip will last as long as the supporting strand, and it has been adopted by several of the larger telephone companies, and experience has demonstrated their practicability.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 6 per cent; time money, 6 per cent for 30 to 60 days, and 5@5½ for three, four, five and six months. In the stock market dullness and heaviness prevailed early in the week, which, however, gave way towards the end to activity and a better feeling. Amalgamated Copper had a sharp advance on more favorable views of the copper situation. United States Steel stocks closed strong on the expected favorable December quarterly earnings statement. Traction shares exhibited a firmer tone, and closed with slight net advances over the prices of the week previous. Brooklyn Rapid Transit closed at 65¼, being a net advance of ½ point, the sales being 17,830 shares. Metropolitan Street Railway sales aggregated 14,410, the closing price being 162¼, ex-div., a net gain of ⅝ point. Manhattan Elevated made a net gain of 8⅞ points, closing at 137⅞. In the electric list Westinghouse, both common and preferred, made notable gains, the former 19 points and the latter 31¾ points net, the closing prices being 177 and 187, respectively. General Electric closed at 283, a net gain of 2 points; Western Union Telegraph, 91¾, a net gain of ⅛; American District Telegraph, 36½; American Telegraph & Cable, 95, and Commercial Cable, 170, the latter representing a net loss of 10¼ points. Following are the closing quotations of Dec. 30:

NEW YORK.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
Amer. Tel. & Cable	96	96*	General Electric	280	283
American Dist. Tel.	36	36	General Carriage	1	1
Brooklyn Rapid Transit	64	64	Hudson River Tel.	104	104
Com. & Pot. Tele.	68	68	Metropolitan Street Ry.	161	161
Commercial Cable	170	170	N. E. Elec. Veh. Tran.		
Electric Boat	19	19½	N. Y. Elec. Veh. Tran.	12	12
Electric Boat pfd.	40	40	N. Y. & N. J. Tel.	167	167
Empire Steel & Iron			Tel. & Tel. Co. of Am.		
Electric Vehicle	2¼	2¾	Western Union Tel.	92	92
Electric Vehicle pfd.	4	4	West. E. & M. Co.	177	177
			West. E. & M. Co., pfd.	182	182

BOSTON.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
Am. Tel. & Tel.	161½	161½	Mexican Telephone	2	2
Cumberland Telephone	—		New England Telephone	133	
Edison Elec. Illum.	241		Westinghouse Elec.	80	85
Elec. Storage Batt'y			Westinghouse Elec. pfd.	—	90
General Electric					

PHILADELPHIA.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
American Railways	44	44	Penn. Traction	97	97
Electric Storage Battery	61		Philadelphia Electric	4¼	4¼
Elec. Storage Batt'y pfd.	61		Phila. Electric Vehicle		
Elec. Co. of America	6		Phila. Rapid Transit		

CHICAGO.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
Central Union Tel.			National Carbon pfd.	82	82
Chicago Edison	190	190	Northwest Elev.	37	39
Chicago Elec. Ry.	25	25	Union Traction	16½	16½
Chicago Tel.	225	225*	Union Traction pfd.	47	47
Chicago Union Tr.					

WESTINGHOUSE-GENERAL ELECTRIC.—The past week was noted by a remarkable rise in Westinghouse Electric, gains of over 30 points being shown. Inquiry did not develop any particular reason, other than the large amount of profitable business being done. Then came rumors which crystallized into the following in the financial columns: "The rise of 30 points in the price of Westinghouse Electric & Manufacturing Company stock in the last few weeks is said to be due to the fact that the General Electric Company has secured a large block of the Westinghouse stock. It is not thought that any change of control is contemplated. But it is believed that the purchase will assure harmony between the two companies, and that hereafter they will work together in better understanding." With respect to this, however, Mr. Arthur Warren, who is at the head of the publication department of the Westinghouse interests, has given out the following: "So far as I am aware, there is no foundation for the report published this morning to the effect that negotiations are pending for a merging of the interests of the Westinghouse Electric and General Electric companies. Such reports are easily originated and readily believed because the majority of financial people and others interested in industrial matters look upon such an arrangement as almost inevitable. The chief obstacles in the way of such an arrangement are probably the conservative views of those in control of the Westinghouse Company as to the capitalization, management and other details."

DIVIDENDS.—The New York & New Jersey Telephone directors have declared a quarterly dividend of 1½ per cent and an extra dividend of 1 per cent, payable Jan. 15. General Electric Company has declared a regular semi-annual dividend of 3½ per cent on preferred stock, payable Jan. 31. Practically all the preferred stock has been exchanged for common, there being only 98 shares preferred outstanding and less than half a million of the debentures. Rochester Railway has declared a dividend of 1 per cent on its preferred stock, payable Dec. 20. The Central & South American Telegraph directors have declared a regular quarterly dividend of 1½ per cent, payable Jan. 8, to stock of record Dec. 26. The following semi-annual dividends have been declared: Norwich Street Railway Company, 2 per cent, payable Jan. 2; Montville Street Railway Company, 3 per cent, payable Jan. 2; New London Street Railway Company, 2½ per cent, payable Jan. 2.

EVERETT-MOORE TROUBLES.—The financial affairs of the Everett-Moore syndicate, owning or controlling several urban and interurban electric railways, and an extensive system of local and long-distance telephone lines in Ohio and Michigan, with a capitalization of $130,000,000, passed into the control of a committee of seven prominent bankers of Cleveland this week, as the result of the financial embarrassment of the syndicate, which has for some time been affected by the stringency in the money market. It is one of the largest trolley syndicates in the world, and one which is also largely interested in independent telephony. The committee now in charge is composed of Messrs. H. R. Newcomb, Myron T. Herrick, Kaufman Hays, W. G. Mather, J. F. Sullivan, Calvary Morris and E. G. Tillotson, all of whom are connected with leading banks. Acting for the Cleveland creditors—mainly banks which hold syndicate collateral—the committee has already instituted an investigation to determine the condition of the various properties. In the meantime, the Cleveland banks have granted an extension of 18 months to the syndicate, and Messrs. Everett and Moore and their associates will go ahead with their projects, under the direction of the committee, which will act in an advisory capacity.

EL PASO ELECTRIC.—There was filed in the Register's office at Newark, N. J., a deed of trust for $1,000,000 executed by the El Paso Electric Company, a New Jersey corporation, to the State Trust Company, of Boston, Mass. The deed was put on record by James B. Dill, as counsel for the El Paso Company. The deed is given as security for a mortgage of like amount, and is described as covering "underlying securities" of certain corporations subsidiary to the El Paso Company. The latter owns or controls all of the electric lighting and power plants centering in El Paso, Texas, and it is on the stocks of the companies operating these systems that the mortgage is given. That lien is held by the State Trust Company as trustee.

GEORGIA RAILWAY & ELECTRIC.—An application for charter has been filed for the incorporation of an organization to be known as the Georgia Railway and Electric Company, with a capitalization of $3,000,000. The application is for 101 years, and includes a right of franchise in all the streets and roads in Fulton County and Dekalb County on which the present companies are now operating. The charter applied for would also give the right to own and operate electric plants, furnish electric power and steam heat. The applicants are all residents of Atlanta.

MANHATTAN FIGURES.—Lee, Higginson & Co., of Boston, issue a circular on Manhattan, in which they say: Manhattan's income available for dividends in the year ended June 30, 1901, was $2,322,336, or 4.84 per cent on the $48,000,000 capital stock. If the rate of increase in the four months to Oct. 31—$318,000 in gross and $212,000 in net—be maintained during the remaining eight months, the company would earn this year about $950,000 (10 per cent) more gross and $636,000 more net.

HUDSON RIVER ELECTRIC.—A $3,000,000 mortgage on the Hudson River Electric Company to the Morton Trust Company, of New York, has been recorded in the Saratoga County Clerk's office. It is a first mortgage to secure the issue of 3000 5 per cent coupon gold bonds at $1,000 each, covering real estate, franchises, etc.

ELECTRIC VEHICLE.—A deed of trust pledging all the real estate, stocks, patents, etc., of the Electric Vehicle Company to the Morton Trust Company, in consideration of $2,500,000, has been filed at Hartford, Conn.

BELL TELEPHONE BONDS.—It is understood that Messrs. Kidder, Peabody & Co. have purchased $10,000,000 American Telephone & Telegraph 4 per cent bonds, which will probably be issued for public subscription after Jan. 1.

ERIE TELEPHONE.—Minority stockholders of the Erie Telephone Company in Lowell have held a public meeting this week to discuss the rights of Erie stockholders under the reorganization plan, and voted to consent.

RICHMOND & PETERSBURG TROLLEY.—For power houses and equipment the Richmond and Petersburg (Va.) Electric Railway has issued $1,000,000 5 per cent 30-year bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—The mercantile agencies report an extremely satisfactory condition of trade. The retail holiday trade was a record breaker, but there was seasonable quiet in the leading wholesale lines. Iron and steel maintained activity at top prices. Continued complaints of car and motive power shortage and a general hardening of speculative markets for food products are the features of advices of the week. The year closed with a cheerfulness of feeling never exceeded, even in late years, and with sober expectations of a new year as bright as any that have gone before. Railway earnings thus far reported for December show an increase of 4.5 per cent over those of 1900, and 17.6 per cent as compared with those of 1899. *Bradstreet's* says: "The year in iron and steel closes with a burst of activity. Pig iron sales for the week have not been equaled this season. The outlook is for a production of 16,000,000 tons of pig iron, of 30,000,000 tons of ore and of 12,000,000 tons of steel in 1902. In finished products the mills are crowded with business. Some foreign steel is coming in, but most of the German products are going to England at very low prices." A large Mexican rail order has been offered, but may go to Europe, as the domestic makers are unable to undertake any new deliveries for some time to come. The copper market, according to the *Engineering and Mining Journal,* is utterly demoralized and business remained at a standstill. The only reliable information that can be gathered as to values comes from abroad where, it was understood, American electrolytic copper has been sold at the parity of 12 cents. In New York transactions, however, have been few and far between, as consumers prefer to await further developments. Following are the nominal quotations: 12¼ @12¾c. for Lake, 11¾@12¼c. for electrolytic copper in cakes, wirebars and ingots; 11½@12c. in cathodes and casting copper. The business failures for the week, as compiled by *Bradstreet's,* numbered 219, against 262 the week previous and 213 the corresponding week last year. R. G. Dun & Co. compute the liabilities of the concerns failing for four weeks of December at $8,273,341, against $9,649,121 the corresponding period of last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 25: Antwerp—36 pkgs. material, $3,855; 2 pkgs. wire, $90. Argentine Republic—270 pkgs. material, $9,691; 3 pkgs. wire, $162. British Possessions in Africa—3 pkgs. material, $550; 40 pkgs. wire, $705. Brazil—38 pkgs. material, $997. British East Indies—38 pkgs. material, $2,747. British Australia—18 pkgs material, $867; 1000 pkgs. wire, $2,495. Brussels—6 pkgs. material, $874. British West Indies—61 pkgs. material, $2,339; 1 pkg. wire, $18. Budapest—1 pkg. material, $25. British Guiana—29 pkgs. material, $1,603. Berlin—4 pkgs. material, $1,375. Bremen—6 pkgs. material, $295. Central America—25 pkgs. material, $699; 1 pkg. machinery, $129; 2 pkgs. copper goods, $305. Copenhagen—5 pkgs. wire, $25. Chili—20 pkgs. material, $784; 3 pkgs. machinery, $210. Cuba—247 pkgs. material, $5,343; 9 pkgs. wire, $97; 18 pkgs. wire, $285. Dutch West Indies—1 pkg. material, $12. Danish West Indies—3 pkgs. material, $40. Ecuador—1 pkg. material, $128. Frankfort—9 pkgs. wire, $112. Gothenburg—1 pkg. material, $110. Glasgow—28 pkgs. material, $2,783; 7 pkgs. material, $468. Genoa—3 pkgs. material, $200. Havre —1 pkg. material, $15; 1 pkg. machinery, $45. Hayti—3 pkgs. material, $125; 36 pkgs. copper wire, $392. Hamburg—6 pkgs. machinery, $378; 88 pkgs. material, $3,275; 1 pkg. wire, $70. Peru—16 pkgs. material, $291. Hong Hong—1 pkg. material, $242. Halifax (Eng.) —1 pkg. machinery, $95. Japan—23 pkgs. material, $1,494. Leghorn —3 pkgs. material, $350. Liverpool—34 pkgs. material, $1,441. London—169 pkgs. material, $4,681; 151 pkgs. material, $8,696; 1 pkg. wire, $28. Liverpool—13 pkgs. wire, $800. Leicester—2 pkgs. wire, $220. Leeds—20 pkgs. wire, $435. Mexico—183 pkgs. material, $12,615; 6 pkgs. wire, $180; 30 pkgs. machinery, $2,023; 74 pkgs. wire, $1,005; 2 pkgs. wire, $72. Manchester—131 pkgs. machinery, $23,250. Milan—167 pkgs. material, $2,993. Market Harborough—2 pkgs. wire, $278. New Zealand—5 pkgs. wire, $96; 8 pkgs. material, $149. New Castle—11 pkgs. machinery, $1,750. Philippines—11 pkgs. wire, $255. Rotterdam—2 pkgs. material, $200. Southampton—1 pkg. machinery, $45; 4 pkgs. material, $210. Uruguay—2 pkgs. material, $70. U. S. Colombia—4 pkgs. material, $72. Venezuela—22 pkgs. material, $52.

EXPORTS OF MANUFACTURED GOODS for November, 1901, were valued at $30,154,895, as compared with a value of $32,281,487 for November, 1900, a decrease of $2,126,592. As has been the case for every one of the recent months, this decrease is more than accounted for by the decrease in the exports of copper, which was $1,039,400, and of iron and steel, which was $1,932,500, the total of these two items being $2,971,900, or $845,300 more than the net decrease in the exports of the products of manufactures. This difference, in turn, is more than made up by increases of $990,000 in the exports of refined mineral oil, and of $353,090 in the exports of cotton goods. It follows that there were decreases in many other items, of more or less importance. Probably the most significant of these is a net decrease for the month of $189,449 in the exports of agricultural implements. The principal decreases were in the shipments to Great Britain, Germany, Cuba, Australia and Africa. Our exports of agricultural implements increased to Canada and Mexico. Another decrease is $493,941 in exports of electrical appliances. The largest falling off is in the exports of these to Great Britain, which is accounted for by the establishment there of branches of American factories. The lower price of copper is a small factor in the apparent decline in value.

TELEPHONY IN PHILADELPHIA.—The Keystone Telephone Company, the rival of the Bell in Philadelphia, goes into operation with the new year. Its central office is at Second and Sansom streets. While the company's system is by no means complete, it is possible to talk with subscribers in the central section of the city. Complete connections have been made between some of the principal office buildings, notably the Bourse, Drexel and Fidelity, and Broad Street above Arch Street. The work of extending the system, which has been going forward with such haste as to cause not a few citizens to complain because of the torn-up condition of the streets, will be pushed with unabated zeal, so that hundreds of telephones will within a few months be working. The Bell telephone rates have been cut about 20 per cent. Details of the Keystone system were given in our pages last year.

THE CUTTER COMPANY, Nineteenth and Hamilton streets, Philadelphia, and 120 Liberty Street, New York City, on Jan. 1 assumed the entire management of the sales of the Keystone electrical instruments. A number of important changes and improvements have recently been made in this well-known line of instruments, whose users include some of the best engineers in the country. Under the well directed management of the Cutter Company the sales should show a very large increase during the coming year. The manufacture of the Keystone instruments and all electrical and mechanical details will, as heretofore, be under the direct management of Mr. J. Franklin Stevens. Requests for catalogues and literature and quotations should hereafter be forwarded to the Cutter Company.

STILWELL-BIERCE & SMITH-VAILE ORDERS.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, report that they recently shipped to their London agent, Mr. Frederic Nell, one pair of 30-inch cylinder gate Victor turbines on horizontal shaft on steel center discharge end. They are also getting out for him one single 27-inch cylinder gate Victor turbine on vertical shaft, one 12-inch cylinder gate Victor turbine on horizontal shaft and a pair of 27-inch cylinder gate Victor turbines on horizontal shaft. They now have about ready for dispatch a large shipment of Victor high-pressure turbines for the Ouiatchouan Pulp Company, Ouiatchouan, P. Q., Canada. The shipment will include two 1000-hp. one 500-hp and one 100-hp turbines.

BULLOCK-WAGNER FOREIGN TRADE.—On Jan. 1, 1902, the Bullock Electric Manufacturing Company, of Cincinnati, and the Wagner Electric Manufacturing Company, of St. Louis, will establish a foreign sales department with headquarters at Cincinnati. Hereafter all foreign business, except in Mexico and Canada, for the two companies will be handled by this new department, which will be under the management of Frank G. Bolles. The work of the "Advance Department," will continue under the direction of Mr. Bolles, under whose charge it has been for the past three years.

POWER EQUIPMENT FOR WINNIPEG.—Mr. T. L. Cooper, hydraulic engineer, of New York, who has been at Winnipeg, Man., inspecting the water power facilities on the Winnipeg River for Messrs. Mackenzie & Mann, has gone to New York to order a large electric plant by which electric power will be furnished to Winnipeg. The work will be installed next spring at the confluence of the Winnipeg and Whitemouth rivers, and will cost about $50,000.

THE AMERICAN BRIDGE COMPANY, of New York, has taken an order for a bridge across the Ohio River at Marietta, Ohio, made up of two 220 ft. spans, one 1380-ft. cantilever span and a viaduct approach of 645 ft. This structure is for highway and electric railway purposes.

BALL ENGINES.—The Royal Bag Manufacturing Company, of Charleston, S. C., have recently installed an electric plant. The General Electric Company furnish the generator and the Ball Engine Company, Erie, Pa., the engine.

DATA OF INDUSTRIAL COMBINATIONS.—Census statistics on industrial combinations show a total authorized capitalization of $3,607,539,200 for the 183 corporations reported May 31, 1900. The capital stock issued was $3,085,200,868. Of this total the authorized capital includes $270,127,250 in bonds, $1,250,540,900 in preferred stock, and $2,077,871,050 in common stock. The capital stock comprises $216,412,759 in bonds, $1,066,525,963 in preferred stock, and $1,802,262,146 common stock. The total value of all the products of the combinations is $1,661,295,364, and after subtracting the value of the products of the hand trades, or mechanical and neighborhood industries, which amount to $1,216,165,160, the products of the industrial combinations in 1900 is found equivalent to more than 20 per cent of the total gross products of the manufacturing industries of the country as they existed in 1890. The 183 corporations reported employed an average of 399,192 wage earners, receiving $194,534,515 in wages. Employment also was given to 24,585 salaried officials, receiving a total of $32,653,628 in salaries. Miscellaneous expenses of the combinations aggregated $151,851,077, and the total cost of material used was $1,085,083,828. The gross value of products, less the value of material purchased in partly manufactured form, gives the net or true value of products of these combinations as $1,051,981,586. This represents the increase in the value of the raw materials resulting from the various processes of manufacture. Control of 2029 plants that were active during the census year and 174 that were idle during that period were reported. The returns show an average of 11 active plants to each corporation. The statistics exclude all corporations manufacturing and distributing gas and electric light and power, as it is impossible to trace all of the latter, and they do not generally possess the same economic significance. The returns show that the iron and steel industry is at the head of the list, with a gross product of $508,626,482, which is more than double the value of the product of any other group, except food and kindred products, and represents nearly one-third of the total gross value of products of all the industrial combinations.

ELECTRICAL MINING AND SMELTING PLANT FOR MEXICO.—The Descubridora Mining & Smelting Company, of Descubridora, State of Durango, Mexico, which is controlled by American capital, has just let contracts through Albert A. Cary, consulting engineer, 95-97 Liberty Street, for the entire electrical equipment of its mining and smelting plants. The boiler equipment, consisting of two water tube boilers of 150 hp each, is to be manufactured by John L. Gill, of Philadelphia, Pa. The engines will be built by the American Ball Engine Company, whose offices are at 95-97 Liberty Street. These machines are to be non-condensing compound type, 100 lbs. steam pressure, of 200 hp each. The generator, having a capacity of 125 kw, 550 volts, direct connected, will be manufactured by the C & C Electric Company, of Garwood, N. J. Three electric hoisting equipments are to be supplied by the Lidgerwood Manufacturing Company, of Brooklyn. One machine will have a capacity of raising 4000 lbs. 300 ft. per minute, and is to be direct connected to a 50-hp motor to be furnished by the General Electric Company. The other two hoists, each capable of handling 2000 lbs 300 ft. a minute, will be operated by 25-hp G. E. motors. The Knowles branch of the International Pump Company, 120 Liberty Street, is to supply an 8 by 8 vertical triplex pumping equipment, which will be driven by a 25-hp motor of C & C type. The Connellsville (Pa.) Blower Company is to furnish a large blowing outfit for the smelting plant, which will be operated by a 100-hp motor. The storehouse and office building will be installed with 12 enclosed arc lamps. The light will be generated by a 6-kw, 110-volt machine. All above-mentioned equipment is to be shipped by Feb. 1. The plant, it is stated, will be considerably enlarged in the near future.

C & C DOMESTIC ORDERS.—Domestic contracts recently allotted to the C & C people call for a 75-kw generator for switchboard, and an engine to be built by the Ames Iron Works, of Oswego, N. Y., for installation for general power purposes in the Scranton, Pa., shops of the Allis-Chalmers Company. The *Daily News* office, Tacoma, Washington, is to be shipped a complete 30-hp series-parallel equipment to be utilized for driving a quadruple press to be manufactured by R. Hoe & Co. F. C. Patten Company, of Sycamore, Ill., has ordered for general power purposes a 65-kw belted generator and switchboard. The National Meter Company, of Brooklyn, is to be furnished with an 18-kw generator, which is to be direct connected to a Nash gas engine for lighting use. The K. D. Box & Label Company, of Cleveland, Ohio, will be equipped with a 60-kw direct-connected generator switchboard, and with six motors, varying in capacity from 3 to 15 hp for power. Joseph Bancroft & Co., of Wilmington, Del., have called for an 85-kw generator, also for power purposes. [illegible] order for a 60-hp motor has been secured from the Tietzjen & Lang Dry Dock Company, of Hoboken. This motor will be used in con-

VARIOUS C & C FOREIGN CONTRACTS.—The C & C Electric Company, of Garwood, N. J., whose local offices are in the Central Building, 143 Liberty Street, reports receipt of a number of orders for motors, etc., through its British representative, Mr. C. R. Heap, of 47 Victoria Street, Westminster, London, S. W. Two 30-hp slow-speed motors and one slow-speed motor of 5 hp, also 19 motors of from 5 hp to 10 hp have been requisitioned for by R. Waygood & Co., Limited, "lift" engineers, of Falmouth Road, London, S. E. A 60-hp series-parallel equipment has been ordered by Harmsworth Brothers, proprietors of the *London Evening News*. This equipment is intended to be used for driving a Hoe printing press.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, announces recent orders for very large Cross oil filters from the Government Printing Office at Washington, from McIntosh, Seymour & Co., Auburn, N. Y., the engine builders, and from the De Beers Consolidated Mining Company, Limited, of Kimberley, South Africa. It has also received a sixth order from the Calumet & Hecla Mining Company, for Cross oil filters, making 12 of its filters now in use in the different mines. In addition to the extended sale of its goods, which embraces the entire world, the Burt Company finds much satisfaction in a large number of "repeat" orders from the larger concerns.

PRICES OF BRASS GOODS.—During this week the leading brass manufacturers are to meet in New York City to consider the trade situation. Just after the first reduction in the price of copper was announced, a fortnight ago, by the United Metals Selling Company, they held a conference and decided not to reduce the price of their product. They have now reached the conclusion that it would be desirable for trade purposes to make some concessions in the price of brass, and it is expected that at this week's meeting they will make the cut.

TROLLEY WIRE FOR ENGLAND.—The British electrical engineering and contracting firm of Macartney, McElroy & Co., through their local offices, 26 Cortlandt Street, are about to award contracts for 44 miles of No. 00 trolley wire for various British orders, which the company have recently secured. The company will also shortly let contracts on this side for two electric sprinklers, together with equipment and trucks. One sprinkler will have a capacity of 3000 gallons of water, and the other 1800 gallons. They are intended for the Durban electric traction system, South Africa.

THE AMERICAN BRIDGE COMPANY has purchased the properties heretofore owned by the Detroit Bridge & Iron Company, of Detroit, Mich., and the same will hereafter be known as the Detroit Plant of the American Bridge Company. Mr. Max J. L. Fowler has been appointed manager. The plant thus becomes a part of the Western division of the American Bridge Company, under the jurisdiction of Mr. August Ziesing, Western manager.

FOREIGN ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, through its New York manager, Mr. W. P. MacKenzie, 203 Broadway, has just sold a 150-hp return tubular boiler for an electric light plant in Brazil, also a 25-hp tandem compound belted Ideal engine for installation in one of the United States Government repair shops at Manila.

POWER IN IDAHO.—The American Falls Water Power Company has secured a franchise at Pocatello, Idaho, to put in a power and light plant for that locality. They bring their power in from the American Falls, 26 miles away from the city. Work has been already begun on the plant, which will be pushed through as rapidly as possible. Mr. John A. Tupper is resident manager of the enterprise.

SAVANNAH ELECTRIC COMPANY.—The Secretary of State of Georgia has granted a charter to the Savannah Electric Company, capitalized at $3,500,000. The charter consolidates all of the street car lines in Savannah. The incorporators, except G. C. Nagle, of Chicago, Ill., are Savannah men.

DISSOLUTION OF PARTNERSHIP.—The partnership of the Lawton-Beattie Electric Company, of Cincinnati, has been dissolved, Mr. Lawton retiring. Mr. A. C. Beattie has acquired all the assets and assumed all liabilities, and will continue the business under the title The Beattie Electric Company.

HALL SIGNAL IN ENGLAND.—The *Westminster Gazette* says the American railway signal has entered the English field. The paper announces that the Northeastern Railway has contracted with the Hall Signal Company, of New York, to equip its system.

RAILWAY MATERIAL WANTED.—Mr. M. V. Cheesman, of Columbus, Ohio, writes us that in the near future he will be in the market for electric railway construction material.

FERRANTI, LIMITED, is the new name of the former concern of S. Z. de Ferranti, Limited, of Hollinwood, Lancashire, England.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER, DEC. 23, 1901.

UNDERGROUND FOR BIRMINGHAM.—The busy city of Birmingham is going to make an attempt to follow London's example, a local leading firm of solicitors having signified that a London syndicate has empowered them to apply to Parliament for powers to construct a number of underground tubes for that city.

SUNDAY CARS IN SCOTLAND.—The Edinburgh Tramways Company has violated some musty old traditions in the Scottish capital by commencing the regular running of cars on Sunday in the city. It is understood that the number of cars running will not be so large as on week days, but much will depend on the amount of patronage offered by the public. In Glasgow, when the Corporation was taken to task for running Sunday cars, the promise was made that there would be only a modified service. Very soon, however, the service accommodated itself to the desires of the public, who overcrowded the cars, and led to others being put on the various routes. Such undoubtedly will also be the result of the Edinburgh innovation and in the meantime it is interesting to note that the men do not appear to have any objection to the extra day's work as long as they get extra pay.

LONDON DISTRICT RAILWAY.—It was announced some time ago that the whole of this equipment had gone to the British Westinghouse Company, and this is now confirmed, and, as already noted also in your columns, steam turbines will be used instead of engines of the ordinary reciprocating type. As the generators are to be 5000 kilowatt capacity, it will be at once seen that the experiment of using steam turbines will be a most interesting one, no turbines approaching that size having ever been constructed. It is stated that recent tests have proven that steam turbines will compare favorably in economy of steam consumption with the best types of compound condensing engines. The great power-house at Chelsea which will be thus equipped is doubtless intended to supply others of Mr. Yerkes' electric schemes, and it would appear as if London were about to see most important electric developments in railway work. Meantime the Metropolitan Company have issued their specifications for their power-house, and there appears to be a general impression that Ganz & Company, of Budapest, will succeed in carrying off this contract. Though nothing definite has yet been given out, it would appear that the great steam railways who have running powers over the underground lines are already making preparation to equip such of their trains as require to run in the Inner Circle, so that the entering edge of the wedge of electric traction as applied to railway work in England will soon have been inserted with all the important applications as to the future that such a movement involves.

POWER PLANT FOR MANCHESTER.—A large electric railway and lighting plant is now under construction for the city of Manchester. There will be six cross-compound engines of 3000 i. h. p., each direct coupled to three-phase generators at 6500 volts. The engines are by Messrs. Yates & Thom, of Blackburn, and all of the electrical equipment is being supplied by the Electrical Company, of London, which will use the apparatus of the Allgemeine Elektricitäts-Gesellschaft, of Berlin. The engines are supplied with steam at 160 lbs. per square inch. The condensers are worked by continuous current motors, the power for which, and also for the necessary motors required for driving fans, coal carriers, etc., being supplied by three auxiliary generating sets, each of 230-kw capacity. Each of these sets consists of a high-speed Willans engine, direct coupled to a continuous current shunt wound generator, generating current at 230 volts. The excitation of the three-phase generators is taken off the auxiliary plant bus-bars at starting up, and afterward from two motor generators, each of 75-kw capacity, consisting of an induction motor, driving a continuous current generator. Each of these motor generators is capable of supplying the full excitation current for three of the main generators. The main generators themselves are of the revolving field type. The sub-station plant comprises thirty motor-generators each of 250-kw capacity, eighteen of which will be used for traction and twelve for lighting purposes, and further, ten balancers. These motor-generators will be erected at ten sub-stations. The station as above described is already being extended by the addition of two 6000 i. h. p. engines and generators and the sub-stations by forty motor-generators, each of 150-kw capacity. This work is also being carried out by the Electrical Company of London.

General News.

THE TELEPHONE.

MOBILE, ALA.—The citizens of Paint Rock Valley in Alabama are building a co-operative telephone line up the valley from Paint Rock station.

NEW DECATUR, ALA.—The City Council at a special meeting has considered a proposition to put in a telephone system at an established rate of $1 per month for residences and $2 for business houses. F. C. and W. E. Bell, of Chicago, made the proposition.

FORT SMITH, ARK.—Poles are being erected for an extension of the telephone line from Poteau to Cameron. Later on the line will be run to Hackett City and Fort Smith.

SAN FRANCISCO, CALIF.—The independent telephone system which connects the towns of Imperial, Iris, Flowingwell and Calexico, in San Diego County, Calif., has been improved and extended.

SAN FRANCISCO, CALIF.—Mr. W. R. Hewitt, chief of the Department of Electricity of San Francisco, recently prepared estimates on the cost of installing a municipal inter-communicating telephone system in the City Hall.

SAN FRANCISCO, CALIF.—The California Northwestern Railway Company recently installed city and long-distance telephone apparatus for the convenience of the passengers on each of the ferryboats, which ply between its Bay terminal and San Francisco.

OXFORD, CONN.—Clayton C. Sears expects to soon begin the work of rebuilding the telephone line from Southbury to Woodbury.

COLORADO SPRINGS, COLO.—The Colorado Telephone Company has arranged to spend $1,200,000 on improvements next year. It has increased its capital stock from $3,000,000 to $5,000,000. Four new lines will be added between Denver and Leadville.

EAU GALLIE, FLA.—A telephone system has been put in here with five subscribers to begin with.

OLIVER, GA.—The Oliver Telephone Company will soon have finished a new line from Halcyondale. The line will be extended to Hugginsville.

MUSCATINE, IA.—The Wilton Telephone Company has been incorporated; stock, $3,000. J. M. Rider is president.

CEDAR BLUFFS, IA.—The Lisbon Telephone Company will build a line from Cedar Bluffs to Morse next spring.

MASSENA, IA.—An independent telephone company has been organized at this place. D. P. Hogan is interested. George Anstey is president and G. A. Hill secretary.

NORTHBORO, IA.—The Coin & Northboro Telephone Company, capital stock $7,000, has been incorporated by J. P. Young, president; K. J. Herron, secretary, and E. F. Rose, treasurer.

CLINTON, ILL.—The Clinton telephone system is to be modernized and enlarged.

DIXON, ILL.—A farmers' telephone line is being erected between Rock Falls and Tampico.

PEKIN, ILL.—The Citizens' Telephone Company, capital stock $50,000, has been incorporated.

BENTLEY, ILL.—The Hancock County Telephone Company is extending its line into Bentley.

MARTINSVILLE, ILL.—The Martinsville Telephone Company has filed a certificate of dissolution.

PITTSFIELD, ILL.—Pike County Telephone Company has increased its capital from $20,000 to $35,000.

ASTORIA, ILL.—Robert Whitlock has sold the telephone exchange to Cyrus Bucher. Mr. Bucher is interested in the Farmers' Telephone Company.

ABINGDON, ILL.—The Mutual Union Telephone Company has been incorporated with a capital of $2,500. The incorporators are Leonard E. Cutler, William H. Beaver and Nellie A. Cutler.

CARBONDALE, ILL.—The telephone exchanges of this city, Marion, Centerville and Murphysboro, have entered into an agreement with the Central Telephone Company for long distance service. A line will be extended to this city.

CHICAGO, ILL.—An ordinance has been introduced in the Chicago City Council giving the United Telephone & Telegraph Company right to run wires all over the city. This company now only has a franchise in the Hyde Park district.

JERSEYVILLE, ILL.—The Calhoun Telephone Company has secured franchises in Hardin, Hamburg, Brussels and Grafton, and will establish local exchanges at once in the several places. The first line to be constructed will be that between Brussels and Grafton in Jersey County.

JEFFERSONVILLE, IND.—The Cumberland Telephone & Telegraph Company will establish exchanges at New Washington, Utica and Henryville.

ROSSVILLE, IND.—A franchise was granted to the Rossville Home Telephone Company to construct and maintain a telephone line upon the public highways in Carroll County.

PAOLI, IND.—The Orange County Telephone Company has completed its line between this city and Menengo and will further develop the field when suitable weather prevails.

HUNTINGBURG, IND.—The farmers are anxious to have telephone connection and are making arrangements to have the Dubois County Telephone Company extend its lines.

MARTINSVILLE, IND.—The Morgantown Independent Telephone line has been completed to this city and connections can now be had with Nashville and other points in Brown County.

ELKHART, IND.—J. F. B. Kauffman, of Goshen, has bought of L. A. Neff the telephone system at Syracuse, and will reorganize the property under a stock company with a capital stock of $25,000.

LA GRANGE, IND.—The Northern Indiana & Southern Michigan Telephone, Telegraph & Cable Company of La Grange, Ind., will increase its capital stock to $25,000, and will rebuild several of its lines to neighboring towns.

PRINCETON, IND.—The Princeton Telephone Company, capital stock $25,000, has been incorporated by John W. Ewing, Henry J. Krizel, Chas. F. Stevens, L. W. Gudgel, Steele F. Gilmore, Vincent W. S. Trippett and William E. Stilwell.

HENRYVILLE, IND.—This town has only a population of 500, yet it enjoys the distinction of having four independent telephone lines. Recently representatives of the Cumberland Company, of Louisville, were here and secured 22 subscribers for its service.

INDIANAPOLIS, IND.—The annual contract for telephones which the city made last year for the fire and police departments will expire in a few days and the Central Union and New Telephone Companies have been requested to present sealed bids for 1902 service.

INDIANAPOLIS, IND.—The Alamo Telephone Company, of Alamo, capital stock $10,000, and the Princeton Telephone Company, of Princeton, capital stock $25,000, have filed articles of incorporation with the Secretary of State. Exchanges will be established at Alamo and at Princeton.

INDIANAPOLIS, IND.—The New Interstate Telephone Company, of this city, shows a gratifying increase of business for November. The severe weather crippled the lines at places temporarily and put a stop to all construction of new lines, but even with these interruptions December promises well. The year closes with a most gratifying record.

SHELBYVILLE, IND.—The anxiety that has been felt because of the contemplated purchase of the local telephone plant by the Bell Corporation has been wholly dispelled by the purchase of the property by John A. Tindall, David B. Wilson and Daniel Deprez. The company has reorganized, with Mr. Tindall as president, J. C. Deprez secretary and Mr. Wilson as general manager.

MUNCIE, IND.—The City Council has introduced an ordinance to admit a new telephone company. The promoters are W. E. Hitchcock, of this city and Ft. Wayne men, who propose to place the wires underground in the business section of the city and pay to the city 2 per cent. of the gross receipts annually for the term of the franchise, thirty-five years. More than 800 citizens have subscribed for the new service.

INDIANAPOLIS, IND.—There is a contest between Ohio and Indiana to become the banner independent telephone State in the Union. A map recently issued by the United States Telephone Company, of Cleveland, showing the independent development of the two States indicates that the race is a close one. The map forms a striking exhibit of the growth of independent lines in the two States, as no line owned or operated by the Bell Company is shown upon it.

ANGOLA, IND.—The Town Board has refused permission for the Farmer's Telephone Company to extend its line into this city. This concern is generally regarded as the Bell Company in disguise, and Angola business men are objecting. The Steuben County Telephone Company, an independent company, is giving the town and county excellent service. Business houses pay $18 a year and residences $12, with privilege of talking all over the county without toll charges.

DUNKIRK, IND.—The citizens have arranged to put in an independent telephone system in opposition to the Central Union Telephone Company, which has 225 telephones in operation. The new company has sold sufficient stock to put in the plant, and from the business men alone has secured contracts for 150 instruments. W. C. Porter and George Whitigar are the chief promoters and they announce that the work of installation will proceed immediately. With the installation of the Dunkirk plant nearly all the eastern part of the State will be supplied with independent service, and over these systems much of it already has communication with the State Capital.

FRANKFORT, IND.—The telephone question is up again in this city. The present trouble is the result of the Bell Company announcing a coming increase in rates and the fact that the central energy plant (independent) will soon be sold by order of court to satisfy claims. The central energy plant was installed by John H. Murphy and other Indianapolis men. Under the terms of its franchise the maximum rates were fixed at 75 cents per month for resident telephones and $1.50 per month for business instruments. The company erected a fine plant and the people supported it. Then the Bell cut rates to 50 cents per month for residences and $1.25 for business houses. The people generally stayed with the independent company, but the latter's affairs got tangled, a receiver was appointed and the plant is to be sold. Everybody believes that the Bell will buy it. In the meantime the Bell announces a new rate of $1 and $2 per month for residences.

PARIS, KY.—The City Council has granted the Fayette Telephone Company of Lexington a franchise for the purpose of maintaining and operating a telephone exchange in this city.

OWENSBORO, KY.—The Southern Telephone Association, of Nashville, has purchased the plant of the Hancock County Telephone Company (independent), together with the toll lines extending from Waitman to Cloverport, Ky. The Nashville Company is friendly to the Cumberland Company of this city. The sale makes a break in the system of independent toll lines in process of construction between this city and Louisville.

JENNINGS, LA.—Arrangements have been completed for a telephone line to the oil fields by the Cumberland Telephone Company. The companies drilling at the Jennings fields have arranged to make use of the service.

BOSTON, MASS.—The new Bell Telephone Company to be formed to take over the Erie Telephone properties will start off Jan. 1 with 162,500 telephone subscribers distributed as follows: Arkansas and Texas, 48,000; Cleveland, Ohio, 14,500; Minnesota and Dakotas, 24,000; Michigan, 52,000; Wisconsin, 24,000. The estimated gross income for 1902 is placed as high as $6,500,000.

AUGUSTA, ME.—The Dirigo Telephone Company has been granted its petition to enter the city of Augusta.

ALMA, MICH.—The Union Telephone Company, of Alma, has increased its capital stock from $200,000 to $250,000.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, of Grand Rapids, will install an exchange at Belding.

KALAMAZOO, MICH., may have an independent telephone system. J. B. Ware, manager of the People's Telephone Company, Detroit, Mich., and D. L. Berry, of Jackson, have asked for a franchise.

GRAND RAPIDS, MICH.—The Michigan Telephone Company has announced an advance in its rates in Detroit and Grand Rapids. Since the opening of the independent telephone company war, both here and in Detroit, the company's rates have been $12 for residences and $18 and upwards, according to distance, for business houses. The Citizens' Company in this city started out with a rate of $18 for residences and $24 for business houses which is limited by ordinance as the maximum. The Detroit rates for the independent telephones were similarly low. The announcement of the advance made by the Michigan company came as a surprise, and already the company has received a number of orders to take out telephones in this city. All business houses in this city are at present provided with both telephones, but an association of local business men is at present considering the question of abandoning the Erie Company instruments on account of the advance.

DARKSVILLE, MO.—B. W. Wright has purchased J. S. McCormick's interest in the telephone line from here to Huntsville.

PIPESTONE, MINN.—The Southwestern Minnesota Telephone Company has filed amended articles of incorporation fixing its capital stock at $150,000.

BLOOMING PRAIRIE, MINN.—At a recent meeting of the directors of the Steele County Telephone Company it was decided to make extensions, including lines to Waltham, Geneva and Ellendale.

PLAINVIEW, MINN.—The Greenwood Telephone Company, with an authorized capital of $25,000, has been organized to build independent lines connecting Plainview, Weaver, Thellman, Kegan and Beaver.

MINNEAPOLIS, MINN.—It is stated that the owners of the independent telephone lines in Wisconsin, Minnesota and northern Michigan will unite to form a long distance toll line service in the northwest to compete with the Erie system in this section. It is said that the Milwaukee Telephone & Telegraph Company, which is now seeking a franchise in Milwaukee, is a part of the proposed new company. It is also rumored, though denied by President Moulton, that the Twin City and the Rapid Service companies of this city are to be included in the amalgamation. A meeting of the owners of the independent lines will be held in Milwaukee in February.

BUTTE, MONT.—Mr. Hatton, manager of the Rocky Mountain Bell Telephone Company at Butte, is at Deer Lodge for the purpose of installing a new pole line in that city.

KANSAS CITY, MO.—The People's Telephone Company, with a capital of $50,000, all paid up, has been incorporated by Henry Wood, John Enoch, Charles B. Stark and others.

OMAHA, NEB.—An order has been secured from the courts, restraining the Plattsmouth Telephone Company from erecting poles or lines in the city of South Omaha until a franchise is secured.

OMAHA, NEB.—The Camp Dewey Telephone system, of which M. C. Thiesen is proprietor, has been pushing its lines quite extensively of late. The system now reaches all points and connects with the O'Neil Telephone Company on the west, the Interstate Telephone Company on the north, the Western Electric Telephone Company on the East and the Nebraska Telephone Company on the south, and includes 225 miles of toll lines. It has 135 local subscribers in Creighton, Neb. Quite a number of ranchmen's lines are connected, and others are building. Material is on the ground for an electric light plant here. Water power from the Verdigre River will be used for the generation of electric energy.

ATLANTIC CITY, N. J.—The Town Council of Absecom has granted the Interstate Telephone Company permission to erect poles and string wires through the town, conditional upon rights of way being obtained from the property owners upon whose land the poles are to be erected.

HALIFAX, N. S.—An increase in the rates has been announced by the Nova Scotia Telephone Company for the city of Halifax from $25 to $35 per year for residences. The City Council will take the matter up.

ITHACA, N. Y.—A telephone line from South Worcester to Summit and Charlottesville is being built.

ITHACA, N. Y.—Ithaca Telephone Company has been incorporated; capital stock, $75,000. Directors: E. C. Stewart, C. H. Blood and J. T. Newman, of Ithaca.

UTICA, N. Y.—The Utica Home Telephone Company has been incorporated, with a capital stock of $200,000. Directors: Charles Poole, Henry F. Miller, Edgar B. Odell, Edward Bushinger, A. Benjamin Tyler, Herbert C. Sholes and T. Henry Ferris, of Utica.

ALBANY, N. Y.—The Inter-Urban Telephone Company, of Utica, has been incorporated to operate a telephone system connecting New York City, Albany, Rochester, Syracuse, Buffalo, Utica, Binghamton, Ogdensburg and other large cities of the State. The capital is $250,000. The directors, all of whom are residents of Utica, are D. Clinton Murray, John D. Kernan, Frank L. Jones, John J. Town, J. Francis Day, Hugh White and Charles I. Williams.

VICKERY, OHIO.—A new telephone line is being built from Clyde to this village.

CHASE, OHIO.—The Irwin Valley Telephone Company, capital stock $300, has been incorporated.

MT. BETHEL, OHIO.—The People's Telephone Company will erect another new line in this vicinity.

SALEM, OHIO.—The Salem Railway will build a private telephone line from Salem to Washingtonville.

BATAVIA OHIO.—The Citizens' Telephone Company will build a branch exchange at Williamsburg.

SALEM, OHIO.—The Columbiana County Telephone Company will establish an exchange in Calcutta.

FAIRVIEW, OHIO.—The Union Telephone Company has increased its capital stock from $10,000 to $25,000.

HAMILTON, OHIO.—The Central Union Telephone Company is building a new line from Hamilton to Mason.

WEST ELKTON, OHIO.—The Gratis Telephone Company will install an automatic exchange at West Elkton.

FRANKLIN, OHIO.—The Miami Construction Company has made application for a franchise for a telephone line.

ALLIANCE, OHIO.—Farmers of Beaver Township are organizing a company to build a system for their own use.

WAUSEON, OHIO.—The Fayette Telephone Company is planning to build a number of extensions in Fulton County.

WESTON, OHIO.—The local exchange will put in a new 100-drop switchboard, which will accommodate 400 subscribers.

CIRCLEVILLE OHIO.—The Circleville Citizens' Telephone Company is building a toll line to New Holland and Washington C. H.

HUDSON, OHIO.—The Central Union Telephone Company has announced a one-minute service rate between Hudson, Bedford and Cleveland.

MILFORD, OHIO.—The Citizens' Telephone Company will build a toll line to Pleasant Hill, Elenor, Belfast, Boston, Newtonsvile and Goshen.

TROY, OHIO.—The Progress Telephone Company is adding a new switchboard to its exchange at West Milton. About 230 lines are now connected.

NEW LEXINGTON, OHIO.—The Hocking Valley Telephone Company has been granted a franchise for an exchange in this place. Work will start at once.

MENTOR, OHIO.—The annual meeting of the Mentor Telephone Company will be held Jan. 20. New officers will be elected and improvements decided upon.

MASSILLON, OHIO.—The Massillon Telephone Company is building lines to Canal Fulton giving the latter place direct communication with Manchester and Canton.

FAIRVIEW, OHIO.—The Union Telephone Company has increased its capital stock from $10,000 to $25,000. O. V. Wells is president and E. P. Shipley, secretary.

MARYSVILLE, OHIO.—The Marysville Telephone Company is constructing a farmers' line to Pharisburg and Bonnette. A number of subscribers has been secured for the line.

LUCAS, OHIO.—The Monroe Telephone Company has increased its capital stock from $500 to $5,000 to provide for improvements. E. E. Culler is president and J. F. Culler, secretary.

BEREA, OHIO.—The Berea Telephone Company is meeting with good success in building up a farmers' system. The local exchange has 200 connections, Strongville 43 and Columbia 35.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association has its solicitors out for subscribers under the new nickel-in-the-slot machine plan, and it is stated that they are taking many contracts.

EAST LIVERPOOL, OHIO.—The Columbiana County Telephone Company is stringing new wires from East Liverpool to Toronto. Work has been delayed through the inability to secure copper wire.

YOUNGSTOWN, OHIO.—The Beaver Township Independent Telephone Company has appointed a committee to sell stock and secure subscription for a farmers' community system which it proposes to build.

WAPAKONETA, OHIO.—The Auglaize Telephone Company, which connects several towns in the county, will extend its lines to St. Johns, Westminster, West Newton, South Warsaw, Holden, Layton and other towns.

LONE STAR, OHIO.—The Wellston, Mineral & Athens Telephone Company of Lone Star, has been incorporated; capital $2,000. Incorporators: R. M. McMangle, F. M. Wood, L. A. Rasson, B. D. Turner and S. J. Jeffers.

KENTON, OHIO.—The directors of the Kenton Home Telephone Company have authorized improvements in the exchange. There will be a large increase in cable capacity and a new board and new instruments will be installed.

BELLEVUE, OHIO.—The Flatrock Telephone Company has completed a farmers' line from Bellevue to Colby, connecting the exchange with Clyde and other large towns in this vicinity. The company is also building a line to Fireside.

GENEVA, OHIO.—The Madison Telephone Company has been given two weeks in which to remove old wires and poles and improve the service in other ways. The company has announced that it will thoroughly overhaul the Geneva system.

IRONTON, OHIO.—The Central Union Telephone Company has a prosperous exchange here. The company has 600 subscribers in the city, and is preparing to connect up 50 farmers' lines and 60 in the neighboring town of Russell.

MARIETTA, OHIO.—The West Virginia Western Telephone Company has completed the work of laying a cable under the Ohio River, connecting Parkersburg and Marietta, giving Marietta connection with the numerous exchanges in West Virginia.

FINDLAY, OHIO.—The Central Union Telephone Company has opened a general supply house at Findlay. A large amount of work is being done on the Findlay exchange. The company has about 1100 subscribers in the city and 250 on farmers' lines.

MILLERSBURG, OHIO.—The Killbuck Telephone Company, which for six months has been endeavoring to secure a franchise in Millersburg, has taken its case to the Probate Court and secured the desired grant. The town will appeal from the decision.

PAINESVILLE, OHIO.—The Painesville Telephone Company has issued an announcement that there is no truth in the report that rates are to be increased after the first of the year. The rates are: Party line, $12; residence, $10, and business, $24.

CHILLICOTHE, OHIO.—The Chillicothe Home Telephone Company is planning to make extensive additions to its switchboard capacity. The Bell Company at Chillicothe has increased its rates, but the Home Company has announced that it will make no change.

CINCINNATI, OHIO.—The Fayette Home Telephone Company, of Lexington, Ky., has bought a franchise for a line between Maysville and Mt. Sterling which will connect a number of Kentucky towns with the Ohio system of the United States Telephone Company.

NEWARK, OHIO.—At the annual meeting of the Newark Citizens' Telephone Company held Dec. 18, new directors were elected as follows: Edward Kibler, C. H. Spencer, J. K. Hammill, Henry Swisher, W. S. Weiant and J. C. Brennan. Another meeting will be held Jan. 6.

KENT, OHIO.—The Kent Telephone Company is making excellent progress under the management of W. H. Butler. The service has recently been extended to Freedom, Freedom Station and Mantua, and next spring a line will be built to Windham. About 500 subscribers are served.

MT. VERNON, OHIO.—The Mt. Vernon Citizens' Telephone Company recently built a farmers' system in the vicinity of Johnstown. At present there are 106 telephones in the system with 40 subscribers waiting to be connected. Subscribers are given connection with all parts of the county as well as with the main exchange.

WOOSTER, OHIO.—The Central Union Telephone Company has applied to the Wayne County Probate Court to grant it a franchise in Wooster under the ruling of the Supreme Court, which says that the Probate Court may grant a telephone franchise where the company and city officials have been unable to come to terms.

CLEVELAND, OHIO.—The Springfield Home Telephone Company has practically completed its underground system. Construction work will start in the near future on an exchange building and headquarters. The company has secured about 1200 subscriptions thus far, and the exchange will be placed in operation about May 1.

FINDLAY, OHIO.—The Findlay Home Telephone Company is preparing plans for the installation of branch exchanges at Arlington, Rawson, and Arcadia in Hancock County. The company has placed an order for 400 additional pairs of cables for city use. It has 150 subscribers in the northern part of the city, on the waiting list.

CRESTLINE, OHIO.—Considerable improvement has recently been made to the exchange of the Crestline Telephone Company. The exchange has been enlarged, giving a capacity of 400 telephones. The company has at present 200 subscribers, but the number is increasing rapidly. A country line has been constructed six miles east.

MANSFIELD, OHIO.—The new exchange of the Mansfield Telephone Company will be placed in operation within a few days. The exchange has been equipped with switchboards of 2000 lines capacity. The company gives service to 500 subscribers outside of Mansfield. The rates for metallic individual lines are $18 for residences and $30 for business.

MASSILLON, OHIO.—The Massillon Telephone Company is making extensive improvements to its system. A new switchboard has just been installed and another has been ordered. Since Jan. 1 last the company secured over 500 subscribers, and the list at present numbers 850. At the first of the year the company is to be consolidated with the Stark County Telephone Company.

CHAGRIN FALLS, OHIO.—Farmers in Ford and Auburn Townships of Geauga County are organizing the Geauga Farmers' Telephone Company. The company will be managed exclusively by farmers on the co-operative basis and service will be furnished at actual cost. Connection will be made with the lines of the Geauga County Telephone Association making the service in that county the most complete of any county in the State.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association of this city has been made defendant in a suit to test the validity of its franchise. A local attorney, named John Rogers, brings the suit. He claims that the incorporated name of the company was not in existence when permission was given to it by the Common Council to operate. This was March 12, 1873; the charter of the association is dated July 5, 1873, four months later.

CLEVELAND, OHIO.—It is reported that as a result of the purchase by the American Telephone & Telegraph Company of the controlling interest in the Erie Telephone & Telegraph Company, the Cleveland Telephone Company, one of the divisions of the Erie, will be operated in connection with the Central Union Telephone Company. It is said that such a change will result in the introduction of so-called Bell methods and fiercer competition than has been the rule in Cleveland under the present management. Manager Yensen claims to have no knowledge of any proposed changes.

CLEVELAND, OHIO.—The Cincinnati Bell Company is just announcing the system of telephone toll charges which the Cleveland Bell Company is endeavoring to abandon as undesirable and unprofitable. On Jan. 1 the City & Suburban Telegraph Company of Cincinnati will furnish nickel in the slot machines to residences at the rate of $18 per year; at least one call per day is required. Business houses are required to have at least two calls per day at five cents each. This is for four party lines. The company will also furnish two party lines requiring at least four calls per day and individual lines requiring five calls per day.

CINCINNATI, OHIO.—Judge Ferris has decided that a franchise granted by a city can not be transferred without the city's consent, accordingly he set aside the court entry transferring from Philip Fitzsimmons to the Fitzsimmons Telephone Company, the famous Fitzsimmons telephone franchise. The court intimated that under the recent Zanesville franchise decision by the Supreme Court, a city has no right to grant a franchise to an individual. On this ground the city will probably bring suit to test the validity of the Fitzsimmons franchise, which is for an independent system in Cincinnati. Prominent capitalists are endeavoring to use the franchise to build a new system, but the decision will probably disarrange their plans.

CLEVELAND, OHIO.—The Springfield Home Telephone Company and the Xenia Citizens' Telephone Company have been consolidated as the Springfield-Xenia Telephone Company. The combined capital stock is $500,000, and officers are as follows: N. I. Dreyfoos, Cleveland, president; S. W. McGrew, Springfield, vice-president; M. Shoup, Xenia, second vice-president; L. M. Blatt, Cleveland, secretary; L. M. Wolfe, Cleveland, treasurer. The above, with C. D. Juvenal, Upper Sandusky; P. E. Montanus, Springfield; John B. McGrew, Springfield; C. W. Collister, Cleveland, and E. E. McGarvey, Xenia, constitute the board of directors. The company has exchanges in operation in Jamestown, Xenia, and Yellow Springs, and is building a large exchange at Springfield, which will be the headquarters of the company.

BATAVIA, OHIO.—A combination will be formed by the Batavia Telephone Company, the Citizens' Telephone Company and the Franklin Construction Company, to compete with the City & Suburban Telegraph Association. The company will be called the Citizens' Telephone Company, and will have headquarters at Batavia. New officers are as follows: B. W. Gilfillan, president; J. W. Ransom, vice-president; W. H. Baum, secretary-treasurer. The Batavia exchange was opened Jan. 1, 1901, with a list of about 40 subscribers. This exchange has made very satisfactory growth, as have the exchanges at Milford, Loveland and New Richmond, which were opened later. At present there are over 400 subscribers connected up, with toll stations at 36 places in this section. The

farmers are asking for connection faster than they can be taken care of, and it is predicted that 1000 telephones will be installed in the county in due course of time.

WOODWARD, OKLA.—The Home Enterprise Telephone Company has been incorporated, with a capital stock of $10,000 by C. R. Alexander, E. S. Wiggins, Geo. H. Brophy and others.

HARRISBURG, PA.—The Common Council of the Borough of Montrose has granted a franchise to the People's Union Telephone Company to set poles etc., through the streets of the borough. The line will extend from Forest Lake to Montrose, thence to Franklin Forks.

QUEBEC, QUE.—The St. Lawrence Telephone Company has been organized at St. Francois du Lac, in the province of Quebec, with a capital of $15,000. J. Allard, M. P. P., is interested.

WOODRUFF, S. C.—The Bell Telephone Company in building its long-distance line between Spartanburg and Columbia, S. C., will put in an office at Woodruff.

BEAUFORT, S. C.—R. A. Long has completed arrangements for a new telephone system. The Sumpter Telephone Manufacturing Company, it is stated, has been given the contract for the necessary equipment. The Bell Company is already maintaining an exchange.

ANDERSON, S. C.—The Consolidated Telephone Company, of Columbia, S. C., has had recorded a charter preparatory to beginning business. The company has headquarters in Columbia and the capital stock is $500,000. The reason for recording this charter is said to be the company's purpose to build a long-distance line from Greenville, S. C., to Anderson and from Anderson to Columbia.

ABERDEEN, S. D.—The Dakota Central Telephone Company is extending its lines to Fort Yates. A line is also being constructed between Doland and Huron.

HEMPSTEAD, TEX.—The Commercial Telephone Company is building a line from Houston to this place.

ABILENE, TEX.—The Texas Telephone Company has increased its capital stock from $6,000 to $12,000.

McMINNVILLE, TENN.—The Citizens' Telephone Company has elected officers. W. S. Lively is general manager. The company has called for bids on poles. Over 100 citizens are pledged to use only this system.

NASHVILLE, TENN.—The Cumberland Telegraph & Telephone Company will make a number of improvements during the coming year and an increase in capital has been authorized. The new issue will be 25 per cent of the present capital, making a total of nearly $2,000,000.

NASHVILLE, TENN.—Parties representing the Tennessee Telephone & Telegraph Company have met a special committee of the City Council. Assurance was given that money was in readiness for building the plant. Also that if the contract desired by the president of the Nashville Telephone Company was legal, that the Tennessee Telephone Company would pay $150,000 for said contract. The meeting adjourned subject to the call of the president.

SALT LAKE CITY, UTAH.—A local telephone exchange is being put in at Miles City, Calif. S. M. Farmer will be the proprietor.

SALT LAKE CITY, UTAH.—H. D. Maiz and a party of Chicago capitalists have formed a company to purchase the Harrison Telephone Company, whose lines run through the Black Hills, in South Dakota. The new company will erect its own building in Deadwood and a $15,000 switchboard.

SALT LAKE CITY, UTAH.—The Bell Telephone Company has completed its line into Billings, Mont., and Douglass, Wyo., and exchanges are being installed at Douglass, Casper, St. Anthony and Rexbury. The company is also arranging to string a line from Montpelier to Afton in Star Valley. The company is closing up a very prosperous year, with a fine outlook for the coming year.

HAMPTON, VA.—The reported offer to sell on the part of the Hampton Telephone Company to the Bell Company is denied by H. H. Carr, the largest stockholder in the Hampton Company. A fight has been on in Hampton since the Bell Company applied for a franchise, but the Ordinance Committee has decided to recommend to the Town Council that a franchise shall not be granted either to the Bell Company or the Phœbus Company, another applicant.

ST. ALBANS, VT.—At a meeting of the stockholders of the Franklin County Telephone Company the following named officers were elected for the ensuing year: President, J. H. Abbott; vice-president, S. W. Flinn; secretary and treasurer, M. P. Abbott; auditor, V. P. Abbott; directors, J. H. Abbott, A. H. Abbott, M. P. Abbott and H. G. Morton. A dividend of 10 per cent was declared. It was also voted to increase the capital stock from $20,000 to $30,000. Mr. M. P. Abbott was reappointed manager of the company. The Franklin Company began business almost two years ago with 150 subscribers; it now has 450, and its business is constantly increasing. It uses the common battery system with lamp signal switchboard and Couch & Seeley apparatus.

SEATTLE, WASH.—The Sunset Telephone Company has taken out a permit for the construction of a three-story addition to its present building on Third Avenue. The addition will cost about $14,000.

SUN PRAIRIE, WIS.—The Dane County Telephone Company has put in a telephone exchange at Waunakee.

STEVENS POINT, WIS.—The Stevens Point Telephone Company will soon put in an exchange. The company will start with 300 subscribers.

MADISON, WIS.—The Farmers' Telephone Construction Company, of Milwaukee, Wis., has reduced its capital stock from $500,000 to $250,000.

OSHKOSH, WIS.—A. W. Bryant, electrical engineer and promoter of independent telephone companies of Oshkosh, has formed a stock company known as the Lake Superior Telephone Company, with $500,000 capital. A system will be built in Ashland, Washburn and Bayfield, Wis., and Iron Mountain and Bessemer, Mich., with toll lines connecting all the above-mentioned cities. Work will begin immediately.

ELECTRIC LIGHT AND POWER.

PRESCOTT, ARIZ.—The Arizona-Utah Light, Power & Canal Company has been incorporated, with a capital of $1,500,000. The officers are: J. F. Welsen, president; H. J. Allen, vice-president; Homer K. Wood, secretary and treasurer; E. M. Gage, J. J. Fisher, J. A. C. Freund and Thomas B. Davis, directors.

VANCOUVER, B. C.—The Vancouver Power Company, of Vancouver, has concluded arrangements with the civic authorities of New Westminster, whereby work may be commenced on the development of the power at Coquitlam Lake.

SOUTH NORWALK, CONN.—The municipal lighting plant reports a clear gross profit of $7,496. It is under the efficient management of Mr. A. E. Winchester. More business offers than the plant can carry and extensions may soon be in order. The city has 120 arcs, and there are 181 commercial customers for light and 33 for power. The plant also has attached to it the fire alarm system.

ORLANDO, FLA.—The new electric light plant has been satisfactorily tested.

LEWISTON, IDAHO.—Mr. Vinson, proprietor of the Walla Walla Marble Works at this place, is organizing a granite works with a capital of $100,000. The carving, polishing and other special machinery will be driven by electric power.

BOISE, IDAHO.—The stockholders of the local electric light company at Boise have given an option on their stock to the Boise-Payette River Electric Power Company. The terms of the sale have not been made public, but it is understood that the amount involved is close to $150,000. The capitalization of the company is $50,000. The Payette Company is establishing a power plant on the Payette River, below Horse Shoe Bend, to furnish power for all purposes, including the mines at Pearl.

POCATELLO, IDAHO.—The American Falls Water Power Company has just secured a forty-year franchise to furnish light and power for the city of Pocatello. The power now comes from Port Neux Creek, which is getting less and less each year as the water is appropriated for irrigating purposes, and it is only a question of time when the city would be without light. The company will put in a 1500-hp plant and will go right to work to secure the business of the Oregon Short Line shops. The company has 10,000 horse-power at American Falls for sale. The company has a capital of $300,000 and was organized last June.

MOUNT STERLING, ILL.—The city has been in semi-darkness for some six weeks, owing to a disagreement between the City Council and the electric light company.

MOUNT VERNON, ILL.—In the Circuit Court the City of Mount Vernon confessed indebtedness to the Mount Vernon Electric Light Company, and judgment in favor of the latter was rendered in the sum of $1,847.98.

RUSHVILLE, ILL.—The electric light plant has been hauling water for fifteen weeks from an old coal mine. This supply having been exhausted, the company notified the City Council that it would discontinue the lights on the streets.

RICHMOND, IND., will try the experiment of municipal electric lighting, and now has under construction a $150,000 plant.

COLON, MICH.—Work has been commenced upon two dams to be built across the St. Joseph River near this place by the Michigan Hydraulic & Electric Company. Eastern capital is backing the company, which will invest $250,000 in a plant to light Colon and surrounding towns and villages. R. Van Schoick, of Albany, N. Y.; Dr. Stewart, of Coldwater, Mich., and Fred. Schurtz and D. L. Akey, of Colon, promoted the scheme and are interested in the company. The Coldwater-Battle Creek interurban line will probably be supplied with power from this plant.

GRAND RAPIDS, MICH.—The new long-distance transmission plant of the Thornapple Electric Company, twenty miles from this city on the Thornapple River, commenced operations a couple of weeks ago and is supplying current for lighting purposes to Hastings and Middleville. A head of eighteen feet of water is available at Labarge. The dam is 160 feet wide and eighteen feet high at the centre. The wheel-pit is equipped with two 45-inch turbines, each capable of developing 300 horse-power. In the power station are two 220-kw, multipolar, 2500-volt generators. Nashville, the farthest point to be supplied, is 25 miles away.

GRAND RAPIDS, MICH.—It is announced that the Newaygo Portland Cement Company, of Newaygo, Mich, has purchased the plant and interests of the Peninsular Light, Heat & Power Company at Lowell, whose plant furnishes a large share of the electricity used for local lighting purposes. The plant was a part of the estate of Fred. Church, of Lowell, and the matter of settling the estate has been in the hands of the Michigan Trust Company, of which L. H. Withey, one of the principal stockholders and the president of the Peninsular Company, is president. As nearly as can be learned the plan of the Newaygo Company is to erect a new dam in Flat River near Lowell to increase the amount of power developed from 300 to 1200 horse-power. The Newaygo Company proposes to erect a new dam in the Muskegon River at Croton, where it is believed 15,000 horse-power may easily be developed at little expense.

GLOSTER, MISS.—Proposals for erecting a waterworks and lighting system will be received until Jan. 7, 1902, all bids to be accompanied with solvent bonds to the amount of $15,000.

MARSHALL, MO.—The citizens at a special election voted to bond the city for $70,000 for the purpose of erecting municipal water and electric light plants.

ST. LOUIS, MO.—It is again reported that the Citizens' Electric Light & Power Company has been purchased by the North American Trust Company of New York, and that the deal is part of the plan of the trust company to consolidate the electric light and power companies of this city. The North American is the company which purchased the Imperial Electric Light, Heat & Power Company.

NEWBERN, N. C.—At a second election matters have been reversed and $15,000 electric light bonds voted.

ROCKINGHAM, N. C.—The new electric lighting system of Rockingham has just been started up.

CHARLOTTE, N. C.—The Carolina Electric Company of Maxton, N. C., has been chartered to furnished light, power and heat. The capital stock is $50,000. W. S. McNair and others are the stockholders.

ALBANY, N. Y.—The Hudson Valley Light & Power Company has been incorporated; capital, $25,000. Incorporators: Harry M. Shon, Henry G. Willis, Peter C. Ackerman, Robert E. Farley, Curtis J. Harrington, Edward E. Shan and Francis F. Barrett.

RAVENSWOOD, OHIO.—This place is now lighted electrically. The new plant has a capacity of 21 arc and 800 incandescents.

CANTON, OHIO.—The Central Heat & Power Company has presented an ordinance for a franchise for a lighting and steam heating plant.

EAST CLEVELAND, OHIO.—The village authorities are discussing the erection of a municipal lighting plant and a committee has been appointed to secure estimates.

UPPER SANDUSKY, OHIO.—J. W. and J. M. Barber, of Columbus, have been granted a franchise in Upper Sandusky for an electric lighting and steam heating plant. They will commence at once on a plant to cost $100,000.

WELLSVILLE, OHIO.—The City Council is dissatisfied with the service furnished by the local lighting company and a motion has been carried empowering the city solicitor to go to court and seek the annulment of the company's franchise.

BROCKVILLE, ONT.—The light commissioners of the city of Brockville have decided to submit a by-law to the ratepayers to raise the sum of $25,000 for improvements to the lighting plant of the city.

OTTAWA, ONT.—Mr. John Knox, of Stayner, Ont., proposes to utilize the Nottawasaga River for the development of electric power. An electrical expert will look over the ground with a view of preparing plans.

MONTREAL, QUE.—It is estimated that the total cost of laying conduits in the city of Montreal, Que., for the use of the various electrical concerns doing business in the city, will be upwards of $7,500,000.

MONTREAL, QUE.—The Royal Electric Company has signed the lighting contract with the city of Montreal, under which, after Jan. 1, 1903, the company will get a five-year extension of its present contract with the city at the price of $60 per arc lamp, instead of $120 per lamp under the old contract.

SALT LAKE CITY, UTAH.—A. B. Frame, of Baker City, Ore., representing Eastern capital, has asked to be given a franchise to install and operate an electric light plant at that place.

HYRUM, UTAH.—The articles of incorporation of the Union Electric Light & Power Company, of Hyrum, have been filed. F. J. Wright, president; J. Howell, vice-president; M. Wright, G. F. Wright, secretary and treasurer; W. C. Parkinson, E. R. Owen, T. A. Kerr.

PROVO, UTAH.—A communication was received from the local electric light company of Provo, offering to furnish electric lights to Dec. 31, 1902, for 50 cents per month for each light, and $25 per month for the renewing and replacing of lamps. The offer was accepted.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company during November expended nearly $10,000 in improving its plant, aside from cost of maintenance and labor. These improvements included new transformers, arc lamps, meters, etc. The company is in readiness to expend a large amount of money in further developments when the time arrives.

LA CROSSE, WIS.—The transfers in the consolidation of the La Crosse Gas Company, the La Crosse Brush Electric Light Company and the La Crosse Edison Light & Power Company. The name of the consolidated concern is that of the La Crosse Gas & Electric Company, and the officers are: President, W. W. Cargill; vice-president and general manager, George McMillan; treasurer, W. S. Cargill; secretary, James B. Taylor.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—Application has been made for a street railway franchise in this city by George S. Leatherburg, Jr., and associates.

MOBILE, ALA.—The City Attorney has been instructed to determine what the city's rights are to annul one of the franchises of the Mobile Street Railway Company on the grounds of non-compliance.

CHICAGO, ILL.—The item in a recent issue with reference to the destruction by fire of 200 trolley cars and the barn of the Chicago Union Traction Company was erroneous in one particular. From later reports it appears that they were not trolley cars, but cable cars. The loss is estimated at $165,000, covered by insurance. This is one of the most important cable lines in the city.

WARSAW, IND.—A $25,000 subsidy has been voted to the Logansport, Rochester & Northern Electric Traction Company, which is to build a line from Logansport to Kendallville.

INDIANAPOLIS, IND.—The Fort Wayne Northern Traction Company and the Fort Wayne Southern Traction Company, each capitalized at $25,000, have been incorporated by W. B. McKinley, of Champaign, Ill.; H. E. Davidson, John R. McCulloch, P. R. Stephens and R. S. Nelson, of Ft. Wayne.

RICHMOND, IND.—Another electric line is promoted to make this city its western terminus. For the purpose the Richmond & Greenville Electric Railway Company has been organized. The road is said to be backed by the Henry Clews Banking Company, of New York. It is the purpose of the company to build in both directions from Greenville.

LOUISVIILE, KY.—T. C. H. Vance has asked the City Council to grant a street railway franchise on all unoccupied streets.

HOLLAND, MICH.—The town board of Holland Township has granted the Grand Rapids, Holland & Lake Michigan Railway Company a franchise to furnish energy for lighting in the township. The township of Laketown adjoining has granted a similar franchise. This gives the company the right to do a lighting business in the various summer resorts on the lake branch of the Holland line. A plant will be erected at Virginia Park and will be in operation next spring.

GRAND RAPIDS, MICH.—If lines now being actively promoted and soundly backed to all appearances are completed, there will be a continuous interurban line around the base of Lake Michigan, from Grand Rapids to Chicago. It will be by way of St. Joseph, South Bend and Michigan City. The Grand Rapids, Kalamazoo & St. Joseph Traction Company is rapidly securing the necessary options for the extension of its lines from Holland to St. Joseph. The Indiana Railway Company has already begun the construction of a road between St. Joseph and South Bend, and this line is expected to be completed during the next summer. The Chicago & Indiana Air Line will make the last link in the chain of roads. Eastern capitalists have this road in mind, and it is projected by way of Hammond and Michigan City, between South Bend and Chicago. The Grand Rapids, Grand Haven & Muskegon road, which will be in operation within sixty days, would make still another link in the chain of electric roads from Chicago to the most important lakeport on this side of the lake.

ALBANY, N. Y.—The Albion Electric Railway has been incorporated; capital, $30,000.

ASHTABULA, OHIO.—The directors of the Pennsylvania & Ohio Railway have decided to make the proposed extension to Jefferson.

OTTAWA, OHIO.—The Ottawa Council has granted a franchise through town to the Toledo & Lima Traction Company.

SEBRING, OHIO.—The Stark Electric Railway which is building between Canton and Alliance, has applied for a franchise in Sebring.

NORWOOD, OHIO.—The Cincinnati & Columbus Traction Company has asked the Council for a franchise for a double track line through the town.

NEW WASHINGTON, OHIO.—The Village Council has granted a 25-year franchise to the Buckeye Traction Company, to operate over a route established some months ago.

CANTON, OHIO.—General Manager Currie, of the Northern Ohio Traction Company, is planning to make extensive improvements to the Canton-Massillon Railway, which has recently been acquired.

GREENSPRING, OHIO.—The Village Council has granted a franchise to J. C. Parker for the Sandusky, Clyde, Tiffin & Southern Railway. The Clyde Council will grant a franchise at the next meeting.

CLEVELAND, OHIO.—The attorneys of the Everett-Moore syndicate are preparing plans for the consolidation of the Cleveland & Eastern, the Cleveland & Chagrin Falls and the Chagrin Falls & Eastern Railways.

YOUNGSTOWN, OHIO.—A new syndicate, said to be composed of New York and Chicago capitalists, has taken up the proposition for a line from Youngstown to East Liverpool, and is securing right of way.

ADDISON, OHIO.—Citizens of Addison want the Dayton, Springfield & Urbana to build a branch line from Springfield to Piqua through Addison. A committee has been appointed and rights of way for the line are being secured.

CLEVELAND, OHIO.—The Cleveland City Railway Company will increase its capital stock $1,000,000. The annual and a special meeting of the stockholders will be held Jan. 20, for the purpose of electing a board of directors; also of voting on a proposition to increase the capital stock from $8,000,000 to $9,000,000.

YOUNGSTOWN, OHIO.—The coke and coal situation which confronts manufacturers in this section is becoming more serious every day. Several times within the past ten days the Mahoning Valley Railway has been forced to resort to burning old ties, and it is feared that it may yet be necessary to shut down the power-house.

DAYTON, OHIO.—The Dayton & Lebanon Railway has filed a mortgage for $2,000,000 in favor of the Cincinnati Trust Company. The company proposes to utilize the old Dayton, Lebanon & Cincinnati Railway for electric and steam propulsion, and an extension may be built from Lebanon to Cincinnati. The road is controlled by A. E. Appleyard, of Boston, who also controls the lines between Dayton and Columbus.

POMEROY, OHIO.—The Ohio River Electric Railway & Power Company has purchased the entire plant and equipment of the Pomeroy & Middleport Electric Company. It will be moved to the power-house of the purchasing company and new machinery added. The new company will at once arrange for the development of commercial and private lighting, and contemplates extending the service to Minersville, Syracuse and Racine.

CINCINNATI, OHIO.—The immense power-house of the Cincinnati & Eastern Traction Company, near California, is nearly completed and the equipment is being installed. The station will furnish current for three interurban lines now under construction by Cincinnati interests, which are largely identical. They are the Cincinnati & Eastern to Richmond, the Suburban Traction Company to Bethel and the Rapid Railway Company ,to Lebanon. The Richmond and Bethel lines will be placed in operation about May 1 and the Lebanon line about Sept. 1.

CLEVELAND, OHIO.—The recently organized Central Ohio Traction Company has closed a deal for the purchase of the property of the Electric Railway & Power Company of Tiffin and the right of way and property of the Toledo, Tiffin & Sandusky Railway. The properties will be merged and the new company will have a capital stock of $600,000. The Tiffin-Fremont line will be completed at once, and it is probable that the Sandusky extension may be built. The new company is headed by James B. McDonnell, of Fostoria, Ohio, and R. S. Vivian, of Chicago.

CLEVELAND, OHIO.—The first car was run through from Cleveland to Detroit over the Everett-Moore system Monday, Dec. 23. The special car "Alpha" left Cleveland at 9:30, having on board E. W. Moore, Barney Mahler, Ira McCormack and other officials of the road, with representatives of several

Eastern bond houses. The party reached Toledo at 4 o'clock, and Detroit in the evening. Mr. Mahler stated that the actual running time from Cleveland to Toledo was 5½ hours, which he considered very creditable in view of the fact that for 32 miles the car was obliged to go very slow, the bonding not having been completed. It was the first car to cross the Vermillion bridge; rails being laid temporarily for the occasion. Regular service will be instituted in a few days between Toledo and Detroit and Cleveland and Toledo.

OKLAHOMA CITY, OKLA.—A franchise for a street railway has been granted to Herold R. Perry, Edmond Harrison, of New York, and A. H. Craney, of St. Louis.

TORONTO, ONT.—Application is to be made to the Ontario Legislature for the incorporation of the Toronto & Hamilton Electric Railway Company.

THE AUTOMOBILE.

THE ST. LOUIS TRANSFER COMPANY, St. Louis, Mo., may substitute automobiles for its drayage wagons and horses. The automobiles that would be required by the company would cost about $1,500 and nearly $400,000 would be invested in them.

A TOY AUTOMOBILE.—George Jay Gould, Jr., nine years old, received from his mother a handsome Christmas present in the shape of a costly toy automobile. The tiny vehicle weighs 200 pounds. It is four feet long and its height from the ground to the seat is two feet. The body is three feet three inches by one foot seven inches. The wheels have pneumatic tires, twenty inches rear and sixteen inches front, with wire spokes. The tires are one and a half inches in diameter. The motive power is electric, obtained from cells weighing 100 lbs. On the right hand is a lever for three speeds, and in front a steering lever. The vehicle will travel from five to seven miles an hour and run twenty miles without recharging. The body is painted black, with the seat raised, double lazy-back, and hood behind in red. The wheels are red, with narrow black stripes. The seat is upholstered in maroon leather.

PERSONAL.

MR. JOSEPH B. CROCKETT has resigned the presidency of the San Francisco Gas & Electric Company.

MR. M. A. BEAL, secretary of the Rockford Edison Company, of Rockford, Ill., gave a banquet to the employes of the company the evening of Dec. 27, 1901.

MR. W. A. ROSENBAUM announces that he has now moved his offices for patent soliciting to the Nassau-Beekman Building, 140 Nassau Street, New York City.

MR. ROBERT DARLING, general manager of the United States Battery Company, has been elected vice-president of that concern, but will continue to hold his former office.

MR. ARTHUR WARREN, who has been so successful a representative of the Westinghouse interests in Europe, and who has been on a brief trip from England to this country, has sailed again for the other side.

M. A. VERNER, of Pittsburg, who is associated with Sellars McKee, of the same Pennsylvania city, in a project looking to the construction of an extensive electric traction system in St. Petersburg, returned this week from Russia.

REEL-PRESTON.—At Kingston, N. Y., on Dec. 28, Miss Charlotte Preston, daughter of Charles M. Preston, a banker of Kingston, was married to Charles Gordon Reel, superintendent of the Consolidated Street Railroads of Kingston.

MR. EDWARD H. TYLER has been appointed chief engineer of the Brush Electrical Engineering Company, Ltd., of England, an old, large and very progressive electrical manufacturing corporation, with a large domestic and foreign business.

DR. M. I. PUPIN had in the *New York World* of December 29 a very clear and interesting discussion of wireless telegraphy, in popular language with diagrams. He holds, however, that "Wireless telegraphy is too slow for commercial use, as compared with the cable," and he shows why.

SULLIVAN—MERCER.—Mr. Hazen P. Sullivan, superintendent of the Peru Electric Manufacturing Company, Peru, Ind., was married on Dec. 17 to Miss Venice E. Mercer. The event was of much social importance, and Mr. and Mrs. Sullivan received the congratulations and good wishes of a large number of friends.

GIBSON-JACKSON.—The marriage is announced, on Christmas Day, of Anna, daughter of Mr. and Mrs. Luis Jackson, to Mr. George H. Gibson, of the publication department of the Westinghouse Companies at Pittsburg. Mr. and Mrs. Gibson will be at home after Feb. 1, at 268 Shady Avenue, East End, Pittsburg.

MR. JOSEPH A. McELROY, of the British electrical engineering and contracting firm of Macartney, McElroy & Company, New York offices, 26 Cortland Street, who has been on a visit to this country for the last four weeks, intends to return to Europe by the North German Lloyd liner *Kronprinz*, which sails January 4.

MR. A. L. RIKER, when in New York last week, confirmed the reports noted by us as to his resignation from the Electric Vehicle Company. It takes effect Jan. 1. Mr. Riker has been a very active man during the past two or three years, and will take a brief but much needed rest. He will then pull himself together for new work in the automobile field.

MR. HENRY C. PAYNE, the new Postmaster General, is credited in electrical circles with having begun his successful electrical career as a telegraph operator. We learn, however, that while Mr. Payne learned telegraphy and was an expert operator, he never worked at the key as a means of livelihood. When the telephone came along, he was quick to see its great utility and future.

BOWKER-MITCHELL.—A special dispatch from Boston of Jan. 1 says: "Richard Rogers Bowker, of New York, and Miss Alice Mitchell, of Cambridge, were married to-day at Brookline by the Rev. Edward Everett Hule. The ceremony was a very quiet affair, but a notable alliance owing to the high standing of the contracting parties. Miss Mitchell is a niece of former Vice-President Morton, and a young lady of rare beauty. She has been a leader in Boston's society and prominent in much of the philanthropic work of this city. The bridegroom was for a long time vice-president of the Edison Electric Lighting Company, and is at present identified with the publishing business as proprietor of the *Publishers' Weekly*, etc., of New York City; the *Library Journal*, etc. He is also prominent in reform, social and political movements."

MR. MARSDEN J. PERRY.—The marriage of Mrs. Marion Lincoln Bogert, formerly of Hamilton Park, to Mr. Marsden J. Perry, of Providence, is noted, at the home of her mother, Mrs. Lincoln, at Worcester, Mass. Mr. and Mrs. Perry will live in Providence, and will occupy one of the handsomest colonial mansions in New England, built in 1786, and recently purchased by Mr. Perry from the Brown and Ives estate.

MR. W. R. MASON, who for the past six years has been acting as manufacturers' agent in the St. Louis territory, for several prominent electrical machinery builders has returned to Chicago and purchased an interest in the Wagner-Hatch Electric Company, 308 Dearborn Street, and has been elected secretary of the company. This company is agent for the dynamos and motors built by the Reliance Electric Company, of Milwaukee.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, of Ampere, N. J., had an agreeable surprise the day before Christmas. The growth of the business had led to the formation recently of a dining club at the works by the numerous heads of departments, and the club made this occasion a memorable one for Dr. Wheeler by presenting him with a handsome silver loving cup. Unknown to her husband, Mrs. Wheeler was invited over to luncheon, but even she did not know what was intended. A very neat presentation speech was made by Mr. H. L. Patterson, purchasing agent, while the response of the recipient was as hearty and feeling as it was undeniably extemporaneous.

MR. E. P. THOMPSON, the patent lawyer, is out with a vigorous letter in the *New York Times* in defence of Admiral Schley. He says: "The result obtained by a great inventor, or warrior, or statesman, or artist, or the like is not to be judged by his little mistakes (mistakes in the opinion of a few), nor by anything whatever, except by the size of the achievement. No doubt that Marconi's, or Bell's, or Edison's, or Westinghouse's methods of making great inventions could be picked to pieces by a court of mechanical experts (who would, however, be inferiors, for the reason that they had not made great inventions). Ought we not to prefer a charge for neglect of due dispatch against Röntgen for not discovering X-rays fifteen hours sooner than he did? Ought we not to bring a charge against Marconi for making a loop from Newfoundland to Nova Scotia, in spite of whatever private feelings may have been aroused in him by the Anglo-America Telegraph Company? Ought we not to enter a charge for retrograde movements against Pupin for not more quickly perfecting his non-inductive telephone system for talking across the ocean?"

Trade Notes.

SEAMLESS STEEL.—The Standard Welding Company, Cleveland, Ohio, has issued a new price list of its seamless steel tubes, rims, cylinders and boiler flues for automobiles and other purposes.

HART & HEGEMAN SWITCHES.—The Hart & Hegeman Manufacturing Company, Hartford, Conn., announces that all Hart rotary switches will hereafter be supplied, should the purchaser so desire, with an "on" or "off" indication free of charge.

THE MARSHALL-SANDERS COMPANY, Boston, has at last caught up with the phenomenal demand for its midget plugs and receptacles, and is now prepared to deliver them in any quantity from stock, having quadrupled its capacity during the last two months.

THE RENIM SPECIALTY COMPANY has removed its office to new and larger quarters in the Weld Building, 176 Federal Street, Boston, occupying an entire floor running through from High to Purchase Street, with freight elevator and every facility for carrying a large stock of Renim specialties.

THE BRISTOL COMPANY, Waterbury, Conn., has just issued its revised recording thermometer circular, which covers recording thermometers for all classes of temperature measurements up to maximum ranges of 800° F. The circular is fully illustrated with views of charts and recording thermometers of different classes. Copies may be obtained on application.

WILLIAMS ENGINES.—In an attractive pamphlet the Quincy Engine Works, Quincy, Ill., gives tables of dimensions, speeds, etc., of the Williams engines built by them, and diagrams of the vertical engines with dimensions are also presented. These engines are built in standard parts, largely interchangeable, and represent the latest development in engine building.

THE WIRT ELECTRIC COMPANY, Philadelphia, Pa., has bound together a number of its circulars in a handsome cover containing embossings of a rheostat. One of the circulars illustrates and describes field rheostats, another motor speed controllers, and the third is devoted to theatre dimmers. The latter contains much information of general interest on the application of dimmers.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing a new bulletin on D. & W. telephone protectors. This protector, which embodies all the necessary elements of such a device, combines a high tension fuse, a zinc coil, and a lightning arrester all arranged on one block making an instrument of neat and compact design. A descriptive bulletin of this material will be sent free to any one upon application.

BRIGHTON GAS AND GASOLINE ENGINES.—In a 40-page catalogue the Pierce-Crouch Engine Company, New Brighton, Pa., illustrates and describes the various types of the Brighton gas and gasoline engines. All of the types and the more important details of this engine are illustrated by excellent engravings and accompanied with full descriptions. The text, in fact, has more the character of technical writing than of the usual trade literature.

ELECTRIC LOCOMOTIVES.—The subject of a recent pamphlet issued by the C. W. Hunt Company is electric locomotives for manufacturing establish-

ments. A number of views of such locomotives operating in manufacturing works are illustrated, and much data of general information concerning the same are given. A storage battery switch locomotive is also described. The final pages of the pamphlet are devoted to industrial railway cars and track.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, Mass., has just issued a pamphlet of unique design, containing a list of users of the Ness automatic telephone system, and a few testimonial letters. In the front cover an oval section is cut out of the centre so as to reveal a picture of a telephone set on the first inside page. The color combination of the green cover and buff inside page is very pleasing. The arrangement of the contents of the pamphlet is somewhat out of the ordinary. Most every State in the Union is represented in the list, also Japan.

THE ACME SWITCH COMPANY, Hartford, Conn., has recently increased its capital stock to $25,000, and removed its offices and works to 438 Asylum Street, near the New York, New Haven & Hartford Railroad station. Its floor space here is larger and its facilities are greater. Considerable new machinery has also been purchased. All of this extension has been made necessary by the heavy demand for the time switches which this company manufactures. Two new types of time switches have just been added to the Acme line.

TELEPHONE CONSTRUCTION TOOLS AND MATERIAL.—Messrs. Johnston & Dean, dealers in tools and materials for telephone, telegraph and electric companies, Wainwright Building, St. Louis, Mo., have just issued a neat pamphlet on the subject, "The Use of Aerial Cable." Considerable practical and valuable information is given on this subject and illustrations show various pieces of apparatus used in connection with the installation of telephone aerial cables. All telephone men would be interested in the contents of this pamphlet.

MR. WM. ROCHE, 42 Vesey Street, New York, reports the year just closed as the most successful in his business career, notwithstanding that fire almost destroyed his entire plant last summer. The "New Standard" dry battery, Mr. Roche states, is enjoying a better sale now than ever before, and the new flashlight which he has recently put on the market is giving the best of satisfaction. A new field for this useful article was recently discovered in the police raids in New York city where each of the raiders was supplied with one of these flashlights.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, is in position to show a full line of samples of its generator call exchange and toll line, and central energy telephones, with combined self-restoring drop and jack for generator call switchboards and answering and multiple spring jacks, lamp signals and sockets, relays, ringing and listening keys and the various parts for a full multiple and trunking central energy exchange equipment. The apparatus contains many new features and its design and construction is neat and of the very highest grade.

GERMAN TRADE CATALOGUE.—The Gesellschaft für Elektrische Industrie of Karlsruhebaden has issued a handsome cloth-bound catalogue with a striking design on the cover page, and containing a large number of full-page cuts giving views of its factory and the various types of machinery manufactured by it. The cuts are on the left-hand page, and the descriptive matter on the right-hand page, is in three languages, there being one column for German, another column for French and a third column for English. A very considerable portion of the space is occupied with illustrations and descriptions of electric cranes and hoists.

PULLEY AND CLUTCH TESTS.—Tests have been made at the Worcester Polytechnic Institute, Worcester, Mass., of "Compo" clutches and pulleys for the Allston Foundry Company, Boston, Mass. The reports of these tests have been published in pamphlet form by the Allston Company. The object of the tests was to obtain the relative power transmitting properties of standard pulleys and a leather-faced clutch, and compare them with pulleys of iron and wood with cork insertions in the rim, and a clutch similarly treated. According to the reports upon the tests the cork-inserted pulley transmitted 51 per cent. more power at a slip of 2 per cent. than the others under test, and the cork-inserted clutch showed a corresponding increase in transmission. The Allston Foundry Company, 620 Atlantic Avenue, Boston, Mass., does not itself manufacture clutches, but is introducing cork-inserts into every well-known make of friction clutches, and for friction driving or braking purposes generally.

CALIFORNIA AGAIN.—The water powers of California have lately been a prominent theme in the pages of this journal. Now, the January *Country Life in America* is a California number with superb pictures, and wholly devoted to the outdoor world on the Pacific Coast. The special covers show big trees of the Sierras, and a magnificent frontispiece, the blooming orchards at the foot of snow-capped mountains. The leading article, by L. H. Bailey, tells of the diversified beauties and peculiarities of the land that flowers in winter and sleeps in summer, where thunderstorms are not, and where the sun shines everlastingly. Throughout, the unusual opportunities for illustrating California at its best have been well taken, but of particularly striking beauty are several series of photographs. Of these, "The Cypresses of Monterey" show a picturesque feature of the Southern coast; the Yucca palms and Gila monsters, the weird life in the Mojave desert; and the poppies and poppy-worts furnish the color that gives California its fame as a land of flowers.

THE FRINK REFLECTORS, which have received awards in every exposition in which they have been entered, more recently receiving the highest award at the Pan-American Exposition, Buffalo, where thirty-two of these reflectors were used in lighting the railway station and transportation building, have been adopted for use in lighting the art galleries of the Charleston Exposition, a species of lighting to which they are specially applicable, and in which they reach the highest results. This is an adaptation of their familiar show-window reflector, which hardly needs any introduction to our readers, as it is in use in so many of the representative stores of the country. Mr. Frink is the pioneer of this reflector trade, being, it is said, the original patentee, and in business close to half a century. The name "Frink" has always stood for what is best in the reflector line. In addition to show case and window lighting, store interiors, etc., they make a specialty of church and building lighting, art galleries, etc., no problem in lighting being too difficult for them to solve successfully.

INCANDESCENT LAMPS FOR ISOLATED PLANTS.—The latest addition to the artistic trade literature of the General Electric Company is a handsome 64-page pamphlet on the subject of incandescent lamps for isolated plants. This particular branch of electric lighting gives special opportunities for the exercise of artistic skill, and many beautiful effects are illustrated in the pages of this catalogue. The text describes lamps of voltages from 90 to 125 and 200 to 250, and gives much valuable and interesting information on the general subject. A chapter is devoted to the importance of good regulation. It includes tables showing the effects of change in voltage on 3.1 and 3.5-watt lamps. Scattered throughout the pages are many half-tone views showing decorative lighting features in several of the most prominent hotels in New York City, Trinity Church New York, the Pan-American Exposition, and many other places of note. Views of many of the prominent office buildings in New York are also shown with high artistic effect, in connection with the general subject of the pamphlet.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DECEMBER 24, 1901.

[Conducted by Wm. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

689,096. ELECTRICAL APPARATUS; T. B. Kinraide, Boston, Mass. App. filed May 4, 1901. The apparatus comprises a plurality of intermittent high potential generating units and means for uniting them in a uni-directional discharge. (Issued Dec. 17.)

689,378. MEANS FOR LIGHTING GAS; H. Borchardt, Berlin, Germany. App. filed Aug. 2, 1900. The invention relates chiefly to the construction of the valves for a pilot light and for the main light. The pilot light is first ignited by electricity, after which the main burner is lighted and the pilot is extinguished.

689,379. MEANS FOR LIGHTING GAS; H. Borchardt, Berlin, Germany. App. filed March 30, 1901. A modification of the preceding.

689,380. MEANS FOR ELECTRICALLY CONTROLLING GAS COCKS; H. Borchardt, Berlin, Germany. App. filed May 28, 1901. A ratchet arrangement operated by an electro-magnet for turning on the gas and igniting it from a distance.

689,406. ELECTRIC EXERCISING APPARATUS; A. Olson, San Diego, Cal. App. filed April 1, 1901. Branch conductors lead from an electric belt to dumb bells or clubs, so that the circuit will include the arms and body of the person exercising.

689,414. SWITCH AND OUTLET BOX; Miner Robinson, Newton, Mass. App. filed Oct. 23, 1901. Projections or pockets from the box receive the end of the conduits in a direction parallel to the face of the box.

689,415. ELECTRIC TELEGRAPH; H. A. Rowland, Baltimore, Md. App. filed March 11, 1901. A method of transmitting intelligence over an alternating current circuit by selecting for each signal or character a predetermined number of the current impulses and modifying them by changing their polarity, but otherwise maintaining their form and characteristics.

689,417. ELECTRIC TRUCK; T. F. Rowland, New York, N. Y. App. filed May 29, 1901. A truck upon which large welded cylinders can be rotated and also moved longitudinally to bring them into proper position with relation to welding mechanism.

689,426. PORTABLE TELEGRAPH KEY; C. Shirley, Brooklyn, N. Y. App. filed July 11, 1901. A key which can be placed in any position on a table and be operated without being attached to the table.

689,438. INTERRUPTER; T. W. Topham, Brooklyn, N. Y. App. filed July 30, 1901. (See Current News and Notes.)

689,445. RHEOSTAT; C. Wirt, Philadelphia, Pa. App. filed Oct. 13, 1900. The resistance is in the form of a ribbon of decreasing width from one end to the other.

689,450. VOLTAIC CELL; H. S. Amwake, Camden, N. J. App. filed Feb. 9, 1901. Details.

689,452. ELECTRIC CIRCUIT CONTROLLER; W. K. Bassford, Jr., Boundbrook, N. J. App. filed June 8, 1901. Controlling and reversing handles are each provided with certain projections so arranged that the projection on the controlling handle acts as a stop for the reverse handle in all of the "on" positions, but in the "off" position it is not a stop to the reverse handle.

689,453. LOCK FOR ELECTRIC CONTROLLERS; W. K. Bassford, Jr., Bound Brook, N. J. App. filed June 8, 1901. A modification of the preceding.

689,483. MAGNETIC ENGINE OR MOTOR; R. R. Gilman, Melrose, Mass. App. filed May 23, 1901. A permanent magnet is mounted to be moved by hand or otherwise, so that its poles may alternately retract and repel the poles of another permanent magnet or magnets mounted on an axis to produce motion.

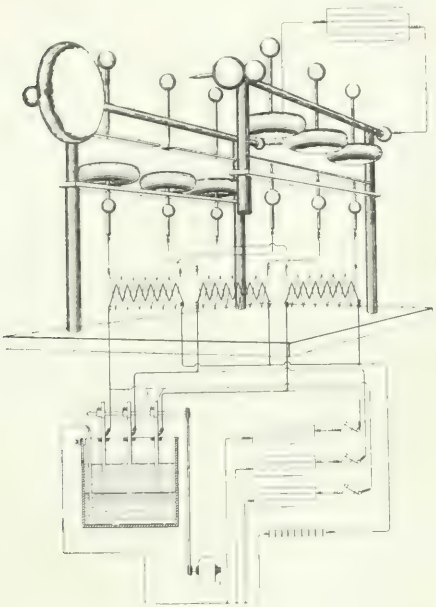
689,489. ELECTRICAL DEVICE; S. C. Harris, New York, N. Y. App. filed March 28, 1901. This device adapted for use as an indicator, clock, or cyclometer, embodies chiefly one or more stationary magnets, an oscillating magnet acting as an armature therefor and a superposed disk acting as an armature for the oscillating magnet and adapted to move therewith when the magnet is excited.

689,503. ELECTRIC TELEPHONE TRANSMITTER; A. M. Massari, Rome, Italy. App. filed [illegible]. [illegible]

689,541. CONDUIT FOR ELECTRIC WIRES OR CABLES; T. Cunningham, Wenham, Mass. App. filed Dec. 26, 1899. The conduit is composed of worn-out boiler tubing, the ends squared and embraced by straps.

689,545. ELECTRIC RAILWAY; C. Hansel, New York, N. Y. App. filed Aug. 8, 1900. The third rail is mounted on supports which permit it to move relatively.

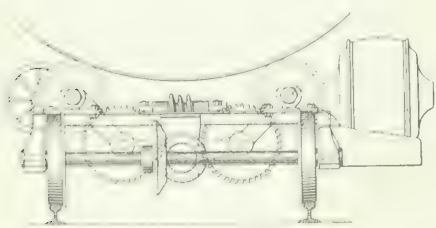
689,561. MEANS FOR MAGNETICALLY SEPARATING DIFFERENT SUBSTANCES FROM EACH OTHER; C. F. McKenna, New York, N. Y. App. filed Dec. 7, 1896. A magnet having pole pieces whose horizontal



689,096.—Electrical Apparatus.

cross section presents a concavity and whose central vertical cross section presents a convexity, in connection with which is used a circular rotary shell fitted to the pole pieces.

689,566.—APPARATUS FOR TRANSFORMING SINGLE AND MULTIPHASE ALTERNATING CURRENTS INTO CONTINUOUS CURRENTS AND INVERSELY; R. Rougé and G. Faget, Paris, France. App. filed April 6, 1900. (See Current News and Notes.)



689,417.—Electric Truck.

689,601. MERCHANDISE TRANSFER APPARATUS; A. W. Swanitz, Chicago, Ill. App. filed March 14, 1901. The apparatus consists of a car adapted to traverse a metallic floor in any direction whatever, the floor being one terminal of a circuit while the other is a ceiling against which a trolley rests. The car can thus be used to transfer goods to and from various locations on the floor.

689,613. ELECTRIC CABLE AND PROCESS OF MANUFACTURING SAME; G. E. Heyl-Dia, Warrington, Eng. App. filed May 16, 1901. An insulated cable of low capacity in which the first insulating covering of each conductor is of greater thickness along one side where related conductors [illegible]

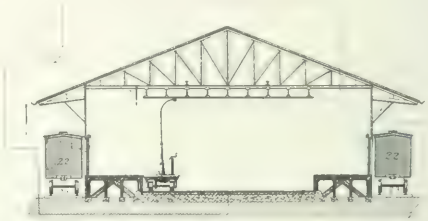
689,615. TROLLEY WIRE OR OTHER CONDUCTOR FOR ELECTRIC TRACTION; G. E. Heyl-Dia, Warrington, Eng. Appr. filed June 3, 1901. The conductor consists of a steel flexible web-portion having a copper facing on one or both edges.

689,631. TELEPHONE INDICATOR; S. J. Ballard, Los Angeles, Calif. App. filed April 11, 1900. (See page 27.)

689,653. ELECTRIC TRAMWAY OR STREET RAILWAY; W. B. Sayers, Glasgow, Scotland. App. filed Jan. 21, 1901. An open slot conduit arranged in the roadway parallel to the track rails and a return conductor that is supported within, but insulated from, the conduit and grounded at one point.

689,670. CUT OUT FOR CRANES; G. A. Hassel, McKeesport, Pa. App. filed July 27, 1901. A tripping shaft for releasing the lock that controls the contact is moved intermittently at each rotation of the shafting, and after a certain number of rotations the lock is tripped and the circuit of the motor opened.

689,674. MACHINE FOR EXTRACTING METAL FROM ORE; A. I. Ir-



689,601.—Merchandise Transfer Apparatus.

win, Cripple Creek, Colo. App. filed Sept. 26, 1900. (See Current News and Notes.)

689,683. ELECTRIC ELEVATOR; J. W. Moore, Newton Highlands, Mass. App. filed June 17, 1901. The speed and power are controlled by cutting in one or more sections of the field winding of a shunt machine.

689,698. BURGLAR AND FIRE ALARM; L. H. Williams, New York, N. Y. App. filed April 20, 1899. Details.

689,706. ELECTRIC RAILWAY SYSTEM; B. Cruvellier, Paris, France. App. filed May 3, 1901. A plunger thrust into a bed of metal filings forms one terminal of the circuit; the plunger is lifted by a magnet on the car to close the working circuit without disconnection from the metal filings.

689,711. ELECTRIC VISUAL SIGNAL APPARATUS; R. Einbigler, New York, N. Y. App. filed March 1, 1901. Details.

689,753. MULTIPLEX PRINTING TELEGRAPH; H. A. Rowland, Baltimore, Md. App. filed July 26, 1901. The invention is a complete system involving the use of alternating or other periodically varying line current, both for transmitting signals and producing synchronous motion.

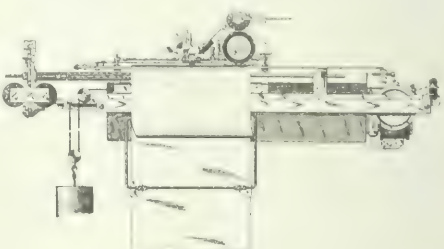
689,754. PAGE PRINTING MACHINE; H. A. Rowland, Baltimore, Md. App. filed Dec. 29, 1899. Covers the construction of the paper carriage and printing mechanism, and includes certain improvements upon the system described in the preceding patent.

689,776. ELECTRIC BATTERY; T. J. Bain, Cairo, Ill. App. filed July 8, 1901. The lower element is in the form of a cone, while the upper element has a downwardly projecting, non-conducting extension resting upon the top of the cone.

689,815. ELECTRIC RAILWAY; G. L. Fowler, New York, N. Y. App. filed July 18, 1900. Provides for the flexible mounting of a third rail.

689,816. ELECTRIC RAILWAY; G. L. Fowler, New York, N. Y. App. filed July 18, 1900. A modification of the preceding.

689,817. FIRE ALARM; A. W. Hansen and S. C. W. Harrison, Evanston,



689,754.—Page Printing Machine.

Ill. App. filed March 25, 1901. A number of circuit closing rods are held under restraint by radiating cords; when a cord is burned the alarm circuit is closed.

689,826. AUTOMATIC COMPENSATORY ELECTRIC REEL; R. L. Montagu, Oroville, Calif. App. filed Oct. 17, 1900. A reel adapted to be erected upon a dredge or boat, with which to take up and pay out electric conductors extending from the shore to the boat as the boat changes its position.

689,830. LIMITER OR INTERRUPTER FOR ELECTRIC CIRCUITS; Ralph J. Patterson, Woburn, Mass. App. filed Dec. 29, 1900. Means for causing lamps to flicker when a house circuit is taking more than a predetermined amount of current. A magnet when operated upon by an excessive current intermittently introduces resistance into a circuit at short intervals throughout the duration of the abnormal conditions, thereby causing the lights to flicker.

689,836. ELECTRIC CUT-OUT; A. D. Wheeler, Hyde Park, Mass. App. filed March 2, 1901. Details.

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OUR INDEX.

A good deal of trouble is always taken in the preparation of the Index to each volume of ELECTRICAL WORLD AND ENGINEER, but on the Index to Vol. XXXVIII. unusual pains have been bestowed, with a closer attempt at classification. The growing magnitude and variety of electrical interests is well brought out by such a survey of the contents of this journal, and looking over it there seems to be hardly any topic of importance in regard to human affairs that is not in some way affected by electricity. We are inclined to believe that many of our readers refresh their memories with the Index, or are notified of things interesting to them by it, as there is always a call for back numbers after its appearance—a call which we are often unable to supply.

SMOKE IN THE TUNNEL.

A terrible accident occurred on Wednesday morning in the Park Avenue tunnel, this city, of the New York Central Railroad, when 15 people were killed outright and some two score injured by a collision, one fast train running into the rear car of another standing in the tunnel. As we go to press, it looks as though signals were working perfectly, but that in the blur of smoke and steam the engineer at fault did not see that the lights were set against him. Be this as it may, there will undoubtedly be a great public renewal of the outcry for the abolition of steam traction in the tunnel and the adoption of electricity. The problem of the change is a serious one, but there is absolutely no good reason why the change should not be made. Electricity brings in its own dangers, as illustrated by the recent disastrous blowing of a fuse in a tunnel on the Liverpool Elevated, but it cannot be denied that, broadly and largely considered, electric locomotion for the tunnel is feasible and will redeem it from its present low estate. We are glad to believe that the New York Central is already actively planning that way. This awful disaster can but stimulate its exertions.

TEST OF POLYPHASE MOTORS.

The article by Mr. McAllister in this number is interesting as indicating what may be computed from the use of a single wattmeter in connection with a polyphase induction motor, supplied from constant-potential mains. The complete test of such a motor is scheduled upon the basis of the primary resistance between any pair of motor terminals, and also upon the secondary resistance, reduced to the primary circuit, from observations made with the secondary element locked. The method cannot pretend to a high degree of accuracy, for it assumes uniform voltages in the different polyphase circuits, and it also ignores load losses in the motor, which are sometimes considerable, owing to variations in the distribution of magnetic flux under variations of load. But within these limitations the analysis is a straightforward calculation, based on the readings of a single wattmeter, and of a single voltmeter.

The deduction of more particular interest is the fact that purely mechanical phenomena can often be measured with a greater degree of precision and convenience by electrical instruments than by the mechanical instruments that would otherwise be necessary. For example, the slip of a large induction motor is very difficult to measure accurately by a speed counter. The amount of slip under full load in a large induction motor is often only about 2 per cent of the synchronous speed, and a very small error in the observation may introduce a large error into the computed slip. But assuming that the secondary is the revolving element of the motor, it is well known that

the slip is the ratio of the secondary copper loss to the secondary-circuit power, just as the percentage drop in speed in a direct-current motor at constant excitation is the ratio of the armature copper loss to the armature power. Since the secondary power and the secondary copper loss are each capable of being computed, their ratio—the slip—can be deduced with much less probable error than the ordinary mechanical method of observing slip will admit of, even allowing for the unknown load losses.

Stroboscopic methods are, however, in use by which the slip of an induction motor can be measured by optically controlled mechanical means with a high degree of accuracy. Thus the Braun cathode-ray tube has recently been applied with apparent success to the accurate measurement of induction motor slips. The torque of an induction motor is another mechanical quantity that is capable of being computed from the secondary power, and the synchronous speed, being the ratio of these two quantities, just as in the direct-current motor at constant excitation, the torque is calculable, as the ratio of the total armature power to the synchronous speed. While, therefore, the analysis given in the article may be useful in many instances where only a wattmeter and voltmeter are at hand, the most reliable method of testing an induction motor is to couple it to a suitable direct-current motor and measure the output with the aid of instruments in the direct-current circuit, while measuring the input by an alternating wattmeter or wattmeters.

ELECTRICITY AND LIFE.

The daily press has recently been paying considerable attention to the theories of Dr. A. F. Matthews, of Chicago University, upon the relation of electricity to nerve action. That there is a close connection between the two sets of phenomena has been evident ever since the time of Galvani, but just what that relation is has never yet been cleared up. All that could be said until recently was that an electric action seems to accompany every nervous action, and that the one action cannot take place without the other. Dr. Matthews' theory, as briefly outlined in the *New York Sun*, endeavors to supply the connecting link between the electric phenomena, on the one hand, and the chemical phenomena of the nerve on the other, by means of what is virtually an electro-chemical explanation. Nerves are stated to contain an active substance which is essentially positive in its electrification. Negative electric ions entering the nerve substance under electric impulse bring about a partial or local neutralization and a partial or local chemical change in the nerve substance, which change is accompanied by a nerve action or nerve stimulus. The hypothesis on its chemical side is a means of accounting for the action of alcohol and anæsthetics, while on the electrical side it is a means of accounting for electrotonus.

In so far as the hypothesis creates working theories harmonizing the chemical and electrical phenomena of nerve operation, it is to be received with interest, but any physiological theory involving the ionic theory of electricity is a theory of the second degree, since the ionic theory is itself only a working hypothesis that has not yet been received as a matter of demonstration beyond the pale of doubt. Moreover, it would seem from the outline given of Dr. Matthews' theory that the ionic theory might fall without necessarily implicating the essentials of the nerve-action theory here considered, so that in a certain sense it would seem that the new theory does not necessarily postulate ions in the definite sense contemplated by the modern ionic theory. Almost any of the more recent theories of electro-chemical action would, perhaps, answer the purpose of the new hypothesis

It is only reasonable to expect that in time physiologists will discover the fundamental laws—perhaps very simple in character, but no doubt very complex in superposition—which underlie nerve action, and the objective side of consciousness. There can be no doubt that electricity takes a share in this action, because all the phenomena of life are phenomena of differentiated liquids separated by thin septa, and it would be practically impossible to assemble such a mechanism without originating electric and electro-chemical actions.

ILLUMINATION.

The meeting last week of the American Institute of Electrical Engineers brought out a great variety of interesting bits of information upon practical lighting, past, present and future. It comprised a general discussion of modern illuminants followed by a group of papers taking up special topics along the same line. Incidentally, there were some notable exhibits. The open paper by Dr. Bell was a treatment of the status of modern illuminants from the physical and physiological standpoints. The essential facts brought into prominence were the necessary limitations imposed on practical illuminants by the physiological requirements of color and intrinsic brilliancy, the importance of visual usefulness as distinguished from intensity of radiant or of the illumination, and the consequent importance of using the very brilliant modern lights in diffused and indirect lighting rather than in the common fashion. The fundamental point raised was that illumination as measured in any of the usual ways does not take account of the fact that visual usefulness depends not only on the light received but upon the intensity of the source if the latter is within the field of view, each increment in intrinsic brilliancy of the source implying lessened visual usefulness in the derived illumination. Thus one may have illumination absolutely equal in amount so far as photometric measurements go from several sources, but unless these sources are of equal intrinsic brilliancy the visual value of the light will vary widely from its photometric value. This is a very important matter, brought out strongly by a later speaker in complaining bitterly and justly of the failure of arc lights as ordinarily placed in giving a clear illumination upon the street. The difficulty of seeing across an arc light and the trouble occasioned pilots by glare have been long well known, but we do not remember before noting so sharp a distinction between physical and physiological values of illumination as Dr. Bell here drew.

Mr. Ryan's interesting paper on some of the problems of street illumination specially brought out the value of enclosed arcs of moderate power in improving the distribution of light. It would have been interesting had there been included in this investigation incandescent lamps of large candle-power, or perhaps Nernst lamps. Of course, small radiants placed rather low and near together give a much more uniform light along the streets than powerful lights more widely spaced. But how far is this affected by the certainty of getting more intense light into the eye from the arcs themselves, and in how far are the conditions modified by the less light thrown upon nearby objects? President Steinmetz very aptly called attention to the fact that the street lighting situation in town and country did not present the same conditions. With high buildings to reflect the light a useful effect was produced that did not at all exist in the open fields. There seemed to be a consensus of opinion that the rather dim light from incandescents or even from oil lamps give a more serviceable illumination, i. e., greater visual usefulness, for those riding along the streets than arc lamps do. Incidentally, Mr. Ryan showed a rather interesting new form of luminometer, based upon the old idea of visual acuteness and intended for measurements of street illumination. This instrument showed itself capable of giving remarkable results, so far at least as relative values are concerned, and should prove a useful addition to the instrumental means for testing

illumination. But neither this nor any other form of portable luminometer quite duplicates practical conditions. For in such devices the eye looks into an eye-piece or hood, and is thus shielded from entrance of extraneous light, which is the very thing that ought to be included if the effect of the glare upon the visual usefulness of the illumination is to be taken into account. We hope that Mr. Ryan will later continue his interesting experiments with this point in view, and extend them to include much less powerful distribution lights than those with which he dealt in the present paper.

The exhibit of vapor tube lamps by Mr. Peter Cooper-Hewitt was a most interesting one, the more so on account of Mr. Hewitt's modest and conservative report of his experiments. It is positively refreshing to have an experimenter in a new field deal with his work in a scientific spirit, instead of playing to the galleries. The mercury arc is certainly enormously brilliant and efficient, the figure stated being 2 to 4 cp per watt, and the light, save in some of the tubes that were intentionally allowed to flame near the electrode, was remarkably steady. If it were not for its disagreeable bluish green color, this lamp would, in our opinion, even now make for itself a considerable place in the art. Just how far the color will prove a drawback in certain classes of work out of doors, experience only can show; but for interior work the present color of the tubes is forbidding, the more so as the trouble comes from an almost entire absence of red in the spectrum rather than merely from a preponderance of blue and green. Therefore, a color screen which would bring the light to a normal color-tone would very greatly reduce its intensity. There is, of course, a possibility that added substances might give to the spectrum its lacking rays, but whether this could be done without making the lamp harder to start or to operate is to be determined. One of the interesting matters in this connection is the possible effect on color vision of a discontinuous spectrum which visually seems to be satisfactory in color. It is possible to produce colored flames which can hardly be distinguished from each other by the eye, and yet have totally different spectra. One might thus very readily get an apparently good light which would still lack entirely certain useful rays. In this case it might fail to give the true color values of modern dyes. But, on the other hand, most of these show general absorption over a good part of the spectrum rather than in well defined bands, so that a fairly well distributed illumination spectrum should not distort the color effects much save in rare instances.

A profoundly interesting incident of the meeting was Mr. Hammer's exhibition of a little tube containing the rare substance *radium*, which has been brought into much prominence of late by the investigations of Becquerel, Curie and others. A constant source of Röntgen rays so powerful that it should be carried in a lead tube to avoid danger of burns, is a bit startling to say the least, and while its visible radiation was not strong, its extraordinary properties are enough to set one thinking strenuously. In point of fact, neither radium nor its ally, the so-called polonium, can be yet considered as a chemical element in good and regular standing. Their chemical status is not fairly determined, but whether they prove to be elements in the ordinary sense or allotropic modifications of better-known substances, their behavior is truly most remarkable. There are, in fact, indications that the radio-activity that characterizes them extends in a minor degree to a considerable number of other substances, but it is only fair to say that in many instances the experimentation on the subject is so difficult that consistent results are hard to obtain. The real nature of the radiation is, of course, involved in the same mystery that surrounds the Röntgen ray. In spite of the very large and valuable body of work that has been done upon this subject, the ultimate nature of the phenomena is still very far from a satisfactory explanation, since several hypotheses meet the facts fairly well, and no one of them can be verified without involving still further hypotheses as part of the argument. But the behavior of radium opens a beautiful vista of possibilities. What would happen in the art of illumination if some one should hit upon a luminous paint 50 times as brilliant and permanent as the ordinary calcium sulphide variety? If one had only to expose the light-giving body to sunlight or bright daylight for a few hours to obtain storage of energy for the evening, how the electrical arts would get shaken up! And yet such a discovery is far less improbable than some that have actually been made—like Moissan's diamonds, let us say. But diamonds are no cheaper yet, and do not sparkle galore on every fair bosom.

Photometric Values of Arc Lamps.

The second Progress Report of the Committee of the National Electric Light Association for investigating the photometric properties of arc lamps, an abstract of which appeared some months ago in these columns, has recently been published in full by the Association, and contains much interesting matter. These results seem to be the first published concerning the spherical candle-power of arc lamps in continued service, and the first to show curves connecting the mean spherical candle-power of arc lamps, plotted in reference to their carbon lifetime. The characteristic life-intensity curve of an alternating-current arc lamp differs markedly from the corresponding curve of an alternating-current incandescent lamp. The latter may be roughly described as consisting of a hill-section with a sharp peak of maximum candle-power, about 75 hours from the start, and with a short straight-line ascent to the peak from the beginning, and a steady straight-line descent from the peak towards the end. The arc-lamp curve is a wavy line, or, at least, only a poor attempt at a straight line, with a slight general descent from the beginning towards the end. The descent is apparently due to the discoloration of the inner globe, and the absorption of light in this discoloration film. The minor fluctuations are apparently due to changes in the positions of the arc, following the consumption.

A general conclusion to which the report points is that the light output of a pair of carbons in the alternating-current, constant-potential arc lamp does not depend so much upon the lifetime of the carbons as upon the efficiency of the arc or of the lamp. If a given current strength or a given real power in the lamp produced the same amount of light, with all the ordinary brands of carbon, then the light output for a given pair of carbons would be simply in proportion to the duration of life, or working lifetime of the carbons. These tests show, however, that while the lifetime of the carbon has an appreciable effect, the efficiency has a still greater effect. The efficiency, with a given lamp in a given state of adjustment, depends in some way upon the quality of the carbons, since the same current strength will produce a greater length of arc with some carbons than with others, and the light emitted is a function of this arc-length at constant current.

The report is a very valuable and creditable record. It is, however, a pity to see so important a piece of literature perpetuating the error in terminology appearing on page 38, where it is stated that "the efficiency" of a lamp is "1.78 watts per mean spherical Hefner unit." The fact that such errors in terminology are common, is no adequate defense. The quantity thus stated of watts per unit of luminous intensity is an inefficiency, not an efficiency, in the same way that nothing in the world can make "two hours per mile" a velocity. "Two hours per mile" must be a slowness, whereas "one-half of a mile per hour" is a velocity. Such inaccuracies may be excusable in the multitude; but not in the reports of technical committees, which form the reference literature of students.

The Government Telegraph Agitation.

It [illegible] that the seat of the agitation for government telegraphs is in Washington and not in New York. But nothing has yet come to light connecting the administration with it in any way. Senator Mason is quoted as saying that at the first meeting of the committee on post offices ,of which he is chairman, he will call up for consideration the proposition for the government purchase of the telegraph lines. The Senator has not yet prepared any bill on the subject, but he has been gathering information. Some of his figures are as follows: The net earnings of the Western Union Telegraph Company for the year ending June 30, 1901, were $6,685,248. Deducting from this the interest on bonds and the amount applied to the sinking fund leaves a net sum applicable to dividends of $5,729,088. Similar figures for the Postal Telegraph Company indicate a net sum applicable to dividends of $2,300,000, or a total for the two companies of $8,029,088. The present valuation of the two companies is $171,400,000, divided as follows: Western Union stock, $92,000,000; leased lines, $11,000,000; bonds, $22,000,000. Postal stock, $24,000,000; bonds, $22,000,000. If the United States Government were authorized to buy the telegraph companies, giving to the stockholders a 2 per cent bond, the results would be as follows: Net earnings as above, $8,029,088; interest on $171,400,000 bonds at 2 per cent, $3,428,000, leaving a surplus of $4,601,088. This surplus at compound interest at 2 per cent would, in about 25 years, produce the price paid for the telegraph property, and the United States Government would then have free of charge the most valuable telegraph system in the world. He does not doubt that the cable companies would make an equally good showing.

Senator Hale, of Maine, chairman of the naval affairs committee of the Senate, has again introduced and had referred to his committee his bill providing for the construction and laying by the Government of the Pacific cable to connect the United States with the Philippines.

Electrical Engineers of the Day—XXVIII.

Reginald A. Fessenden.

Professor Reginald A. Fessenden was born on Oct. 6, 1866, at Bolton, P. Q., Canada. His family left Canterbury, England, in the early part of the seventeenth century, simultaneously with the progenitor of the Maxim family in this country, and founded the town of Cambridge, Mass. His branch of the family crossed the Canadian border and settled in Bolton about 1850. Mr. Fessenden received his early education at the DeVaux Military School, of Niagara Falls, N. Y., and subsequently at the Trinity College School of Port Hope, Canada, where he remained nearly four years. He early developed a talent for mathematics, and, on leaving school at the age of 16, was appointed senior mathematical master at the Bishops College School, Lennoxville, P. Q., Canada.

In 1885, at the age of 19, he went to Bermuda as principal of the Whitney Institute on that island, and occupied this position for two years. He came to New York in 1887 and entered the employment of the Edison Machine Works, which had then recently settled in Schenectady, N. Y., as tester and inspector in laying underground Edison tubes in New York City, and assisted in laying a large quantity of underground mains in the Edison district between Twenty-third Street and Central Park. In the spring of 1888 he was sent by the Edison Machine Works on special duty to the Edison laboratory of Orange, N. J. Shortly afterwards he undertook chemical work for Mr. Edison in the laboratory, of which he was head chemist from 1889 until 1890, when he left to take a position as assistant electrician with the United States Electric Company in New York. In the same year he was married to Miss Helen Trout, a descendant of one of the first governors of Bermuda. In 1891 he joined the Stanley Laboratory Company, of Pittsfield, Mass., as chemist. In 1892 he was appointed professor of physics and electrical engineering at Purdue University, Lafayette, Ind., and the following year accepted the chair of electrical engineering at the Western University of Pennsylvania, Allegheny, Pa., which he occupied until April, 1900, when he was appointed special agent for the United States Weather Bureau to take up the subject of wireless telegraphy for that Bureau. He is at present busily engaged on this work, with headquarters at Roanoke Island, N. C.

Professor Fessenden has published in all about 70 papers on chemical, physical and electro-technical subjects. These papers have appeared mainly in these columns, in the *Physical Review, Chemical News, Nature, Science,* and the *Transactions* of the American Institute of Electrical Engineers. He is not only a theorist and mathematician, deeply interested in the more remote and recondite questions concerning the nature of electromagntism, but he is also very practical and utilitarian, and has undertaken a large amount of purely experimental work. He is also an inventor and has taken out a number of patents for improvements in applied electricity.

Prominent among his published papers are two on "The Electrostatic Theory of Cohesion," published in these columns and in *Science* in 1891-1892. In these papers electrical charges were, for the first time, quantitatively considered as specific properties of atoms, and the forces due to these charges were analyzed. This paper was a forerunner of the existing ionic theory of matter, which has since been developed by a number of prominent physicists. A formula was also deduced in the paper, connecting the electric conductivity of metals with the size of their atoms, and these values have since received experimental verification.

Another important paper was "On the Nature of the Quantity Upon Which the Nature of Electricity and Magnetism Depends," published in these columns in 1894. In this paper the consequence was first deduced, prior to the experimental discoveries of Zeeman and Lenard, that ions placed in a magnetic field must rotate and influence light passing through the medium.



In his paper "On the Nature of Electric and Magnetic Quantities," published in the *Physical Review* in January, 1900, it was deduced that either a linear relation between magnetic force and reluctance as well as a second power relation between electric force and electric resistance or vice versa; also that an experimental determination as to which of these alternatives exists is sufficient to determine the dimensions of electric and magnetic quantities in absolute measure. The linear relation between magnetic force and magnetic intensity was here first demonstrated as a necessary consequence of the theory, and it was also predicted for the first time that the capacity of a condenser varied with increasing voltage by an amount depending upon the square of the voltage, a fact which has since been announced as having been experimentally observed in Europe.

Professor Fessenden has invented a number of physical measuring instruments, which have been described from time to time in these columns, such as frequency measurers, curve-tracers, permeameters, balance thermopiles, acetylene standards of lights, etc. He has also worked out successfully various new methods of sending and receiving signals in wireless telegraphy. Professor Fessenden is a member of the American Institute of Electrical Engineers and a number of scientific bodies. Direct and earnest in all his work, he is equally direct and unassuming in his manner, and a universal favorite among those who know him.

The Waterside Station of the New York Edison Company—II.

THE GENERATING SYSTEM.

IN the first section of this description of the new Waterside plant of the New York Edison Company, a comprehensive statement was given as to the general conditions and the problems of current generation and distribution which the station is intended to dispose of satisfactorily, and some details were also entered into with regard to the main engineering features. It will have been gathered that in such a plant and such a system mere figures in itself introduces new complexities and brings itno sight a new range of difficulties. In electrical work that deals with the distribution of current, light, power, intelligence, etc., from a central source, the natural tendency and the unceasing cry is for a larger station, a larger operating room, a large exchange, but at each remove the danger grows of a more complete shut down in case of trouble and disaster. How to deal with this contingency and circumvent the peril is one of the superadded elements of the problem of giving service, and the extent with which it necessitates heavier outlays on construction realized by the public.



FIG. 15.—NEW WATERSIDE STATION, NEW YORK EDISON COMPANY, FROM FIRST AVENUE AND THIRTY-EIGHTH STREET, SHOWING DYNAMO ROOM SIDE AND WEST FRONT.

Central station work of late years growing into mechanical and electrical organisms that deal with huge volumes of current liable to incessant and wide fluctuation of demand, has been peculiarly

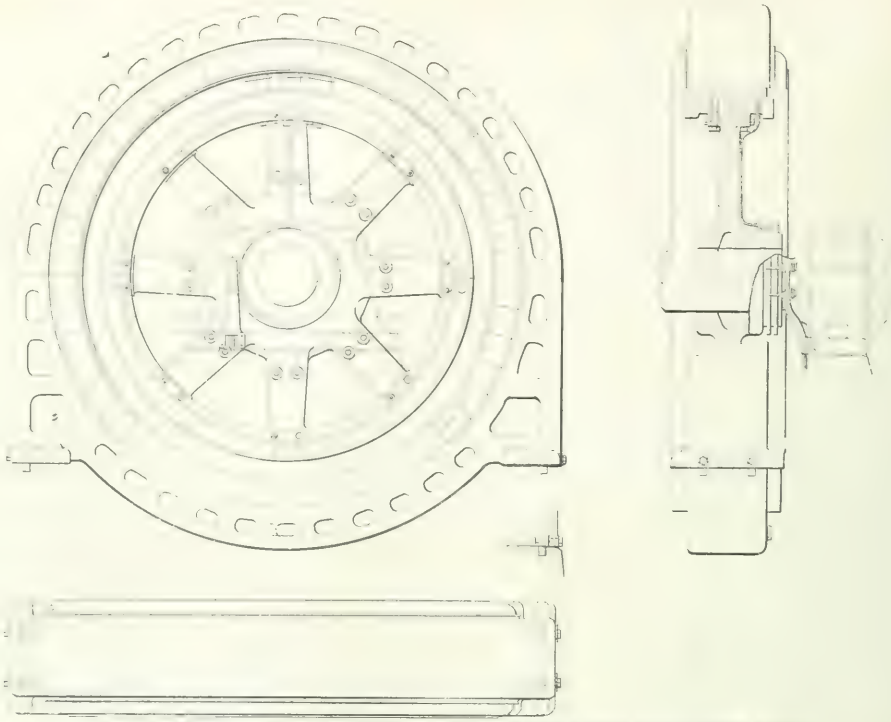


Fig. 16.—Elevation, Plan and Section of Three Phase Generator Waterside Plant.

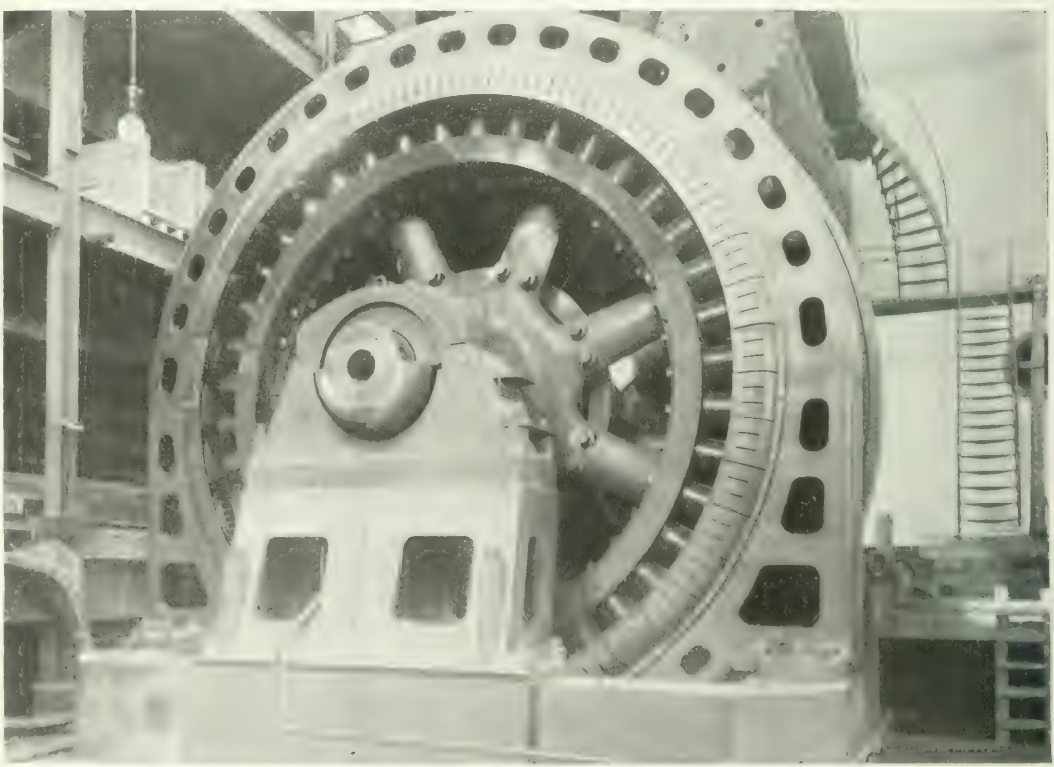


Fig. 17.—A General View of Three Phase Generator, Waterside Plant.

occupied with the burden of this vital problem of avoiding interruption or shut-down. In New York City the Edison Company can certainly "point with pride" to its maintenance of service, so smooth and regular that we hesitate to discuss even thus tentatively its possible interruption; but the company in its wider, larger scope of operation has planned, as wise engineers should, to furnish every precaution for every lurking trouble, known or unknown, and has also had to evolve many novel ideas in practice to this end. We are dealing now with the power plant, but the map given in our last issue showed the extent of the area and the number of the sub-stations to be kept in constant supply and touch, looking to Waterside as the mighty heart sending out to all its pulses of current. It may not be generally known that the direct-current generated directly or transformed from alternating by the scattered rotaries of the New York Edison Company is fed by 76 stations and sub-stations at more than 200 points into one immense network of underground mains. This network is continuous, and, as will be seen by referring to the map we gave extends from the Battery on the south to 130th Street on the north, and from the Hudson to the East River. To this special feature, however, we shall return later.

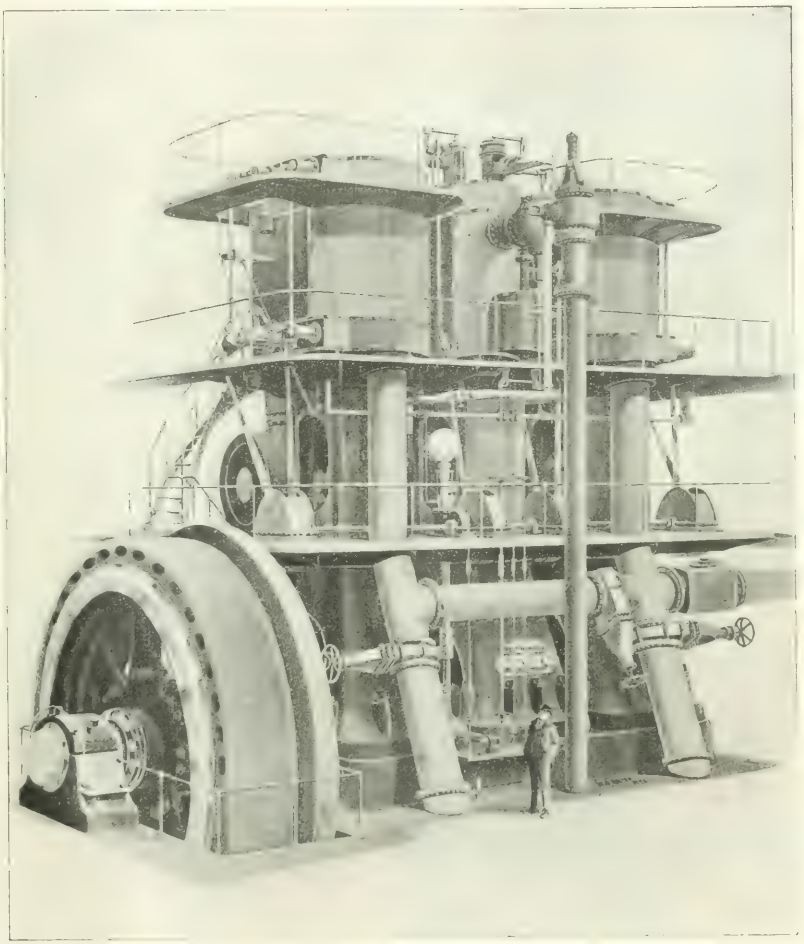


FIG. 18.—ONE OF THE 5000 HP UNITS, NEW WATERSIDE STATION, NEW YORK EDISON COMPANY.

Meantime, let us note that in the Waterside station the principal aim in planning the electrical plant was to so design it that in case of any accident, burn-out or short circuit occurring on any cable, switch or piece of apparatus, it could be confined to the place in which it originated, so that it could not communicate in any way with or cause injury to any other part of the system. The underlying idea is, so to speak, that of cellular or compartmental construction, starting out with any given generating unit, so that it and its auxiliary apparatus might fairly be considered in each case as a separate complete station. There are thus 16 central stations in one. The same idea is indeed carried out in the subways and cables connecting with the various rotary stations, each station receiving its supply by at least two cables following entirely different routes from the Waterside bus to the switching panels at the rotary station. This important and interesting point being noted therefore and emphasized as it deserves, we may now take up the station electrical equipment, beginning with the generators.

THE GENERATORS.

The 16 General Electric 4500-kw, three-phase generators deliver 25-cycle alternating current at 6600 volts. They are of the revolving

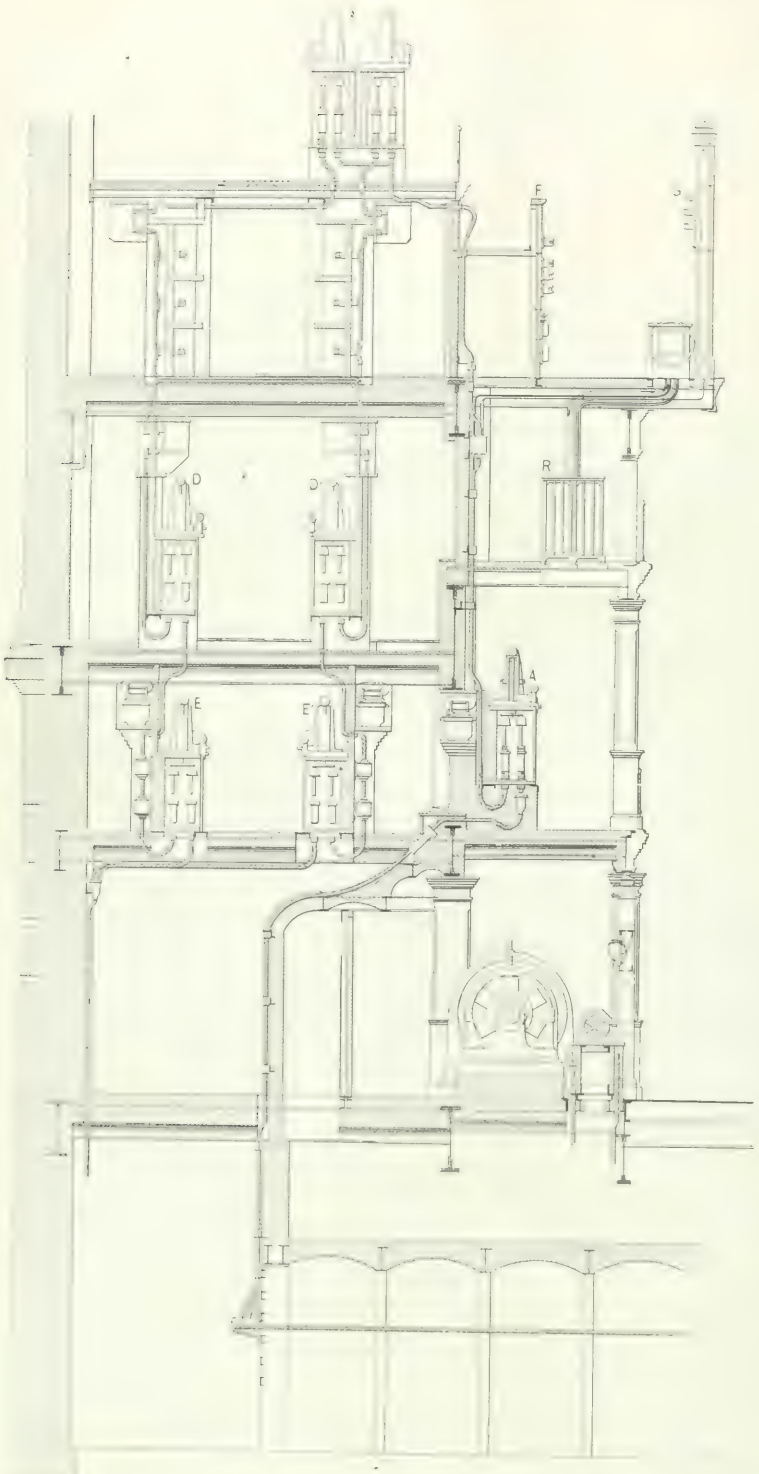


FIG. 19.—SECTIONAL VIEW OF HIGH-TENSION SWITCHBOARD.

either main or auxiliary bus-bars. Generator instrument panel. R—Field rheostat, controlled from generator pedestal

field, direct-connected type, and as they run at 75 r. p. m. have 40 poles. The revolving field is keyed to the engine shaft and bolted to the hub of the flywheel, which is extended so as to form a heavy flange on the side toward the generator. The field magnet cores are bolted to the outer surface of an iron ring, which is made in two semi-circular pieces fastened together by I links. This ring is supported by a spider having eight spokes, through each of which pass two bolts, securing the revolving element to the flywheel hub.

The fields are wound with copper ribbon set on edge, and give full excitation at 220 volts, thus making it possible to take the exciting current either from the low-tension board or storage battery in case of failure of the exciter sets. The exciting current passes to the revolving field through two iron collector rings. Iron rings were used because of their superior wearing qualities. Four carbon brushes on the 1½-inch face of each ring give ample current carrying capacity.

The armature is built of laminated steel of the highest magnetic quality. The armature coils are secured by dove-tailed wedges in slots 4⅛ inches deep and 1½ inches wide. There are 240 slots, 2 per phase per pole. The ends of the coils are so formed as to leave a space of at least an inch between adjacent windings. These end extensions are protected from mechanical injury by curved iron shields bolted to the armature frame.

The revolving field weighs 130,000 lbs., the armature 125,000 lbs., and the foundation plates 20,000 lbs., making the total weight of each generator 275,000 lbs.

The design is such that all necessary repairs to field and armature windings may be made without removing the upper half of the armature. By taking out the two bolts, securing it to the yoke, any field spool may be removed, and by taking out two poles the armature coils may be removed and replaced. The armature coils will carry a non-inductive load of 250 amperes per phase for 24 hours without the temperature of any part exceeding that of the air by more than 30 degs. C. A non-inductive load of 400 amperes per phase carried for three hours causes a temperature rise of less than 50 degs. C. In making the heating tests the resistance method of calculating the temperature was used in addition to thermometer readings. In all cases where the latter gave the higher reading the results as indicated by that method were used.

The armatures are designed to withstand a test of 15,000 volts alternating, applied for half an hour, and a puncture test of 25,000 volts alternating for one minute. The insulation between the field coils, collector

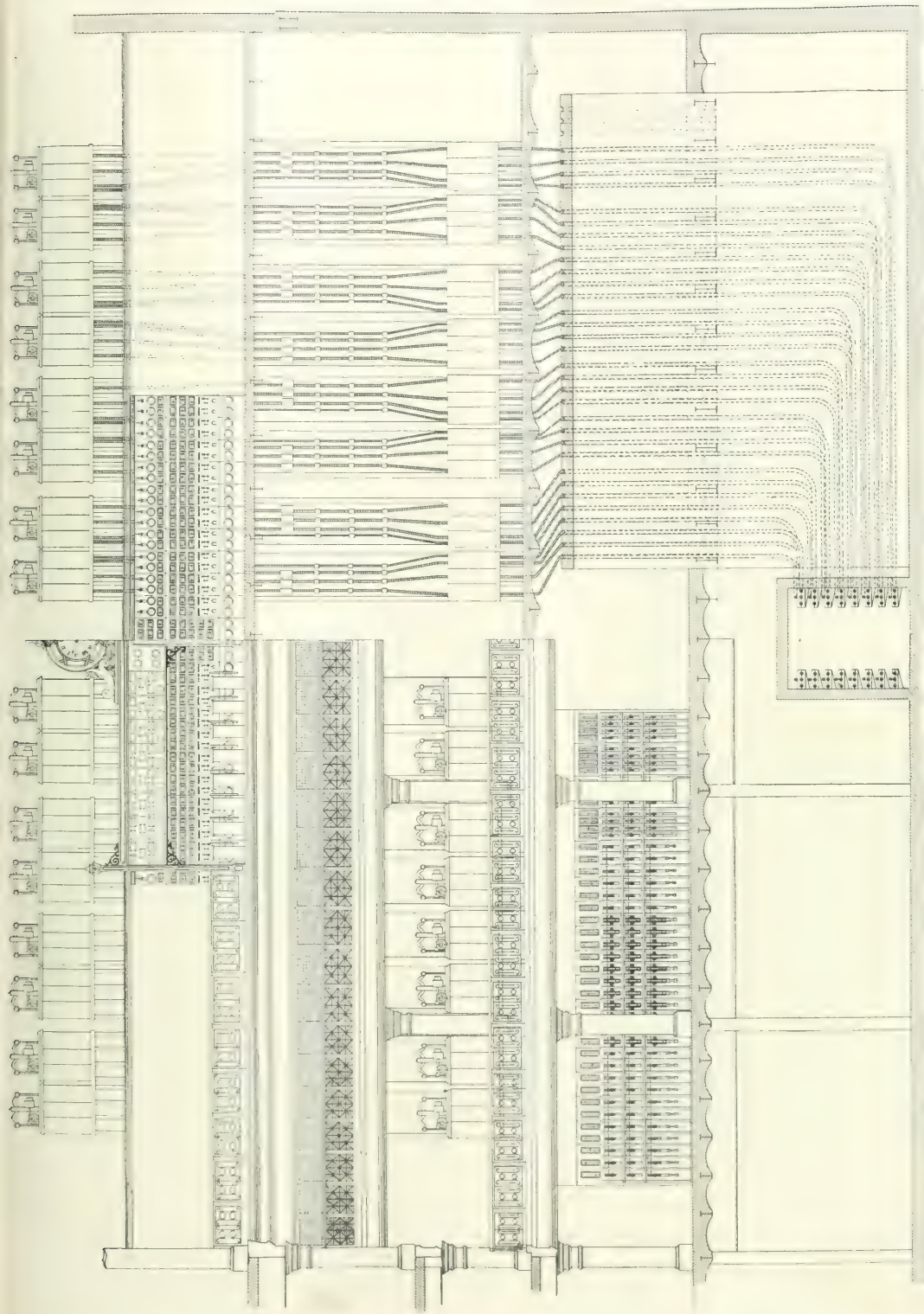


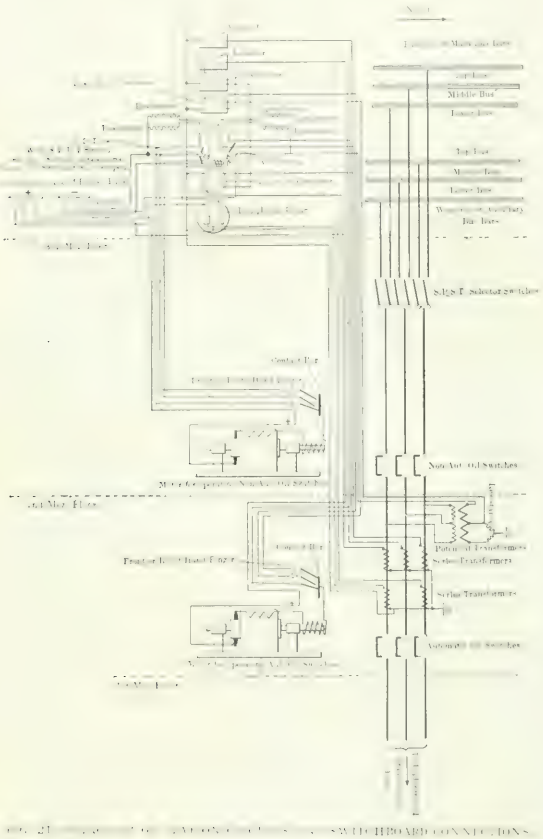
FIG. 20 ELEVATION AND SECTIONAL VIEW, FIVE STORY HIGH-TENSION SWITCHBOARD, WATERSIDE NEW YORK EDISON STATION

rings and generator frame is such as to withstand 25000 volts continuously. The efficiency at full load and one-quarter overload is 97 per cent; at three-quarter load, 96 per cent; at one-half load, 95 per cent, and one-quarter load, 91 per cent. The regulation is such that with the sudden throwing off of full load the rise in voltage does not, with constant excitation, exceed 8 per cent.

MOTOR-GENERATOR EXCITER SETS.

There are three exciter sets installed, each consisting of a 225-hp, 6600-volt, three-phase induction motor, direct connected to a 150-kw, direct-current, 4-pole generator, giving a potential of 200-280 volts. These exciter sets can be run continuously at full load with a rise of temperature not to exceed 40 degs. C. above the surrounding air, and will carry 33⅓ per cent overload for three hours without injury.

In order to insure absolute continuity of current for exciting the fields of the generators a storage battery was installed, having ca-



(With Special Reference to G. E. Oil Switches.)

pacity sufficient to excite the fields of 16 generators for one hour. This battery is of the chloride type, built by the Electric Storage Battery Company, and similar to those used in all the annex stations, to be described later in detail.

HIGH-TENSION INDICATING AND CONTROLLING SWITCHBOARD.

The high-tension controlling switchboard of this station differs from those in the two other large alternating-current generating stations in New York, in that each generator is controlled from an individual pedestal, and each feeder from an individual panel, instead of mounting the controlling devices of all the generators upon one bench board, and the controlling device for all the feeders upon another similar board. In this way the small wires which operate the switches, relays, instruments, etc., of one generator are separated from the similar wires of all other generators. With this arrangement the pedestal containing the controlling apparatus for one generator occupies the same lateral space as the panel containing the instruments of the same machine. There is, therefore, no opportunity for the operator to note the indication on the instruments of one generator and by mistake throw the switches of an adjacent machine.

The generator pedestals are 26 inches by 15 inches by 32 inches high, and have mounted on them a field break switch, the rheostat dial switch, the switch for controlling the speed of the engine, the synchronizing plug and the three-pilot switches, which control the main and selector oil switches.

The instrument panels for the generators are mounted directly over their respective pedestals upon girders carried upon three columns, as shown in the general cross-section. Upon each panel, which is 2 ft. wide by 3 ft. 3 inches high, there are three ammeters, one voltmeter, one power factor indicator, one integrating wattmeter and the field ammeter. The current for operating these instruments is supplied by series and potential transformers connected in and across the generator cables; one lead to each instrument being grounded for safety. The two center panels have each mounted on them eight ammeters, which are connected one to a phase of each of the eight generators on that side of the aisle. This enables the operator to see at a glance the load on each generator.

The instruments for the feeders and the pilot switches, relays, etc., for controlling the feeder oil switches are mounted on panels directly back of the generator pedestals. Each feeder occupies a space 11 inches wide upon this panel board. At the top are pilot lamps and below these is the indicating wattmeter, the power factor indicator, three ammeters, the pilot switches for controlling and the colored lamps for indicating the position of the oil switches and the time limit relays. The two center feeder panels have each mounted on them 20 ammeters, which indicate at once the load on all the feeders.

It may be added that the instruments described above are of the horizontal edgewise type, built by the General Electric Company.

The generator cables are single conductor, 500,000 cm. copper, insulated with 12/32-inch paper and protected by ⅛-inch lead. The generator field cables are single conductor, 212,000 cm. insulated, with 5/32-inch rubber and lead covered. These five cables, together with the seven conductor lead-covered cable for signaling purposes, are carried from each generator on iron brackets in the central cable runway to the cable vault under the switchboard. In the runway the six cables of one generator are separated from the cables of the adjacent generator by cast-iron septums. From the cable-vault the generator cables are carried up in individual brick ducts to the generator switch. This switch is of the General Electric motor controlled oil type. It is mounted in a cell structure built up of buff brick, firebrick and soapstone. The two potential transformers are also mounted in this same structure and completely enclosed in the fire-resisting materials mentioned. The primaries of these transformers are connected to the same phase, one on the generator and the other on the bus side of the switch. These transformers are used for synchronizing and are so connected that when the potentials on the two sides of the generator switch are equal and are in phase with each other, the synchronizing voltmeter indicates zero. In this way it is impossible to synchronize a generator with the auxiliary bus, and then throw it in on the main bus. These same transformers also furnish potential for the voltmeter, power factor indicator and the integrating wattmeter. Above the main switch the cables are carried up between brick barriers to the series transformers, which operate the instruments, and then on to the oil selector switches above the bus house. These switches are similar to the main switch, and allow a generator to be connected to either bus. The controlling switches and wires for them are so arranged that it is impossible to close both the main and auxiliary bus switch at the same time.

THE BUS-BARS.

The high-tension bus-bars are mounted in a bus house built of buff brick and firebrick directly behind the high-tension controlling switchboard. There are two sets of bus-bars, the main and an auxiliary, to either of which any feeder or any generator can be connected. The group bus-bar system was not deemed advisable in this case, but it is possible, however, to divide each bus at the center of the station, thereby giving four sets. Each bus-bar is composed of four strips of three by one-eighth inch rolled copper supported on studs, which are enclosed in linen tubes and pass through porcelain insulators, as shown in the drawings. The bus-bars are spaced about 3 ft. apart, and separated by 3-inch firebrick slabs, so that it is practically impossible for a short circuit to occur between them. On the outer end of the studs supporting the bus is a plate to which are attached three cable lugs, one for the generator cable coming from the

floor above and two for the feeder cables running down through the floor below. The cables to the different busses are 12 inches apart, and separated by 4-inch brick barrier walls. These feeder cables pass through porcelain floor tubes to the feeder selector switches. These are of the knife-blade type, mounted on glass pillars on soapstone bases, and efficiently protected by soapstone barriers. An interlocking device is provided for these switches so that it is impossible

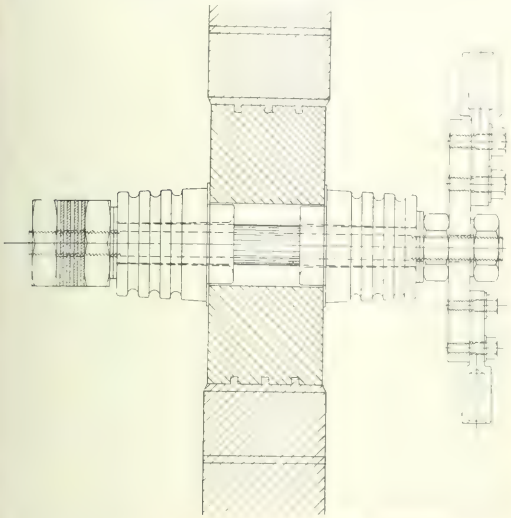


FIG. 22.—SUPPORT AND REAR TERMINALS FOR HIGH-TENSION BUS.

to connect a feeder to both busses at the same time. Directly below the selector switches are the feeder oil switches. There are two of these in series on each feeder, the single conductor cables between them being recessed in brick ducts. The upper one is controlled only by the pilot switch on the feeder board, but the lower one in addition acts as a circuit breaker, and is opened automatically by the overload and time limit relay.

This overload time limit relay is adjustable and can be set to open the automatic oil switch when the current in the feeder exceeds a



FIG. 23.—BUS BAR PARTITIONS AND CONDUITS BACK OF HIGH TENSION SWITCHBOARD.

given number of amperes for a given period of time. If before the expiration of the time limit the current again drops below the amount for which it is set, the oil switch does not operate, and the time limit relay resets itself automatically. The range of the time scale of this relay is from 2 to 6 seconds, and the range in current is from 2 to 6½ amperes. As the series transformers in use with these relays have a ratio of 70 to 1, they can be set to operate when the current in the feeder is at any point between 140 and 455 amperes.

The time limit relays in the Waterside station are set to open in 4 seconds; those in the sub-stations at points where feeders branch are set for 2 seconds, and the overload relays in the sub-stations at which the feeder terminates are set to open instantaneously.

The cell structure of the oil switch on the lower feeder switch-gallery contains the series and potential transformers for operating

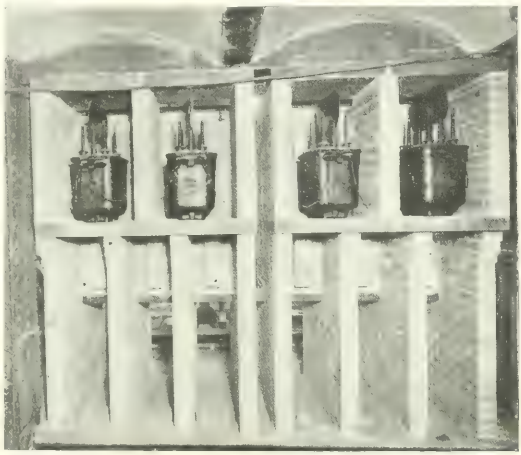


FIG. 24.—POTENTIAL TRANSFORMERS FOR VOLTMETERS ON HIGH-TENSION BOARD.

the relays and feeder instruments. These, as will be seen by referring to the cross-sections through the electrical galleries, are completely enclosed by buff brick and firebrick cellular partitions.

The three conductor lead-covered feeder cable coming from the street ends at a point directly below the lower feeder switch. A specially designed right-angle bell, or terminal head, is placed on the cable, from which three single conductors are led into the bottom



FIG. 25.—END OF HIGH TENSION BUS BARS.

terminals of the switch. These single conductor ends are just long enough to permit any one of them being placed on any of the terminals of the oil switch directly above it, thus giving an opportunity to twist the conductors when necessary for multiple connection with other feeders.

From the lower feeder switch to the manholes in front of the sta-

tion, each three-conductor cable is separated from the one on either side of it by iron or brick septums.

GENERAL SWITCHBOARD DATA.

As will have been seen from the diagrammatic plans, the high-tension switchboard, which is placed at the west end of the building, occupies four galleries. The main operating board, as described above, is on the third gallery on practically the same level as the top engine platform. Resuming in detail the features referred to, the course of the current from a single generator can be traced by referring to Fig. 19, which is a vertical cross-section through all four galleries. From the generator the current is carried in single conductor cables through the generator oil switch *A* on the first gallery, to the oil selector switch *B* on the top gallery. The object of these selector switches is to permit the generator to be connected to either the main or auxiliary bus-bars, both of which run along the rear of this gallery. From the bus-bars the current passes down through two-oil break switches, *D* and *E*, to the feeders. The object of having two switches in series is to make certain that one at least will operate to cut off the feeder when necessary. From the oil switches the feeders pass down to the basement and out into the subways, as shown in Fig. 20.

The vertical section, 4 ft. wide through the switchboard galleries, thus contains all the high-tension connections of one generator, and is so thoroughly protected by the fireproof brick partitions that it is claimed that one section complete with cables, switches and transformers might be burned up without injury to any of the others.

OIL SWITCHES.

The oil switches used are of two types, one furnished by the General Electric Company, and the other by the General Incandescent Arc Light Company, both being new types. In the oil switches supplied by the General Electric Company six simultaneous breaks are made by the raising of copper connecting *U*'s fastened to a common yoke by wooden rods. Fig. 21 shows the connections for operating these switches. The heavy lines on the right indicate the course of the high-potential current from the bus-bars to the underground transmission lines. The lighter lines show the connections for operating the oil switches and indicating instruments. The switch designated "automatic" is so called because it is opened by an overload relay; the non-automatic switches being controlled only from the switchboard.

With the connections as shown the oil switches are open. They are closed as follows: The small controlling switch, marked S. P. D. T. is raised, thus making contact on the upper point. This closes the circuit through a ½-hp series motor and a solenoid shown at the end of the shaft. The motor starts, and at the same time a worm and gear wheel is connected to it by the action of the solenoid. The gear wheel revolves and carries a crank-pin off a dead center, which pin is the middle point of a toggle. As soon as it is carried out of line, a powerful spring closes the oil switch, carrying the crank pin through nearly 180 degs. This motion is independent of the motor, which runs free, gaining speed as the spring closes the switch. There is a ratchet connection between the crank shaft and gear wheel which permits the former to be carried around by the switch mechanism free of the latter. The moment the action of the spring ceases the ratchet catches and the crank-pin is carried through the remainder of the 180 degs. by the motor, which then cuts itself off. The crank-pin is then again on a dead center, being now the lower point of a toggle. During the latter part of the closing action, the opening spring is compressed and four spiral springs are extended, all tending to open the switch but unable to do so, because of the condition due to the dead center. The entire operation takes about one second.

The main switch may now be opened by throwing the operating switch to the lower contact, closing the motor circuit through the finger 2. The toggle is thus upset and the switch flies open, actuated not only by the opening spring, which is similar to that which closes the switch, but also by the four extra springs. The opening is, therefore, made even quicker and more certain than the closing action.

The only difference between the automatic and non-automatic oil switches is that the controlling switch of the former, marked "Aut. Switch" in the figure, in addition to being operated by hand, is opened by a tripping solenoid in case of overload.

Guide rods are provided, which prevent binding against the soapstone cover and insure the accurate alignment of the contact parts. If it is desired to operate the compartment switch by hand a pair of rods with screw eyes at the base are provided into which can be hooked into a handle for operating it manually. Air bumpers are supplied to take up the final rush of the solenoids, so that no jar is transmitted to the supporting structure.

Fig. 30 shows the connections by which the main switch is operated from the switchboard or by the time limit relay. The cut shows the switch open; to close it, close the operating switch, thus energizing the right solenoid. The switch starts to move and almost instantly the blade *A* moves from point 1 to point 2, shutting the operating switch so that the motion of the main switch must continue until it is completely closed. At the moment of closing the blade *A* moves from point 2 to point 3, leaving the switch ready to be opened. In opening, the blade *A* jumps first to point 4, shunting the operating switch, and when the main switch is open, returns to 1, completing the cycle and leaving the connections, as shown in the figure.

The time limit relay is operated by current transformers in the feeder circuits. Should the current in the feeder exceed the amount for which the device is set, one of the small plungers shown is raised, and releases a disk, which revolves until it closes the circuit of a tripping solenoid which opens the operating switch. This opens the main switch in the manner already described. The relay may be set so as to take any desired amount of time after the contact disk starts before it finally opens the operating switch. The figure also shows the connections by which the pilot lamps indicate to the operator the position of the main switch. The contacts for this are independent of the position of the operating switch.

The General Incandescent switch chamber is of brick, divided by soapstone partitions into three compartments, one for each phase, and has a removable soapstone front. In each compartment are two oil wells, consisting of seamless brass tubing, with insulating lining, mounted upon porcelain insulators and connected by an inverted copper *U* connector. A wooden rod, which, after heating to drive out the sap, has been boiled in paraffine for 24 hours, connects this *U* to an iron rod at the top of the switch to which the *U*'s in the other two phases are similarly joined. This iron rod has a motion of over 14 inches, and when raised lifts the *U*'s in the oil chambers so as to make two 12-inch breaks in each phase. The switch is actuated by two solenoids, which operate a crank and connecting-rod movement so arranged that very little work is required of the solenoid at the beginning and end of its motion. The cores of the solenoids are connected by a steel tape passing over a wheel, which is turned 180 degs. to the right or left, as the right or left solenoid is excited.

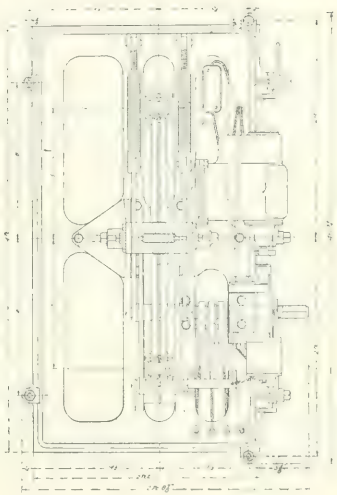
THE LOW-TENSION SELECTOR SWITCHBOARD.

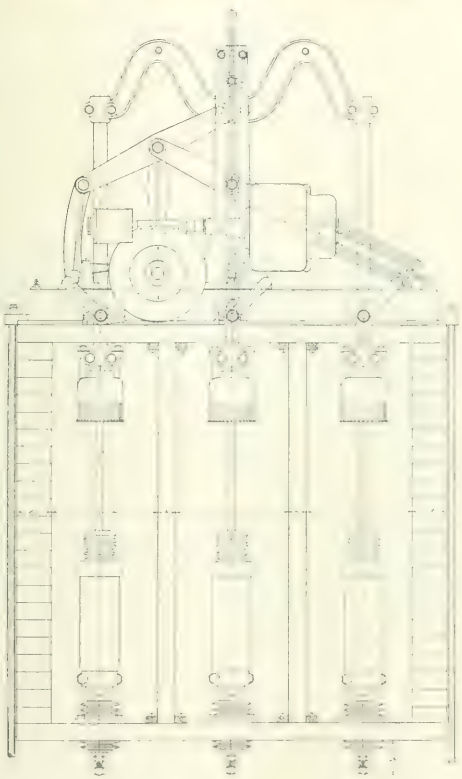
The low-tension selector switchboard (Fig. 33) on the first floor really consists of two distinct switchboards, each with three sets of bus-bars, which in case of emergency can be tied together. One of these is the exciter switchboard, from which is supplied current to the fields of the generators, and all the apparatus for operating the generator and feeder oil switches, relays, etc. The other switchboard is that of the local rotary converter sub-station, which supplies the low-tension feeders in the neighborhood, and also the crane, elevator and other motors in the building.

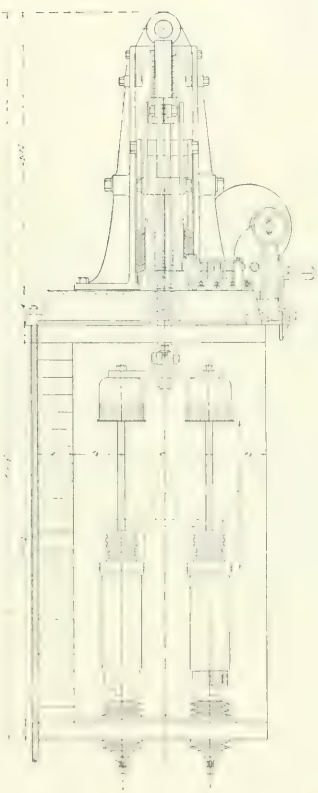
For the exciter bus-bars the current is furnished by the four exciter generators and exciter storage battery, which will be charged by a special booster. In general practice the exciters and generator fields will be connected to the lower set of bus-bars, which will be run at a potential of 240-250 volts. If it is necessary at the same time to carry the extreme overload with low power factor on some of the generators, thereby requiring maximum field excitation, their fields will be connected to the upper bus-bars, which will be supplied with current via the booster, or by an exciter run at higher voltage. The middle bus-bar of the exciter switchboard will be connected by the tying-in switch to the same bus-bar on the local rotary switchboard, so that current from the rotaries can be used for field excitation in so that current from the rotaries or from the feeders connected to the general external low-tension network can be used for field excitation in case of emergency.

The exciter generators will feed the bus through reverse current circuit breakers, so that in case of the high-tension circuit breaker opening on the alternating-current motor, the direct-current generator will be automatically disconnected from the bus as soon as it "motor-will be automatically disconnected from the bus as soon as it runs as a motor. For the local rotary station bus-bars the current will be supplied by six rotaries of 500 kw capacity each, a local storage battery and a local booster. To this bus are connected eight low-tension feeders, which supply the section of the city between Fourth Avenue and East River and Thirtieth and Fiftieth streets.

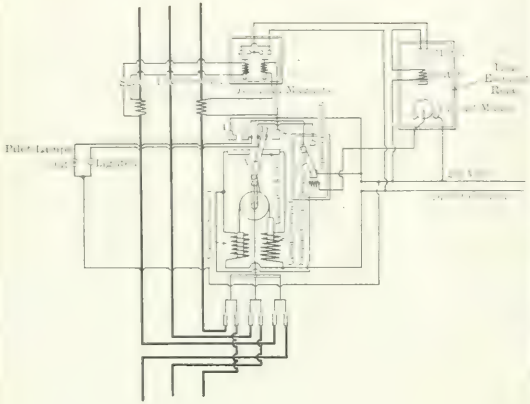


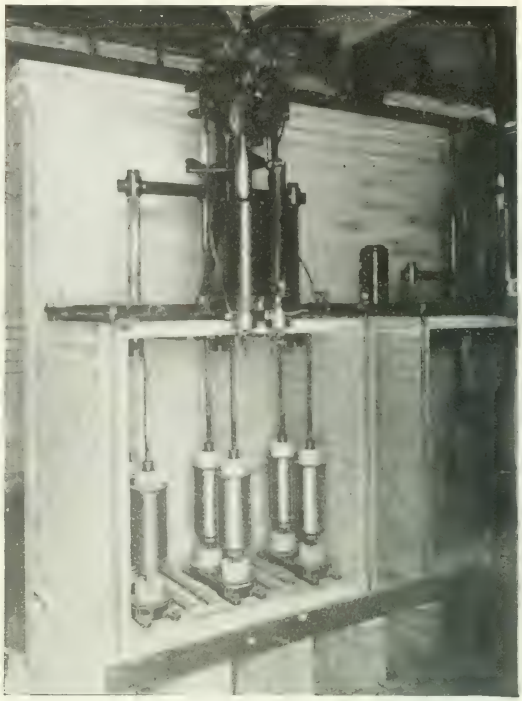


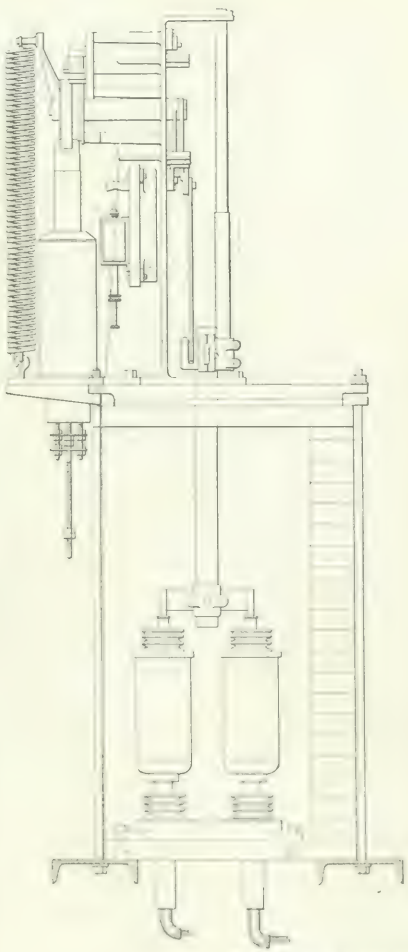


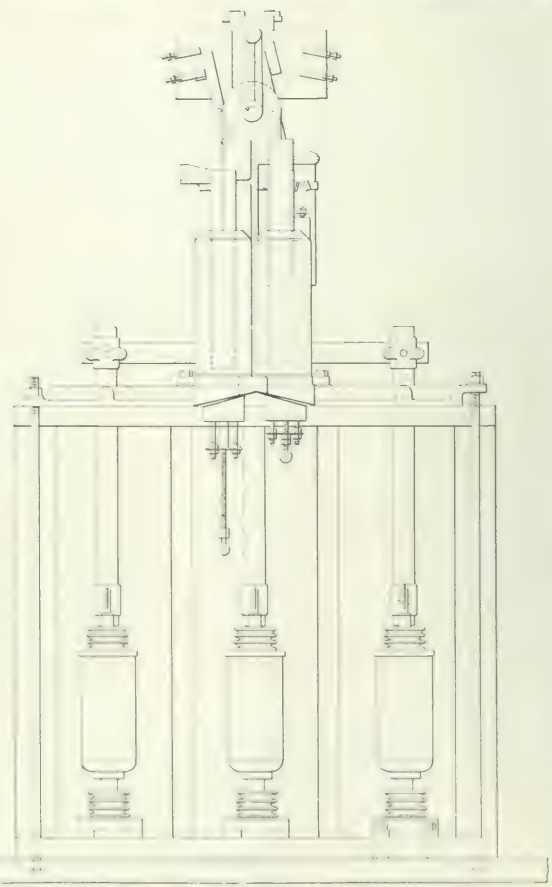


FIGS. 26, 27, 28 AND 29.—GENERAL ELECTRIC OIL SWITCHES.
WATERSIDE PLANT, NEW YORK EDISON COMPANY.









Figs. 30, 31, 32 and 32a—General Incandescent Oil Switches.

At present there is but one battery and one booster installed, and the two switchboards are operated as one. This was rendered possible by having the fields of the main generators, the fields of the exciter generators, the motors (or solenoids) on the oil switches, tripping coils of the time limit relays, crane motors, elevator motors, coal conveyor motors, etc., etc., all wound to operate satisfactorily at from 240 to 250 volts.

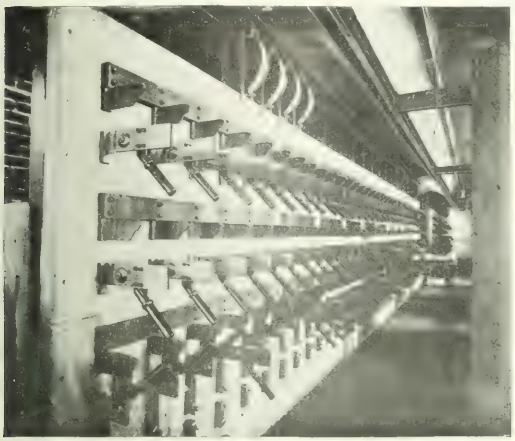


FIG. 33.—ONE SECTION OF LOW TENSION SWITCHBOARD.

The low tension selector switchboard was built by the General Incandescent Arc Light Company, on the specifications of the New York Edison Company. All the ammeters are of the Van Vleck edgewise pattern, manufactured by the Weston Electrical Instrument Company. They are of the shunt type. For the ammeters on the feeders, part of the conductor is used for the shunt. In all other cases special alloy shunts are used.

LOW-TENSION OPERATING SWITCHBOARD.

The rheostat dials, switches, etc., for controlling the exciters, rotaries and boosters are mounted upon pedestals, and directly above the pedestal of each machine is a marble panel containing the in-



FIG. 34.—CABLE VAULT.

struments. On each exciter pedestal there is a direct-current main switch, the field rheostat dials, field-break switch and the pilot switch and overload relay for controlling the oil switch. The work the exciters are doing is indicated by an alternating-current ammeter and power factor indicator for the motor, and a direct-current ammeter for the generator. On the rotary pedestal is a combination starting and main switch, by which the rotary is started as a direct-current motor. When this switch is in the starting position a rheostat and a fuse are in series with the armature; when completely closed in its running position, the fuse and starting box are short circuited. Above this switch is the field rheostat dial, the field-break switch, receptacles for synchronizing and balancing plugs, and pilot switch for operating the magnetic switches which are placed between the static transformers and the rotary.

On the booster pedestals is a combination starting and main

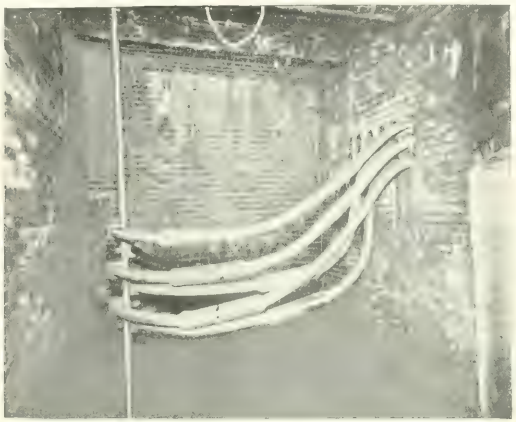


FIG. 35.—CABLE VAULT MANHOLE.

switch for the booster motor and main switches for closing the circuits of each of the booster dynamos.

The bus from which current is to be taken and the bus to which it is to be fed are determined by the switches on the selector switchboard. Above these are the rheostat dials for each dynamo, field switches, etc.

The apparatus for the control of the battery is mounted directly above the booster pedestal. This consists of four special reversing switches of the push-button type, furnished by the Electric Storage

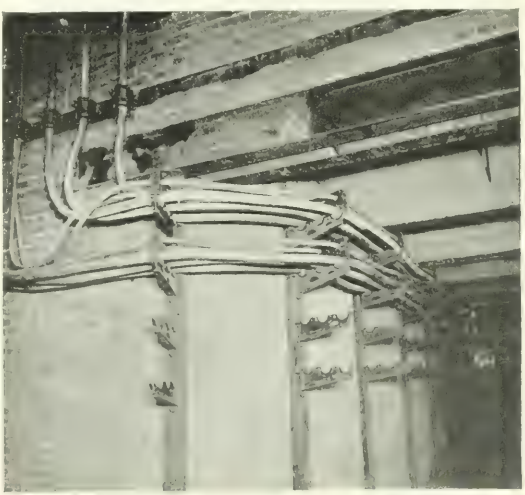


FIG. 36.—CABLE RACKS IN VAULT AND THE DYNAMO ROOM.

Battery Company. These switches control the motors operating the cell switches, which are placed in a room in front of the battery room and separated from it by an "acid fume proof" partition. Above the push-button switches are the indicators, which show the number of cells in circuit, that is, the position of the end cell switches.

THE CABLE VAULT.

The cables coming from the generators are carried on cable racks

through a cable vault running the full length of the operating room between the two rows of engine foundations. A view of this vault showing some of the cables in position is given in Fig. 36. Each rack contains three lead-covered, paper-insulated, single-conductor cables of 500,000 circ. mills cross-section, two lead-covered cables carrying the field current, and smaller wires for the motor operating the engine governor, signaling, etc. Each rack contains the wiring for one generator, and is separated from its neighbors by fireproof partitions.

From the cable vault the cables are fanned out and pass up through bricked-in cable ways to the oil-break switches on the first switchboard gallery.

The cable vaults by which the cables leave the building are also shown in Figs. 34 and 35. They are of most ample and solid construction, there being in reality a fine large cable chamber extending out from under the west front of the station, with abundant duct capacity for increase in service up to the full generating limit of the plant.

Electrical Equipment of the Manhattan Elevated Railway—I.

IN our first issue of last year a description was given of the generating plant and electrical equipment of the Manhattan Elevated Railway. During the past year the work on the plant proceeded rapidly, and it is announced that the first electric train for public conveyance will be run the present month; in fact, an experimental train may be said to be already in successful operation, and the addition of the road on an electrical basis to the rapid transit facilities of New York is eagerly awaited by the citizens. As already understood, it is proposed to start out electrical operation of the system with the Second Avenue line, and the other divisions will be taken up in regular order. An immense amount of work was necessarily done during 1901 in completing the initial equipments of the great power plant, as well as in securing rolling stock, completing track work on the Second Avenue line and making the innumerable investigations, tests, etc., that were necessary before an enterprise of this magnitude could be perfectly adapted to its destined work. Messrs. Skitt, Baker, Stillwell ,Stott and others, in fact, all the executive officials from President Gould down, have had their attention engrossed during the past twelve months by the heavy problems of this enterprise, and are, of course, still in the very thick of it. The data and the few views which are given in this and a succeeding article must, therefore, be considered as of merely a tentative nature pending fuller description and treatment of the various features of this most interesting and important work.

The central generating station, an exterior view of which is given in Fig. 1, is an imposing structure occupying the block bounded by Seventy-fourth, Seventy-fifth and Exterior streets, and fronting on the East River, this being the most centrally located site available. All the current is generated here, the plant having a maximum capacity of 80,000 hp. The main building is divided by a longitudinal wall into two parts, the boiler plant and accessories occupying one-half and the engines and dynamos the other. The dimensions of the building are 204 ft. 4 inches wide, 395 ft. deep on Seventy-fourth Street and 413 ft. on Seventy-fifth Street.

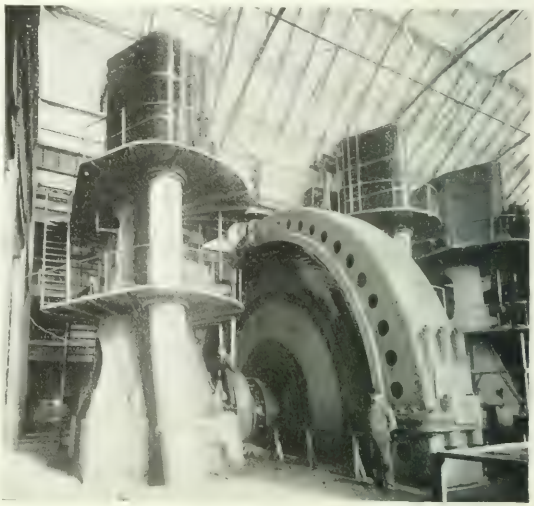


FIG. 2.—VIEW OF ENGINES AND ONE GENERATOR.

The unit plan was adopted for the general design of the power plant, the equipment being arranged in eight complete and practically independent units, each consisting of one engine and alternator, four batteries of boilers, one condenser and one boiler-feed pump, all connected by the necessary piping. The location of the plant on the river front affords an easy and economical means for handling coal and ashes.

The boiler equipment comprises 64 Babcock & Wilcox horizontal water-tube boilers of 525 hp each, arranged in batteries of two each, and capable of sustaining safely 200 lbs. working steam pressure. Mechanical stokers of the Roney type are used, and it is estimated by the engineers for the Manhattan Company that while at least 270 men would have been required to fire these boilers by hand, with the mechanical stokers, this force can be reduced to 90 men, a saving in labor alone of over $400 per day. Another important advantage thereby gained is that hard or soft coal may be used, either separately



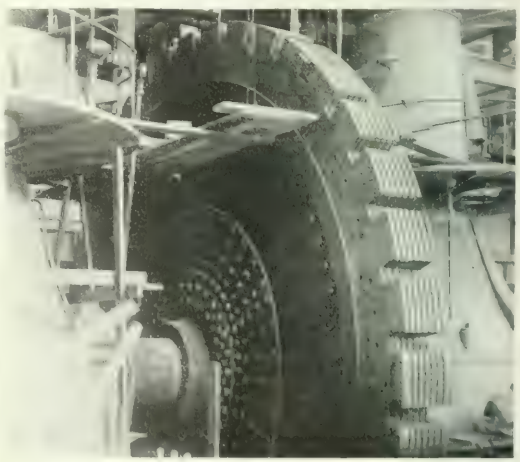


FIG. 3.—REVOLVING FIELD.

or mixed. For this no alteration is required in the arrangement or construction of the stoker, merely a different adjustment of the feed and grate-actuating mechanism. The present installation will consist of 256 stokers under the 64 525-hp boilers, and they will be capable of developing 50 per cent above the rated capacity of the boilers. The total equipment when the plant is completed as designed will consist of 384 stokers attached to 96 525-hp boilers, or a total of 50,400 hp, making this the largest boiler plant ever designed or installed.

Sixteen Green fuel economizers are employed, one for every two batteries of boilers. They are of the high-pressure type and aggregate 8192 tubes. Huge stcks have been erected, which are of sufficient dimensions to furnish enough draft for ordinary requirements, but as a precautionary measure 16 Sturtevant blowers are installed to furnish forced draft when needed. These blowers will be operated by alternating-current motors. All of the feed pumps, eight in number, of the Gould triplex, single-acting type, are driven by 500-volt direct-current motors.

The generating machinery will comprise eight 5000-kw Westinghouse alternators, directly connected to Allis-Corliss engines, of which two units are now ready for use, the others being in various stages of completion. A general view of the generating room is given in Fig. 4, and another view in Fig. 2. Each unit has a nominal rating of 5000 kw, but has a maximum capacity of 10,000 hp, and enjoy the distinction of being the largest electrical generators that have ever been erected.

The steam engines were built after designs of Mr. Edwin Reynolds, and each consists of a pair of compound engines working upon the same shaft, the high-pressure cylinders being horizontal and the low pressures vertical, the high and low of each end taking hold of the same crank pin. The dimensions are 44 inches and 88 inches and 5 ft. stroke, the revolutions being 75 per minute.

The capacity of the engines is from 7500 hp to 12,000 hp maximum. To get this capacity into a two-cylinder engine of the ordinary cross-compound type would require cylinders 62 and 124 inches in diameter. By the use of four cylinders each crank is given four instead of two impulses at each revolution, which makes the turning effort upon the shaft so uniform that the revolving field of the generator takes the place of the flywheel. The ordinary Reynolds-Corliss valve gear is employed, with a single eccentric on each high-pressure cylinder and separate eccentrics for the steam and exhaust valves of each low-pressure cylinder. The two sides of the engine are entirely distinct, and one can be run with the other uncoupled without affecting its steam efficiency.

Each of the great Westinghouse generators delivers three-phase currents at 11,000 volts, which, if necessary, may be raised to 12,000 volts. The wave-form generated is practically a true sine curve under all conditions of load and power factor, and the regulation from no-load to full load is guaranteed to be within 6 per cent. The rise in temperature above the surrounding air of any part of the machine under full load for 24 hours is not to exceed 35 degs. C., and at 50 per cent overload, or 7500 kw, it is not to exceed 55 degs. C. The efficiency at full load from engine to switchboard is 96.5 per cent.

The revolving parts of the dynamos are particularly designed to secure very unusual strength and consequent ability to resist the tendency to burst and fly apart in case of temporary abnormal speed through accident of any kind. The hub of the revolving field, which is also the flywheel of the engines, is of cast steel, and the rim is carried not by the ordinary spokes, but by two webs of rolled steel.

The angular velocity of the revolving field, as determined by the

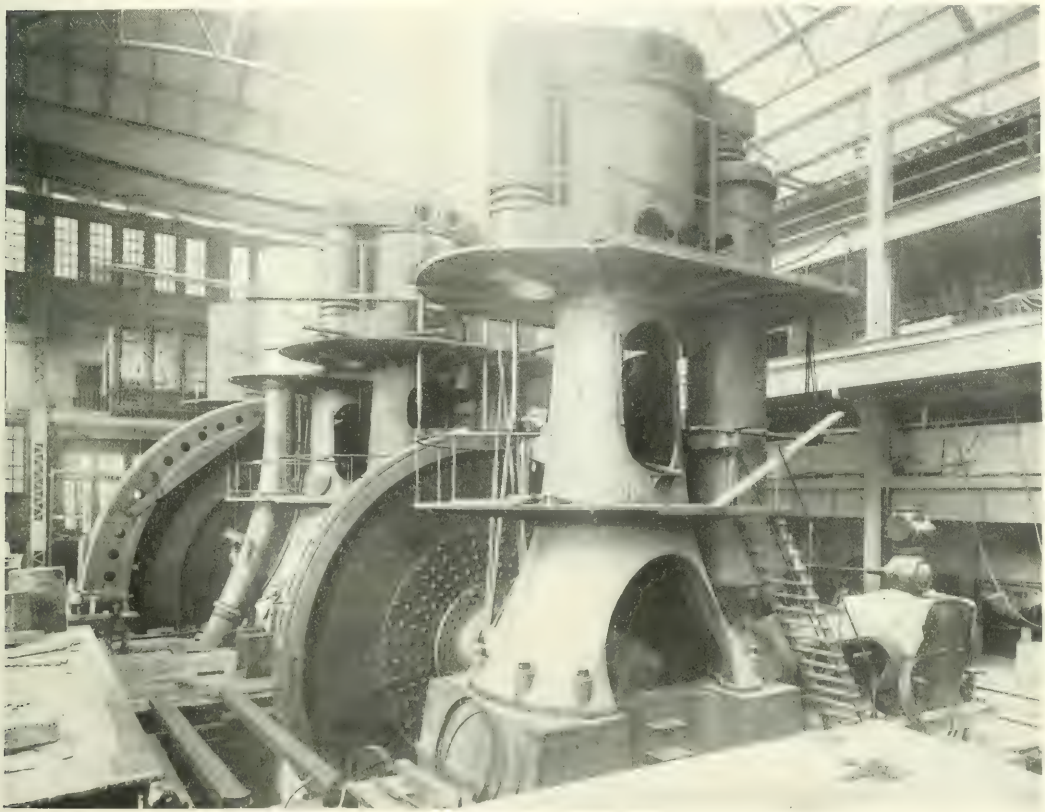


FIG. 4.—GENERAL VIEW OF ENGINE ROOM, MANHATTAN RAILWAY POWER HOUSE

relation of flywheel effect and torque or turning moment exerted upon the shaft by engine pistons, is uniform to an extraordinary degree. The revolving field, which is shown in Fig. 3, is 32 ft. in diameter, and in operation turns at 75 r. p. m., making its peripheral speed 7540 ft., or more than a mile a minute. Its weight is 370,000 lbs.

There are 40 field poles, built up of laminated steel. They are wound with copper strap on edge, one layer deep and the insulating material is cemented in place between the turns. The edges of the strap are exposed in order better to dissipate the heat developed. The normal exciting current for each alternator field is approximately 225 amperes at 200 volts, and the winding is so designed that the excitation can be increased to care for an overload of 50 per cent and a 90 per cent power factor. The field windings are held upon the poles by copper wedges driven between the pole tips. These wedges also serve to preserve constant the wave-form generated.

The armature, of which a section is shown in Fig. 5, consists of six castings bolted together, to which is attached the armature core. The latter is a built-up ring composed of thin, soft steel plates with slots on the inner surface, in which are placed insulated coper bars, con-

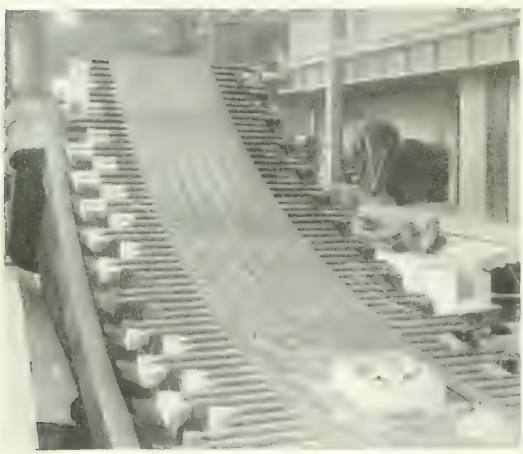


FIG. 5.—SECTION OF THE STATIONARY ARMATURE.

stituting with their end connectors the armature winding. The steel plates are separated at intervals by ventilating spaces.

In order to produce a wave-form free from irregularities and of the same shape at different loads, a distributed winding with four armature slots per phase per pole was adopted. This tends to avoid the production of harmonics, which is an especially important matter in view of the large capacity and self-induction of an extensive system of cables and transmitting apparatus, especially where a large number of 1500-kw rotary converters are to be employed. Each slot contains three bars, which are securely fastened to the end connectors. The bars in any slot may be removed without disturbing the bars in the other slots and without moving the frame of the machine. The armature conductors are insulated to withstand a puncture test of 25,000 volts alternating current for 30 minutes.

The most important feature of the auxiliary plant at the power house is the exciter equipment. Current for exciting the fields of the alternators will be supplied by a battery of four 250-kw exciters, also furnished by the Westinghouse Company. These exciters are of the engine type, the armature and commutator of each machine being bolted together upon a ventilated cast-iron sleeve and pressed upon the engine shaft.

It is proposed also to install rotary converters and transformers at the central power station for furnishing current for operating motors, and the lighting plant. Altogether the lights and motor service from this plant irrespective of the car equipments will require as much current as many central stations in fair-sized cities.

In a following article the distribution system, including the rotary converters, will be described.

Complete Commercial Test of Polyphase Induction Motors Using One Wattmeter and One Voltmeter.

By A. S. McAllister.

THE ordinary factory or laboratory method of testing induction motors for performance and efficiency by direct measurement of the input, output, power factor, speed, etc., leaves little to be desired in cases where suitable testing apparatus is available. Even in such cases, however, the large number of instruments ordinarily required for testing is a source of objection, since each for accurate results must be properly calibrated and used without error in observation during a test. Obviously the less the number of instruments used in a test the less the liability for errors, except in such cases where one instrument may be used as a check upon another.

Outside of laboratories and the testing rooms of manufacturing establishments the number of instruments available for testing an induction motor is usually quite limited, in most cases including only ammeters, wattmeters and voltmeters, and seldom, indeed, any equipment for directly measuring the mechanical output. The desirability of reducing the requisite apparatus for a complete test is recognized by all. The suggestions offered herein are such as tend towards the elimination of all unnecessary apparatus.

The method of testing a transformer by separation of the losses is well known. Such a method, which by a few slight modifications can be applied to induction motors, is given below. Most of what is

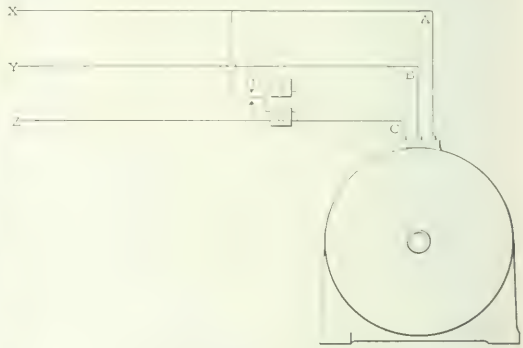


FIG. 1.—DISPOSITION OF TESTING CIRCUITS.

stated in this connection is true for any induction motor under any condition of service, though the greatest simplicity in testing and the requisite use of the least number of instruments will be obtained only with polyphase motors operating on well balanced and regulated circuits. Each element of a test will below be treated separately.

Slip.—The determination of the slip of induction motor rotors by counting the r. p. m. of both generator and motor is open to many objections. If the two readings of speed be not taken simultaneously though the true value of each be correctly observed, when the speed of either is fluctuating the value of slips will be greatly in error. A slight proportional error in either speed introduces an enormous error in the slip. Where the generator is not at hand the above method obviously cannot be directly applied, and is applicable only when a synchronous motor is available for operation from the same supply system as the induction motor.

When the secondary current can be measured and the secondary resistance is known, the most accurate and convenient method for determining the slip is from the ratio of copper loss of secondary to total secondary output.

If we let I_2 be any observed value of secondary current, R_2 the secondary resistance and W_0 the output of the motor, then

$$\text{Slip} = S = \frac{I_2^2 R_2}{W_0 + I_2^2 R_2} = \frac{\text{Copper loss of secondary}}{\text{total secondary output}}$$

As a proof of this fact, consider the magnetism cut by the secondary windings to be of a strength which would cause to be generated E_2 volts in the windings at 100 per cent slip.

Let S be any given slip, W_2 the total secondary watts, φ the angle of lag of secondary current, and $L_2 W$ the secondary reactance at 100 per cent slip, then

$$\frac{I_2 R_2}{W_2 - I_2 R_2} = \frac{I_2 R_2}{W_2} \qquad \frac{I_2 R_2}{I_2 E_2}$$

$$I_2 = \frac{S E_2}{R_2 - S W_2} = \frac{S E_2}{R_2}$$

and $$\frac{I_2 R_2}{I_2 E_2} = \frac{S I_2 E_2 R_2}{I_2 E_2 R_2} = S$$

Since neither E_2 nor $I_2 W_2$ appears in the above equation, the relation is independent of the strength of field magnetism cut by the secondary windings and of the secondary reactance.

Torque.—The rotor torque can be ascertained with the highest degree of accuracy and facility from the ratio of secondary input to the synchronous speed, that is, the torque is expressed in pounds at one-foot radius by the following equation:

$$\text{Torque} = T = 7.04 \frac{W_p - L_p}{\text{syn. speed}}$$

where Wp is the total primary input; Lp the total primary energy losses, and the synchronous speed is in r. p. m.

If Lp includes the friction, T will equal the external rotor torque, while if Lp includes only the true primary iron and coper losses, T will be the total rotor torque.

To prove the above expressed relation, let Ws be total secondary input, W_0 the motor output, and s the rotor slip. Then

$$T = 7.04 \frac{W_s}{\text{r. p. m.}}$$

but $W_s = W_0 (1 - s)$ and $\text{r. p. m.} = \text{synchronous speed} (1 - s)$

Therefore,

$$T = 7.04 \frac{W_0}{\text{syn. speed}}.$$

Therefore, for a given primary input and primary losses the rotor torque is independent of secondary speed or output, and any error in the determination of either of the latter quantities need not affect in the least the value obtained for the torque.

If the total energy received by the secondary is used up in the secondary resistance the equation for the torque will be

$$T = 7.04 \frac{I_2^2 R_2}{\text{syn. speed}},$$

or starting torque, which, as is well recognized, may be increased by any method which will increase the stationary secondary copper losses.

Resistance of Squirrel Cage Secondary.—Due to the inability to insert measuring instruments in the secondary of squirrel-cage induction motors, the ordinary direct-current method of determining the resistance cannot be used.

If the rotor be clamped to prevent motion a wattmeter placed in the primary circuit will read the copper loss of both primary and secondary when the e. m. f. across the leads is reduced to give a fair operating value of primary current. If from the reading of watts thus obtained there be subtracted the known copper loss of the primary for the current flowing, the value of the secondary copper loss will be secured. The resistance of the secondary (reduced to primary) will be obtained by dividing this loss by the square of the primary current.

Secondary Current.—When the motor has a squirrel cage secondary winding, measurement of the secondary current cannot be made directly, but the determination of its value must be by calculation. The variation in value and phase of the primary current may serve as an indication of the current flowing in the secondary windings, though the actual increase in primary current does not represent the increase in secondary current.

The difference between the power components of the primary current at no load and under a chosen load equals the equivalent increase in the power component of the secondary current under the same conditions, while the difference between the quadrature components of the primary current at the same time is a measure of the equivalent increase in the quadrature component of the secondary current.

When the no-load value of secondary current is negligible the vector sum of the above-found components represents the secondary current for the chosen load in terms of the primary current.

Primary Power Factor.—For a single-phase motor the determination of the primary power factor will usually involve the measurement of primary watts, volts and amperes.

For two-phase motors with equal e. m. f.'s across the separate phases, one wattmeter alone may be used to obtain the power factor by simply transferring the pressure coil from one phase to the other, leaving the current coil always in one lead. The reading of the wattmeter in one case will be $W_1 = I E \cos \phi$, and in the second case, $W_2 = I E \sin \phi$; whence $\tan \phi = \frac{W_2}{W_1}$, from which may be obtained the power factor.

For three-phase motors one wattmeter can similarly serve to indicate the power factor. The wattmeter readings will be $W_1 = I E \cos (\phi - 30^\circ)$; $W_2 = I E \cos (\phi + 30^\circ)$, whence $\tan \phi = 1.73 \frac{W_1 - W_2}{W_1 + W_2}$.*

Primary Current.—If the primary e. m. f. watts and power factor

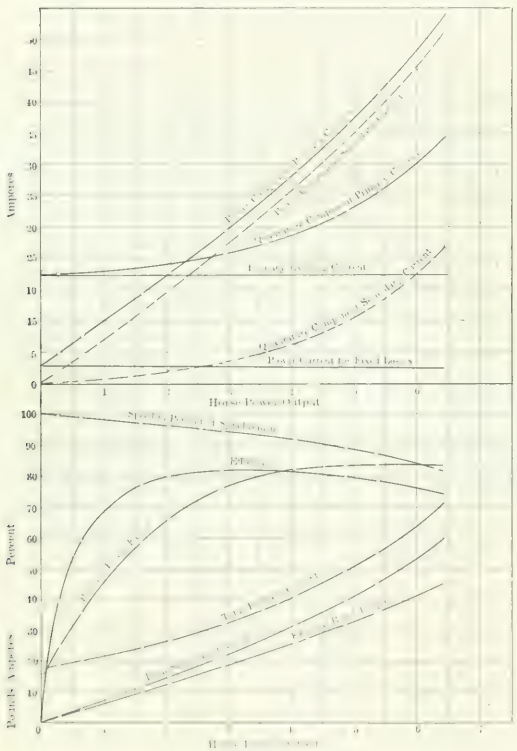


FIG. 2.—TEST CURVES.

be known, the primary current can readily be calculated and, therefore, need not be measured.

It is evident from the above discussed facts that with two and three-phase induction motors operated from circuits having constant and equal e. m. f.'s across the separate phases, one wattmeter and one voltmeter can be used to determine primary watts, amperes and volts, and secondary amperes, and that when the primary resistance is known or can be measured the complete performance efficiency, etc., of the motor can at once be calculated.

Below there is given the log orithmic calculations and curves of such a test made upon a 5-hp, eight-pole, 60-cycle, three-phase induction motor. The primary resistance between leads at running temperature was .155 ohms, equivalent to a secondary resistance of .56 ohms.

Since the copper loss of three-phase receiver is expressed by the equation $W = 3 C^2 R$, the [illegible] between lines and [illegible] the current flowing in each lead, for either star or delta-connected receiver no attention need be paid to the method by which the primary coils are interconnected within the motor or, in fact, whether the secondary be wound delta, star or squirrel cage.

Tests made upon this same motor by the output-input methods agree throughout the whole range of the test with the herewith recorded test within the limits of the inevitable errors of observation of the various instruments used in the tests.

Electric Gas Lamps and Gas Electrical Resistance Phenomena*.

BY PETER COOPER HEWITT.

ON a former occasion I had the honor of showing to the members of the Institute lamps utilizing the conductivity of gas for illuminating purposes, including experiments illustrating certain laws of conductivity of gases, and I also presented curves directing attention to various characteristics. It gives me pleasure to-night, while showing lamps in operation lighting this room, to describe some of the phenomena exhibited by the lamp and to indicate some of the difficulties encountered in determining the relative values of the resistances therein.

The mercury gas lamps exhibited to-night are operated on the standard Edison 118-volt direct-current circuit installed in this building; lamps of this class consume amounts of current varying from 1 to 6 amperes, and the energy is approximately ½ watt per spherical candle-power. Under better conditions as high an economy as ¼ watt per spherical candle-power has been obtained, determined by careful and accurate measurements. Measurements were made by measuring sections of the lamp varying in length from ¼ of an inch to 3 inches, shielding the lamp and leaving a slot in the shield of the length mentioned and measuring the light transmitted through the slot. These measurements have been made with lamps of various diameters. Dr. Max von Recklinghausen has made independent measurements, comparing the illuminating value of the lamps with incandescent lamps of equivalent rated candle-power, and the results of such tests agreed remarkably well with the mesurements obtained upon photometers.

I have made lamps with diameter of bore less than ⅛ of an inch and as large as 3 inches, and from less than 3 inches in length up to over 10 ft., giving from less than 10 candles up to fully 3000. Lamps of very small bores give more trouble in manufacture and operation than those of moderate size. Lamps of innumerable shapes and dimensions have been constructed and great variation of candle-power for various diameters obtained. There appears no reason why lamps may not be made of any size required and of any desired candle-power per inch within wide limits, the only limitation appearing being that imposed by softening of the glass when too many candle-power per inch are produced. The general rules established regarding their operation hold good in so far as examined, and it is possible to predetermine with almost absolute exactness the voltage, current consumption and candle-power of a lamp when the manufacture is perfect.

The light produced by pure mercury gas comprises orange-yellow, lemon-yellow, green, blue, blue-violet and violet; and although all shades of these colors may not be present, their absence would not be so seriously felt were it not for the absence of the red. For some purposes the lack of red in the spectrum is objectionable, but for many uses it is a positive advantage.

For shop work, draughting, reading and other work where the eye is called upon for continued strain, the absence of red is an advantage, for I have found light without the red is much less tiring to the eye than with it. It is possible to transform some waves of this light, especially the yellow light, into red light, and thus in a measure to overcome this defect where required for general indoor illumination. A moderate amount of ordinary incandescent light interspersed with the mercury gas electric light serves to supply the deficiency, and the mixture may be made most satisfactory. For ordinary street lighting purposes the mercury light is available even without the red, and it should be noticed that this light has very great penetrating power and seems to be effective through greater distances

* A paper read before the American Institute of Electrical Engineers, New York, [illegible]

than an equivalent amount of measured candle-power from the ordinary incandescent lamp. This may be due to the fact that the waves of the red light are less penetrating than those waves which are present in the mercury light, and hence the least valuable portion of the spectrum having such illuminating effects is omitted and the energy is practically expended in the more useful portions of the spectrum.

I have made lamps in which this color objection has been overcome, sacrificing on some occasions the extremely high light efficiency obtained in this particular lamp. Without doubt lamps of this type will be produced whose light will be even more beautiful than this light is objectionable; in fact, I have produced very beautiful and becoming light. Every gas gives its own particular spectrum when traversed by current, only part of which is visible, and that one having its spectrum richest in the visible portion is the most efficient for service as a lamp. Each develops its own color peculiarities and presents its particular electrode phenomena, chemical and physical, but I am convinced it is only a matter of patient work to render many gases practically available as light-giving media. When it is considered that this light, when obtained with mercury gas, has an efficiency at least eight times as great as that obtained by the ordinary incandescent lamp, it will be appreciated that it has its use in places where lack of the red is not important, for the economy of operation will much more than compensate for the somewhat unnatural color given to illuminated objects.

I would like to state some of the phenomena that had to be unraveled before it was possible to establish the laws governing the operation of electric gas lamps. The conductivity of the gas of the lamp, which is the most important factor, is dependent upon the diameter of the gas column, the length of the gas column, the density of the gas in the column and the resistance factor of the particular gas; with these must be considered the resistance at and about the respective electrodes to obtain the total resistance presented by the lamp. In determining the relative values of these it was assumed that the resistance of the gas column would vary directly as the length; this has so far proved to be true. From the results of a great number of experiments, and from some particular ones, I was able to demonstrate that the resistance varied inversely with the diameter; not as a square, as in metallic conductors, but very nearly as the first power. It is very difficult to obtain identical surroundings for lamps of different diameters, and I am of the opinion that any discrepancy that occurs is due to difference of environment. I was able to demonstrate that the resistance varies inversely with the quantity of the current passed, which means that the lamp requires a constant voltage unless some change takes place. The voltage across the terminals of the lamp is modified by the density of the gas, a gas having a density of maximum conductivity or a certain definite amount of matter and molecular movement best suited for conduction. Beyond the point of maximum conductivity the resistance appears to increase absolutely directly with the density, but I wish to state that my means of measuring at these low densities were not sufficiently accurate. The density is an entirely controllable factor, and is one of the best means of controlling the voltage. The laws above stated appear to hold good as to gases, generally.

The electrode resistance at the positive, providing there is no alteration of the chemical or physical condition of the electrodes, may, from a practical standpoint, be regarded as being very slight and will be neglected for the present.

The negative electrode resistance offered very great difficulties and required long and patient experimental investigation. I found that it consisted of a variety of factors, and I will briefly direct attention to those which appear to have the more important bearing upon the operation of the lamp. There is a reluctance to the initial passage of current which appears as if self-created by the current—as if by induction. Upon increasing the voltage applied thereto, current passes to a very small extent and thereupon there is a fall in resistance. To increase this small amount of current the voltage must be still further increased. On further increase of current this resistance apparently ceases and there is an enormous decrease of voltage. This resistance apparently does not exist when chemical or physical alteration occurs at the electrodes.

When the last-named resistance is overcome by reason of passing current, a flame may be noticed proceeding from the negative electrode in a direction perpendicular to the surface from which it issues. If this flame meets the current in a right line, that is to say, projects in the direction of the flow of the current at the point of meeting, the total resistance of the lamp is materially greater than when the flame proceeds in a direction at an angle to the flow of the current.

When the flame is proceeding from the negative electrode at an angle to the line of the current, then the resistance at the negative electrode, under the conditions which are established is reduced, and practically speaking, the principal and controlling resistance of the lamp is then located in the gas-path proper.

The reluctance to starting is greatly modified by charging the surface of the lamp exterior to the negative electrode positively, and also in a less degree by dissipating the charge that collects there. It is for this reason that the lamps have a conducting band exterior to the negative. This resistance may also be modified by charging and discharging the lamp with a high-voltage current.

I may here add that these initial resistances to the passage of current may be overcome by an impulse of high potential, as by the discharge of a reactive coil.

Electrical relations, as well as chemical, exist between the various kinds of gases used and electrodes of different materials, so that the presence of some other matter, "foreign matter," may bring about a total change of conditions and phenomena which normally should exist at the negative electrode in a state of purity. These conditions give rise to new and unexpected phenomena, and phenomena of great importance are brought into existence at the positive electrode. In the practical manufacture of the lamp, when abnormal conditions arise, that is to say, when other phenomena than those above outlined appear, or those above outlined do not appear, it is customary to attribute them to the presence of "foreign matter."

From what has been stated, it will be seen that the problems, which had to be solved to produce a lamp, comprised, among others, not only the determination of the conductivity of the gas column, involving the relations of the length and diameter, but determining the relative values of the other different factors of the electrical resistances, resistance at the electrode, etc.; determining the conditions accompanying varying densities, the variations in the conductivity with respect to the amount of current flowing; also methods of finding a pure gas with stable chemical and physical conditions within the lamps, and also determinnng the relations of the electrodes and gas with respect to each other under operating conditions.

In one experiment shown upon the former occasion referred to, the initial resistance to the passage of the current was illustrated and the electrical leak through this resistance was measured; but at that time no attempt was made to point out the several resistances or factors thereof which have been referred to above.

In some particular forms of lamp the resistance at the negative electrodes has been availed of to render the negative electrode itself a source of light. Such conditions were established that no physical or chemical change took place at the negative electrode, and it developed that the electrode could then be heated to any desired temperature. Iron electrodes under these conditions may be maintained at a very high temperature and give off considerable light, the electrode itself being then the chief source of light. I even succeeded in melting platinum and maintained it in a molten puddle.

I might mention an interesting negative electrode experiment where an ordinary lamp about 30 inches in length contained a rod of metal one-eighth inch in diameter, projecting from the mercury negative to an eighth of an inch of the positive electrode, which was located as usual, and a movable bridging piece permitted bringing this rod into electrical connection with the positive. On forming contact and breaking, the current shoots to the mercury negative, although the total resistance over the lamp requires 60 volts with about two amperes passing, while that of the rod was negligible with respect to ohms.

The presence of slight impurities in the lamp serves to vary the resistance to starting in a very marked degree. Under some conditions impurities or "foreign matter" facilitate conduction, whereas under other conditions "foreign matter" serves to greatly increase the resistance.

Referring again to the flame occurring at the negative which is present while the lamp is in operation, it may be stated that the direction of the flame is largely, if not entirely, independent of the direction of the current, and is determined by the plane of the surface receiving the current. The direction of the flow of the current to that surface is, generally speaking, through the shortest path from the positive electrode, so that if the entrance plane of the negative electrode surface be out of the perpendicular to the flow of the current, then the flame may be made to proceed in a direction out of the path of the current, and thus will not interpose its resistance to the current flow. In some of the types of lamps shown here to-night, the surface of the mercury constituting the negative electrode, as will be seen, does

occupy such a position with relation to the path of the current, and the flame proceeds in a line out of the path of the current. In some of the lamps, for the purpose of causing the position at which the current passes into the negative electrode to remain fixed and the flame regulated, the metal leading-in-wire is carried to a point at the surface of the mercury, and the path of the current once being fixed upon this point, remains there instead of wandering about the surface of the mercury, the current entering the meniscus. The flame may be deflected and its position controlled by the use of a magnet when so desired. Where no point is used there is a tendency for the current to wander and burrow, as it were, into the body of mercury. This results in temporary depressions, so that the flame may proceed from the walls of these depressions in a direction at an angle to the direction taken by the current, but the wandering of the current about the surface of the mercury will necessarily cause a constant shifting of the direction of the flame and cause variation in the resistance of the lamp.

I have used other gases than the vapor of mercury as the gas-path, but mercury is more convenient for general experimental investigation for many reasons, among them the fact that as a negative electrode, its resistance is stable; the readiness with which the alteration of its condition may be brought about; the high efficiency of a mercury gas as a light-giving medium, and also the fact that it can easily be obtained in a fairly pure state.

"Illumination" Discussion Before the Institute.

"Illumination" furnished the topic for the meeting of the American Institute of Electrical Engineers held in New York and Chicago Jan. 3. This meeting, according to the regular schedule, would have been held the last Friday in December, but as this date fell in the holiday week it was deferred to Jan. 3. Six papers were read before the meeting, of which we print two in full elsewhere in this issue—that by Mr. Peter Cooper Hewitt on mercury vapor lamps, and the paper by Mr. Clayton H. Sharp on the advantages of the acetylene-oxygen flame for use as a primary photometric standard. The other papers, of which abstracts are given below, were presented by Dr. Louis Bell, Mr. John W. Howell, Mr. S. Everett Doane and Mr. W. D'A. Ryan.

Dr. Bell discussed the subject of illumination in its general and practical aspects rather than with relation to the technical details of electrical lighting. He considers that the three most important qualities for a practical illuminant are, in their order of importance, as follows: Steadiness, suitable intrinsic brilliancy and suitable color. The importance of steadiness cannot be overestimated, for without it in a rather high degree, an illuminant is both impracticable and dangerous to the eye. Eyes differ in sensitiveness, but a variation of 10 per cent with some is annoying and trying. Assuming the constant or retinal persistence to be one-fiftieth second, a 10-per-cent falling off in brilliancy would correspond to about one-fiftieth second, and one is safe in saying that sudden flashes one-fiftieth second apart would cause trouble at once, and probably, owing to frequent recurrence, very serious trouble. An alternating arc worked with small current density gives such succession of flashes, and instead of a certain amount of thermal stability, would be quite impossible at a frequency of 25 cycles, and is bad even at a frequency of 100 cycles per second. Since incandescent lamps have a greater thermal stability, they present smaller fluctuations due to frequency, but are very bad at 15 to 20 cycles, and show fluctuations troublesome to some eyes up to and even about 35 cycles. In conclusion, Dr. Bell considers that any source of light subject to rapid and frequent variations as great as 5 per cent is unfit for use as an illuminant for work requiring steady use of the eyes.

As to intrinsic brilliancy, the brightness of the radiant used in artificial lighting is a matter of great physiological moment. The fundamental rule of proper illumination is to keep brilliant radiants out of the field of vision. The real criterion of visual usefulness is not the illumination, but the product of this by a factor dependent upon the effect of the aperture of the iris. A criterion to be applied is illumination divided by a constant referring to the intrinsic brilliancy of the retina. The comparative values of this constant as given by L. Weber are as follows: Horizontal white card, brilliant sunlight, 25; white sunlit cloud, 7; Argand burner, 6.25; horizontal white card, dull winter day, .26. Dr. Bell concludes that for radiants within the field of vision at the distance ordinarily met with in interior lighting, a value of 5 is about as high as it is wise for hygienic reasons to go. With proper diffusion, the entire globe surface may be taken as radiant, and for a first approximation the radius of a spherical diffusing globe should be at least

$$r = \frac{C.\ P.}{5}$$

C. P. being the candle-power.

As to color, it is the orange, yellow and green that make up the working luminosity of the spectrum formed by sunlight, to the extent of about 80 per cent, and even were a brilliant deep blue or red light produced it would require far greater energy for the same luminous effect than the yellow or greenish light. The eye unquestionably does its best work by light approximately like that through which it has been evolved—sunlight. The ideal artificial light, from a purely utilitarian standpoint, should resemble average sunlight.

Dr. Bell divides classes of illumination into general and directed, and draws a distinction between light intended to be generally diffused and light intended to facilitate particular operations at particular points. By skilfully treating illumination, superior results may be produced with a saving of energy. There are two criteria for judging sources of light—illumination and intensity. The former is an extremely difficult thing to measure with precision, as there may be 10 per cent or more error, and the instruments are subject to peculiarly large personal errors. Dr. Bell considers that to judge commercial illuminants as far as quantitative relations are concerned, intensity measurements should be used, qualitative relations being left to consideration on their merits.

Under the head of "Intensity of Illuminants" the several more important sources of light are discussed. The Hefner-Alteneck lamp is stated to be quite accurately reproducible and fairly steady, but is open to the objection that it is of very small intensity and of extremely bad color. Dr. Bell considers that the Vernon-Harcourt pentane standard is worthy of respectful consideration.

As to units, that which has the greatest importance in a practical way is the unit of luminous flux called lumen. The conception of light outflowing from the center and of all available light as quantity, based upon this conception, Dr. Bell considers to be a most useful one. The total light given by any radiant must evidently be expressed in some such way as this in order properly to take account of its sometimes very great variations in different directions. The total luminous radiation is an important scientific problem, and the main spherical intensity is the only ground in common upon which all can stand. Dr. Bell states that as chairman of the committee of the National Electric Light Association for the rating of incandescent lights, he has wrestled for the last five years with the intricate and annoying problem of finding for commercial convenience, if possible, some reliable and simple method of applying a common test to radiants differing even so little in distribution as do incandescent lamps; after canvassing the whole question and examining a vast amount of data on the subject, and after struggling to escape all the details of the somewhat intricate mean spherical measurement, he is compelled to fall back upon it as the court of last resort in matters of illumination.

The paper presented by Mr. W. D'A. Ryan consisted mostly of an argument in favor of the alternating-current arc lamp for street illumination as against the open arc, incandescent lamp and the direct-current enclosed arc. The conclusions of Mr. Ryan are as follows:

First.—Open arcs give a higher maximum candle-power than enclosed arcs of corresponding wattage, but the maximum candle-power is in an undesirable direction and the light fluctuates through wide limits. Enclosed arcs give a higher candle-power through the most useful angle from, say, 3 to 10 degs. below the horizontal. The light from the enclosed arc is more uniform and steadier and generally superior from an illuminating point of view to open arcs.

Second.—Direct-current enclosed arcs produce slightly higher candle-power than alternating-enclosed arcs of corresponding wattage, but so far as the illuminating value is concerned the two lamps are on a fair basis of equality, both being superior to the direct-current open arc.

Third.—Small unit arcs will illuminate proportionately greater distances than large units for a given expenditure of energy.

Fourth.—Incandescent lamps do not illuminate brilliantly to a sufficient height above the street surface to produce the effect of good lighting and are, therefore, not comparable with arc lights.

Mr. John W. Howell read a paper entitled "The Incandescent Lamp of To-day," in which he considered the subject in relation to the topic of the meeting. He referred to the adaptability of the incandescent lamp to any system of electrical distribution, there being no difference in its operation on direct or alternating current, provided the latter has a frequency of 25 cycles or more per second.

Two kinds of carbon are used in making filaments, and the best results require the proper combination of the two kinds. The specific resistances of these two kinds of carbon limit the voltage of lamps of a given candle power and efficiency in which this proper combination can be made. Lamps for a higher voltage than will permit the proper combination of the two kinds of carbon may be made with less of the graphitic coating which has a low specific resistance, or entirely of the base carbon; but in either case the lamp should be operated at lower temperature to give equally good life and candle-power results. The best results are obtained with lamps of not higher than 120 volts; 250 volts are now regarded as the maximum desirable voltage, and at this point there is an increase of about one-half a watt per candle for equally good results.

The economy of an incandescent lamp depends upon the temperature of the filament—the higher the temperature the better the efficiency and the shorter the life. Lamp economies are usually stated in watts consumed per horizontal candle. The commercial limits are between 2½ and 4 watts per English candle, or about 120 per cent of these figures if spherical candle-power is considered, the 2½-watt lamps being used where electricity is expensive and regulation good, and the less efficient lamps where electricity is less expensive or regulation is not so good, or where other considerations demand a longer useful service from the lamps.

The color of the light from an incandescent lamp depends entirely upon the temperature of the filament; the higher the temperature the more nearly white the light becomes. The color of the light generally is yellow. Weber observed that the first visible radiations from a filament as it was heated came not in the red region of the spectrum, but in the yellow region, where the maximum radiation occurs when the lamp is at high temperature. Dr. Nichols observed that carbon has a selective radiation in the yellow region of the spectrum, the radiations there increasing faster than radiations in the other parts of the spectrum.

The use of higher efficiency lamps is becoming quite general. Very few 4 w. p. c. are now used for multiple lighting, while a few years ago no lamps of less than 4 w. p. c. were sold. This is due to the improvement in quality of the lamps and also to better regulation of current. High efficiency lamps are more satisfactory than low. The filament being smaller, the bulbs blacken less and being hotter they break before reaching very old age. Low candle-power lamps are also coming into more general use. The demand for these has increased very considerably in the last two or three years. The use of lamps for decorative effects and for special work of various kinds has increased the usefulness of the lamp and added to its popularity.

Mr. S. Everett Doane, in a paper entitled "Some Common Faults in Exterior Illumination," pointed out objectionable features in the use of high-intensity outdoor illuminants, such as high-power arc lamps, and make a plea for the use of the incandescent lamp for exterior illumination.

In answer to the question, Why, with all its drawbacks, the arc light is used almost universally and incandescent lamps to so limited an extent? Mr. Doane says he thinks there will be no discussion as to the reason. Incandescent lamps for street lighting have always been difficult to make and less satisfactory than other types of incandescent lamp. The ordinary 100-volt to 125-volt 16-cp, 3.1 watts per candle, incandescent lamp gives more candle-hours for a given input than any other incandescent lamp. Could this lamp be used for street lighting the cost of street lighting by incandescent lamps could be materially reduced and the service rendered be much more satisfactory to the user of the highway.

There are many streets in which low-voltage mains run the length of the streets, and where these lamps could be used in multiple with no inconvenience. There are many other streets where 10 or 20 could be used in series, each on a cut-out box, no more complicated than the Nernst lamp. These cut-out boxes would not be so complicated as the arc lamps, which operate with practically no attention.

At present, the arc lamp lines are no longer the only wires on the poles. Probably one-half of the electric lighting poles carry alternating current mains also. Incandescent lamps are now universally fastened to their bases by a waterproof cement, and waterproof sockets are in stock everywhere.

The arc lamp has its use in street lighting. There are places where it is wisest to use it. The public think they are getting more for their money with the brilliant arc lamp, but Mr. Doane believes that as the users of the highways come to appreciate how much safer and more satisfactory is well-placed incandescent illumination, we shall learn to light our streets as well as our homes.

For a given expenditure of energy, more light can be actually delivered to a highway by incandescent lamps than by arc lamps, and it can be better distributed. Arc lamps are at their best in densely settled districts. The reflected light from buildings helps to economize the distribution, and the great quantity of light from store windows also assists to so brighten the surroundings that the arc light is less blinding. Arc lights are also more closely spaced in these localities, which is to their advantage. It is the opinion of Mr. Doane that incandescent lamps are much to be preferred for residential streets, side streets and outside the more congested portions of a town or city.

The Present Status of the Question of a Standard of Light.*

By Clayton H. Sharp.

THE situation as regards a standard of luminous intensity has shown in recent years a marked tendency towards simplification and unification. A number of standards or would-be standards, which were formerly taken seriously, have disappeared from practical use. Of the various candles, the British candle is the only one which survives, and the practical use of it is steadily decreasing. The Carcel lamp is held in much less esteem than formerly. Practice is settling down to the selection of one of two classes of standard, either the pentane standard in one of its forms, or the Hefner amyl-acetate lamp.

The small 1-cp and 1½-cp pentane lamp has proven itself worthy of confidence as a result of thorough investigation in the Reichsanstalt. The 10-cp pentane lamp is coming into very extensive use by the gas men here and in England, and commends itself by its simplicity of operation, by its relatively high intensity and, as far as is known, by the constancy of its indications. Unfortunately, there is on record no such careful investigation of its properties in this particular as has been made for the smaller pentane lamp and the Hefner lamp.

If gas practice is looking more and more to the pentane standard, electrical practice is looking towards the Hefner lamp. The careful study made in the Reichsanstalt, the adoption of it officially in Germany, the resolutions in its favor by this Institute and by the Geneva Congress of 1898 have served to popularize it and to intrench it strongly.

While the facts enumerated show that great progress, it is not to be assumed that a satisfactory solution of the problem of a standard has been reached. A standard must be as nearly as possible a common denominator of the sources of light in ordinary use. No one integrated source of light can be in all strictness a common denominator for all, on account of the existing differences in quality or color. That light most nearly fulfils this condition which most nearly approaches in color the average color tone of the sources of light in use to-day. Now this is much higher than it was a few years ago, due to the extensive introduction of whiter hued sources of light. The standards referred to above stand, as far as color is concerned, about at the bottom of the list, and from this point of view are as bad as possible. Photometric comparisons with them of most modern lights are very uncertain and the results are misleading in that they do not give to the whiter sources credit for the greater visual acuity per candle-power which is their due.

It follows that a standard of light of considerably whiter hue than the present ones would be intrinsically better if of equally good qualities in other respects, and it is towards the definition of such a standard that efforts should be directed.

Quite a good deal has already been done in this line. A notable advance has been made by Petavel[1] in his investigation of the Violle platinum unit. He has indicated the precautions which must be taken to secure good results, and has demonstrated that the limits of error may be made quite narrow. The color of this standard is quite good. Violle has stated that it is very similar to that of the

*A paper read before the American Institute of Electrical Engineers, New York, and Chicago, January 3, 1902.

[1]Proc. Roy. Soc., Vol. LXV., p. 181, 1900.

acetylene flame, but this statement does not seem to be entirely consistent with the known fact that platinum can readily be fused in the acetylene flame.

The studies by Paschen and by Lummer of the theoretically "black" body has indicated a method by which a perfectly definite radiating surface can be secured, and it needs only a sufficiently accurate method of defining the temperature of such a surface to give us a standard of light. Since, however, the luminous radiation from such a surface increases as a high power of the temperature, a sufficiently accurate method of temperature definition cannot easily be found.

Among the ordinary sources of light, the acetylene flame probably approaches most nearly in color to the average hue. The ease with which this gas can be produced in a good degree of purity and the steadiness and manageability of its flame also commend it for use as a standard. Violle,[2] Fessenden[3] and Féry[4] have made independent propositions to this end, but no definite standard has yet been the outcome.

Fessenden showed how a stable flat flame can be produced with this gas employing the method of the converging jets now in common use. He found the flame to be very steady and moderately immune from outside influences. Such a flat flame, with the light from its edges screened off, has been used very successfully by Professor Nichols[5] in his spectro-photometric investigations of the radiation of carbon. The flame was controlled by measurements of the pressure of the gas.

The proposition of Féry looked to the use of a long, slender flame. He used a bit of thermometer tubing of internal diameter of 0.5 mm. as a jet. With this he found that the luminous intensity of the flame was proportional to the flame height between the limits of 1 cm. and 2.5 cm., that is, he substituted for control by pressure measurements, control by measurement of the flame height.

What is now known of the properties of the acetylene flame indicates that a search for the best method of producing and defining an invariable acetylene flame would be fruitful of valuable results.

It has been proposed to employ as a standard flame one in which a pure gas burns under standard conditions in a pure atmosphere, both of known chemical composition. A practical method of burning pure acetylene in an atmosphere of pure oxygen has been found, as well as direct and interchecking methods for the control of such a flame, but the investigation has not led to any definite result.

Until a more satisfactory standard is introduced, photometrists are practically limited to the choice of either a pentane standard or the Hefner lamp as primary standards. An incandescent lamp carefully seasoned and measured furnishes for most purposes a thoroughly satisfactory secondary standard, and we are looking forward to the time when the National Standardizing Bureau will establish an authoritative standard and will measure and will certify to lamps sent to them for this purpose.

Boston Elevated Railway Company.

With regard to the plant of this company, which includes the West End surface system, President Bancroft states in his annual report that during the year the company increased its motive power by putting into service two new engines of large size, each of 4050 hp, operating a 2700-kw generator, at the Lincoln power station. Provision has been made for two other engines and generators of corresponding size, one at the Lincoln power station and one at the Charlestown power station. When these are installed, the company will have a motive power of 55,316 hp or 36,944 kw, at normal capacity, capable of sustaining an overload of 15 per cent for hours, of 5542kw in addition, so that under stress the generators ought to supply power to the amount of 63,612 hp. The use of horses as the motive power for street cars was given up by the company on Dec. 24, 1900. Horses had been used to draw cars for nearly 45 years.

Municipalization at Worcester, Mass.

The committee of the Worcester Common Council appointed to investigate the purchase of the local lighting company has now reported adversely. A very thorough study of the question was made, and the committee quotes a number of plants to show that the city could not better the service, and prices it is now enjoying from the company, some 17 cities being taken into consideration.

[2] *Trans.*, A.I.E.E., Vol. XII., p. 500, 1895.

American Institute of Electrical Engineers.



FIG. 1.—TUBE AT DOORWAY.

A MOST successful meeting of the Institute was held in New York City on Jan. 3, starting off the new year very auspiciously, the general subject for discussion being methods of illumination and units of light. A number of papers were presented, of which note is made elsewhere in this issue. At least 250 members were present during the evening, and great interest was aroused by the display of tube lighting by Mr. Peter Cooper Hewitt, who had on view and in operation six of his ordinary mercury vapor lamps. One of these suspended vertically over the main entrance, was an object of great curiosity to the passers-by, its gleaming white light being visible at a great distance. We have endeavored to present a view of it here, the dim lights seen below it being the incandescents on each side of the steps.

Within the building the main meeting room was lit with five of the mercury arc tubes, as shown in one of the cuts herewith, one being hung vertically and the other four being bracketed horizontally around the sides of the library gallery. At times these were burned in company with the regular incandescents, but they were also run separately, and were in continuous use throughout the evening from 8 until 11 P. M., and longer. It will be remembered that Mr. D. Mc-



FIG. 2.—PRESIDENT STEINMETZ.

Farlan Moore also has illuminated the same large room with his vacuum tubes, so that it is becoming quite historic for experiments of this kind. The picture we show of the tubes themselves is virtually an instantaneous photograph. The fine portrait of President Steinmetz was taken in about 12 to 15 seconds' exposure, and the result is very striking, as to its sharpness of definition, the photograph showing clearly the little vibration of the presidential cheroot when Mr. Steinmetz took a new bite on it as he called the meeting to order. The view of the other end of the room was of about equal

exposure, and is not less sharp in its outline. Our photographer, who takes many thousand views a year for this and other public prints, remarked that the light, while very deficient in red rays, was remarkably revelatory and seemed to him to "get in under the surface" like the Röntgen ray, and he could only compare it with daylight. The tubes were run on the regular direct-current Edison system, with the starting devices grouped on the platform. Mr. W. J. Hammer used the same devices to show up one or two of Mr. Edi-



FIG. 3.—VIEW OF MEETING ROOM LIGHTED WITH LAMPS [illegible]

son's fluorescent tubes, and exhibited also the weird effects of "radium," of which he had an infinitesmal quantity in a tube. In the dark, unexcited, the radium showed with curious phosphorescent gleam, and when the tube was wrapped by Mr. Hammer in cotton wool the whole mass—tube, wool and all—took on the same firefly glow.

At the council meeting in the afternoon the following were duly elected to associate membership:

Amstutz, Noah Steiner, Amstutz Osborn Company, 27 Hillside Avenue, Cleveland Ohio; Armstrong, Samuel George, 1 Kimberley



FIG. 4.—VIEW OF REAR OF ROOM LIGHTED [illegible]

Villa, Harrington Street, Cape Town, South Africa; Arnold, Chester Hastings, Assistant Engineer New York Telephone Company, 18 Cortlandt Street, residence 241 East Eighteenth Street, New York City; Averrett, Andrew E., engineer, General Electric Company, Schenectady, N. Y.; Erwin, Frank Bennett, demonstrator, Federal Instrument Company, 293 Clinton Avenue, Albany, N. Y.; Estes, Orange A., Central Union Telephone Company, Akron, Ohio; Everit, Edward Hotchkiss, superintendent of equipment, The So. N. E. Telephone Company, 641 Whitney Avenue, New Haven, Conn.; Ferguson, Samuel, engineer, General Electric Company, Schenectady, N. Y.; Fitzgerald, Thomas, Jr., superintendent, F. C. E. R. R. Company, Fairmount, W. Va.; Gray, Edward Wyllys Taylor, manager, New York sales office, Westinghouse Electric & Manufacturing Company, 120 Broadway, New York City, residence Montclair, N. J.; Hanks, Marshall Wilfred, engineer, Nernst Lamp Company, residence Amber Club, Pittsburg, Pa.; Henry, George Clinton, assistant to president, The Johnson Law Company, 51 West Forsythe Street, Jacksonville, Fla.; Herzog, Josef, chief of installations department, Ganz & Co., V. Elisabetplatz 1, Budapest, Hungary; Hillman, Harry W., General Electric Company, Schenectady, N. Y.; Hutchinson, Rolin William, Jr., student, Polytechnic Institute, residence 302 Clinton Street, Brooklyn, N. Y.; Kerr, Samuel Ross, foreman in testing department, Triumph Electric Company, 610 Baymiller Street, residence 616 West Eighth Street, Cincinnati, Ohio; Kershner, Jefferson E., consulting engineer, The Lancaster R. & L. Company, Lancaster, Pa.; Kline, James Joseph, engineering student, Stanley Electric Manufacturing Company, residence Beech Grove Inn, Pittsfield, Mass.; Lamb, Francis Joseph, electrical engineer, Lamb & Co., corner Kent and Lyon streets, Grand Rapids, Mich.; Layton, Gordon, electrical engineer, British Westinghouse E. & M. Company; residence 48 Lancaster Park, Richmond, England, 327 Pitt Street, Wilkinsburg, Pa.; Maxim, Hiram Percy, engineer, vehicle motor department, Westinghouse E. & M. Company, Pittsburg, Pa.; McCarthy, Albion Fuller, inspector New York Edison Company, 23 Manhasset Place, Brooklyn, N. Y.; Newell, Frank Clarence, consulting electrical engineer, Westinghouse Air Brake Company, residence 526 Wallace Avenue, Wilkinsburg, Pa.; Pratt, William Hemmenway, designing engineer, General Electric Company, residence 60 Eastern Avenue, Lynn, Mass.; Ramson, Allen Edward, engineer and salesman, W. E. & Mfg. Company, 314 Occidental Avenue, Seattle, Wash.; Reilly, Harry Winne, J. G. White & Co., Monroe, Mich.; Shuster, John Wesley, instructor in electrical engineering, University of Wisconsin, residence 18 East Dayton Street, Madison, Wis.; Szuk, Geza, chief engineer, Ganz & Co., residence Csalogany utcza 52 Budepast II, Hungary; Taylor, Frank H,. Westinghouse Electric & Manufacturing Company, residence 7422 Penn Avenue, Pittsburg, Pa.; Treat, Robert Belden, electrical engineer, Crocker-Wheeler Company, Ampere, N. J., residence 43 South Tenth Street, Newark, N. J.; Vankirk, Edward Power, electrical engineer, Westinghouse Air Brake Company, Elizabeth, Pa.; Webster, Walter Coates, assistant to fourth vice-president, Westinghouse Electric & Manufacturing Company, 120 Broadway, New York City; Whittemore, George W., engineer, Bell Telephone Company, residence 24 W. Seneca Street, Buffalo, N. Y.; Zurfluh, William Nicholas, superintendent, Home, Light, Power & Heat Company, Room 11, Arcade Building, Springfield, Ohio.

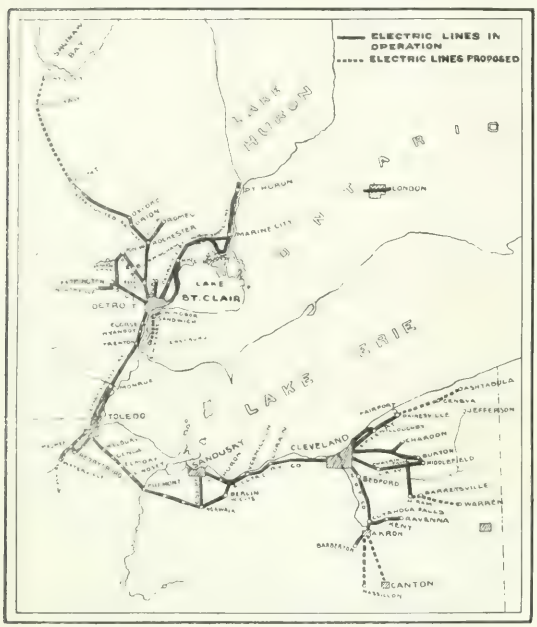
The Everett-Moore Trolley System.

The recent financial embarrassments of the Everett-Moore Syndicate have directed special attention to this organization, which is more or less well known to our readers through frequent references in these columns in the recent past to its development. Latterly the syndicate has become largely interested in independent telephone properties, but its original undertakings were in electric railway work, and this is yet its principal business.

The extensive railway system now controlled by the syndicate is located in the northwestern section of Ohio and the southeastern corner of Michigan, and is known as the Lake Shore Electric Railway, although the various constituent properties have names of their own. The rapid growth of this combination of railways, and the wide scope of its plans, constitute one of the most remarkable features of electric railway enterprise development. Combinations of this character are developing in many sections of the country, but none has attracted more widespread attention than this one has. Enterprises of this nature are usually conducted in the East with more or less conservatism, but in the West they are carried forward with a vigor that is refreshing, if hazardous. This is particularly true of the Everett-Moore Syndicate, which has attained much prominence in the financial and electric railway worlds.

The extent of the Lake Erie Electric Railway's system is shown in the accompanying map. The system embraces the Cleveland Elec-

tric Railway Co., which controls about two-thirds of the Cleveland street railway system; the Cleveland, Painesville & Eastern Railroad Co., which operates a suburban line from Cleveland to Painesville; the Cleveland & Eastern Railway Co., operating a line between Cleveland and Chardon, Burton and Middlefield: the Cleveland & Chagrin Falls Electric Railway, running between Cleveland and Chagrin Falls; the Detroit United Railway, which is a consolidation of the entire street railway system of Detroit, and suburban electric railways from Detroit to Pontiac, Wyandotte, Trenton, Flint, Romeo, Rochester



MAP OF EVERETT-MOORE TROLLEY SYSTEM.

and Orchard Lake; Detroit & Port Huron South Shore Line Railway Company, operating suburban roads between Detroit, Port Huron and Mt. Clemens, also the city lines in Port Huron and Mt. Clemens; the Lorain & Cleveland Railway, a suburban line between Cleveland and Lorain; the Northern Ohio Traction Company, which is a consolidation of all the street railway lines in Akron, suburban lines to Ravenna, Kent, Barberton, Cuyahoga Falls, Bedford and Cleveland, also the electric lighting plants in Akron and Barberton, and the Toledo Railways & Light Company, which includes the entire street railway system and every public lighting plant in the city of Toledo. The companies above-named are integral parts of the system, and all together the roads form a practically continuous line of electric railway from Painesville, on the east, to Toledo and beyond, on the west, and northward through Detroit to Port Huron over one branch and to Flint over another. As shown on the map, extensions from the extreme termini are projected eastward from Painesville to Ashtabula, and westward from Flint to Bay City, Mich.

The following table shows the miles of track of the above-named companies, and is compiled from a circular recently issued by the Everett-Moore Syndicate:

Company.	Miles of Track.
Cleveland Electric Railway Company	136
Cleveland, Painesville & Eastern Railway Company	41
Cleveland & Eastern Railway Company	45
Cleveland & Chagrin Falls Electric Railway Company	15
Detroit United Railway	365
Detroit & Port Huron Shore Line Railway Company	106½
Lorain & Cleveland Railway	24
London (Ont.) Street Railway Company	28
Northern Ohio Traction Company	89
Toledo Railways & Light Company	101
	950½

The above table includes the system of London, Ont., which was not included in the first list of roads for the reason that it is not a part of the main system, although it is controlled by the syndicate.

It is now possible to travel continuously from Painesville to Toledo, a distance of about 140 miles, on the electric railways of the Everett-Moore syndicate.

The total capitalization of the component roads of the Lake Shore Electric Railway is $47,000,000. From end to end, nearly 360 miles, it draws from a population of from 4,000,000 to 5,000,000 people.

In a recent banquet of the Toledo Chamber of Commerce, Mr. Albion E. Lang, president of the Toledo Railways & Light Company, gave some interesting facts concerning the interests of the Everett-Moore Syndicate. The effect of the electric railways in Cleveland, he said, was shown in the case of the Hollenden Hotel, which had to build two additional stories because of the growth of patronage due to electric roads. Traveling men now take the cars to the surrounding small towns, transact their business and return to the city for the night. What is true in Cleveland is true elsewhere. He stated further that the company's engineers are now engaged in the preparation of the plans for what will be the largest power house in the world. It will be located in the coal belt of Ohio, and it will utilize refuse coal. Its energy will reach out 100 miles in several directions. Other power houses will then be dismantled, only central plants being retained, one each in Detroit, Toledo and Cleveland. It will be a zone system, the big houses feeding in a measure on the others. Economy in this way means reduced charges on passenger traffic.

Electro-Chemical Patents of the Week.

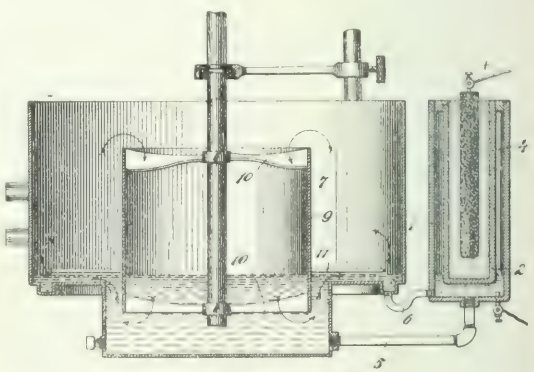
The final patent issue of the year comprises a number of interesting processes and devices relating to widely different branches of the general subject of electro-chemistry.

CALCIUM CARBIDE.

Isaiah L. Roberts, of Brooklyn, proposes to form this compound by supporting a body of commingled lime and carbon in the angle between two plate electrodes, pivotally supported at their upper ends, and brought into arcing distance below by adjusting screws. The claims are restricted to a mode of manipulating the current whereby the carbide is fused as formed and caused to drop away from the electrodes. The application upon which this patent issued was filed early in 1896, before the lack of economy and loss of efficiency by complete fusion of the carbide were fully established.

TREATMENT OF ORES.

Edward Leslie Graham, of Upper Warlingham, England, suggests a method of electrolytically comminuting ores preparatory to mechanical concentration by known means—a method which seems to depend



ELECTRIC AMALGAMATOR.

The solution used is dilute sulphuric acid, to which hydrofluoric acid or fluor-spar may be added. The ores are immersed in the liquid and the current transmitted. A method practically identical with this save as regards the specific electrolyte employed has been heretofore patented in England. While it is conceivable that the liberated gases and the heat developed by a heavy current might rapidly break down certain ores, and that the presence of hydrofluoric acid might aid the process as applied to a siliceous gangue, it is evident that the method is by no means of general applicability.

An electric amalgamator patented to Vicente Pazos y Sacio, of Peru, is in essential respects the device patented in England nearly 20

years ago by Donkin, a device which was the precursor of the Castner alkali cell. Referring to the accompanying illustration, an electrolytic cell 1, containing an anode 4 and diaphragm 2, communicates through pipes 5, 6, with the amalgamating vat 7, mounted centrally within which is the agitator 9, 10, 11, with helical blades disposed to effect a circulation of the ore in the direction indicated by the arrows. A body of mercury fills the lower reduced portion of the vat and the bottom of the electrolytic cell, and is kept in circulation between the two by the movement of the blades 10. In operation the vat 7 is filled, above the mercury, with ore pulp and dilute cyanide solution, and the porous cup 2 with a solution of sodium chloride. Under the action of the current sodium amalgam is formed in the smaller cell and at once transferred to contact with the ore, where it serves to amalgamate such free gold as may be present, and to reduce from its solution the metal which has been dissolved in the cyanide.

SOLUTION OF NATURAL PHOSPHATES.

The natural phosphates, as the mineral apatite, the coprolites, and the phosphate rocks, consist largely of the tri-basic phosphate of calcium, the immediate plant-food value of which is slight. By treatment by acids or acid salts this tri-basic salt passes into the mono and dibasic compounds, the former soluble in water, and the latter, to some extent at least, in the soil moisture. Lewis Cheeseman, of Alexandria, Va., proposes to accelerate this conversion by the use of a strong electric current. The solvent used is acid sodium sulphate (nitre-cake), and there seems to be no doubt that the current very materially increases its solvent effect, probably owing to the concentration of the SO_4 ions in the neighborhood of the anode. The effect would probably be even more strongly marked were the phosphate confined to the anode compartment of the cell.

CHLORINE AND ALKALI.

Wilhelm Gintl, of Aussegg, Bohemia, patents an interesting modification of the well-known Richardson-Holland electrolytic cell. The anodes are contained in inverted bells, which the cathodes surround. No diaphragm is used, but for preventing intermingling of the caustic and chlorinated solutions dependance is placed upon their widely differing specific gravities. It is clear that to maintain a stratification of this character, the electrolyte must be fed in with absolute uniformity, and this is the object of the improvement now patented. It is accomplished by using an anode of such size and shape as nearly to fill the inverted bell, and feeding the electrolyte by means of a distributor over its upper submerged surface. The fresh electrolyte, in passing downward through the narrow spaces around the anode and through perforations in the latter, meets the rising chlorine bubbles, and is thereby thoroughly commingled, yet with the minimum of agitation, with the exhausted liquor, maintaining the necessary uniformity of its composition. Recent measurements have indicated a surprisingly high efficiency for cells of this character, and it is not beyond the range of probability that this or a similar cell may successfully enter the commercial field.

New Telephone Patents.

To the last issue of the Patent Office of the year just closed telephony contributes four patents, all of them of substantial interest to the art of telephony, party line systems, freak receivers and telephonic relays for once being entirely absent. Mr. Francis W. Dunbar, of Chicago, patents and assigns to the Kellogg Switchboard & Supply Company a switchboard system in which the principal feature is a relay for switching the line from the line signal to the answering jack, and which is an improvement on his previous system of the same order. This invention also provides an improved form of test for multiple switchboard systems, the additional contact usually provided on the spring jack for testing purposes being dispensed with, and one of the line contacts being used for the test terminal.

When the line is not in use, the line contact of the spring jack is disconnected from the portions of the limbs of the line extending to the sub-station, and is also disconnected from the individual indicator and the central station circuits. The line contact of the spring jack is thus free from all extraneous currents or sources of electricity that might impart a difference of potential when not in use. Accordingly, no false test can be given, and the line contact may be used as a test terminal.

In the diagram Fig. 1 shows two subscribers' lines and the central

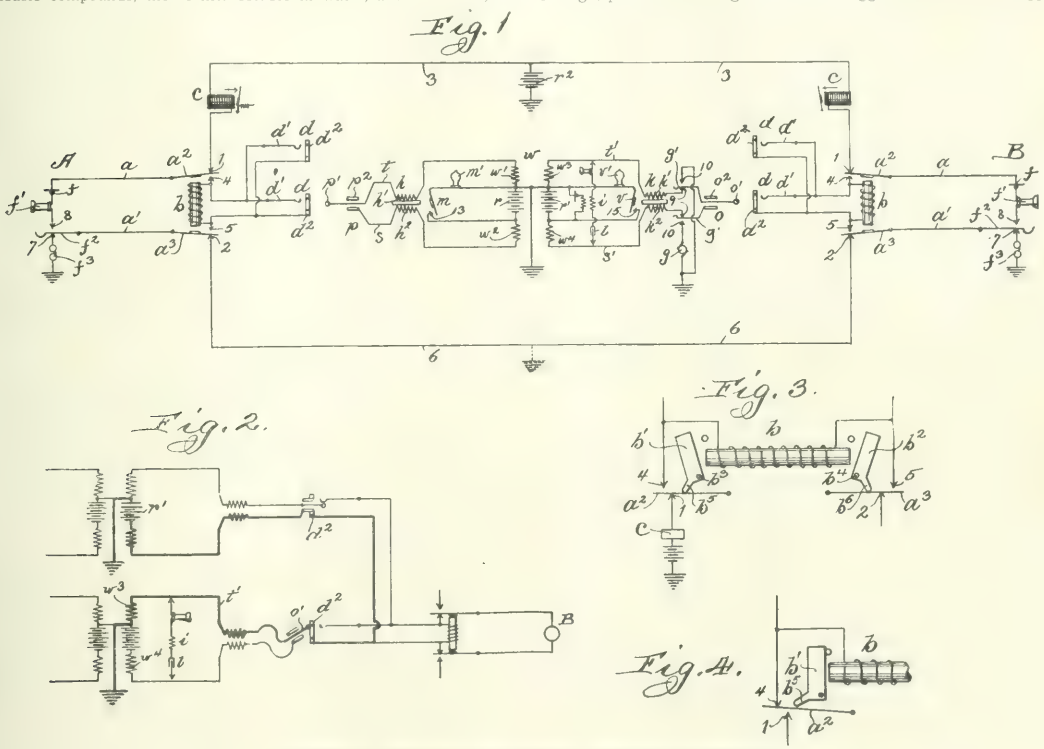


DIAGRAM OF CIRCUITS OF THE DUNBAR TELEPHONE SWITCHBOARD

office connecting circuits. Fig. 2 shows the test circuit. Fig. 3 shows the relay preferably employed, and Fig. 4 illustrates one end of the relay with the armature attracted.

Referring to Fig. 1 the sub-station lines normally connect with the line signal and ground by reason of the springs a^2 a^3, in which the lines terminate, being normally in contact with 1 and 2, and so connected through line signal c through battery r^2 to ground on the one side, and to the common ground by wire 6 on the other. The two wires, s^1 and t^1, of the calling plug o, are connected to a repeating coil w, having two coils, w^3 and w^4, between which is inserted a battery r^1. The calling plug in the same way is connected to windings w^1 w^2, with battery r. One pole of each battery is connected to ground. In the cord strands t and s are included, the windings h^1 h^2 of a relay h, and in the strands t^1 and s^1, the windings k^1 and k^2 of relay k are included. When the battery current for talking traverses the coils of these relays they neutralize each other and are inert; when a circuit is made from the ground through battery r^1 along strand s^1, coil k^2, sleeve o^2 and line a^1 to ground at the sub-station (by the replacement of the receiver on the hook), the relay is energized and the disconnection signal r^1 is displayed.

The relay b is constructed so that it will respond to alternating as well as to continuous currents, the armatures being mounted so that they are withdrawn from the relay poles by gravity. The withdrawal of the armatures is thus sluggish, and upon the passage of an alternating current a succeeding alternation will magnetize the core and cause it to grasp the armature before it has had time to be withdrawn. As shown in Fig. 3 the armatures b^1 b^2 are pivoted at b^3 b^4, respectively, so that the weight of the armatures serves to withdraw them from the core. The armatures are provided with arms b^5 b^6, adapted to engage springs a^2 a^3. When the relay is inert b^5 holds a^2 in engagement with contact 1, and b^6 holds a^3 in engagement with contact 2. When the armatures are attracted b^5 and b^6 allow a^2 and a^3 to engage contacts 4 and 5.

When a subscriber, say, A, lifts his receiver from the hook line signal c is energized by battery r^2. When the operator plugs in relay b is energized by battery r and the line is switched from the line signal contacts to the jack contacts by the closing of a^2 a^3 on 4 and 5. The same occurs with the second line on the insertion of the calling plug o in the jack of the second line. During conversation the battery r supplies subscriber A and the battery r^1 subscriber B, talking currents being transmitted by the windings of repeating coil w. When the operator rings B the battery r^1 is cut off by the ringing key, but relay b is in bridge with the generator, and being responsive to alternating currents maintains the line in connection with the jack. In testing for "busy" the operator touches the tip of plug o to the rim of the jack in the usual way; if the line is idle the jack is totally disconnected, and there can be no signal. If the line is engaged, as shown in Fig. 2, the line springs of all the jacks are charged to a difference of potential relative to the ground. When the operator touches plug-tip o^1 to jack-sleeve d^2 the current from battery r^1 finds a path through o^1, strand t^1 and winding w^3 of repeating coil to ground. The closing and opening of the circuit caused by touching the tip o^1 to the sleeve and the removal of the same therefrom causes a current of self-induction from winding w^3 to traverse the local circuit, including the windings w^3 and w^4, and the receiver of the operator's telephone, and the induced currents thus produce the click in the operator's receiver which indicates to her that the line is busy.

Mr. James L. McQuarrie, of Chicago, patents and assigns to the Western Electric Company an improved test circuit for multiple switchboards. This is designed to prevent the production of a false busy test, which, under certain conditions, may occur in the common battery system through current from the central source returning through the circuit of the calling line and changing the electrical condition of the testing plug. In such an event the operator would be supplying from within, as it were, what she ought only to get from without, and would herself be causing a line, which might be free, to test busy—a very annoying defect, and one most detrimental to good service. Mr. McQuarrie applies a remedy by so arranging listening key and repeating coil that the tip conductors of the two plugs are not continuous while the test is being made, consequently no false test can occur through one plug supplying the other with current.

An interesting development of the use of ten-party lines is the invention of a time-regulated ringing key for mechanically sending signals over party lines where the call for each station is distinguished by the number of rings given. Since the use of these ten-party lines has been more largely developed in California than in any other part of the country, this invention most appropriately hails from San Francisco, and is due to the ingenuity of Mr. Frank W. Alston. As might be expected, it is a fairly complicated device, and one, since it would be so constantly in use, that would have to be very strongly made to give the required performance without frequently getting out of order. It is difficult to do justice to such a complicated piece of mechanism in an abstract, but briefly put, the time-regulated ringing key consists of a plunging key, a selector which is set to give the required number of signals, and which releases the depressed key when the determined number of signals has been given, and a contact sector with a clockwork-driven contact brush that connects the generator to the connecting cord at fixed intervals as long as the plunger is depressed.

In using the key the operator turns the plunger until the pointer shows that the selector has been set to allow of the proper number of rings being given and then depresses the key. If, say, 3 rings are required the selector pointer is set at 3, and this causes the plunger to be released when three rings have been given by the contact brush coming in contact with a segment that has been connected by the selector for the purpose of energizing the releasing magnet.

An ingeniously worked out telephone meter is patented by Mr. Henry A. Holdrege, of Chicago. One difficulty with a meter automatically operated by the action of inserting the answering plug in the answering jack is that the call so registered is so far merely a call and not a message. The call may never become a completed message because the second subscriber may be busy or may not answer. This occurs sufficiently often to render a meter operated by the answering plug practically useless. Mr. Holdrege's meter operates only when the connection is completed, the last step in the registration taking place when the connection is broken.

The meter does not begin to register until the called subscriber takes down his receiver and does not complete the operation until the connection is taken down. Moreover, the meter will register a unit only without regard to the duration of the connection. The meter will not meet all points that arise in telephone traffic, but in postponing registration until the two stations are in communication, Mr. Holdrege's has scored a distinct point. Whether the unbalanced circuit that results from the insertion of a relay in one leg of the line will offer serious inconvenience is a question that experience will answer.

General Greely on Wireless Telegraph Matters.

With regard to the adoption of wireless telegraphy by the United States Government services, General Greely says: "The system has its limitations, which are not entirely dependent on distance. For example, we wanted to lay a cable between a point on the Connecticut coast and Gardiners Island. I was asked by the members of the appropriations committee whether it would not be cheaper to establish a wireless system between these two points. I showed that as far as simply establishing that plant was concerned it would be cheaper to put up the wireless systems than to lay the cable, but when it came to operating the systems, I showed that the cable was the cheaper of the two. In wireless telegraphy you have to have two experienced electricians, one at each station, and they must have assistants. With the cable you can put in two long-distance telephones, and anybody can use them who is able to turn the magneto crank. While it costs more to lay the cable, yet in this case we found that it would be cheaper in the end than the wireless system."

General Greely has received recently a very interesting report from Signal Corps Sergeant F. E. Peters at San Francisco as follows, on the plant in the harbor there:

"The stations in operation in this harbor have been working uniformly and satisfactorily each day, thus proving that so far as the transmission of messages is concerned, the system is an absolute success. It lacks speed as compared with wire lines and is only capable of dispatching accurately 15 words per minute. There seems to be no limit in sending, but the speed is lost in the receiving instrument. There are many conditions under which it could be used, but in nearly every case it would merely intrude upon a field which could be easily covered by telephone or telegraph lines. The following defects have come under my notice: First, the apparatus needs condensing and simplifying; second, a lack of speed, compared with land lines; third, the inability of an operator to break or interrupt another; fourth, the lack of secrecy in regard to matter being handled; fifth, the impossibility of operating more than one set of instruments in

an office; sixth, the impossibility of operating more than one system within the limits of its range.

"The first three defects seem entirely within our ability to overcome. The fourth is that we cannot prevent our system from being tapped, except by the adoption of a secret code. The fifth and sixth objections, as far as I can see, must remain with us unless our knowledge of syntonizing arrangements be advanced materially."

Automatically Closing Bulkhead Doors.

By invitation of President Schwab, of the North German Lloyd Steamship Company, a party was entertained on board the steamship "Kronprinz Wilhelm" on Friday, Jan. 3. The occasion was the first public exhibition of the Dörr system of safety doors in bulkheads of steamships, and after a thorough inspection of the apparatus the guests were entertained at luncheon. For a number of years, the steamship line has been investigating devices which would insure the greatest amount of safety to its vessels in case of collision, and after a number of most extensive and costly experiments it has introduced the present system on a few of its boats, and intends placing it on all of the rest. The doors slide in vertical ways, and are closed automatically by hydraulic pressure from an operating wheel on the bridge behind the pilot house, and the system is applied to the 19 or 20 bulkhead doors below the water line. In order to operate the wheel on the bridge, a trip lever has to be elevated out of the way, and by an ingenious ratchet arrangement, it requires some 20 seconds before the wheel is free to turn. While the lever is being moved electric bells are sounded at every door, giving warning for about 20 seconds before the doors begin to close slowly from the action of the hydraulic cylinder. The doors can be closed by hand, independently of the hydraulic apparatus, and a lever is provided at each door by which it can be made to drop into its closed position almost instantly. An ingenious system of electric signals has been adopted in connection with the doors all over the ship. In the pilot house is a large diagram, showing all the decks, and at each point where there is a bulkhead door a small bull's-eye is placed. Behind these bull's-eyes are signal lamps connected to switches at the doors in such a manner that whenever a door is closed the lamp is lighted. In this way the officer on watch has the position of the bulkhead doors throughout the entire ship directly under his eye. A complete fire-alarm system is also included in the equipment of the "Kronprinz Wilhelm," with stations located in all parts of the steamer. The signal boxes are similar to those found on land, a glass pane having to be broken to set the alarm in action. An annunciator in the pilot house shows the location from which the alarm is sent in.

Mr. Carnegie's National Institute.

Some details have already been given in these pages as to the plans of Mr. Andrew Carnegie for founding a new educational institution at Washington. In accordance with the desires of Mr. Carnegie, a corporation known as the Carnegie Institution has been formed in Washington for the purpose of holding in trust the $10,000,000 which he will give to found a national university. The certificate of incorporation, filed with the Recorder of Deeds, is signed by John Hay, Secretary of State; Edwin D. White, Justice of the United States Supreme Court; Daniel C. Gilman, former president of Johns Hopkins University; Charles D. Walcott, superintendent of the United States Geological Survey; John S. Billings, former Surgeon General of the United States Navy, and Carroll D. Wright, Commissioner of Labor.

The certificate placed on record sets forth that the incorporators desire to establish in the city of Washington an institution for prosecuting original research in science, literature and art. The corporation is empowered to acquire, hold and convey real estate and other property, and to establish general and specific funds; to conduct, endow and assist investigation in any department of science, literature or art, and to this end to co-operate with governments, universities, colleges, technical schools, learned societies and individuals; to appoint commissions of experts to direct special lines of research; to publish and distribute documents, to conduct lectures, to hold meetings and to acquire and maintain a library.

The significance of the incorporation is that the government is relieved from becoming trustee of the Carnegie fund, whether it takes the form of steel bonds or United States securities.

The Grounding of High Potential Circuits.

At the joint meeting the Chicago Electrical Association and the American Institute of Electrical Engineers held at Chicago Jan. 3, John D. Nies, instructor in electrical engineering at Lewis Institute, presented a short paper on the "Grounding of High-Voltage Circuits." The paper was a mathematical discussion of the practice of grounding the neutral point of a three-phase transmission line when the transformers are connected Y fashion. The paper was suggested by calculations recently made by Mr. Nies to determine whether the practice of grounding the neutral point of certain transmission lines introduced any greater element of danger to insulation or to persons. The conclusions reached in the paper were that in the majority of ordinary conditions where there is capacity in the lines to any appreciable amount, the grounding of the neutral point is a practice which affords less danger from leaks to earth and from shocks than the practice of leaving the neutral not grounded. Each case must, of course, be calculated, but in the great majority of cases which come up in practice the condenser capacity of the transmission lines is sufficient so that the danger from shocks and tendency to leak from one wire to the ground is greater with a non-grounded neutral. This is, of course, due to the capacity of the lines. Mr. Nies considered first a single-phase circuit with the middle point of the transformer grounded, and then a three-phase circuit with the Y connection of transformers. The relation between any two wires and ground is that of two condensers in series, the line wires forming two plates of the condenser and the ground the third plate. Mr. Nies' calculations on a number of cases showed that the current flowing through a person or other leak to ground would be greater and the effective voltage would be greater with the neutral point not grounded.

CURRENT NEWS AND NOTES.

TRANS-ALPINE TELEPHONE LINE.—The telephone systems of France and Italy are now connected by means of a trans-alpine telephone line, which was inaugurated on Jan. 1. Signor Galimberti, Italian Minister of Posts and Telegraphs, exchanged greetings from Turin with President Loubet at Paris.

PARIS METROPOLITAN.—A cable dispatch from Paris of Jan. 4 says: The extension of the Metropolitan Underground Electric Road has encountered unexpected difficulties. A new section from the Etoile to the Place du Trone, passes under the catacombs. The line will have to be carried much lower down before a firm roofing can be safely built. Its completion will probably be retarded for an indefinite time.

TRAIN LIGHTS.—A telegram from Chicago of Jan. 4 says: Train dispatchers of the country want all possibility of collisions removed by doing away with the present system of train orders that can be misinterpreted and signals that may be unseen. Instead of these methods it is proposed to substitute colored electric lights in the engine cab, signals that always can be seen and never can be misunderstood. This system of movable blocks or lights in engine cabs is being installed on the Chicago & Eastern Illinois Railroad. The experiment will be watched with interest by railroad men throughout the country.

ELECTRIC RAILWAYS IN OHIO.—J. C. Morris, State Railroad Commissioner, has filed with Governor Nash a complete report of the status of railroads in Ohio for the year ending Nov. 15. A portion of the report was devoted to electric railways. Mr. Morris states that the history of electric railways in Ohio began with the incorporation on July 30, 1889, of the Soldiers' Home Electric Railway, operating from Dayton to the National Soldiers' Home, near that city. During the year ending Nov. 15, 1901, 96 electric railway companies were incorporated, with total capital stock of $24,361,000. On May 1 there were 63 operating companies in the state with 1,818.16 miles of line, an amount equal to one-fifth of the total steam mileage of the State. For 1900 the Ohio roads reported to the State Auditor total gross earnings of $11,301,172, while for 1901 the figures were $13,582,851, a gain of 20.18 per cent.

WIRELESS TELEGRAPHY FOR TIMBUCTOO.—The French Government proposes to connect Algiers and Timbuctoo by wireless telegraphy.

DR. F. A. C. PERRINE will lecture before the New York Electrical Society, at the College of the City of New York, on Jan. 15, his subject being water power conditions and electric power transmission on the Pacific Coast. Dr. Perrine is an authority in this field, and has lately returned from a personal investigation of work in the Far West. His lecture will be freely illustrated with lantern slides, and will doubtless be one of the best of the season.

CONDITIONS OF RAILWAY TRAVEL.—As a result of the withdrawal of exchange passes by Eastern lines, traveling passenger agents on Western roads in New England are to use every effort to travel as little as possible over the railways and use the trolley lines whenever it is possible, in preference to the railroads. At a meeting in Chicago last week between General Manager Delano and the principal passenger officials of the Burlington system in the East, they were instructed to reduce traveling expenses to a minimum and to use the mails, telephones and telegraph whenever possible, if business can be secured, instead of paying railway fares from point to point.

IRELAND-AZORES CABLE.—Consul Thackara reports from Havre, Dec. 5, 1901, that the Commercial Cable Company, of New York, has laid a new submarine cable between Horta, Island of Fayal, Azores, and Waterville, Ireland. The shore connections at the latter place were successfully made on Nov. 30. This cable, says the consul, is an extension of that laid by the same company in 1900, and increases to four the number of cables operated by the Commercial Company between Canso and Waterville. As Havre is connected by a submarine cable with Waterville, the direct-telegraph service with New York will be benefited by the new cable. Note of this cable has already been made in our pages.

FRENCH AUTOMOBILISM.—It is stated from Paris that Mlle. Chossegros, who left $400,000 to the Société Protectrice des Animaux, made provision for the creation of an automobile van for removing injured horses from the street. The society has opened a competition among automobile constructors for the new ambulance, which is to cost $4,000, Baron de Zuylen having the project in charge. The Automobile Club has inaugurated an auxiliary membership, constituting a kind of annex for modest chauffeurs whose wealth and station are not important enough to secure regular membership. The new members pay $4 a year, and will have a room reserved for their use in which lectures and technical conferences will be held.

MARCONI IN CANADA.—Mr. Marconi has been at Ottawa, Canada, during the present week in conference with the officials of the Dominion Department of Marine. The negotiations appear to deal with the utilization for wireless telegraphy of Sable Island, known as the "graveyard of the Atlantic," on account of the number of wrecks that have occurred there. A dispatch from Ottawa of Jan. 5 says: "It need surprise nobody if, as a result of Signor Marconi's visit to the Department of Marine, Sable Island, the scene of so many shipwrecks, is chosen as a Government station for transmitting warning signals to the throng of steamers that continually cross and recross the Atlantic within a comparatively short distance of its treacherous shores."

ELEVATED RAILWAY IN PHILADELPHIA.—In a dispatch from Philadelphia the announcement is made that work will soon begin on the construction of an elevated railway on Market Street, in that city, from the Delaware River to Sixty-third Street. It is expected to have the road in operation by the first of January next, if there is no delay in the delivery of structural steel. The road is to be of the modern construction, and will be operated on the third-rail system. It is further stated that elevated roads will be ultimately constructed on Woodlawn Avenue, Broad Street and other thoroughfares. It is the intention to connect the stations of the Philadelphia & Reading and the Pennsylvania Railway companies with the Market Street elevated. It is intimated that Mr. J. Pierpont Morgan is interested in the enterprise, and that he is financing the scheme.

DINNER TO MR. MARCONI.—Learning that Mr. G. Marconi would pass through this city on his way to England within the next few days, the American Institute of Electrical Engineers, with commendable energy and judgment, telegraphed to Canada, inviting him to be the Institute's guest at the annual dinner which usually takes place this month. Mr. Marconi has accepted this honor in a cordial response from Ottawa, where he has been in consultation with the Government. He arrives in New York Saturday to sail for England on Wednesday, and the dinner committee have, therefore, chosen Monday, Jan. 13, at 7 P. M., in the Astor Gallery of the Waldorf Astoria. The price of tickets, which can now be obtained from Secretary Pope, is $4, without wine, and in response to the very general inquiry and request, ladies will also attend and participate. A large gathering is indicated for this most interesting occasion, and it is expected that President Steinmetz will preside. Among the speakers will be Professor Elihu Thomson, Dr. M. I. Pupin and other well-known gentlemen.

LETTERS TO THE EDITORS.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I regret that other important work has precluded my doing the requisite experimental work to reply before this date to the article of Dr. Roeber in your issue of Dec. 7, in which Dr. Roeber criticises my brief discussion of the electro-chemical theory of the nickel-superoxide-caustic potash-spongy-iron accumulator, commonly called the Edison storage battery. I read the article with interest and surprise, for I failed to comprehend how any one with such a knowledge of physical chemistry as Dr. Roeber shows he possesses in his able analysis of reversible electrodes should have misquoted and misunderstood any person in the manner that he has misquoted and misunderstood me.

I said in my article that p_1 and p_2 represent the "aqueous tension" of the solutions. Dr. Roeber says that "what is meant by 'aqueous tension' is not clear, but he evidently means osmotic pressure." Aqueous tension of a solution can only mean one thing, the "vapor-pressure" of the water, causing it to leave the solution in the gaseous form, with a resultant concentration of the solution. Any chemist can understand this and only this in the phrase "aqueous tension." (Dampfspannung.)

It is quite different from osmotic pressure ("Osmotischer druck"). This latter registers the tendency of the solute to leave the solution in the form of solid, or liquid, or gas, with a resultant diminution of the solution. Osmotic pressure and aqueous tension are, it is true, both pressures and both usually measured in millimeters of quicksilver, but they are opposite in action and as different as the poles of a magnet.

The formula for the difference of the e. m. f. of two cells of the type $Ni\ Ni(OH)_2\ KOH\ H_2\ Pt$ is derived as follows

The chemical reaction is $Ni + Ni(OH)_2 + KOH + 2H = Ni(OH)_2 + KOH + 2H$, where p_0 is the very small oxygen dissociation pressure of the oxide in millimeters Hg; p_h the pressure of H_2, usually 760 millimeters; Hg, p the aqueous tension of the solution measured in millimetres of Hg. Accordingly p_0 and p_h are independent of the concentration of the KOH, as can be seen readily.

On passing 96,540 coulombs of electricity through two of these cells of different concentration connected positive to positive, the net change that takes place is the formation of 9 grams of water in the concentrated cell, and the disappearance of 9 grams in the cell with dilute electrolyte. The combination of the metal with the oxygen in the first cell and the dissociation of the oxide in the second cell as they take place at nearly the same pressures, balance each other and cannot evolve any electrical energy.

We have merely transferred water from one pressure p_1 to water at another pressure p_2, assuming that the cells are so large that the concentrations of their electrolytes are not affected materially by the change. As the cell is reversible, the energy given out in external work, in overcoming the electrical resistance of the circuit (in other words, the free energy or potential of the system), is equal to the work which would be done in distilling at constant temperature 9 grams of water from p_1 to p_2.

Expressing the above mathematically in the proper units we have

$$\epsilon_1 - \epsilon_2 = 0.029 \log \frac{p_1}{p_2} \text{ volts.}$$

The above formula I have tested experimentally in the cases of cuprous oxide, cupric oxide, electrolytic cobalt peroxide and electrolytic nickel peroxide. As the theoretical differences are in the millivolts, the limits of experimental error are such that the verification was not as close as could be desired.

The e. m. f. of cells of the type *M/K O H/M Ox*, or "oxygen lifts," are also nearly independent of the concentration. The free energy of the process is the same because the solvent plays no part in the reaction. As was remarked in the previous article, the lead accumulator requires a different formula because both the electrodes react with the solvent. The free energy of the reaction $Pb + Pb O_2 + 2 H_2 S O_4 = 2 Pb S O_4 + 2 H_2 O$, varies greatly with the concentration of the electrolyte, consequently the voltage varies considerably with the concentration of the electrolyte. This is brought out clearly in Dr. Dolezalek's book, "Die Theorie des Bleiaccumulators," p. 34 *et seq.*

WOOLSEY MCA. JOHNSON.

HARTFORD, CONN.

Safety of Consumers and Grounding of Secondaries.

To the Editors of Electrical World and Engineer:

SIRS.—It appears to me that the attention of the electric lighting interests of this country should again be called to the recurrence at various intervals of serious accidents to electric light consumers in the way of shocks received from supposedly harmless low-tension incandescent lighting circuits run as secondaries from transformers fed by high-tension alternating current. These shocks are due, of course, to leaks from the primary to the secondary coils of a transformer or to crosses of high and low-tension overhead wires. There is undoubtedly considerable negligence in this respect in many quarters, when it is considered how easy it is to make low tension secondary circuits and lamp sockets connected thereto perfectly harmless to the lives of those handling them. The precaution of grounding the secondary circuits at some point or putting in some equivalent automatic device makes it impossible to have a dangerous potential between any part of the circuit and ground. This is an absolute safeguard against loss of life from contact with such low-tension circuits.

The practice heretofore in this country has generally been not to ground the secondaries. This was formerly due partly to a harmful conservatism on the part of the underwriters, but mainly to the theory inherited from the early days of alternating-current distribution that transformer primaries and secondaries never become crossed and that hence there could be no danger. Every one who operates an alternating-current lighting plant knows how far it is from true that transformers never become defective so that there is a leak between coils. While it is true that this is not of frequent occurence that very fact makes it the more dangerous when it does occur, because it is unlooked for. Furthermore, the general public has a right to expect and does expect that all wires within reach will be absolutely harmless at all times. Safe they cannot be with a leak between primary and secondary transformer coils unless the secondary is grounded, because there is always sufficient leak between the primary distribution system and ground to make it uncomfortable for any one who puts himself between primary and ground. That more accidents do not occur from the numerous defective transformers that are taken down every year is due simply to the fact that no one happens to make a sufficiently low resistance path with his body between secondary and ground in the majority of cases. In the remaining minority of cases there is a call either for a doctor or a coroner, depending on the ohmic resistance of the path.

While the decision of the courts in damage suits resulting from such cases may not entirely agree up to date, owing to a misty understanding of technical matters in the judicial mind, it is manifest that in the end electric lighting companies will be held liable for damages from shocks received in this way in all cases, and the electric lighting companies of the country will be wise to take cognizance of the possible dangers and apply the remedy.

That there are some small objections to grounding the secondaries does not justify not doing so when it is a case of protection of human life, especially when it is considered how frequently transformers have insulation punctured during lightning storms without any one's knowledge. One argument against grounding secondaries is that in case the transformer becomes defective the fuses will blow and cut off the service. When a transformer is leaky it is high time that the service be cut off before some one is hurt, and the only practical way to find out the dangerous condition immediately upon its occurrence is to ground the secondary. Again it is argued that with the secondaries grounded the insulation in the transformer is put under greater strain. The answer to this is that when the primary insulation is so weak to ground that it needs the help of the secondary insulation to help it out it is so near a point of breakdown that the small increased life gained by the absence of a ground on the secondary is not worth the risk. Whatever objections may be urged, it can be taken for granted that they received due consideration from the committee of the American Institute of Electrical Engineers charged with the investigation of the subject, the report of which committee favoring grounding was adopted by the Institute, and, we believe, indorsed by the Underwriters' Association.

CHICAGO, ILL. CHAS. T. DASHIELL.

Conditions of Money Order Telephony.

To the Editors of Electrical World and Engineer:

SIRS.—I have read with much interest the opinions presented in your issues of Dec. 7 and 14 in regard to the telephone money order system. The great difficulty in such a system seems to be the proper identification of the persons sending the order, to insure the company against loss.

What I want to suggest is a little instrument that we might call an "identifier," that would identify the party sending the order beyond any doubt. By the use of this little instrument we obviate all, or nearly all, of the difficulties connected with sending money by telephone, especially those difficulties pointed out in your editorial of Dec. 14. It would not be necessary to have a special money order wire, as some suggested, nor would the publicity of the telephone be any disadvantage whatever, as only the proper parties could be identified.

This little instrument could very easily be made to give forth sounds into the transmitter of the sending telephone, that could be instantly recognized, but would be impossible to imitate without the little instrument itself. The sound-producing part of the instrument would best be made on the principle of the phonograph, or some other form of the talking machine, i. e., a record and a reproducing mechanism or diaphragm. The sound-producing part or record should be made interchangeable, similar to the interchangeable record of the phonograph. It could be made to reproduce any combination of words, sentences, musical notes or any imaginable combination of sounds. As the record need contain only a few words or sounds, the whole machine could be made very small and compact. It could be made as a part of the telephone instrument or could be made very compact and portable to be carried in the pocket.

The principal parts of the "identifier" are: An interchangeable record; a speaking diaphragm; a spring motor or some driving mechanism to insure uniform speed; a case or box to contain the mechanism, provided with a key or combination locking device.

I believe an instrument as above described would have a much wider field of usefulness than just in the transmission of money. It could be used in a great variety of business transactions over the telephone, giving, as it would, a stamp of genuineness to the communication.

It would be a very easy matter to establish a reliable system of stations where money could be paid and transmitted by telephone. It certainly would be of immense value to the public, as well as increase the income of telephone companies to no small extent.

I see clearly how an instrument of this kind could be made. I am a student in electricity, but have not the means to develop the idea. I would be very glad to correspond with any one who may be willing to aid me in perfecting this little instrument. I believe that an instrument of this kind will have a great future.

DAVID J. MONGSMITH.

SPENCER, OHIO.

A 19,000-Volt Shock.

To the Editors of Electrical World and Engineer:

SIRS.—In your issue of Dec. 28, 1901, I notice a communication from M. Henri Pieper regarding the survival of a man after receiving a 10,000-volt shock. In this connection I would call attention to

the circumstance related on page 1114 of your issue of June 29, 1901, which, for the benefit of those who have not the article at hand, I will briefly relate here. The Santa Ana-Los Angeles transmission line, owned now by the Edison Electric Company, of Los Angeles, is 83 miles in length, and is operated at about 33,000 volts. The transformers are connected Y fashion, with the neutral point or center connection grounded at both ends of the transmission. This gives approximately 19,000 volts between each wire of the circuit and ground. It is related that a workman one day while climbing up over a transformer case got near enough to one of the high-tension lines so that an arc struck between his skull and the wire. He was picked up for dead, with a hole burned in his skull and the skin burned off the soles of his feet. Fortunately, a gentleman was at hand who was expert in effecting revival from shocks. He rescuscitated the man so that with proper medical attendance and the grafting on of skin to replace that lost he ultimately recovered.

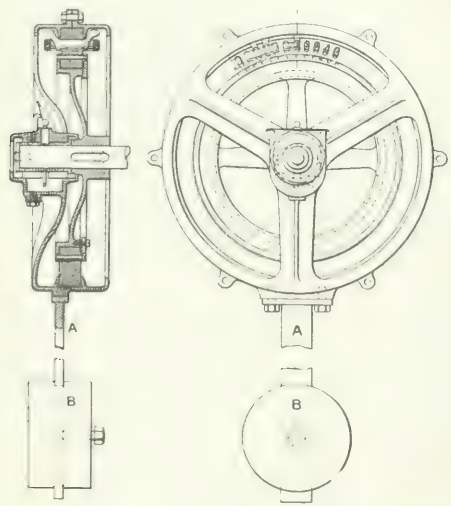
Of course, in none of these cases reported where a human being has inserted himself accidentally in some part of a very high-voltage circuit has he received as large a volume of current as would flow if he were placed directly between the conductors, as no man could do that and live. These acidents simply go to show that it is sometimes possible to get mixed up with such circuits and receive shocks from them in such a way as not to receive the full potential.

CHICAGO. J. R. CRAVATH.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Small Three-Phase Motors.—The three-phase induction motors of small capacity and with a short circuited armature, have generally too great an angular speed for most applications, and also a small starting torque. These disadvantages are claimed to be avoided in motors made by Prinetti and Stucchi, of Milan. To reduce the angular velocity to 100 or 200 r. p. m., they use a large number of poles of the inductor. To obtain a sufficient starting torque, the inductor is not fixed on the ground, but is mounted on the armature axle, around which it can turn, but a long pendulum *A B*, ending in a heavy disk, keeps it in a vertical position, when the motor is at rest, as shown in the adjoining figure. When the motor is started, the pendulum is



SMALL THREE-PHASE MOTORS.

deviated in the direction of the rotation of the armature. The angle of deviation enables one to find the power given out by the motor; it is equal to the product of angular velocity, the weight of the pendulum, its theoretical length, and the sine of the angle which the pendulum makes with the vertical direction. As the power of the motor is thus always evident, overloads are at once apparent; and the arrangement may be made that for a certain overload the circuit is automatically broken by the pendulum. The motors are especially adapted to drive spinning and weaving looms. (A similar device was suggested by the compiler years ago, the only difference being that a coil spring was used instead of the weighted pendulum. This has the additional advantage that the inductor can then make a number of revolutions instead of less than half a revolution, as in the above. It was also suggested to use it in order to facilitate bringing synchronous motors into synchronism and diminishing the risk of their pulling out of step.)—*L'Ind. Elec.*, Nov. 25.

POWER.

Transmission Plant in Agricultural District.—APT.—An illustrated description of the electric power transmission plant at Crottorf, Germany. The plant is in the center of a very fertile agricultural district. The water power of the Bode River is utilized to the extent of 500 hp; the balance of the power is generated by steam engines, coal mines being in the neighborhood. There are two 500-kilovolt-ampere, three-phase generators, the one driven by a steam engine, the other by steam and water power together. At low load the water power alone is sufficient. The voltage given by the machines and used for transmission is 7000. The area over which the power is transmitted, and in the center of which the generating station is situated, has a diameter of 18 miles and contains 27 towns, which are supplied with light and power. Most of the towns, i. e., all the smaller ones where there is no great use of power, contain each a transformer sub-station for supplying the current for lighting and power purposes. The larger towns which consume not only much light, but also much power at an irregularly varying load for agricultural purposes, have separate lighting and power circuits. The sub-stations in these towns contain storage batteries which are charged by motor-generators. During the day the batteries are charged and supply at the same time current to the few burning lamps. During the night the battery and motor-generator operate in parallel. Power is used especially for thrashing. The motor is placed on a carriage in order to connect it easily with any machine to be driven. To take current from the high-tension circuit on the open field, a portable transformer on a carriage is used.—*Elek. Zeit.*, Nov. 28.

Steam Generator.—BRABY.—A communication in which he explains the essential difference between his system of producing steam, and that of an ordinary boiler. Water is a bad conductor of heat, and heat can only be distributed in water by circulation. When circulation is perfect the steam bubbles are detached from the surfaces as fast as they are formed, and the maximum economical effect is obtained from the fuel. He considers circulation to be defective and slow, when it depends only upon the convection currents due to gravity. A boiler of ordinary construction is considered as a shell of metal, which is a good heat conductor, partly filled with water, which is only capable of distributing heat by circulation, yet the only circulation made use of is that caused by gravity, which necessitates a more or less large quantity of water being used to give passage for the convection currents and to provide a surface for ebullition. His steam generator is described as one or more plates or blocks of copper or other good heat conductor, having waterways formed therein, through which water is forced to circulate rapidly while under the application of heat. The temperature is equalized throughout the blocks by the heat-conducting power of the mass of metal, through which the water circulates with sufficient rapidity to carry away the heat and to prevent corrosion. No more water is brought into contact with the heating surfaces in a given time than can be converted into steam within that time, there is no surface for ebullition, prim-

ing is an impossibility, and there can be no danger of explosion. He claims that his method of converting water into steam is scientifically correct; that by it he has increased the evaporation efficiency of a square foot of heating surface as 5 is to 1, compared with the results obtainable from ordinary boilers, water tube and otherwise. Economy of fuel is also assured, and perfect immunity from explosion.—Lond. *Elec.*, Dec. 13.

TRACTION.

High-Speed Railways.—An editorial note on the results of the experiments of the German society for the study of electric high-speed railways. It is remarked that the speeds obtained thus far—maximum 100 miles per hour—are not record breaking, as the same speed and even 102.8 miles has been obtained on American steam railways. In this comparison it must be borne in mind, that the American records were all made by regular passenger trains which could hardly be classed as light, while the German records were obtained with specially designed experimental cars. "If any one desires to operate a train schedule at speeds of 80 to 100 miles per hour or even more, and is willing to run such light cars as those which the German experimenters are using, there are plenty of American locomotive designers who can produce a machine to meet the requirements.—*Eng. News*, Dec. 26. (A criticism of the Zossen experiments based only on the maximum speed actually obtained is unfair. The real value of the experiments lay in the test of a type of electrical equipment for traction service involving a great delivery of energy, and the result demonstrated the entire practicability of electric power for any railroad service, and particularly for express service.)

Shallow Underground Tramways.—WORDINGHAM.—An article on the report of Baker and Rider to the London County Council, on the Boston and New York shallow underground tramways, which has already been mentioned recently in the Digest. Some critical remarks are added on special points of the report. While the report points out the advantages of shallow subways over deep level tubes, the present writer says that the essential feature of the shallow subways is that they provide a means of affording nearly all the advantages of a quick service of tram cars in crowded streets; i. e., they run at moderate average speed with very frequent stopping places, whereas the deep-level tubes afford rapid transit between extreme points with comparatively few stops on the way. There is no doubt that there is a great advantage of running the trams in subways instead of on the surface in crowded thoroughfares. The report expresses astonishment at the fact that no provisions has been made either at Boston or New York for the accommodation of pipes in the tram subways. The present writer denies that the subway is really a solution of the problem of placing pipes. It is true that it would be effectual so far as trunk gas mains, electric feeders, etc., are concerned, but there would always remain the danger of serious explosions in the event of the gas escaping. On the other hand, it is the distributing mains, whether of electric energy or gas, or of water, that present the real difficulty; and it is difficult to see how a subway is to enable attachments to each system of mains to be made from every house on both sides of the street.—Lond. *Elec. Rev.*, Dec. 13.

Electrification of Railways.—DAWSON.—An article in which he says that the problem of the electrification of our railways is at present concerned, not with the high-speed main line trains, but only with the heavy suburban traffic. In this respect a large amount of experience has been obtained. A table is given with some data relative to the installation of several such railways in America and Europe. In this case the most important point is to get as high an acceleration as possible with due regard to the comfort and safety of the passengers, because if the acceleration can be increased in short distance runs the average speed of the train is increased, and with the same factor of safety as regards running, the number of trains can be increased. The maximum acceleration for traffic of this sort, which seems to be possible on steam railways, is 9 inches per second per second. Electrically, it is quite feasible, although not advisable, either economically or for reasons of safety, to exceed an acceleration of 24 inches per second per second. Regarding the electrifying of our railways, he says that the conductors cannot be overhead as long as a combined steam and electric service is run over the same lines, because the deposits formed on the wires would cause serious sparking. If the conductors are on the ground, they must be protected so as not to be easily accessible to the employes. At the same time the voltage used should be such as not to be fatal should any one come in momentary contact with them. The ideal method of operating an electrical suburban service would be to have a light structure on which the electric train would run, elevated above the existing lines. At junctions, the lines would be run over or under each other in such a way as to totally avoid crossing on the level. At the termini, loops might be provided. This would enable the trains to follow each other continuously, and the danger of collisions could be greatly reduced. Should this "double story" line be impossible, which is the case as long as steam trains are run under it, separate lines should be provided for the electrically operated trains, so as to reduce the delays to a minimum.—Lond. *Elec. Rev.*, Dec. 13.

Storage Batteries in Traction Systems.—An article in which attention is called to the fact that storage batteries are largely used for traction plants in the United States and Continental Europe, but are only beginning to make headway in Great Britain. The use of batteries in traction systems is discussed. It is said that the practice of connecting a battery of such a number of cells as will give the average voltage of the power circuit at the point where the battery is located, in parallel with the load, seems to be rapidly disappearing in favor of a smaller number of cells discharging through a booster. This enables a smaller size of battery to be installed. The fluctuations in load are taken up by the booster for charging the battery. The watt-hour efficiency of the battery is very considerably improved, being as high as 85 to 90 per cent when working under these conditions. This is due to the fact that, when working through a reversible booster on a traction load, the discharge is followed so rapidly by a charge that the average e. m. f. per cell is more than 2 volts, even on a heavy discharge. By this means the battery at the end of the day's run is practically fully charged and ready for the night load. Another advantage is the absence of any regulating cells.—Lond. *Elec. Rev.*, Dec. 13.

Conduit Systems in England.—A brief article stating that the conduit system will be used by the Bournemouth municipality for a length of 3 miles, and by the London County Council for 16 miles. At Bournemouth the side slot will be used, the width of the slot being inch and 1⅛ inches, the latter occurring on the curves. There will be a combination of the conduit and overhead trolley construction, as about 14 miles of overhead structure are to be installed at the extremities of the conduit tracks. The London County Council will use the conduit system throughout for 16 miles, the center slot being used, the width of the slot being ¾ inch.—Lond. *Elec. Rev.*, Dec. 13.

REFERENCES.

Machinery and Equipment for Electric Traction Systems.—A very large number of illustrated trade notes of British manufacturers, filling 35 full pages, including the following: Willans-Lancashire steam sets for tramway power stations; car lifting jacks; Ferranti-Westinghouse generators for Manchester tramways; Browett-Lindley engines for traction; engines for the Sheffield tramway power station; work wagons for heavy castings; Willans engines for electric traction; Doulton conduits and troughs; car heating, switchboard equipment, electric locomotives; storage batteries; instruments; traction accessories, etc.—Lond. *Elec. Rev.*, Dec. 13.

Train Control.—The first part of an illustrated article by Sprague on his multiple unit system, as applied to the Boston elevated railway. An illustrated description of the master control system of the British Thomson-Houston Company, as used in the Great Northern & City Railway, and an illustrated article on the Westinghouse electro-pneumatic system for the control of electric trains.—Lond. *Elec. Rev.*, Dec. 13.

Traction Plant.—An anonymous article on "Economy in plant for traction stations." As an example, the general design of a station is given, in which it is proposed to run a service of 27 cars with a load factor of 33 per cent. Two different designs are given, one with and the other without a storage battery. The differences between the two schemes are shown.—Lond. *Elec. Rev.*, Dec. 13.

Track Construction.—An illustrated article on the substantial system of street railway track construction at Scranton, Pa. This track comprises a concrete base, T-rails, steel ties, and reinforced joints, with brick and asphalt paving.—*Eng. News*, Dec. 26.

Installations. Systems and Appliances.

Installation of a Meat-Packing Plant.—An illustrated description of the electric installation of a large, new Chicago meat-packing plant. The power house contains two 250 generators, giving 1000 amperes direct current at 250 volts. There are 16 lighting circuits and 16 power circuits. Practically all the machines and apparatus throughout the plant are operated by means of 230-volt direct-current motors, there being altogether 50 motors with an aggregate capacity of 1023 hp. The lighting system is also operated at 230 volts, there being 2000 incandescent lamps of 16 cp and 100 enclosed arc lamps of 6 amperes.—*West. Elec.,* Dec. 21.

Five Thousand-Ampere Switch.—An illustrated description of a great four-pole switch, installed in the power house at Willesden. It weighs about a couple of tons. It is used for joining up the busbars in the station and works on two phases. There are really four separate switches, and each is mounted on a marble base 30 inches by 13 inches by 3 inches. They are all operated simultaneously by worm gearing from a handwheel, the shaft being divided into sections between which are inserted insulating couplings, each worm is, of course, also insulated from the switch that it actuates. Stencil copper brushes built up to give a sectional area of 16 square inches are used for contact.—Lond. *Lightning,* Dec. 12.

Electro-Physics and Magnetism.

Electrification of Air.—Lehmann.—An account of an exhaustive study of the distribution of electrified air in a large room. He claims to show that the convection of electricity from a point, during glow discharge, cannot be attributed to a conductivity of the air itself. He reproduces a large number of diagrams showing the distribution of the equipotential surfaces round the point, and this distribution is essentially different from what it would be in the case of a bad conductor like water. A charged conductor brought into a current of electric wind does not lose its charge if the electrifications are of the same sign, even though its own potential be much higher than that of the electrified air. If the conductor is positively electrified, it will lose its charge and assume the potential of the surrounding negatively electrified air. This fact is of vital importance in the use of probes generally, as they do not indicate the surrounding potential unless they are previously discharged. The electrification of air cannot be due to electrons, neither can it be due to dust particles.—*Ann der Physik,* No. 12; abstracted in Lond. *Elec.,* Dec. 20.

Fatigue of Luminosity.—Schmauss.—The reversible cross, first exhibited by Crookes, has been explained on three distinct theories. One is heating, the other chemical change, and the third is precipitation of metallic particles which are detached from the cathode. While the first can only explain a temporary change, and the last only a permanent change, a chemical effect might either produce a permanent or a reversible change. He made some experiments from which he concludes that the temporary fatigue observed in the case of most substances is due to heating under the influence of cathode rays. As regards the permanent fatigue he distinguishes two classes of substances; in the first, to which Balmain's luminous paint belongs, the permanent fatigue is due to changes produced by heat. The substances turn brown, just as they do in heating above a certain temperature. The fatigue sets in in ten minutes in the case of luminous paint, but requires several hours in the case of chalk. This shows that the fatigue cannot be due to the deposition of metallic particles, since these would affect all bodies equally. The temperature of the maximum of luminescence lies at 70 degs. for Balmain's luminous paint. Eggshells and glass shine the brighter the lower their temperature.—*Phys. Zeit.,* Dec. 1; abstracted in Lond. *Elec.,* Dec. 13.

Drop of Potential at the Electrodes in Vacuum Tube Discharges.—Skinner.—A very high potential is required to force a discharge directly through a rarefied gas across the space between the electrodes, when these are brought within a certain small distance of each other. This potential is due to a drop at the electrodes. He gives an account of a complete investigation of the conditions existing at the two electrodes. A special result obtained by him is interesting. Of two metals in the same gas the one showing the greater drop of potential as cathode possesses the smaller drop of anode.—*Phil. Mag.,* Dec.

Magnetic Elements in France.—Mathias.—The law of variation of the horizontal component of the earth's force formulated by him for the Toulouse district, has since been shown to apply to the whole of France and to represent the observed elements within the limits of observation. He has tried to find similar laws for the distribution of declination and dip, but has not met with the same success.—*Comptes Rendus,* Nov. 25; abstracted in Lond. *Elec.,* Dec. 13.

Temporary Set and Magneto-Striction.—Barus.—A long paper, illustrated by diagrams, on the "Temporary set, as associated with magneto-striction." He believes the phenomenon of magneto-striction to be inherently associated with what he interprets as viscosity. In other words, if deformations evoked by physical charges of molecular configuration within the metal, be termed viscous, whether gradual or sudden, then viscosity enters essentially into magneto-striction. With each twist, however small, and within the elastic limits, the wire receives a certain amount of set, instantaneously. The whose of this set may be shaken out by the first magnetization, and it is thus called temporary, to distinguish it from the permanent set which comes much later, as a second phase lying beyond the limits of elasticity. On removing the magnetic field, therefore, the unmagnetic wire is molecularly different from the same unmagnetic wire before magnetization, and the new molecular arrangement is permanent so long as the twist is unchanged. He gives an account of a series of experiments which show the dependence of temporary set on the antecedent strain. He first experimented with successively increasing alternating twists and then with successively increasing, asymmetrically alternating twists. Apart from its inherent importance as an introductory phase of permanent set, he believes temporary set to have the additional interest of being a clear cut instance of purely mechanical hysteresis, without necessary relation to magnetism.—*Phys. Rev.,* Nov.

References.

Light Pressure.—Nicholas and Hull.—A preliminary communication on the pressure of heat and light radiation. They give an account of experiments which prove qualitatively the existence of a pressure, not due to gas molecules, of the nature and order of magnitude of radiation pressure.—*Phys. Rev.,* Nov.

Colored Rings Due to Cathode Rays.—Von Czudnochowski.—An account of a continuation of his experiments on the colors produced by cathode rays on plates of fluorspar. He tested the influence of the geometrical form of the cathode.—*Phys. Zeit.,* Dec. 1; abstracted in Lond. *Elec.,* Dec. 13.

Construction of Electromagnets.—Conor.—A symmetrical outline of the calculation of electromagnets for other purposes than in dynamos and motors.—*L'Elec.,* Nov. 30.

Electro-Chemistry and Batteries.

Conductivities of Solutions.—F. Kohlrausch.—One of the fundamental quantities in electrolysis is the temperature coefficient of ionic friction in water (the change, with the temperature, of the "mobilities" of the ions). He discovered some striking relations between the figures hitherto accumulated, chiefly through the work of Deguisne, and these relations make the facts of electrolysis appear in a new and comprehensive light. The ratio of the conductivity of very dilute aqueous solutions at the temperature t (deg. C.) to the conductivity at 18 degs., is, according to Deguisne, equal to

$$1 + a(t - 18) + b(t - 18)^2$$

In attempting to find the conductivities of infinitely dilute solutions, he encountered the difficulty that there is a considerable change between dilutions of 0.001 and 0.0001 gram equivalents. This change is due to the conductivity of pure water, and he himself, therefore, introduced a correction based upon his own experiments. He then found that the second coefficient, b, could be expressed in terms of the first, a, by the equation,

$$b = 0.0163\,(a - 0.01741)$$

In this equation the two numerical values are nearly equal, and no great error is introduced by making them equal. If this is done, a very important result is obtained by exterpolation. It is found that for a certain temperature all the conductivities of aqueous solutions must be zero. This temperature is — 39 degs. C. He proposes to examine this result by testing under-cooled solutions. He believes that this temperature represents the "limit of the liquid state of

water," apart from crystallization. Another conclusion which he arrives at is that the electrolytic mobility of monovalent ions in water is determined by their mobility at a single given temperature.—*Sitzungsber. Akad. Wiss. Berlin*, Oct. 31; abstracted in Lond. *Elec.*, Dec. 20.

Copper-Cobalt Alloys.—REICHARDT.—An account of an investigation of the electrical properties of alloys of copper and cobalt. The electrical properties of copper are greatly influenced by the addition of small quantities of cobalt. For small additions of cobalt the influence is about the same as that of manganese, and three times that of nickel. An addition of 3 to 5 per cent brings down the temperature coefficient of the alloy to a minimum at + 0.00077, and at the same time yields the maximum thermo-electric force against pure copper with 33 microvolts per deg. C. Meanwhile, "the specific resistance increases to 9.5 microhms," and is only slightly increased by farther additions of cobalt. On the other hand, a slight addition of copper to cobalt considerably modifies the electric porportions of the latter. At a point lying between 0 and 10 per cent of copper the specific resistance reaches a maximum and the thermo-electric force a minimum. On the whole, the results do not show any discovery of great practical importance. But an alloy of copper with 1 or 2 per cent of cobalt may possibly be useful for thermopiles, since it combines a high fusing point, a high thermo-electric force ,and a resistance only four times that of copper.—*Ann. der Physik*, No. 12; abstracted in Lond. *Elec.*, Dec. 20.

Polarization Capacity of Platinum.—SCHOENHERR.—An account of an investigation of the polarization capacity of cells containing 0.1 normal sulphuric acid, as free from gas as possible, the electrodes being pieces of platinum foil of 6 sq. cm. area, kept at a distance of 0.6 cm. apart by means of glass beads. After the cell is charged, the capacity is found to fall regularly from 77 to 44 microfarads after 72 hours. At the same time the apparent resistance increases. When the cell is heated, the capacity rises from 41 microfarads at 20 degs. to 45 at 60 degs., and then falls to 40.5 at 79 degs., while after cooling the value is 25.6 microfarads at 17.2 degs. Repetition of this treatment lowers the capacity still further to 22.2. These results are explained by the diminution of the gas content at the surface, between the platinum and the electrolyte, brought about by the heating. By passing hydrogen over the surface of the electrolyte in the cell, and turning the latter, so that the platinum plates come into contact with the gas, the capacity is increased from 20 to 33.4, while treatment with oxygen in the same way has no effect. When by means of an auxiliary electrode placed in a beaker of the electrolyte surrounding the cell, so that the liquids inside and outside the cell are in communication, electrolyte hydrogen or oxygen is evolved at the surface of the electrodes, the capacity rises to 73.8 microfarads, a number almost equal to its initial value. The capacity of the cell with bright platinum electrodes is practically independent of the frequency of the alternating current, but when the electrodes are acted upon by a constant polarizing force, it is found that for different frequencies the capacity is approximately inversely proportional to the square root of the frequency. About 20 hours after the removal of the polarizing force the cell returns to its original condition, in which the capacity is almost independent of the frequency. The removal of gas from the surface of platinum can be effected by igniting the plates, and in this way results are obtained similar to those produced by heating the whole cell.—*Ann. der Physik.*, Aug.; abstracted in *Sc. Abstr.*, Nov.

REFERENCES.

Metallic Carbides.—MOISSAN.—An article in which, after an historical introduction, he gives as summary of the different metallic carbides, dividing them into those which are not soluble in water and those which are.—*Rev. Gen. des Sc.*, Nov. 15.

Thermo-Chemistry of Very Dilute Solutions.—STEINWEHR.—An account of an experimental investigation of the heat evolved by the dissociation of various acids, and of the temperature coefficient of the heat of dissociation.—*Zeit. Phys. Chem.*, Aug. 23; abstracted in *Science Abstracts*, Nov.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Permeameter for Testing Magnetic Quantities in Bulk.—An abstract of the discussion which followed Drysdale's paper, recently abstracted in the Digest. Generally the opinion was expressed that the instrument would supply a long-felt want in practice. But more experiments are needed concerning the accuracy of the instrument. Walker said that one had to rely upon the e. m. f. of the battery being absolutely constant. He suggested making a scale which gives different values for different values of the e. m. f. of the battery, then it would be a small matter to take the voltage of the battery before the test and read the values off the scale. Perry suggested to cut away the pin left by the drill and turn it up a little smaller, annealing it if necessary. By making a very slender pin it was possible to get over all sorts of difficulties as to joints. It would also entail less waste of material all over the casting. Drysdale, in his reply, agreed that there were difficulties still to be confronted. The apparatus did not give the same result as the older methods at low induction densities, yet so far as he could see, if there was an air-gap effect it was one which was most remarkably constant. He had found throughout his tests that he could put the plug in and take it out several times, and the results were remarkably consistent. If this were so, he did not think that it affected the use of the instrument from a commercial point of view. The whole point turns on the drilling, and this is a critical matter.—Lond. *Elec.*, Dec. 20.

Electroscope.—HURMUZESCU.—A description of an electroscope which has three metal sheets 2 mm. apart. On the outer two are hung two gold leaves. Beneath these three sheets, and in electrical communication with the case of the instrument, are two similar sheets, which can be moved up between the three sheets so as to form a condenser, or moved away from them. When the electroscope is to be charged, the two sheets are moved up so that the capacity of the electroscope is large, then if the voltage be too feeble to diverge the leaves, the two sheets are lowered, diminishing the capacity and increasing the pressure till the leaves diverge.—*Ann. Sci. de l'Un. de Jossy*, March; abstracted in *Science Abstracts*, Nov.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy Over the Ocean.—Some editorial notes on Marconi's achievement, which is said to be a germ that promises to develop into "abundantly fruitful maturity," but in another direction than is thought by the general public. "It is not in the interlinking of continents divided by an ocean, but rather in the overspreading of the ocean itself with telegraphic facilities that the power and fruitfulness of this latest achievement of Mr. Marconi is to be perceived. Submarine cables already link ocean-divided continents far better than wireless telegraphy can ever do." The true field of wireless telegraphy is across comparatively short distances of water. "It is really a disadvantage to wireless telegraphy to be able to take in such a wide compass as an entire ocean. Indeed, when such immense areas are covered, the probabilities of confusion and clashing of signals is a thousand-fold increased." No serious competition with submarine telegraphy can ever take place on a commercial basis, at any rate until the Marconi system is evolved into something very different from what it is now. Wireless signals in the ether can never be secret; it will always be possible to intercept them.—Lond. *Elec.*, Dec. 20.

Thermopiles in Telephone Stations.—TUCH.—An article on the experiments made by the German Post Office with Guelcher thermopiles as a substitute for primary or secondary batteries in telephone stations. Thermopiles of 50 junctions, giving 3 volts, and of 66 junctions, giving 4 volts, were tried. Curves are given showing the variation of volts, amperes and watts as the number of microphone circuits increased, for storage batteries, primary cells, and different arrangements of thermopiles. It was found that the thermopiles, owing to their high internal resistance did not furnish a corresponding amount of energy, as the number of microphone circuits was increased, and that their first cost, upkeep, and the cost of gas far exceeded the cost of accumulators. The thermopiles are now relegated to the Post Office Museum.—*Archiv. Post. Tel.*, July; abstracted in *Science Abstracts*, Nov.

REFERENCES.

Wireless Telegraphy.—An illustrated description of the Slaby-Arco portable field equipment for wireless telegraphy. Their tuned system has been described before at length in the Digest.—*Sc. Amer.*, Dec. 28.

German-American Cable.—An illustrated description of the construction of, and the instruments used, on the German-American cable between Emden, Fayal and New York, which has been in successful operation for one year.—*Elek. Zeit.*, Dec. 5.

Statistical.—The first part of a long article on the telegraph and telephone cables of the German Empire; comparative statistical tables on telegraphy in various countries in 1900 (the United States not being included), and a statistical article on telegraphy and telephony in the colony of Victoria in 1900.—*Jour. Tel.,* Nov. 25.

Electric Clocks.—Dary.—An illustrated article on electric clocks, exhibited at the Glasgow Exhibition.—*L'Elec.,* Oct. 23.

Miscellaneous.

REFERENCE.

Lightning Rods.—Neesen.—An article in which he describes several instructive cases of lightning flashes and gives conclusions regarding the proper construction of lightning rods.—*Elek. Zeit.,* Nov. 28.

New Books.

Die Neusten Fortschritte auf dem Gebiete der Funkentelegraphie. By Professor A. Slaby. Berlin: Julius Springer. 30 pages, illustrated. Price, 80 pfennige.

This is a somewhat elementary but interestingly written paper upon the principles of wireless telegraphy, or, as the author calls it, "Spark Telegraphy." The writer is of a somewhat imaginative disposition, to judge from the statements made in the opening paragraph concerning the faculties apparently possessed by Oriental races for becoming acquainted with distant events in a time too short for the dispatch of news by the ordinary means of transmission. Thus it is stated "The death of General Gordon was known in the streets of Cairo on the day of its occurrence, although the telegraph lines were destroyed." The facts in connection with the elementary theory of wireless development are, however, set out in an interesting and thoroughly scientific manner, together with some of the details through which the Slaby system of wireless signaling, now used to some extent in Germany, has been developed. The pamphlet is well worthy of the attention of all readers interested in the subject of wireless transmission.

Elektro Ingenieur Kalender 1901. Von Arthur H. Hirsch und Franz Wilking. Berlin: Oscar Coblentz. 173 pages, illustrated, with detachable note book. Price, 2.50 marks.

This is the first edition of a new electrical "almanac," as the Germans like to call a "pocketbook" which is published annually. It is smaller in size than Uppenborn's, which has been well known among German electrical engineers for many years. In its contents and scope the new publication also differs distinctly from Uppenborn's, so that it may be expected to hold its place successfully by the side of the older one.

The book is intended to give easily found, reliable information about all important questions of electrical engineering. This information is given in condensed form, there being very many tables of useful practical data. The authors have especially endeavored to give such data which the engineer needs while away from his office. The reviewer has found, while using the book for a while, that the data seem to be reliable and have been collected with care.

After 20 pages of mathematical tables, a comparative table of the measures and weights of different countries is given, followed by a table of specific gravities. The following chapters deal with the building of electric stations; the choice of power, such as water power, gas or steam; choice of prime movers, gearings, electric generating station, wiring, installation at the consumers' terminals, light and power, motors required for driving different machines, in sugar plants, in workshops, pumps, ventilators, elevators, brewery machines, in wood workshops, in brick kilns, on farms, in printing plants; electric traction. Some rules and regulations, issued by German authorities and societies, follow.

The arrangement of the single chapters seems very practical. The engineer is thought to be called in to give his opinion regarding the installation, say, of electric pumps. On the four pages of the "almanac," dealing with this subject, he finds the most important formulas for different kinds of pumps, several practical tables of numerical data, with a brief explanatory example, and a series of questions which must be answered in order to give a complete opinion and specification. The arrangement of the advertisements (40 pages) is ingenious. They are made a part of the book, and are arranged uniformly, as they give throughout standard sizes and prices of the manufacturer. Each chapter of the book has a little note, "for prices see advertisements, pages ——," so that the engineer is at once enabled to find out quickly the cost of what he wants to install.

Although much information, especially regarding prices, is based solely upon German conditions, and would not apply to the conditions of this country, there is no doubt that the American engineer will find in this little book much that is useful to him. The size of the book is such that one can easily carry it constantly in the pocket.

Die Beleuchtung von Eisenbahn-Personenwagen. Mit Besonderer Berucksichtigung der Elektricitat. By Dr. Max Buttner. Berlin: Julius Springer. 134 pages, 60 illustrations. Price, 5 marks.

This book gives a review of the methods of train lighting, and more especially of the various electrical systems which have been devised for this purpose. The author believes the public has a right to demand a system which will enable the passenger to read comfortably in the car, but the railroad companies do not seem to be in general of this opinion. Any oculist will say, however, that reading in a railroad car under the present conditions of lighting is unsafe, and it is certain that an improvement of these conditions will come from a general introduction of electric train lighting.

The author gives first a brief historical introduction. Figuratively, he starts from Adam and Eve—that is, from an edict of the King of Prussia, issued in 1844, and ordering the railroad cars to be lighted during the night "for the sake of safety and decency." Before that time there had only been signal lamps at the front and rear ends of the train. The first two chapters of the book (17 pages) deal with the methods of lighting with candles, oil, petroleum and gas. The balance of the book (117 pages) deals with systems of electric lighting of trains. As an introduction to this part of the book the author describes in the third chapter the construction and treatment of storage batteries.

The fourth chapter deals with the lighting of a total train by dynamos and batteries. The following systems are described: Stroudley and Houghton, used on the London-Brighton & South Coast Railway; that of Langdon, tried on the Midland Railway in England; that of Dietrich, tried on the railways of Wuertemberg, and that of Dick. The Dick system is described in detail. The fifth chapter deals with the lighting of single railroad cars by means of dynamos and batteries. The systems of Stone, Dick, Moskowitz, Vicarino and Aubert being described. The sixth chapters deals at some length with those systems of train lighting in which no dynamo is on the train, but the lighting current is furnished by storage batteries alone. Many of the systems described in these three chapters are well illustrated by diagrams.

In the seventh chapter the author gives some general notes on electric train lighting, and discusses briefly the relative advantages of the different electric systems. He says that the number of railroad cars at present lighted by electricity is 12 000, of which 5500 cars get the current from a combination of dynamo and storage battery, while 6500 are provided with batteries alone. In Continental Europe the pure storage battery system is preferred, in other countries a combination of dynamo and battery; in England, for instance, the Stone system is much used. The author believes that the Nernst lamp will not be introduced in railroad cars, as it cannot be made for voltages below 70. He seems to hope much from the Welsbach osmium lamp, as it is well suited for low voltages. He remarks that the German Incandescent Gas Light Company, which owns the patents for Germany, expected to put the osmium lamp on the market in the autumn of 1901. In view of the fact that nothing has been heard of the osmium lamp for quite a while, one is tempted to ask, What has become of it?

In the eighth and last chapter the author discusses the advantages and disadvantages of the different methods of train lighting, especially of gas and electricity. He also gives an estimate of the first cost of installation and of the cost of operation for the different systems. He concludes that the future of train lighting certainly belongs to electrictiy.

The book, as a whole, can well be recommended, especially to railroad engineers who desire to be posted on the subject of train lighting, which is certainly a subject of timely importance. While the author does not seem to give much that is new, his book is a fair and plain review of the subject. The descriptions are clear and concise. Print and illustrations are good.

MESURES ELECTRIQUES. Leçons Professées a L'Institut Electrotechnique Montefiore. By Eric Gerard. Second edition. Paris: Gauthier-Villars. 532 pages, 217 illustrations. Price, 12 francs.

The first edition of this work was published in 1896 and attracted the attention of American readers who were already acquainted with the author's earlier book, *Lecons sur L'Electricite*, which was subsequently translated and published in this country, with the addition of several chapters by American authors. The "Mesures Electriques," by Gerard, proved to be no mean successor to the classical volumes of Mascart and Jubert, and it confirms the reputation of French writers as distinctly excellent in the elegance of their presentation of the theory of electricity and magnetism in its applications in measurements.

To those not familiar with the former edition of this book, its character may largely be inferred from the statement in the preface: "The progress of applied electricity has been rapid because the electricians trained in laboratory methods have applied in their subsequent work the rigorous methods of investigation which characterize physical research." An American reader receives a statement of this character with certain qualifications. The workshop and testing rooms of certain of our electrical manufactories have usually gone in advance of laboratory investigations and scholastic instruction, and the gravity of the French professor's attitude toward his subject matter, seems to be ill warranted.

In general this most excellent book is characterized by a lack of technical taste or judgment, though for a French electrician these strictures would have less weight. The book is evidently a compilation from materials used with schoolboys in their studies, and suffers somewhat from lack of sympathy with the needs of the practicing engineer. Upon reading this second edition it is noticeable that the whole work has been conscientiously re-edited, and that many parts have been rewritten and considerable new matter has been added. These changes have generally resulted in added precision of statement (though this is a hobby gallantly ridden by many scientists) and symmetrical treatment.

The introductory chapter on principles of measurement and the limits of error is one of the best discussions of the subject matter that has been presented. The same is true of Chapter III., which deals with photometry, which, in this later edition, has been revised and brought fairly up to date. The subject of galvanometry is rather thoroughly discussed, and the treatment is unusually clear, though at the present rate of elimination of the galvanometer *per se* from applied electrical measurements, the subject is overtreated. In this same connection an illustrated description of many commercial forms of ammeters and voltmeters is given without any adequate analytical statement of the mechanics of their action. Noticeably again, in Chapter XVI., the same vague descriptive treatment is given to the various integrating electricity and energy meters. These descriptions are aggravated cases of the infliction of catalogue matter within the dignity of book covers. It is surprising that the author has not availed of several very complete and elaborate articles in which these various types of instruments are analytically treated; the engineer would not object, and the schoolboy would be vastly profited.

The testing of iron for permeability and hysteresis receives a fairly good treatment, though it suffers by omission of recent developments in apparatus and methods. Following this, some three chapters are given to tests of motors and dynamos, of direct, alternating and polyphase types, and here the author is rather more successful, though much of his practice would not be followed in this country. Finally, a chapter is awarded to testing transformers, and through its 15 pages the discussion is so insufficient that the matter is practically valueless.

The work of M. Gerard has two pronounced faults: One occurs through ignoring foreign methods, which in so many instances are in advance of the practice he describes, and the second happens through an almost total absence of references.

For the physicist, the schoolman or the scholarly engineer *Mesures Electriques* will prove an unusually suggestive book from its cleanness of presentation where analysis is used. Had the author confined himself to those academic mathematical subjects with which he has shown he is so vitally conversant, a symmetrical work would have resulted. But, unfortunately, through an endeavor to be practical, he has ventured into subjects with which he evidently has only a tentative familiarity.

Though the importance of this French work scarcely merits such an extended review for American readers, its shortcomings are pregnant with suggestion and they have been emphasized in detail. As we turn away in disappointment from one work after another on electrical measurements, each one in turn has shown no more clearly what its successor should be, and the net gain has been small.

Westinghouse Standard Transformers.

We illustrate herewith the Westinghouse O. D. type of transformer and give some curves showing its efficiency, and also some temperature curves. This transformer is of the shell type, which type the manufacturers consider to be much superior to the core type, owing to the less voltage that exists between adjacent layers and the greater facilities offered for the conduction of heat from the core. In a comparison made between these two types, the voltage between the first turn of the first layer and the last turn of the last layer is stated in the core type to amount in a particular case to 500 volts, while in the shell type it is but 50 volts. A marked advantage of the lower temperature of the shell type is that there is less aging of the iron of the core.

A feature that has been introduced into the design of these transformers is a system of connections whereby an unusually large number of ratios of transformation may be obtained. For example, a lighting transformer for a 2100-volt primary circuit admits of the following secondary voltages: 52½ — 105 — 210; 55 — 110 — 220; 58 — 116 — 232. The standard Westinghouse method of cross connecting the secondaries has been retained in these transformers. This is a method devised to overcome the large difference in voltage between the two sids of the circuit when they are unequally loaded.

When the rated primary voltages are 1050 or 2100, the transform-

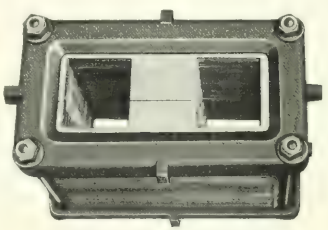


FIG. 1.—SHELL OF TRANSFORMER.

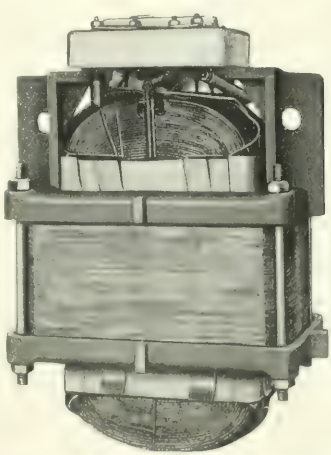


FIG. 2.—TRANSFORMER READY FOR CASING.

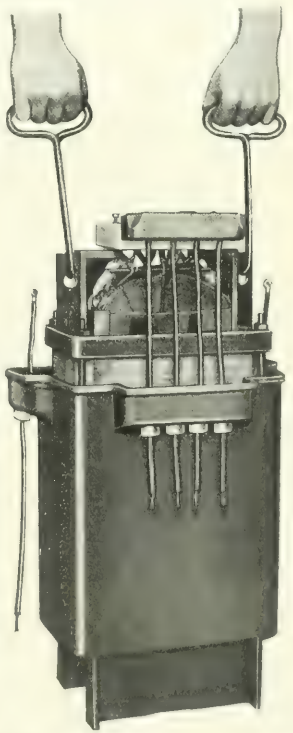


FIG. 3.—LIFTING TRANSFORMER OUT OF CASE.

ers will operate satisfactorily at any e. m. f. from 950 to 1150 volts, or from 1900 to 2300 volts. The 60-cycle transformer will operate at

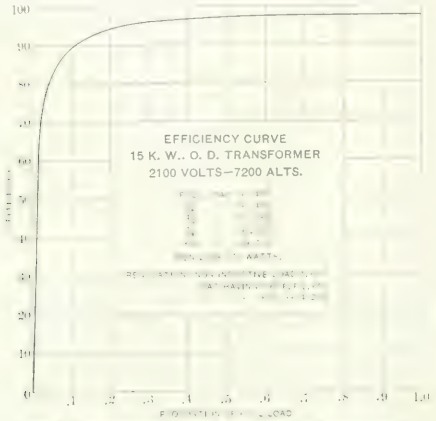


FIG. 4.—EFFICIENCY CURVE FOR 1-KW TRANSFORMER.

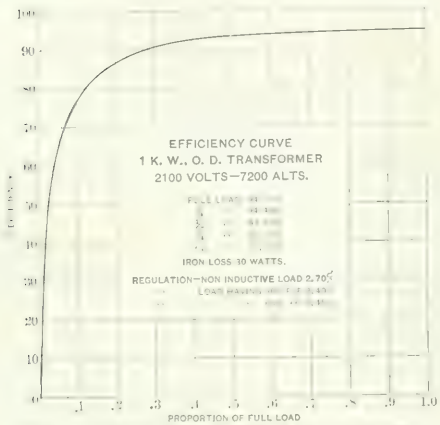


FIG. 5.—EFFICIENCY CURVE FOR 15-KW TRANSFORMER.

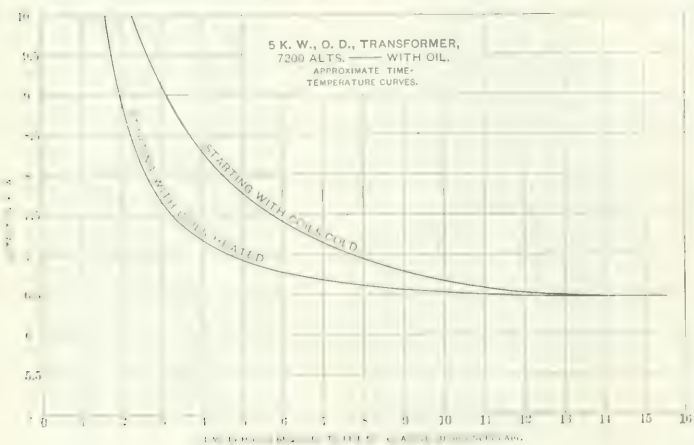


FIG. 6.—TIME TEMPERATURE CURVES.

any frequency from 40 to 133 cycles, and the 25-cycle transformers will operate on circuits of a frequency up to 40 cycles.

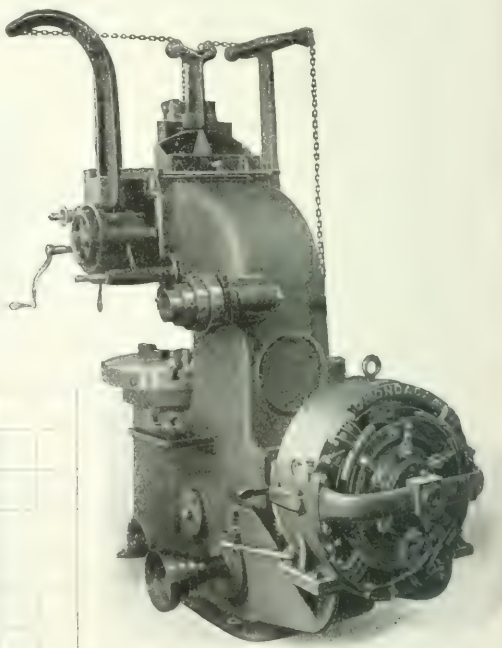
Of the efficiency curves shown, that of Fig. 4 is for a 1-kw transformer and that of Fig. 5 for a 15-kw transformer. It will be noted that the efficiency of the small transformer is 94.7 at full load and drops to only 88.75 per cent at quarter load, while the efficiency of the larger transformer is 97.4 at full load, and no less than 95.03 per cent at quarter load. In the case of a 50-kw transformer these figures attain 98.05 and 96.85 per cent, respectively. In each of the above cases the frequency is 60 cycles.

Fig. 6 gives a full load temperature test of a 5-kw, 60-cycle transformer. It will be noted that these curves extend over 15 hours of test instead of 8 hours, as has been the general custom. As the curves show that the temperature for an 8-hours' run is considerably below the maximum temperature attained, the advisability of using the longer period in transformer tests is obvious.

In Fig. 1 the shell of an O. D. transformer is shown, and in Fig. 2 the transformer is represented ready for casing. Fig. 3 shows a transformer being lifted out of its case. The use of oil in this type of transformer is recommended, though not obligatory.

Electrically Driven Boring Machine.

The accompanying illustration shows a boring machine, which is driven by an Onondaga motor geared thereto. The standards, or feet of this motor, are cast solid into the magnet frame, providing for adjustment to the base frame of the boring machine, as shown. These motors are applicable to other machine tools, such as lathes, drill presses, bending rolls, pumps, blowers, etc., and also to printing presses. They are intended for use only in cases where very slow



BORING MACHINE DRIVEN BY ELECTRIC MOTOR.

speed is required. The bearings are supported from the center of the magnet frame by cast iron brackets bolted to the frame.

The cast iron magnet yoke is split horizontally to facilitate assembling. The armature of these motors is of the barrel type, and is well ventilated by means of openings from the inside of the spider, which allow the air to pass out through the core and circulate about the windings.

These motors, which are manufactured by the Onondaga Dynamo Company, Syracuse, N. Y., are made in sizes ranging from 1 to 10 hp, and designed for use on direct-current circuits of 110, 220 and 500 volts.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed nominally at 6 per cent; time money was inactive, due chiefly to the fact that borrowers are disposed to defer making time contracts, awaiting lower rates. The closing rates are 5 per cent for 30 to 60 days, 5@5½ per cent for three, four, five and six months. In the stock market there was a stronger tone as the result of large investment demands and renewed speculative buying. In the face of very firm money rates speculative interests seem inclined to discount the probability of easier conditions as to loans and the continuance of investment buying. Public participation in the market increased considerably. In the traction list Brooklyn Rapid Transit stock was a feature on Friday, and made a sudden manipulative advance, the closing price being 66⅞, a net gain of 1⅝ points. The range of prices during the week was from 65⅝ to 68⅜, the number of shares sold being 57,710. Metropolitan Street Railway closed at 163, being a net gain of ¾ point, the sales aggregating 16,100 shares. Manhattan Elevated lost ⅞ of a point on the week's trading of 58,950 shares, closing at 137. General Electric closed at 280, ex-dividend, which is a net loss of 1 point as compared with the closing price of the previous week. Westinghouse Electric, common, made a net gain of 2 points, closing at 179, but first preferred lost 5 points, closing at 182. Western Union closed at 92¾, being a net gain of ⅝ point, the sales aggregating 17,325. Closing quotations of other electrical securities are: American District Telegraph, 38, a net gain of 1¾ points, and Commercial Cable, 160, a net loss of 10 points. Following are the closing quotations of Jan. 7:

NEW YORK.

	Dec. 30.	Jan. 7.		Dec. 30.	Jan. 7.
American Tel. & Cable..	96*	90	General Electric.....	283¾	279
American Dist. Tel.....	30		General Carriage		
Brooklyn Rapid Transit.	67⅛	65⅝	Boston Rivers Tel		
Ches. & Pot. Telephone..	65	—	Metropolitan Street Ry...	161	162¾
Commercial Cable.....	170	155	N. E. Elec. Veh. Tran...	—	½
Electric Boat.....	19½	24½	N. Y. Elec. Veh. Tran..	12	12
Electric Boat pfd.....	40	45	N. Y. & N. J. Tel.....	167	—
Electric Lead Reduc'n...	1½	1¾	Tel. & Tel. Co. of Am...	—	—
Electric Vehicle.....	2¼	2	Western Union Tel.....	92⅜	91
Electric Vehicle pfd.....	4	4	West. E. & M. Co.....	177	177
			West. E. & M. Co., pfd..	182	—

BOSTON.

	Dec. 30.	Jan. 7.		Dec. 30.	Jan. 7.
Am. Tel & Tel.....	164½	161	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	133	137
Edison Elec. Illum.....	242	—	Westinghouse Elec.....	85	90
Erie Telephone.....	15½	15⅜	Westinghouse Elec. pfd..	90	89¾
General Electric pfd....	—	—			

PHILADELPHIA.

	Dec. 30.	Jan. 7.		Dec. 30.	Jan. 7.
American Railways	44	44	Penn. Traction	97¾	97⅝
Electric Storage Battery.	62	62	Philadelphia Electric	4¼	4⅜
Elec. Storage Batt'y pfd.	62	—	Pa. Electric Vehicle.....	¾	—
Elec. Co. of America....	[illegible]	[illegible]	Pa. Heat, Light & Power	2	2

CHICAGO.

	Dec. 30.	Jan. 7.		Dec. 30.	Jan. 7.
Central Union Telephone.	—	—	National Carbon pfd.....	82½	84
Chicago Edison.....	160		National Electric Vehicle	30	30
Chicago City Ry.....	185	188	Penn. Traction	10	10
Chicago Telep. Co.....	225*	230	Union Traction pfd.....	47	—
National Carbon.....	19	19			

*Asked.

NEW YORK DISTRICT TELEGRAPH is the storm center of a big row, and a movement has been launched against the present management by a number of stockholders who have issued a circular against President T. T. Eckert and his following. As might have been expected, the doughty general joins issue. His circular requests the stockholders to give an expression of opinion on a plan to decrease the capital stock of the company from $4,000,000 to $2,000,000. A resolution to this effect will be introduced at the annual meeting on Jan. 23, if, in the judgment of the directors, the stockholders are willing that this shall be done. No reasons are given for cutting the capital of the company in two. The point is made, however, that during the last nine years, from 1892 to 1900, inclusive, dividends amounting to 19½ per cent have been declared upon a capital of $4,000,000, or on an average of 2 1-6 per cent a year, which would have been 4⅓ per cent on a capital of $2,000,000. The company has about 30,000 messenger call boxes in the city, and works closely with the Western Union. The business has undoubtedly suffered sharply from the growth of the telephone, and the trouble appears to lie in the proposal to adjust the capital to newer conditions.

CLEVELAND FEDERAL TELEPHONE.—There has been a severe decline at Cleveland in the shares of the Federal Telephone Company, independent, which has been backed by the Everett-Moore Syndicate. The shares have declined from $25 to $5. The Federal Company is a parent company controlling 20 sub-companies and 36 exchanges. Its principal exchanges are in Cleveland and Detroit, where it has been in competition with Erie companies. It has been expanding rapidly, and is now engaged in building exchanges in Toledo, Dayton and Springfield, Ohio, and extending into Michigan. Among the telephone properties owned outright or controlled by the syndicate are the Cuyahoga Telephone Company, of Cleveland, with upward of 10,000 subscribers; the United States Telephone Company, the Federal Telephone Company, the Stark County Telephone Company, the Columbian County Telephone Company,, the People's Telephone Company, of Detroit; the Wood County Telephone Company, and several others in which the Federal Telephone Company is the controlling factor.

BELL TELEPHONE.—The American Telephone & Telegraph instrument statement for the month ended Dec. 20 shows:

	1901.	1900.	Changes.
Gross output	92,732	63,196	Inc. 29,536
Returned	34,688	23,593	Inc. 11,095
Net output	58,044	39,603	Inc. 18,441
Since Dec. 20, 1900:			
Gross output	960,055	683,955	Inc. 276,100
Returned	386,861	372,311	Inc. 14,550
Net output	573,194	372,311	Inc. 200,883
Total outstanding ...	2,526,010	1,952,816	Inc. 573,194

This should mean about 1,100,000 subscribers, or about 200,000 to 250,000 in the last year. No great hurt is shown from the independent movement.

CONSOLIDATED EXCHANGE TELEGRAPHS.—A meeting of the board of directors of the New York Consolidated Stock Exchange last week was held to consider a proposition to establish a special wire system for the Exchange to Western cities. This is for the purpose of securing a large part of the trade that at present is going to bucket shops. President Wagar said that the plan was enthusiastically approved of. The work of constructing this system will now be placed in the hands of a special committee. When the intention of the Exchange to inaugurate a service of this kind was made known, $1,000 was bid for a seat on the Exchange. The only seat offered was held at $1,100.

EVERETT-MOORE TROLLEYS.—A special telegram of Jan. 4 from Cleveland, Ohio, says: After a busy session lasting from early this morning until 9 o'clock to-night, the Cleveland Bankers' Committee in charge of the Everett-Moore Syndicate's affairs announced that there would be a surplus of about $3,000,000 over all liabilities, providing the committee succeeds in bringing about a general extension of credit. More than 50 per cent of the liabilities were represented by the creditors the committee talked with, and not a single refusal had been received when the committee asked for an extension of time of 18 months.

TROLLEY PARALLEL DIVIDENDS.—A telegram from Hartford, Conn., of Jan. 2 says: The declaration of a semi-annual dividend of 3 per cent by the electric street railway between Norwich and New London is of interest as illustrating the profitableness and effectiveness of the trolley's competition with a steam line. This interurban trolley parallels the Central Vermont Railroad, and when it was built many observers predicted that the venture would not be financially profitable. The trolley has not only diverted a large amount of patronage from the steam road, but it has also developed a considerable volume of traffic that was previously dormant.

DETROIT & TOLEDO SHORE.—The Ohio Savings Bank and D. B. Cunningham, Toledo, Ohio, have been appointed receivers for the Detroit & Toledo Shore Railroad. The Strange Contracting Company is the complainant with a claim of $158,000. This is an Everett-Moore electric line, and the action is due to the troubles of the syndicate.

WESTINGHOUSE MACHINE COMPANY.—The capital of the Westinghouse Machine Company has been increased from $3,000,000 to $5,000,000. The preferred rights will be relinquished and all stock will be the same. The company earned 20 per cent net for the year.

CONNECTICUT RAILWAY & LIGHTING.—There have been listed in Philadelphia $8,355,000 first and refunding 4½s gold bonds of the Connecticut Railway & Lighting Company, due 1951, also

$2,500,000 first mortgage 5s gold bonds of Syracuse Rapid Transit Railway due 1946.

SAVANNAH ELECTRIC COMPANY.—With regard to the electric light deal at Savannah, Ga., it is now announced that Lee, Higginson & Co. and Stone & Webster, of Boston, have organized the Savannah Electric Company, with $2,500,000 5-per-cent 50-year bonds, $1,000,000 6 per cent preferred stock and $2,500,000 common stock, to take over the entire street railway and lighting system of Savannah, Ga., which have perpetual franchises. The companies taken over comprise the Edison Electric Illuminating Company, which has an extensive underground system of distribution and has been paying regular dividends at the rate of 6 per cent; the City & Suburban Railway Company and the Savannah & Thunderbolt Line, which traction companies control the street railway facilities of the city. Of the $2,500,000 5 per cent bonds $1,000,000 will be reserved to retire $1,000,000 4 per cent bonds of the Savannah & Thunderbolt Company. The bond mortgage contains a provision allowing the further issue of $1,000,000 bonds for new equipment and construction. The entire bond issue is subject to call at 110. The railway system of Savannah comprises about 54 miles of track and the present plant, with some suburban extensions, should meet the needs of the city for some years to come. Messrs. Stone & Webster have managed the lighting company since Jan. 1, 1899, and will be continued as managers of the combined properties. Earnings are sufficient to make sure the 6 per cent dividends on the preferred stock. The securities will be listed on the Boston Stock Exchange, as Boston capital is largely interested in the enterprise.

PORTO RICO ELECTRICS.—The Ponce Electric Company and the Ponce Railway & Electric Light Company, capitalized at $415,000 and $50,000, respectively, have been incorporated in Trenton to do business in Porto Rico.

DIVIDENDS.—The regular quarterly dividend of 1¼ per cent has been declared upon the preferred stock of the Bullock Electric Manufacturing Company, payable Jan. 2.

Commercial Intelligence.

THE WEEK IN TRADE.—Industrial, commercial and financial conditions are in every respect satisfactory, although during the past week there was some dullness as regards new business, due, to some extent, to stock-taking and preparing for the future. A conspicuous exception to the general quietness was the iron and steel situation, which was more active. The car shortage is still a disturbing element in the situation, and continues to unsettle both production and consumption considerably. The only appearance of weakness in finished products is in wire and nails, which are $2 per ton lower, owing to increased competition. Heavy rail orders for Mexico are reported pending. An international competition promises to be begun in this respect. Floods in the mining regions have interfered with production, and the car shortage still accentuates the scarcity of coal, particularly bituminous. Anthracite supplies are smaller, notwithstanding the total production last year in excess of 53,000,000 tons, a total 12 per cent larger than ever before produced. On Friday the United Metals Selling Company, the selling agent for the Amalgamated Copper Company, announced a further cut—the fourth—in the price of copper of ⅞ cent a pound for Lake. This brings the price of Lake practically 5 cents a pound under the 17-cent price at which the Amalgamated interests originally attempted to hold the metal. The quotations are now 12⅛ cents for Lake, 12 cents for electrolytic and 11½ cents for casting. Still lower prices are looked for. It is stated that the last cut was forced by recent reductions in the prices of all grades made by independent producers. Brass has been lowered to meet the decline in copper as presaged in last issue. The business failures for the week, as reported by *Bradstreet's*, number 270, as against 219 the week previous and 268 the corresponding week last year. *Bradstreet's* points out that the business failures were unusually small after the holidays, and failures were fewer in December than in the same month of the preceding year. For the year they number 10,657, with liabilities of $129,978,838, an increase of 7.5 per cent over 1900 as to number, and of 2.4 per cent as to liabilities. The percentage of assets to liabilities was only 46.9, the smallest proportion reported since 1885.

ARGENTINE REPUBLIC TRADE.—Electrical machinery from the United States has a constantly augmenting representation in the Argentine Republic. Wherever the electrical manufacturers of the United States have (as has been the case in the Argentine Republic) introduced their wares by means of intelligent, well-informed and persistent resident agents, speaking the language and acquainted with the customs of the people, they have been successful in building up a large and growing demand for supplies. The increase in the value of electric and scientific apparatus taken by the Argentine Republic from the United States is shown by the following statistics: Fiscal year 1899, $247,062; 1900, $259,608; 1901, $307,490. The connection between the national telegraph systems of Uruguay and the Argentine Republic has been completed by a cable crossing the Uruguay River, uniting Santa Rosa and Monte Caseos. The other three points of connection are at Martin Chico, on a direct line from Montevideo and Buenos Ayres, Salto to Concordia, and from the Uruguayan frontier at Paysandu to Concepcion. The latest connection, besides completing the unity of the two systems, will be of great importance in communication from both Republics to the Republic of Brazil. Before long the telegraph systems of all three of these South American countries will be united.

AUTOMOBILE TRADE SHOW FOR WASHINGTON.—On Friday evening, Jan. 3, 1902, a meeting of the local dealers in automobiles was held at Barton's Hotel, Washington, and resulted in forming the Washington Automobile Dealers' Association. The following were elected officers for the ensuing year: Frank Boyd, president; Schuyler S. Old, Jr., secretary; W. J. Foss, treasurer. The above-named constitute the executive committee. It was decided at this meeting to hold an automobile show in Washington during March, 1902, each dealer pledging to take space, and to contribute to the general expenses of holding a show. A number of prominent manufacturers of automobiles and automobile accessories have also pledged their support, so that the show will be held in spite of failure to secure the sanction of the National Automobile Manufacturers' Association. The show will be held in the large armory of the Washington Light Infantry Corps. The automobile dealers are doing a good business, and feel the money spent on a show will be the best form of local advertising they can do. Mr. B. C. Washington, Jr., has been elected as general manager by the Dealers' Association.

CRUDE RUBBER FAILURE.—The electrical trade generally is very much interested in the failure of the Crude Rubber Company to meet its obligations, as it seems to involve much cheaper rubber for insulation purposes, etc. The failure has naturally unsettled the market, as with between $2,000,000 and $3,000,000 worth of rubber in the hands of the bankers it is somewhat difficult to say at what price it will be sold. Since the failure of the Crude Rubber Company the price of Up-River Para has declined 2 cents per pound to 82 cents. It is trade rumor that the United States Rubber Company in purchasing $1,000,000 worth of crude from the Crude Rubber Company, paid 81 cents per pound for Up-River Para and 77½ cents for Island rubber, but this rumor lacks confirmation. It is thought not unlikely, however, that the elimination of the Crude Rubber Company from the field, with its stock of high-priced rubber, will be taken advantage of to form a crude rubber combination, as great economies could be introduced through such a combination and the importers and consumers of rubber alike benefited.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY has added four new and important foreign agencies. Wm. M. McLean & Co., of Melbourne, Australia, will have direct supervision over Australia, New Zealand, Tasmania and Fiji. Arrangements have been perfected with the Bullock Company by Mr. O. L. Remington, of the firm, who has been visiting headquarters in Norwood. J. H. Newby, of the Bullock works, will also be identified with the Melbourne office. The new agency for Manchuria and Eastern Siberia will be in charge of E. L. Richardson & Co. Mr. Richardson will ultimately make his headquarters in New York. He will travel extensively in Russia for a few months. The new Japanese agency is at Tokio, and H. S. Tanaka & Co. will be in charge. The new agency for Porto Rico is at San Jose, with T. S. Allen in charge. Mr. F. G. Bolles, who has been in charge of the publicity department of the Bullock Company's business for several years, was promoted on the first of the year to be manager of foreign agencies.

PROMINENT LONDON ENGINEER HERE.—Mr. Charles S. Drummond, who is one of the active directors of the British Electric Traction Company, Limited, of London, which concern is the largest company of its kind in the United Kingdom, is now in this city. Mr. Drummond devotes his attention principally to the management of the various traction enterprises in which the British Company is interested. He may be found at the offices in the Broad Exchange Building, 25 Broad Street, of Frederic B. Esler.

VENTILATING FAN MOTORS.—Sealed proposals will be received by the United States Engineer Office, Washington, until noon, Feb. 3, 1902, and then publicly opened for furnishing ventilating fans, with direct connected motors for the new building for the Government Printing Office. Information will be furnished on application by Captain John Stephen Sewell, of the United States Engineer Corps.

ELECTRIC LIGHTING IN SUEZ.—Tenders are called for until Jan. 15 for the installation of an electric lighting system in Suez and Damanhour, including the overhead wires for distribution. Specifications for the work may be obtained of the Minister of Public Works, Cairo, Egypt

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 31: Antwerp—2 pkgs. machinery, $317; 8 pkgs. material, $335. Bristol—8 pkgs. machinery, $480; 40 pkgs. wire, $610; 62 pkgs. copper material, $3,500. Berlin—1 pkg. material, $100. British Australia—96 pkgs. wire, $2,287; 22 pkgs. material, $1,654; 259 pkgs. machinery, $20,864. British Possessions in Africa—5 pkgs. material, $466. British Possessions (all others)—1 pkg. machinery, $35. Bolton—4 pkgs. wire, $275. Brazil—76 pkgs. material, $3,207. British East Indies—302 pkgs. material, $5,680; 8 pkgs. machinery, $1,800. British Guiana—26 pkgs. material, $400. British West Indies—24 pkgs. material, $566; 2 pkgs. wire, $59. Central America—15 pkgs. material, $193; 2 pkgs. copper wire, $93. Cuba—154 pkgs. material, $1,758; 18 pkgs. wire, $64. Chili—74 pkgs. material, $3,260. Glasgow —12 pkgs. machinery, $1,025. Genoa—1 pkg. material, $113. Hamburg—14 pkgs. material, $2,222. Havre—13 pkgs. material, $983; 18 pkgs. machinery, $4,668. Leicester—3 pkgs. wire, $322. Leeds—15 pkgs. material, $261. Liverpool—86 pkgs. machinery, $6,761; 43 pkgs. material, $2,605; 674,123 lbs. copper, $113,095; 890 pkgs. material, $79,500; 120 pkgs. wire, $2,730; 6 pkgs. motors, $1,173. London—173 pkgs. machinery, $7,317; 163 pkgs. material, $8,857. Manchester—179 pkgs. machinery, $38,533; 3 pkgs. wire, $15. Mexico—127 pkgs. material, $3,497; 41 pkgs. machinery, $5,040. Marseilles—1 pkg. material, $75. Milan—3 pkgs. material, $60. Nice—2 pkgs. machinery, $500. Newcastle—14 pkgs. machinery, $2,297. Oporto—2 pkgs. material, $200. Peru—8 pkgs. material, $338. Rotterdam—8 pkgs. material, $131. Santo Domingo—4 pkgs. material, $124. Southampton —19 pkgs. material, $1,236; 10 pkgs. wire, $735. Sunderland—1 pkg. material, $16. U. S. Colombia—2 pkgs. machinery, $100.

HARRISBURG ENGINE SALES.—Mr. W. P. Mackenzie, 203 Broadway, New York, reports that the Harrisburg Engine domestic contracts recently secured through its local offices include one for high-speed engines, intended to displace others for lighting purposes, at the Hotel Netherland, New York City. The order calls for a 300-hp simple Harrisburg standard engine, also a 225-hp machine of the same type. These engines are to be direct connected to generators of 200 kw and 150 kw capacity, built by the Western Electric Company. Two 150-hp compound engines have been ordered by the Pennsylvania Steel Company for the equipment of its Steelton (Pa.) plant. The generators therewith are to be built by the Eddy Manufacturing Company. These machines will be 100 kw each. The Farrell Foundry & Machine Company, of Ansonia, Conn., has ordered a 220-hp tandem compound standard engine for direct connection to a 150-kw General Electric generator. This equipment will be used to run cranes. The Ashley & Bailey Mills, Paterson, N. J., are to be installed with a 75-hp simple engine, direct connected to a 50-hp generator manufactured by the New England Electric Company, of Lowell, Mass. The Northport (L. I.) Electric Light Company has requisitioned for a 100-hp, also a 60-hp Harrisburg standard-belted engine for street railway work. Contracts recently secured through the Philadelphia offices of the Harrisburg Company include one for two tandem compound four-valve engines, of 600 hp each, for Reading (Pa.) street railway work, and a machine of similar description for the Wilmington (Del.) electric traction plant.

VILTER ORDERS FOR ENGINES.—The Vilter Manufacturing Company, among their recent orders, including a large variety of refrigerating plants, etc., report also the following sales of Corliss engines: Goetz & Brada Manufacturing Company, Chicago, Ill., 12 by 30; Sawyer & Austin Lumber Company, Pine Bluff, Ark., 24 by 42; Duluth Brewing & Malting Company, Duluth, Minn., 16 by 36; Allentown Shoe Manufacturing Company, Allentown, Pa., 12 by 30; Ambrose West, Plymouth, Pa., 14 by 36; Deerbrook Milling & Mercantile Company, Deerbrook, Wis., 12 by 30; South Bend Chilled Flow Company, South Bend, Ind., 24 by 42; Wendnagel & Co., Chicago, Ill., 16 by 36; Schiess y Cia., Torreon, Mex., 14 by 36; Hess & Hopkins Leather Company, Rockford, Ill., 18 by 42; Binsfeld Brothers, Chilton, Wis., 14 by 30; O. F. Mayer & Brothers, Chicago, Ill., 12 by 30; Foster-Hafner Mills, Oshkosh, Wis., 24 by 48; Bloch Brothers Tobacco Company, Wheeling, W. Va., 18 by 36; T. G. Mandt Vehicle Company, Stoughton, Wis., 18 by 36; American Hulled Bean Company, Battle Creek, Mich., 14 by 36; Moore-Cortes Canal Company, Crowley, La., 22 by 44 by 48 tandem compound Corliss engine; Roller Canal Company, Crowley, La., 26 by 48 Corliss engine.

AN ELECTRICALLY EQUIPPED BREWERY FOR SOUTH AFRICA.—An American electrically equipped brewery is now under construction at Cape Town, South Africa, which will be the first electrical plant of its description on that continent. The brewery is being erected from plans executed by H. Steinmann, the brewery architect, of 66-68 New Street, New York City, and will be operated by the South African Breweries, Limited, a syndicate composed of some of the leading brewers in Great Britain. Everything, otherwise than the bricks and mortar, will be manufactured in the United States. The total cost of the establishment will be about $550,000, the equipment alone causing the expenditure of over a quarter of a million dollars. The plant is to have an annual capacity for turning out 120,000 barrels of ale, 60,000 barrels of lager and 40,000 barrels of porter and stout. The electrical apparatus, etc., will consist of two 75-kw General Electric generators, direct connected to horizontal compound engines, to be supplied by the Payne Engineering Company. There are also to be one 35-hp, one 25-hp, four 15-hp, two 7½-hp and one 5-hp motors. The brewery is expected to begin active operations by May 1.

TELEGRAPH, TELEPHONE & CABLE COMPANY.—Advices from Cleveland state that Judge Thomas is there working on a plan to take the Federal & United States Telephone properties off the hands of the Everett-Moore bankers and consolidate with the Telephone, Telegraph & Cable Company of America. It is alleged in New York and Boston financial organs that the difficulties met by the Everett-Moore Syndicate in raising further money were due to opposition stirred up by Bell telephone interests, who tried to buy their independent telephone properties at the panic prices so as to turn them over to the Central Union system, and that it was in this way rather than by opposition due to steam railroad financiers that the troubles really arose; in fact, large amounts of the telephone stock are said to have been bought up with Bell capital, but these later dispatches would leave it to be inferred that the properties have not yet been "gathered in." If they were, it might make considerable difference to the independent telephone cause. Hence the interest attaching to these rumors about Judge Thomas and the T., T. & C. plans.

THE PENN MANUFACTURING SUPPLY COMPANY, of Philadelphia, which has been doing business as a partnership, has recently incorporated with $100,000 paid in capital. This concern is likely to play a prominent part in the electrical field as manufacturers' agents, because of the extensive connections which it has with the buyer and the seller in the larger realm of electrical supplies and novelties. The multiplicity of electrical specialties, which are being put on the market to-day, and the increasingly large expense for marketing the same, opens up a productive field for the manufacturer's agent. The Penn Manufacturing Supply Company has opened attractive offices in the Forest Building in Philadelphia, and is looking forward a little later in the year to establishing offices in New York, Boston, Pittsburg and Chicago, and has our best wishes for its success.

LOWER COPPER.—One more cut in the price of Lake copper was announced last week—seven-eighths of a cent per pound—making the price 12⅛ cents per pound, or nearly 5 cents less than the early December prices. It was also announced that a reduction of seven-eighths of a cent had been made in electrolytic copper, making the price 12 cents; and in castings a 1-cent reduction to 11½ cents. There have been three previous reductions in the price of copper. The first, on Dec. 13, was from 17 to 15½ cents; the second, on Dec. 18, from 15½ to 14 cents; the third, on Dec. 19, from 14 to 13 cents. It would seem that the latest quotations must be bed rock—possibly intended to shake out cheap independent producers.

FOREIGN CONTRACTS PENDING FOR CONDUIT.—The American Vitrified Conduit Company, whose offices are in the Taylor Building, 39-41 Cortlandt Street, is anticipating the receipt, within the next week or two, of a substantial Russian contract for conduit. The material is intended to be utilized in connection with electric lighting, etc. Quotations have been asked on some 3,500,000 ft. of conduit, which will represent the expenditure of some $250,000. The company is also said to be bidding on a large Belgian contract. In this instance the conduit is required for telephone wires.

PHILIPPINES CABLE.—The United States Government is about to let a contract for the furnishing of some 250 miles of single conductor telegraph cable, which is to be used for military purposes in the Philippines.

SUMPTER DEVELOPMENT COMPANY, of Sumpter, Ore., who own the Sumpter Light & Power Company, are building an electric road, and have been in the market for direct-current generator, engine and boiler plant, etc.

THE GRANBY RUBBER COMPANY, Granby, Que., will build an industrial railway system in connection with its works, for which plans are now being prepared. The railway will be narrow gauge and motive power electricity.

CATALOGUES WANTED.—The Patterson Tool & Supply Company, Dayton, Ohio, is opening an electrical supply branch in connection with its business, and solicits catalogues and prices from manufacturers of electrical goods.

BRASS PRICES.—The Brass Association announces the following cuts: Wire and rods from 30 to 37½ per cent, brass tubing from 40 to 45 per cent. Like the cut in sheets, to 18 cents, these reductions put the product on a price equality with copper at 13 cents.

EXCELSIOR IRON WORKS, Cleveland, Ohio, are reported in the market for various electrical equipment.

General News.

THE TELEPHONE.

SADORUS, ILL.—It is reported that Sadorus is to have a new telephone line for the benefit of the grain merchants.

ELGIN, ILL.—The Northwestern Telephone stockholders held a meeting at Aurora and voted to consolidate with the Interstate Telephone Company.

MORRISON, ILL.—The Central Union Telephone Company is building a line from Garden Plain to Albany. The line will be continued on to Cordova in the spring.

GREENFIELD, IND.—The Extra Telephone Company, capital stock $160, has been incorporated. Directors: J. C. Catt, A. L. Zimmerman, G. E. Lacy, N. S. Catt, Lena Walker, C. A. Jackson and R. S. McClannon.

HENRYVILLE, IND.—The Cumberland Telephone Company has announced that its telephone exchange in this place will be ready for business Feb. 1. The exchange will include Memphis and Ostisco subscribers. This will make three telephone companies in this city.

TERRE HAUTE, IND.—The farmer lines of telephones are playing an important part in the enforcement of the game law. A woman owning a farm in this county telephoned the game warden that hunters were on her farm without permission. The warden arrived on her farm in time to arrest the four hunters, who had no idea an officer could be summoned without their being aware of the fact by seeing the messenger start to town. Each offender was fined.

INDIANAPOLIS, IND.—The Board of Public Safety has awarded a contract to the Central Union Telephone Company to furnish the fire department with three business independent line connections, four business independent line connections for the police department and seven resident independent connections. The consideration is $490. The "big end" of the telephone contract—$1,310—went to the New Company, and it is thought the board let the contract to the Central Union to "even up."

INDIANAPOLIS, IND.—The following telephone companies have filed articles of incorporation: The College Corner & Southern Telephone Company, to operate a telephone system in Union and Franklin counties; directors, Charles Stout, J. C. Barkley, James James, L. B. Barkley and W. E. Bake. The New Ross Co-operative Telephone Company, of New Ross, Ind.; directors, C. E. Johnson, F. J. Brooker, R. F. King, R. L. Brattan and D. W. Lane. The Branch Independent Telephone Company, of Saratoga; capital, $10,000; directors, P. A. Dailey, Cyrus Bousman, Eliza Dailey, M. Y. Bousman and Charles Skinner.

INDIANAPOLIS, IND.—The New Telephone Company was the successful bidder and will furnish telephone service to the various city departments. The contract calls for two trunk lines from the exchange to the police headquarters and three trunk lines to fire headquarters. The contract for furnishing receivers and transmitters for the Gamewell police and fire alarm boxes at the rental rate of $150 per year for 105 boxes and transmitters and receivers was also awarded to the New Company. The city also agreed to purchase for the city the receivers and transmitters for $400, and if the purchase is made within six months the sum to be paid for rental will be applied on the purchase price. Free telephones and service will be given to the homes of the members of the Board of Public Safety, the clerk of the board and other officers of the department.

WASHINGTON, IA.—A new telephone line is to be built from Bishop, near Lexington to Wellman. A line to Washington from the same starting point is talked of.

ATCHISON, KAN.—Edward Foote, of Clyde, is trying to secure a franchise to build a telephone exchange in Effingham.

PADUCAH, KY.—A new telephone line is to be built from Paducah, Ky., to Joppa, Ill.

MAYSVILLE, KY.—The farmers of Mason County are organizing a Home Telephone Company. The leaders of the enterprise are William Luttrell, Abner Hord, John T. Martin, W. L. Holton, W. H. Robb, William McLlelland and others.

MOREAUVILLE, LA.—The Avoyelles Telephone Company, of which Mr. A. O. Boyer, of this town, is president, has completed its line from Bunkle to this place. The company will have in the near future lines from this town to Bordelonville, Plancheville, Mansura and Marksville.

PORTLAND, ME.—The Dirigo Telephone Company has been granted permission to construct conduits and run its wires through them in many streets in this city.

ONTONAGON, MICH.—The Ontonagon Telephone Company, capital stock $25,600, has been incorporated.

MARQUETTE, MICH.—A company has been organized to construct a telephone line between Ironwood and other cities on the Gogebic range and those at the head of the lake.

MARSHALL, MICH.—In compliance with the resolutions adopted at a citizens' meeting some time ago about 100 Michigan Telephone Company residence telephones were ordered taken out on Jan. 1, as the subscribers refused to agree to the raise in rates. Two other telephone companies are seeking franchises.

VIRGINIA CITY, MINN.—People's Telephone & Telegraph Company, capital stock $50,000, has been incorporated by P. E. Bailey and A. C. Orborn, Evelett; and P. A. Coffey, D. W. Freeman and R. B. Greedy, Virginia City, Minn.

WINONA, MINN.—The Greenwood Telephone Company has been formed at Plainview with an authorized capital stock of $25,000. Plainview, Weaver, Thellman, Kegan and Beave will be connected. The incorporators are Andrew French, Wm. Lea, F. D. Washburn, Lawrence Ryan, F. H. Hanneman, Frank Appel and Hey Grove.

HAVRE, MONT.—The Town Council has decided to grant the electric light, waterworks, steam heat and telephone franchises petitioned for by E. V. Hauser.

HELENA, MONT.—Articles of incorporation have been filed by the Montana & Wyoming Telephone Company, with a capital stock of $40,000. The purpose of the company is to connect Montana and Wyoming points by telephone. The present termini of the company's lines are Billings, Mont., and Basin, Wyo. The principal places of business of the company are designated as Red Lodge and Billings. Incorporators: L. L. Moffett, Billings; C. C. Bowlen, Red Lodge; P. B. Moss, Billings; J. F. Trumbo, Bridge; B. E. Vaill, Carbondale; Charles M. Blair, Billings; R. L. Davis, W. A. Talmage, J. S. Robbins, Red Lodge.

KANSAS CITY, MO.—The People's Telephone Company, capital stock $50,000, has been incorporated by Henry Wood, W. H. Steele and others.

JEFFERSON CITY, MO.—The De Kalb County Mutual Telephone Company has filed a statement of increase of capital stock from $5,000 to $25,000.

MEMPHIS, MO.—The telephone system here has passed into the hands of a new company composed of John M. Jaftes, W. L. Scott, David Secor, J. J. Risk, G. E. Leslie, W. W. Eckman and J. J. Townsend.

HASTINGS, NEB.—The American District Telegraph Company has asked the City Council of Hastings for a franchise.

AURORA, NEB.—The Nebraska Telephone Company is at work on a plan to consolidate Aurora, Hampton, Marquette, Giltner and Phillips into one exchange with the central station in Aurora.

MANCHESTER, N. H.—At the annual meeting of the Northern Telegraph Company the following officers were re-elected: President, Marion C. Smyth; clerk, Arthur H. Hale; directors, Marion C. Smyth, Arthur E. Clarke, Charles H. Anderson. The treasurer, A. F. Emerson, holds over. A dividend of two and one-half per cent. was declared.

ROCHESTER, N. Y.—The Rochester Telephone Company, of Rochester, has filed a certificate of increase of capital from $400,000 to $700,000.

MINGOE JUNCTION, OHIO.—The Bell Telephone Company has opened a new exchange here.

NORWALK, OHIO.—The Bankers' Telephone Company, capital stock $10,000, has been incorporated.

ZANESVILLE, OHIO.—The board of education has called for bids for telephones in all school buildings.

CALCUTTA, OHIO.—The Columbiana County Telephone Company is planning to establish an exchange in this place with toll lines to East Liverpool.

URBANA, OHIO.—C. H. Marvin, of this city, has filed a petition asking for the appointment of a receiver for the Mechanicsburg Telephone Company.

ORRVILLE, OHIO.—The Central Union Telephone Company has filed a petition in the Probate Court to have the mode of construction for its lines determined.

EAST LIVERPOOL, OHIO.—Operators at the Columbiana County Telephone Company's exchange went on strike a few days ago, but the difficulty was soon adjusted.

LIMA, OHIO.—The Lima Telephone & Telegraph Company has cut in its new exchange, which has just been completed. The company is securing many new subscribers.

GENEVA, OHIO.—The Madison Telephone Company is building several farmers' lines in the vicinity of this town, and is preparing to place metallic circuits on all lines.

CADIZ, OHIO.—The Harrison County Telephone Company has just installed an addition to its switchboard, the increase being necessary to take care of a large number of new suscribers.

ALLIANCE, OHIO.—The exchange of the Stark County Telephone Company at Alliance is now in full operation, with 400 subscribers connected up. The list is increasing every day.

COLUMBUS, OHIO.—The Central Union Telephone Company has appointed a subscribers' agent whose duty it will be to inspect telephone instruments and receive suggestions from subscribers.

ORWELL, OHIO.—The directors of the Madison Telephone Company have declared a 3 per cent. dividend, payable Jan. 20. The company will make a number of improvements to its system.

HAMILTON, OHIO.—The City & Suburban Telegraph Association of Cincinnati, has been granted a franchise by the Butler County Commissioners to build a number of pole lines in the county.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Home Telephone Company is making rapid gains among the farmers in this vicinity. Over twenty-five subscribers were secured in the rural district within ten days recently.

YELLOW SPRINGS, OHIO.—It is reported that the two separate telephone systems now being established in Clarke and Greene counties, will ultimately be merged under one management, to be known as the Home Telephone Company.

MECHANICSBURG, OHIO.—C. H. Marvin, a former director of the Mechanicsburg Telephone Company, has asked that a receiver be appointed for the company in order to protect him on certain notes which he signed as surety while he was a director.

CONNEAUT, OHIO.—The new exchange of the Conneaut Telephone Company will be placed in operation in about two weeks. Cables have been laid for 1500 lines and the switchboard has a capacity of 700. A number of lines have already been connected.

PORTSMOUTH, OHIO.—During November, the Portsmouth Telephone Company made a net gain of nearly 100 subscribers, which will necessitate the installation of another switchboard and additional cable. The telephone business along the Ohio River is growing rapidly.

CHILLICOTHE, OHIO.—Because of an advance in rates by the Bell Company the physicians of Chillicothe have signed an agreement dispensing with the use of Bell telephones after Jan. 1. The Ross County Telephone Company made a proposition which was accepted by all the physicians.

TOLEDO, OHIO.—The Toledo Home Telephone Company has opened an exchange at Whitehouse with sixty subscribers, and another at Maumee with about

the same number. The new exchange at Sylvania will be opened within a few days. Work on the main Toledo exchange is progressing rapidly.

ST. CLAIRESVILLE, OHIO.—The Belmont Telephone Company has completed its line to West Wheeling. At this point it was expected that the line would connect with the independent company at Bellaire, but there has been a hitch, and it is stated that the Belmont Company may build a line of its own through Bellaire.

OKLAHOMA CITY, OKLA.—The Oklahoma Consolidated Railway Company will operate a telephone system in connection with its electric railways.

PHILADELPHIA, PA.—A local telephone line will connect the villages of Worcester, Centre Square, West Point, Lansdale and Kulpsville.

SIOUX FALLS, S. D.—For the third time Judge Jones, of this city, in the suit between the City of Bridgewater and the Bridgewater Telephone Company, has decided in favor of the company and against the town. His decision places all the costs and damages amounting to over $1,000, on the town, and gives the company the right to go ahead and establish its system if it so desires.

MEMPHIS, TENN.—The Citizens' Telephone Company has been organized at McMinnville, Tenn. Orders have been placed for poles, and other necessary materials for constructing the plant and lines of the company and work will be pushed as rapidly as possible. Already more than 100 patrons of the Cumberland Telephone & Telegraph Company have signified their intention of using the lines of the independent concern.

DENTON, TEXAS.—The City Council has granted to W. A. Armstrong, of Sherman, a franchise to install another telephone exchange in this city.

SPOKANE, WASH.—It is announced that the Pacific States Telephone Company is planning to build a new line from Wenatchee to Malaga and Rock Island.

EAST TROY, WIS.—The farmers' telephone line now in operation has 110 subscribers connected.

GRAND RAPIDS, WIS.—The Wood County Telephone Company has increased its capital stock from $10,000 to $18,000.

WAUKESHA, WIS.—The Bell Telephone Company is arranging to give the city of Waukesha better telephone service. The lines are to be entirely rebuilt.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Standard Electric Company, of California, recently won a suit for right of way for its long-distance transmission pole line from Blue Lakes to San Francisco. It fixed the damages for passing through the Corbitt ranch at Burlingame at $400. But one more suit will have to be decided to give entrance to San Francisco.

SAN FRANCISCO, CALIF.—Reno, Nevada, is now connected with the Truckee River General Electric Company's transmission lines. Both Virginia City and Reno are now lighted by this company, which is now able to pay dividends without depending upon the business of the Comstock Lode, although the mines of that district gave a bonus of $100,000 to secure the plant.

SAN FRANCISCO, CALIF.—Santa Rosa now receives electricity for lighting and power purposes from the transmission lines of the Bay Counties Power Company. An all-night street lighting service is now in operation. The California Gas & Electric Company, which distributes the current locally, also controls the local gas plant and is rebuilding it. A pipe line 16 miles in length will be laid to convey gas to Petaluma for lighting purposes.

CHICAGO, ILL.—The Litchfield Electric Light & Power Company, of Litchfield, has changed its name to Litchfield Gas & Electric Company, and its capital stock has been increased from $25,000 to $50,000.

ALTON, ILL.—A petition is being circulated for signatures calling on the City Council to pass an ordinance regulating the maximum price to be charged for electricity for illuminating purposes. The Alton Railway, Gas & Electric Company has the franchise for serving gas and electric light, and it is claimed by the company that it is operating under a franchise that will admit of no regulations being made for some time to come. The matter of regulating the electric light prices has not been looked into. It is alleged that the prices charged are unreasonable.

INDIANAPOLIS, IND.—The Merchants' Light & Power Company has been organized here. The company has asked the Board of Public Works for a franchise.

UNION CITY, IND.—An effort is being made by H. P. Lucas, owner of the electric plant here, to induce the City Council to extend his franchise, promising a first class plant if they will. The load at present is entirely too heavy for the present plant.

INDIANAPOLIS, IND.—The State authorities have concluded to build a plant to furnish heat, water, light and power for the State House and Soldier's Monument in this city. The cost of the proposed plant will exceed $100,000. The Legislature will be asked for an appropriation.

LAWRENCEBURG, IND.—The new electric light plant is now in operation. The company, which was incorporated by John N. Fox, T. J. McKim and W. T. Sortwell, has a 30-year franchise and a ten-year contract to furnish the city 63 arc lights of 2000 nominal candle-power at $48.25 each per year. The company also provides commercial lighting.

INDIANAPOLIS, IND.—The Board of Public Works is receiving numerous petitions for franchises for electric light and power plants. The petitioners are groups of merchants who propose to erect plants to supply light, heat and power to their buildings. In some instances the petitions include the same, or parts of the same territory, and the competition is growing spirited. The Board has not acted on the petitions, as it has not yet decided on its policy as to franchises for light and power companies, and is unwilling to grant such franchises indiscriminately.

VAN HORNE, IA.—Mr. J. A. Wicke is putting in an electric light plant and is receiving bids for first and second-hand apparatus, consisting of a 30 to 40-hp engine, 30 to 50-hp boiler and a generator of 600 lamps of 16-cp capacity. He wants to get the plant running in 60 days.

LEAVENWORTH, KAN.—The Leavenworth gas and electric light plants have been purchased by S. Reading Bertron and Richard S. Storrs, both of New York. The price paid was $250,000.

NEWBERN, N. C.—The electric light bonds issued by the city have been sold to F. M. Stafford & Company, of Chattanooga, Tenn., at 108½.

STATESVILLE, N. C.—The electric light plant at this place was partially destroyed by fire; loss estimated between $2,500 and $3,000. Dynamos, switchboard, etc., were ruined.

GLENS FALLS, N. Y.—In regard to the rumor that the General Electric Company had purchased the Palmer Mills plant of the International Paper Company, on the Hudson River above Glens Falls, for the power privileges, it is authoritatively stated that the General Electric Company has made no such purchase, nor has it any intention of so doing.

HUBBARD, OHIO.—The citizens of Hubbard are agitating for a lighting plant of some kind. The town has been without illumination for several months.

OTTAWA, ONT.—It is reported that a company will build conduits for the electric light and power companies in Montreal. Senator Forget's idea is that the city should control the conduits and provide the means for their construction, charging the companies a rental.

OTTAWA, ONT.—The Canadian Niagara Falls Power Company has acquired some 300 acres back of the high bluff at Niagara Falls. The property will be used for factory and industrial sites. The same plan is to be carried out on the Canadian side as has been adopted on the American side of the river, which is to provide sites and power for any company desiring to locate there.

OTTAWA, ONT.—The directors of the Lachine Hydraulic & Land Company have declared a semi-annual dividend of 3½ per cent. This makes the sixth semi-annual dividend declared by this company, the first being 2 per cent. It is said that the company might have easily made the present dividend declared for 4 per cent., or even more, but deemed it best to declare only 3½ for the half-year.

OTTAWA, ONT.—It is reported that the Chambly Manufacturing Company, of Montreal, is about to acquire the Lachine Hydraulic & Land Company, at a cost of $4,000,000. The Chambly Company is already under the control of the Montreal Light, Heat & Power Company, and this deal will give the Power Company a practical monopoly in Montreal, unless new opposition should be forthcoming. Since the organization of the latter concern, with its $17,000,000 capitalization, less than a year ago, it has absorbed all the lighting and power concerns doing business in the city of Montreal, except the Lachine Hydraulic Company. Negotiations have been under way for some time, looking to the purchase of that company. The power combine will not be the direct purchaser of the Lachine Company's plant. It will pass into the hands of the Montreal & St. Lawrence Light & Power Company, formerly known as the Chambly Manufacturing Company, which recently obtained authority to change its name and issue bonds.

ANDERSON, S. C.—On the night of Dec. 20 part of the dam of the Anderson Water, Light & Power Company was washed away and the damage is estimated at $100,000. The dam was 700 feet long, 44 feet high, and 30 feet wide at the base. About 150 feet is missing in the centre. It is estimated that the cost of repairing will not be less than $60,000. In the meanwhile, many industries in the city of Anderson will be compelled to remain idle.

ELIZABETHTON, TENN.—Col. Chas. Toncray and Geo. E. Boren have returned from New York, where they have been closing negotiations for the erection of a modern steel plant at Elizabeth. An 8000 horse-power electric plant will be erected as soon as a location is decided upon.

EVANSVILLE, WIS.—The city contemplates erecting a $51,000 electric light and waterworks plant.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—It is reported on good authority that the Oakland Transit Company has almost completed negotiations for the remaining half interest in the Macdonald and Henshaw franchise for an electric road from Martinez, via Richmond, to Oakland, Calif.

SAN FRANCISCO, CALIF.—The Oakland Transit Company will construct an additional electric railway line giving North Berkeley, Calif., connection with the company's system. The new road will be in the form of a loop, running north of the grounds of the University of California and connecting with the West Berkeley lines.

SAN FRANCISCO, CALIF.—The latest report on the prospective sale of the North Pacific Coast Railway, which terminates in Sausalito, Calif., is that the price has been set at $2,000,000, or about one-half the cost of the road. It is the intention of Messrs. Childs, Colgate and Martin, of the new California Electric Company, to extend the road to Sacramento and operate it by electricity. The deal my be consummated on Jan. 15.

ATLANTA, GA.—The Georgia Railway & Electric Company has applied for a charter; capital stock, $3,000,000. H. M. Atkinson and others are interested.

SAVANNAH, GA.—The Savannah Electric Company has been chartered, with a capital stock of $3,500,000, consolidating all of the street car lines in Savannah. Geo. Baldwin, J. R. Anderson and others are interested.

INDIANAPOLIS, IND.—The Commissioners of this county have granted a franchise to M. D. Whitney and others to build and operate an interurban railway line from the city limits northeast to the county line, along the Pleasant Run road.

WABASH, IND.—Messrs. Drake, Breed & Company, of Philadelphia, have taken the contract to build a 20-mile stretch of interurban electric railway connecting this city with Marion, beginning work early in the spring. The promoters are G. A. H. Shiedler, R. E. Breed and C. S. King. The contractors have made a careful inspection of the route and say Philadelphia capital has been provided to construct the line. Terminal rights are now being arranged at Marion and this city.

MOUNT STERLING, KY.—The Lexington Electric Railway Company has been granted the right of way from Winchester to Mt. Sterling. The line may also be extended to Maysville from Mt. Sterling.

LOUISVILLE, KY.—President T. J. Minary, of the Louisville Street Railway Company, has addressed a letter to the Mayor outlining the plans of the company. The company will purchase for delivery during 1902 from 75 to 100 electric cars. A new engine and generator have been installed representing a heavy expenditure. The lines of the company have also been extended, represent-

DETROIT, MICH.—There is talk that the Everett-Moore syndicate will extend its Detroit-Pontiac line to Ly sing by way of Milford, Howell, and Will-

MINNEAPOLIS, MINN.—An electric railway line between Mankato and St. Cloud is projected, the distance between the two points being about 100 miles. Col. Chase, of Cleveland, Ohio, is promoting the enterprise.

SUMMIT, MISS.—The electric railway between this town, McComb and Magnolia in Pike County, is still being agitated, and is now said to be assuming something like tangible shape.

ELIZABETH CITY, N. C.—A charter has been granted and the company incorporated to build the proposed electric railway to Norfolk, Va.

TRENTON, N. J.—Mayor Briggs vetoed the ordinances giving the Camden & Trenton Traction Company authority to extend its lines into the centre of the city of Trenton. The ordinances will probably be passed over the Mayor's veto.

SCHENECTADY, N. Y.—The Schenectady Railway Company, of Schenectady, has filed a certificate of increase of capital from $300,000 to $600,000.

SYDNEY, N. S.—The Cape Breton Electric Company, of Sydney, N. S., is about to commence the erection of a new power house. Engines of 1000 horsepower will be installed at the outset.

TROY, OHIO.—Work has commenced on acquiring right of way for the Dayton-Kenton electric railway.

WOODVILLE, OHIO.—The Lake Shore Electric Railway has applied for a franchise to double track its line through the town.

DOYLESTOWN, OHIO.—The Doylestown Council has granted a franchise through town to the Canton, Lodi & Medina Electric Railway.

FINDLAY, OHIO.—The Findlay & Marion Railway Company, which is promoted by Hon. David Joy and others, has applied for a franchise in Findlay.

DAYTON, OHIO.—The Dayton & Northern Traction Company is making preparations to extend its road to Muncie, Ind. Right of way is being secured.

HAMILTON, OHIO.—The Miamisburg & Germantown Traction Company has issued $50,000 in bonds which have been taken by the Cincinnati Trust Company.

AKRON, OHIO.—The annual meeting of the stockholders of the Northern Ohio Traction Company will be held Jan. 18. It is stated that a number of important changes will be made.

ATHENS, OHIO.—It is stated that the promoters of the Athens & Nelsonville Traction Company will carry out their long-talked-about project of a line from Athens to Nelsonville and other places.

DAYTON, OHIO.—The Dayton & Xenia Transit Company, controlling the two lines between Dayton and Xenia, has issued $800,000 in bonds, which have been taken by the Old Colony Trust Company.

SPRINGFIELD, OHIO.—Harry Frey has secured a street railway franchise through Greene County from Clifton to Xenia. The line will be a spur of the road he proposes to build from Springfield to Wilmington.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway is reported to be buying up all the cordwood in sight, as it is almost impossible to secure enough coal to keep the power house in operation.

CONNEAUT, OHIO.—The Conneaut & Erie Traction Company, of which J. S. Van Cleve is president, and H. E. Fish, secretary, has secured nearly all of the right of way for its proposed line from Conneaut to Erie.

WILMINGTON, OHIO.—Franchises are being secured for the proposed electric railway from Springfield to Hillsboro. Right of way has been secured through Greene County. The road is to be built in the spring.

PIQUA, OHIO.—A new line is proposed from Springfield to this place, passing through Lawrenceville, North Hampton, Dilton, Addison, and Casstown. The company already has right of way from Springfield to Addison.

TOLEDO, OHIO.—The Tiffin & Southern Railway Company has placed a contract with the Pennsylvania Contracting Company for the construction and equipment of the road from Tiffin to Kenton, a distance of 43 miles.

ASHTABULA, OHIO.—The Ashtabula Rapid Transit Company has made a proposition for a franchise covering existing lines and proposed extensions. The company agrees to pay a portion of its gross receipts to the city.

MARIETTA, OHIO.—The Marietta Electric Railway Company has formally transferred its property to the Marietta & Parkersburg Interurban Company. The Marietta-Parkersburg line will be placed in operation within a short time.

GALION, OHIO.—The Ohio Central Traction Company commenced regular service Christmas day between Galion and Crestline. Cars are now operated from Bucyrus to Crestline. Work on the line between Crestline and Mansfield is being pushed.

SMITHFIELD, OHIO.—Local people are securing right of way for a line to extend from Adena through Smithfield, Dillonvale, Harriettville and Mt. Pleasant to Warrenton, where it would connect with the line between Steubenville and Wheeling.

NORWALK, OHIO.—The Norwalk, Greenwich & Mansfield Railway Company will shortly be organized. M. J. Roseboro, of Canton, and J. C. Laser, of Mansfield, are the promoters, and they claim to have secured nearly all right of way and franchises.

FINDLAY, OHIO.—Dr. O'Benbaugh, of Sandusky, one of the promoters of the Findlay & Southern Railway, claims that all right of way for the road has been secured and that construction work will start in the spring. R. Rosenstock & Company, Cleveland, are engineers for the road.

SPRINGFIELD, OHIO.—The scarcity of coal is proving a serious embarrassment to power-houses in Springfield and Dayton. The Dayton, Springfield & Urbana power-house burned wood part of the time recently, and several times there was danger that the road would be tied up.

YOUNGSTOWN, OHIO.—The Youngstown Park & Falls Electric Railway has declared a semi-annual dividend of 3 per cent., the highest ever paid. The old officers were re-elected. An appropriation of $15,000 was made to improve Idora Park, and other improvements were discussed.

LIMA, OHIO.—D. J. Cable, president of the Lima, Delphos, Van Wert & Ft. Wayne Traction Company, states that all right of way for the line has been secured, and that engineers will commence surveys within the next two weeks. The line will be 60 miles in length, and it is claimed it will be in operation by Dec. 1, 1902.

NEWARK, OHIO.—It is stated that L. C. Taylor and John S. Black, promoters of the line between Newark and Wheeling, have secured all the required right of way, and that they have completed arrangements with New York financiers to finance the project. The road if built will give Columbus direct electric connection with Wheeling.

TOLEDO, OHIO.—C. A. Denman, heretofore general manager of the Toledo & Maumee Valley Railway, which has just been sold by the Detwiler-Griffin syndicate, has been appointed to a similar position with the Toledo & Lima Traction Company, a road being built by the same syndicate. Mr. Denman is one of the pioneer street railway men of Toledo.

UPPER SANDUSKY, OHIO.—It is stated that the Tiffin & Southern Railway Company, which has recently secured Eastern financial backing and has placed a contract for the immediate construction of the road, has acquired the right of way and franchise secured last year by the Tiffin & Southwestern Railway, which was promoted by Samuel Bullock and others of Tiffin. The road will be built over the route proposed by the Bullock Company, extending from Tiffin to Kenton by way of Upper Sandusky, McCutchenville and Marseilles.

TOLEDO, OHIO.—The Everett-Moore syndicate has closed the deal for the purchase of the Toledo & Maumee Valley Railway and the Toledo, Waterville & Southern Railway. Immediately after the transfer of the properties, special meetings were held and officers of the companies were elected as follows: Toledo & Maumee Valley Railway: R. H. Baker, president; William H. McLellan, Jr., secretary; Barton Smith, Guy M. Walker, William R. Hodge, and Conrad Weil, directors. Toledo, Waterville & Southern Railway: Ernest J. Bechtel, president; W. W. Brown, secretary; C. N. Jackson, Guy M. Walker, Charles T. Munz and Josiah Scott, directors. L. E. Beilstein, of the Toledo Railways & Light Company, was made general manager of both properties.

OTTAWA, ONT.—The franchise of the South Essex Electric Railway Company, of Windsor, Ont., has been purchased by the Everett-Moore Company, of Cleveland, Ohio. The charter and franchise extend from the city of Windsor to Point Pelee and Leamington.

ROSEBURG, ORE.—An electric railway between here and the coast would be well patronized, and there is a good field for such an enterprise.

NORRISTOWN, PA.—The Trappe & Limerick Electric Railway and the Roxborough, Chestnut Hill & Norristown Railway have been leased to the Schuylkill Valley Traction Company for 950 years. This combines all the lines heretofore operated under the several names, with a centre of operations here. The new power house at Collegeville will furnish power for the entire line, from Pottstown to Chestnut Hill, Manayunk and Wissahickon.

PITTSBURG, PA.—The Philadelphia company of this city on Jan. 1 absorbed all the street railway and electric lighting interests in and about Pittsburg. The interests which have been amalgamated are the Consolidated Traction, Pittsburg and Birmingham, Monongahela Street Railway, Pittsburg & Charleroi, Suburban Traction, Southern Traction, Tustin Street Railway, Monongahela Heat, Light & Power, Southern Heat, Light & Power Company, and a number of other electric traction or lighting companies of minor importance. The bonded indebtedness has been increased from $6,500,000 to $22,000,000, and the capital stock from $21,000,000 to $36,000,000. The Philadelphia company forms one of the largest corporations in the electrical business of this country. Mr. James D. Callery is the president and Mr. John Murphy, the general superintendent.

KNOXVILLE, TENN.—The promoters of the electric railway from Knoxville to Sevierville, it is said, have about decided to make the line a third-rail system.

MANITOWOC, WIS.—The Manitowoc-Two Rivers interurban electric road now being constructed, will soon be opened for business.

MILWAUKEE, WIS.—The Columbia Construction Company of this city, has charge of the construction of the electric railway to be built between Fond du Lac and Oshkosh. The line will cost about $12,000 a mile, or $144,000 for the entire system.

OSHKOSH, WIS.—The proposed Ouiro-Oshkosh electric railway seems practically assured. The franchises have all been secured between Ouiro and Oshkosh. The line will be constructed to carry passengers, express, mail and freight. The proposed line will be extended through Eureka to Berlin in time, and may eventually follow the Fox River Valley through to Portage, connecting there with the proposed lines to Madison, Janesville and the Wisconsin River points.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL ACCESSORIES COMPANY, of New York City, has been incorporated with a capital stock of $50,000.

THE NORTH BRADDOCK ELECTRIC COMPANY, of North Braddock, capital $1,200, has been incorporated at Harrisburg, Pa.

THE RANKIN ELECTRIC COMPANY, Rankin, Pa., has been incorporated; capital, $1,200.

THE PHOENIX GAS & ELECTRIC FIXTURE MANUFACTURING COMPANY has been incorporated at St. Louis, Mo. The capital stock is $15,000, all paid. A. D. Gratian, Chas. M. Wempner, Maurice W. Koenigsberg and Frank X. Chassaing are the stockholders.

THE GREEN TELEPHONE & ELECTRIC MANUFACTURING COMPANY, recently incorporated in Milwaukee, Wis., by J. H. Green, T. J. Seely and Chas. Hemsing, is manufacturing a line of telephone apparatus containing some new ideas. The company, it is said, has a new transmitter and a novel scheme in an automatic intercommunicating switchboard.

LEGAL.

GLAZE FILLED INSULATOR PATENT.—Note has already been made in these pages of patent decisions in favor of the glazed filled insulator patent of Mr. John W. Boch, of the R. Thomas & Sons Company. The last action in the affair is a supplementary opinion from the United States Circuit Court of New Jersey, against the defendant's plea for reargument, and sustaining Boch as follows: "Boch has conceived and perfected that which others had striven for in vain. Characterized in a phrase, his invention may be spoken of as a glaze-filled multi-part porcelain insulator. Its particular features have already been adverted to. The process he employs and has patented seems peculiarly fitted to accomplish the end desired, but the fact that there may be others, does not debar him from laying claim to the result attained, of which he seems to be the discoverer."

PERSONAL.

MR. GODFREY MORGAN, formerly general manager of the Niagara Gorge Railway, has been appointed general superintendent of the Youngstown & Sharon (Ohio) Electric Railway.

MR. WALTER C. ALLEN, the electrical engineer to the Commissioners for the District of Columbia, has just issued through them the annual report of the work done and supervised in Washington. It constitutes a very interesting and instructive document.

MR. T. AHEARN, president of the Ottawa, Can., Electric Company, which controls the lighting and street railway systems, has started off with his family for the Mediterranean. The Ahearns are great globe trotters, and are not long at home from a trip around the world.

MR. GEORGE F. PORTER, secretary of the National Electric Light Association, returned last week from Alaska, where he had been for some three months for the purpose of superintending the laying of the submarine cable between Skagway and Juneau, the contract for which was secured by his firm.

MR. EDWARD HEITMANN contributed to our pages last year an interesting serial on the inductor alternator. We are glad to note that the articles have now been reprinted in a bulletin by the Stanley Electric Manufacturing Company, with whose engineering staff he is associated.

MR. HENRY C. PAYNE, the new Postmaster-General, will, it is said, resign his position as vice-president of the Milwaukee Electric Railway & Light Company, at the annual meeting in February. It is understood, however, that he will retain all his interests in that and other enterprises, such as the Wisconsin Telephone Company, with which he is much less actively connected.

MR. D. F. HENRY, vice-president of the Central District Printing & Telegraph Company, Pittsburg, which is the local branch of the Bell Telephone Company, has resigned his position on account of the great demand made upon his time by his many other business interests. Mr. Henry is considered the father of the telephone in Pittsburg, as he introduced and installed the first one there in 1878.

LIEUT. COMMANDER B. A. FISKE, U. S. N., well known for his electrical work, has just contributed to the *United Service* a most charming narrative of his share in, and observations made during, the famous battle of Manila, when he served as navigating officer of the U. S. S. "Petrel," under Dewey's orders. Commander Fiske is not only modest, but cool, and his notes show that all through the fight his sub-consciousness was also working at full efficiency.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, of Ampere, N. J., is the subject of a biographical sketch in *Cassier's Magazine* for January. The article is written with insight and appreciation, and does justice to Dr. Wheeler's technical work, while bringing out what is not so generally known, his skill in directing and organizing shop management and accounts. Reference is made to his recent gift of the Clark Library to the American Institute of Electrical Engineers, and a fine portrait accompanies the article as frontispiece to the magazine.

MR. CHAS. S. DRUMMOND, of the Electric Traction Company of England, is visiting this country. The *New York Times* tells the following story of him: "Mr. Drummond arrived from London a couple of weeks ago and started for British Columbia. On the way he met with a railroad accident. As usual, the serious situation was not without its comedy. As the car in which Mr. Drummond was sleeping heeled over and rested upon its side, and Mr. Drummond was clinging to the edge of his berth, he heard a feminine voice from out the depths of the opposite berth—which was now below him, say: 'Please, Mr. Drummond, won't you take off mother? She is dreadfully heavy.'"

Trade Notes.

THE H. E. LINDSEY ELECTRICAL COMPANY, of St. Louis, Mo., has increased its capital stock from $5,000 to $10,000.

THE MICHIGAN CARBON WORKS, Detroit, Mich., has been licensed to do business in Illinois; capital stock, $600,000; capital in Illinois, $2,500.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has brought out a special loud-ringing extension telephone bell, which is just what is needed for noisy places.

FIRE DAMAGE.—The College City Electric Company, Galesburg, Ill., manufacturer of automatic time switches, suffered a disastrous fire on Dec. 11, but by two days before Christmas it succeeded in getting back to its office.

BULLOCK CALENDARS.—The Bullock Electric Manufacturing Company's calendar for January, 1902, contains a vignette portrait of Benjamin Franklin. This is the first one of the series containing pictures of great men of science and engineering.

SUPPLY HOUSE IN MANILA.—Messrs ellinger & Landon, electrical engineers and contractors, Manila, P. I., have opened an electrical supply house in that city and are arranging to execute electrical work in all parts of the islands.

THE FORT WAYNE ELECTRIC WORKS has, through its Cincinnati office, just sold to the village of Madisonville one 100-kw alternator and one 125-light arc machine for installation in the new power and lighting plant. The Tudor Boiler Works, of Cincinnati, furnished the boiler equipment.

RELIANCE BULLETINS.—The Reliance Electric Company, Milwaukee, Wis., has issued three bulletins devoted to direct-current multipolar dynamos and motors for lighting and power, and motors especially adapted for crane, bridge, pumps and elevator work. They are illustrated, and briefly point out the features of these machines.

FORGES.—The B. F. Sturtevant Company, Boston, Mass., has issued a pamphlet on its small forges, various styles of which are illustrated. These forges are designed for every use where portable forges are desired, and one is fitted with electric blower. The principal dimensions of the different sizes of each style, and a price list are also given.

ELECTRIC AND STEAM HOISTS.—The C. W. Hunt Company has just issued a pamphlet on electric hoists of the type described and illustrated in our last issue. The pamphlet is fully illustrated. A catalogue has also been issued by the same company describing and illustrating its line of steam hoisting engines. Copies of the above can be obtained on application.

ARTISTIC CALENDAR.—The twentieth century calendar of N. W. Ayer & Son, Philadelphia, Pa., keeps up its high artistic merit, and this year's is better than that of last year. The background and main sheet is a work of art, which is enhanced by some tasteful color work by the printer. Messrs. Ayer & Son charge 25 cents for these calendars, to cover the cost of their production, handling, etc.

GENERAL ELECTRIC BULLETINS.—Bulletins 4267, 4268, 4269, 4270 of the General Electric Company have for their respective subjects: Low-voltage arc lamps, Brush arc generators, direct-driven revolving-field alternators for electric lighting, and feeder regulators. In each case the apparatus is excellently illustrated, diagrams of the connections and circuits being given where necessary.

SILENT DRIVING CHAIN.—"Renold High Speed Silent Driving Chain" is the title of pamphlet No. 203 (32 pages) issued by the Link-Belt Engineering Company of Nicetown, Philadelphia, descriptive of this new device for transmitting power. It appears from a perusal of the booklet that the silent drive is supplanting other means of transmission in many places, and that almost as soon as its properties are comprehended, engineers suggest innumerable applications for its use.

A NEW YEAR'S CHECK.—The American Electrical Heater Company, of Detroit, Mich., has done so well last year that it is remembering its friends by sending them a "check" upon the "National Bank of Prosperity" for 365 "prosperous days." If the prosperity called for is realized the American Electrical Heater Company will have good reason to feel satisfied with the investment. The check is signed by B. H. Scranton, president, and countersigned by John Scudder, secretary-treasurer. The idea is a capital one.

THE GEORGE F. BRUNT PORCELAIN WORKS, East Liverpool, Ohio, are to be congratulated on the very charming souvenir which is being sent out under their name. It is in the form of a large calendar, which surrounds a most pleasing portraiture of Shakespeare's Ophelia. The coloring is very beautiful. The artist has shown Ophelia in a character of gentleness, and has succeeded in producing an excellent piece of work, which the George F. Brunt Porcelain Works have honored themselves in presenting to their friends.

DECENNIAL OF CORRESPONDENCE SCHOOLS.—Many worthy and ambitious young men have received valuable assistance through correspondence schools in their endeavor to attain better positions in their chosen vocations, and the standing of some of these schools has been recognized by leading educators. This system of teaching has just closed its tenth year of existence in Scranton, Pa., where the International Correspondence Schools are located. These schools began on Oct. 16, 1891, when the first student was enrolled. They began in a limited way under the name of "Correspondence School of Mines," and since that time the idea has been extended in its application to embrace many of the professions and trades, and thousands of scholars have been materially benefited by the instruction received in this way. The International Correspondence Schools was, some months ago, awarded a diploma and silver medal by the Philadelphia Export Exposition, through the Franklin Institute, for "a unique, thorough and comprehensive system of technical education by correspondence." The history of the growth of these schools is full of interest to any one who has ever given a thought to the subject of education.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DEC [illegible]

[illegible] St., N. Y.J

689,849. APPARATUS FOR DETECTING AND LOCATING METALLIC ORES, MINERALS, ETC.; F. H. Brown, Chicago, Ill. App. filed Jan. [illegible]

689,877. ELECTRICAL CONDUCTOR AND ANODE; L. Hargreaves and W. Stubbs, Farnworth in Widnes, England. App. filed June 17, 1899. The head of the anode is sealed into the bottom of a pan which contains oil to prevent disintegration at the junction between the anode and its conductor.

689,889. TRANSMITTER; O. L. Kleber, Pittsburg, Pa. App. filed Sept. 10, [illegible]

689,894. ELBOW FOR CONDUITS FOR ELECTRIC WIRES; G. A. Lutz, Brooklyn, N. Y. App. filed May 23, 1901. The elbow is provided with a hinged joint so that the conduit can assume any angle.

689,929. CONTROLLING DEVICE FOR CONNECTING STORAGE BATTERIES WITH CHARGING LINES; N. H. Suren, Needham, Mass. App. filed June 19, 1899. A polarized relay inserted between the charging circuit and battery automatically opens the circuit in case the polarity of the charging current is not suited for charging.

689,930. APPARATUS FOR CONTROLLING THE CONNECTION OF STORAGE BATTERIES WITH CHARGING CIRCUITS; N. H. Suren, Needham, Mass. App. filed June 29, 1899. A modification of the preceding invention in which a cut-out magnet is used to automatically open the circuit when the voltage of the charging current is too low or the counter current of the battery too high.

689,937. COMBINED FLEXIBLE CONDUCTOR AND RESISTANCE CORD; E. E. Werner, Indianapolis, Ind. App. filed Aug. 13, 1900. A resistance conductor is incorporated with the main conductor in a flexible cord.

689,947. ADVERTISING DEVICE; E. M. Bantley, Lawrence, N. Y. App. filed Jan. 19, 1897. A slow-acting circuit closer is attached to a trolley wire so that as each car passes, a circuit to an advertising device along the roadway will be closed, and the advertisement for a short predetermined time displayed.

689,959. PROCESS OF DISINTEGRATING AND COMMINUTING MINERALS OR ORES; E. L. Graham, Upper Warlingham, Eng. App. filed March 26, 1901.

689,975. RAILWAY SIGNALING APPARATUS; F. A. Landee, Moline, Ill. App. filed Sept. 29, 1900. A signal actuating instrument adapted also to prevent the actuation of the signal under certain conditions.

689,976. RAILWAY SIGNALING APPARATUS; F. A. Landee, Moline, Ill. App. filed Sept. 29, 1900. As an improvement on patent No. 467,570, means are provided by which more than one signal placed at different railroad crossings can be operated simultaneously by a train approaching in either direction.

690,040. ELECTRIC FIRE ALARM; O. B. Thompson and W. G. Midgley, Buffalo, N. Y. App. filed Feb. 23, 1901. A circuit closer operated by the fusing of a soft metal.

690,048. PROCESS OF TREATING NATURAL PHOSPHATES; L. Cheeseman, Sr., Alexandria, Va. App. filed Feb. 16, 1901.

690,060. ALTERNATING INDUCTOR DYNAMO; J. Jacoby, Elizabeth, N. J. App. filed May 13, 1901. A drum fixed on the shaft and having an integral exterior flange out of center lengthwise of the drum and a laminated primary polar ring on the drum, the ring having polar projections and being fastened to the integral flange.

690,105. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed April 25, 1901. An impedance coil is automatically thrown into a circuit around the lamp when the resistance of the arc exceeds a pre-determined amount.

690,108. ELECTRIC CONTROLLER; G. H. Hill, Glen Ridge, N. J. App. filed Aug. 5, 1901. A solenoid automatically cuts resistance out of its own circuit as its core moves inward to thereby afford uniformity in the force acting upon the plunger in its various positions; means are also provided to vary the value of the current in the solenoid in order to move or check the plunger at any position.

690,110. TROLLEY RETRACTOR; A. J. Johnson, Cleveland, Ohio. App. filed Oct. 12, 1901. Details.

690,141. CONTINUOUSLY ELECTROLYZING ALKALI CHLORIDS; W. Gintl, Aussegg, Austria-Hungary. App. filed Nov. 17, 1900. (See page 86.)

690,151. METHOD OF UTILIZING ELECTRICAL EARTH CURRENTS; E. Jahr, Berlin, Germany. App. filed July 24, 1900.

690,155. STAGE POCKET; J. I. C. King, New York, N. Y. App. filed Aug. 20, 1901. A pocket in the floor of a stage is provided with a hinged cover which in moving to its closed position closes electrical contacts for the branch circuit provided the plug has first been adjusted in position to be acted upon by the cover.

690,181. ELECTRIC ACCUMULATOR; A. Pouteaux and A. Wolff, Dijon, France. App. filed April 9, 1901. (See Current News and Notes.)

690,190. APPARATUS FOR TREATING GOLD ORES; Vicente Pazos y Sacio, Yauli, Peru. App. filed Nov. 8, 1900. (See page 86.)

690,219. ELECTRICAL EQUIPMENT OF RAILWAY VEHICLES FOR THE PURPOSE OF LIGHTING, HEATING, AND VENTILATION; A. Zehden, Charlottenburg, Germany. App. filed July 14, 1900. An arrangement of automatic switching devices for charging and discharging a battery and controlling a dynamo driven from the axle.

690,248. SYNCHRONIZING SYSTEM; W. Duane, Boulder, Colo. App. filed March 19, 1901. Motors at different stations coupled to sun-flower contacts, are maintained at uniform speed by utilizing variations in the speed between the motors at different stations, to cause such a change in the circuit of one or the other of the motors as will so far correct its movements as to bring the motors into synchronism with each other.

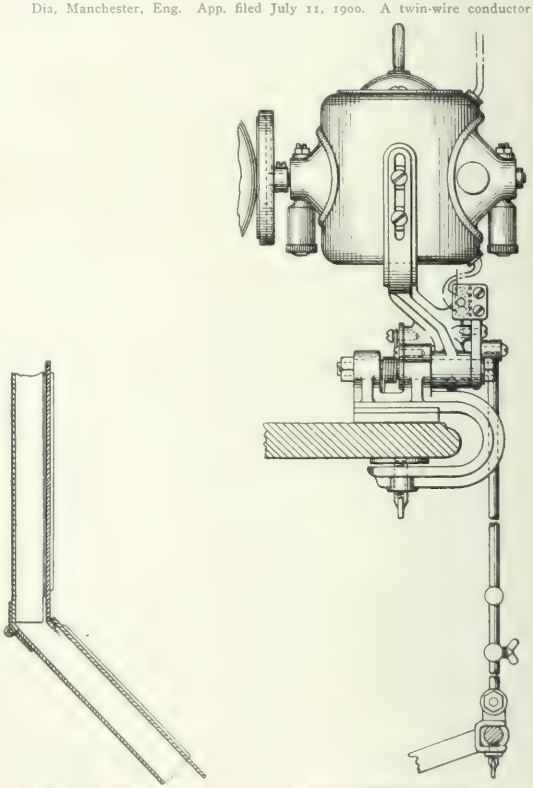
690,255. ELECTRIC SHIFTING DEVICE FOR RAILWAYS; H. S. Esch, New York, N. Y. App. filed April 26, 1901. Details of an electro-magnetically controlled railway switch.

690,256. AUTOMATIC TRACK SWITCH FOR ELECTRIC RAILWAYS; H. S. Esch, New York, N. Y. App. filed April 26, 1901. A construction affording a short insulated section in a trolley wire.

690,268. PRIMER FOR ORDNANCE; C. Von Gortz, Vienna, Austria. App. filed Sept. 28, 1900. The primer is constructed so that in case the electric firing devices fail, it can be fired by percussion.

690,282. ELECTRIC SIGNALING APPARATUS; F. B. Herzog and S. S. Wheeler, New York, N. Y. App. filed Jan. 25, 1886. A transmitter comprising a rheotome and a step by step escapement, a motor-spring, and a magnet, all co-operating to rotate the wheel as a result of the operation of the rheotome, and circuit controlling elements co-operating with the wheel to produce predetermined signals.

690,283. INSULATED ELECTRIC CABLE OR CONDUCTOR; G. E. Heyl-Dia, Manchester, Eng. App. filed July 11, 1900. A twin-wire conductor



690,294. Elbow for Conduits for Electric Wires.

690,334. Motor for Driving Sewing Machines.

having a fillet of permeable material inserted centrally between the wires through which to drive nails to fasten the conductor in place.

690,313. TROLLEY POLE ATTACHMENT; G. F. Nelson, Washington, D. C. App. filed May 16, 1901. Details.

690,319. PROCESS OF PRODUCING CARBIDS; I. L. Roberts, Brooklyn, N. Y. App. filed April 6, 1896. (See page 86.)

690,334. MOTOR FOR DRIVING SEWING MACHINES; H. R. Wellman, New York, N. Y. App. filed June 6, 1901. On the motor shaft is a friction disk which bears against the sewing machine wheel; the motor is pivotally mounted so that by means of a treadle it can be bodily moved to change the speed and stop and start the motor by changing the relative positions of the friction gear.

690,364. ELECTRIC SWITCH; J. J. Gaffney, Newark, N. J. App. filed March 2, 1901. A two-part spring, between the members of which a non-conducting rod is thrust to open one circuit and close another.

690,365. APPARATUS FOR THE CONTINUOUS ELECTROLYSIS OF ALKALI CHLORIDS; W. Gintl, Aussegg, Austria-Hungary. App. filed Oct. 10, 1900. (See page 86.)

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NEW YORK, SATURDAY, JANUARY 18, 1902.

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THE NEW YORK CENTRAL.

It is an important statement that is published in our issue this week, from the directors of the New York Central Railroad, as to their early use of electricity in the Park Avenue tunnel for suburban traffic. To what extent the recent sad accident has hastened this decision we cannot say, but it is a fact within our own knowledge, and one that we have already recorded in these columns, that the company has for months past been studying this problem with the aid of some of the best electrical engineering ability in this country. We have no doubt that the company in its slow and rather old-fashioned way will reinforce itself with the best advice as to the general plans now said to be ready for adoption, for its own satisfaction equally with that of the public. There would be wisdom in this, however, in more respects than one, and especially in view of the manner in which every act of the company is viewed in some quarters.

The definite plan announced is that of operating the suburban trains by electricity through the existing side tunnels, "equipped with the most modern appliances for underground traction." This phrase does not commit the company to third-rail methods, and does not exclude an overhead contact. It would appear, however, to involve the use of electric locomotives. The phrase, "suburban trains," has a rather elastic meaning, but in the case of the New York Central would presumably include all commuter service, although we have heard of daily commuters living as far out as Poughkeepsie.

This first step towards the general adoption of electricity is cautious and tentative, but we think that once the start is made, there will be no going back until the tunnel is wholly purged of steam and smoke, and the entire Central system is "electrified." The change may extend over years, but if we can read the signs of the times aright it is coming. The expense involved in the preliminary installment is quite considerable, and the statement we publish is supplemented by the news that the company is to raise $35,000,000 from its present stockholders, half of which will be subscribed immediately for the work. We are heartily glad that this conclusion has been reached, for even upon its surface it implies better service to the community and an increase of the facilities for travel and connection between lines without the city, and those within. We do not apprehend that the Legislature will dare oppose measures necessary to enable the company to carry out its plans and adopt electricity.

MARCONI AT THE A. I. E. E. ANNUAL DINNER

One of the most successful occasions in the history of the American Institute of Electrical Engineers was the annual dinner of that body this week, at which Signor Marconi was the guest of honor. Though the committee in charge of the affair had but a few days in which to plan and complete all arrangements—and these in several respects were quite elaborate—the affair passed off without a hitch. It is worth noting that Institute functions are, as a rule, admirably conducted. This, however, is not so surprising when one considers that they are in charge of men who, as engineers, are accustomed to dealing with matters not only involving great detail, but which have to be carried out with almost mathematical precision.

In the extended accounts of the dinner which appeared the following day in the newspaper press, the modesty of demeanor and speech of the guest of honor was much dwelt upon. Newspaper writers had apparently expected a grandiloquence of expression and generosity of prediction, such as have too often characterized the public utterances of those whose names have become deservedly prominent in connec-

tion with some subject that has attracted wide attention; for some members of this class mistake natural interest in the subject of their work, for admiration of their personality, and then endeavor to heighten personal appreciation by sensational statements. Those present who had closely followed the career of Signor Marconi were but confirmed in their opinion of his personal modesty by his bearing, and by his deliberation and care of statement, as manifested during the evening in his remarks. Though a very young man, he has the mental poise which usually is only associated with mature age, and the excellent form of his remarks is more characteristic of the savant than of the practical worker.

It will be recalled that in the five years or more in which his name has been prominently before the world, Signor Marconi has at no time announced what he expected to accomplish, in every case the public having obtained knowledge of his plans only after they had been carried to successful completion. To this is largely due the confidence he has inspired and which caused his unsupported statement as to the reception of the famous signal at St. Johns to be accepted without question by all who knew of the man. At the dinner Professor Elihu Thomson said that when asked by a newspaper reporter if he placed confidence in Marconi's statement, he replied, "If Marconi said he did it, I believe he did"—which is the same reply made to a newspaper reporter by Edison; and Dr. Pupin, in his remarks at the dinner, said that he would not now believe that the signals had been received if he did not know Mr. Marconi personally. Surely this is a case of a virtue meeting with merited reward.

In his remarks at the dinner Signor Marconi cleared up the misapprehension as to his syntonic system which had arisen from the fact that it has not as yet been put into commercial use. Thus far the commercial use of the wireless telegraph system has been to communicate with ships, and as pointed out by Signor Marconi, a syntonic system for this purpose would not only not be necessary, but would be disadvantageous. The statement of his belief in the practicability of syntonic telegraphy, and that he has proceeded far in the development of such a system, is perhaps the most important part in his address. It was doubtless due to his confidence in this system that he expressed a strong belief that wireless telegraphy eventually will be a real competitor of the submarine cable, though not necessarily superseding it. Commenting upon this later in the evening, Dr. Pupin directed attention to the fact that even if wireless telegraphy were to be a competitor of submarine telegraphy, it did not signify that the latter industry would necessarily be endangered; and, as an illustration, he pointed out how the competition of electric lighting has aided the gas industry and enhanced rather than decreased the value of investments in that industry. He instanced also telegraphy and telephony. It would, in fact, be hard to name one real beneficent invention that has been wiped out by another.

The Carnegie Institution.

Among many striking acts of benevolence Mr. Andrew Carnegie has done no finer or wiser thing than his recent gift founding a national institution for the promotion of research. We are heartily glad that he has not merely founded another university. Of such, doing sterling work up to the limitations of their equipment, we have have enough and to spare. There is no section of the country where a young man cannot obtain a sound collegiate or technical education, but collegiate institutions are of necessity devoted mainly to the fundamental and necessary work of instruction, and can undertake serious research work only in a fragmentary way. Of post-graduate institutions there are comparatively few, and, for the most part, their work is the higher work of educational training rather than pure research. The great achievements of German science are due to the body of trained investigators who, having already attained the doctorate, devote their subsequent years to advancing the bounds of human knowledge. They are gathered about the various universities often in the position *privat-docent*, gradually working their way into prominence. In the English universities the Fellows form a similar body of enthusiastic workers in special lines. The great source of weakness in our own country so far as research is concerned is the lack of investigators holding this sort of relation to the universities. Unless a man is the lucky possessor of a private fortune he is compelled, as soon as he obtains his degree, to assume the position of instructor in some institution overburdened with students, and thenceforth his time is so taken up with the routine of instruction that his usefulness as an investigator is seriously impaired. Even if he finds time for original work the resources of most American institutions are so absorbed by work of instruction that they have scant funds to apply to even the material of research.

Hence, while we have plenty of places where proper instruction can be obtained, albeit insufficiently endowed, there are few opportunities for those who would settle down to serious scientific work. Nor is there any proper co-ordination of resources such as enables scientific work to be done with economy of effort. A brilliant young chemist, for example, has to take a place in some technical school that is struggling to build up a strong course in mathematical engineering, or a particularly clever astronomer finds himself marooned in a biological desert. We have in mind not a few unfortunate misfits of this kind that represent a real and great loss to science. Now the full plans of the splendid Carnegie Institution have not been made public, if, indeed, they have been completely formulated, but it is evident enough that they may include work of inestimable value to American science and arts. The location of the Institution at Washington, where the immense resources of the Government scientific departments can be co-ordinated with it for the maximum of mutual helpfulness, is a particularly wise step. We believe it is better out of direct government control, although the Government will assuredly join forces with it in its noble work. But its usefulness will assuredly not be limited to gathering a body of advanced students and investigators in Washington. It will be in a position to stretch out a helping hand to promote investigation in pure or applied science elsewhere. Those who know what the Rumford and Bache funds have done with comparatively little to promote American science can realize something of the extra-mural power for good that the Carnegie Institution may have. It is within its scope, in fact, to organize American investigation into coherent lines, and in no small measure to direct its progress. Free from the necessity of caring for a great body of elementary students it can put its resources where they will do the most good and produce the most valuable results.

To electrical science in particular it can be of immense service. There are many problems that require the most vigorous attacks on the part of trained and skillful investigators, but there was little prospect for their solution in this country. No work in electricity is merely of academic interest—the theory of yesterday and to-day is the practice of to-morrow. Yet much important work is apparently of so remote practical bearing that the great electrical manufacturers cannot see their way clear to undertaking it, and if done at all it must be attempted by hard working instructors in the crowded electrical departments of colleges and technical schools. The material of modern investigation is costly, and not a little important work has been blocked by insufficient appropriations. A foundation big enough and broad enough to undertake helpful development of great beginnings can confer inestimable benefits. Obviously no institution could fairly undertake much in the direct line of promoting practical im-

provements in the arts, nor is it necessary that it should do so, for in most cases they can take care of themselves if of real merit. But a wise and far-seeing outlook over the field of science can detect many a line of advance before the workers in the fields can recognize its true bearing. Both in theory and practice the Carnegie Institution will have an almost unlimited field for good before it. But to our minds its greatest opportunity is in the work of co-ordination, of strengthening American investigation where it is weak, of bringing united effort to bear where united effort will count, of reaching out to various points and attacking a pending problem from all sides. In endowing such an institution, Mr. Carnegie has earned the heartiest gratitude of his countrymen, and conferred a benefit, the greatness of which can hardly yet be realized.

The Electrical Section of the International Engineering Congress, Glasgow, 1901.

The December (1901) number of the *Journal of the Institution of Electrical Engineers* (London) contains six papers of considerable engineering interest, read before Section IX. of the Glasgow International Engineering Congress last September. Perhaps the most interesting was the paper describing the design and experimental preparatory work in connection with the construction of a 3000-horse-power, high-speed railway car for the German military railway between Berlin and Zossen. This paper is splendidly illustrated, and is a model of compactness with breadth of information. The general features of this experimental car are well known to our readers from the accounts that have been published from time to time. The car was equipped with four 750-horse-power triphase, 400-volt induction motors, their secondaries being wound two-phase to simplify rheostat connections. Transformers for stepping down from 12 kilovolts, are carried on the car, an arrangement which while having the disadvantage of adding to the weight to be moved an amount equal to half the total weight of motors, yet has the advantage of permitting smaller trolley wires to be used throughout the system, and greatly diminishing the cost of conductors. Numerous difficulties are necessarily encountered in the first development of a speed of 200 kilometers per hour with a 3000-horse-power induction-motor equipment. One of the principal difficulties in design appears to have been the spring support of the induction motors. These were finally carried on sleeves covering the axles, and spring-connected with the wheels. Very interesting three-dimension diagrams in isometric projection are given graphically representing the experimentally observed temperature elevation of the bearings, for different speeds of rotation, in association with different coefficients of friction. This type of diagrams is evidently capable of being introduced with advantage into many engineering applications.

The control of the motors is entirely by the aid of secondary resistance, using a very ingenious form of soda-water rheostat in which the electrodes are stationary, the liquid level being varied by a small electrically-driven pump, through which the electrolyte is kept constantly circulating. By this means the motorman is prevented from turning the current on too rapidly at starting. For stopping there are no less than three independent sets of brakes, the first being a hand-applied brake for shunting, the second a Westinghouse air-brake system, and the third an electric brake in which the line connection is shut off, and the stator of the motors excited by direct current from a storage battery on the car, while the rotor is gradually short circuited. It is clear that the limitations of rheostatic control and braking determine the commercial limits of this system. There can be no doubt of the great simplicity of the equipment and of its safety and readiness of control, which, in fact, were satisfactorily demonstrated in the recent Zossen trials. On the other hand, none of the energy of momentum is restored to the line when the car is stopped, and for all speeds below the maximum the rheostats must be kept in service with more or less attendant waste of energy. Such a system, while not so objectionable for long-distance passenger traffic at high speeds, does not appear to be adapted to short-distance running with frequent starting and stopping. If the speed control and braking of the car could be effected with a greater efficiency and saving of energy, not only would the generator installation at the central station be greatly reduced, but the system would be much more likely to supersede the ordinary direct-current street railway system. For very high speeds and long distances, however, the triphase induction-motor car equipment seems to have special advantages.

Dangers from Trolley Wires and Their Prevention.

This is the title of a paper read at the Glasgow Engineering Congress by Professor A. Jamieson. The paper points out the dangers which exist when telegraph, telephone and lighting wires overhang and cross trolley wires. In several British cities attempts have been made to protect overhanging wires against trolley-wire contacts in case of rupture by supporting a wooden strip on the upper side of the trolley wire. This method has, however, been found to be either ineffective, or at least incompletely effective. The British Post Office rules require two guard wires over each trolley wire, the guard wires being 16 inches apart, and on the same level 2 ft. above the trolley wire. These guard wires are usually about the size of No. 5 B. & S. gauge. It is advocated, very properly, that the only safe method of installing these guard wires is to keep them well and permanently grounded at suitable short intervals. After discussing the various methods of preventing accidents by crosses between trolley wires and other neighboring non-trolley wires, in cases of accidental rupture, the paper takes the position that the only safe and sure plan of preventing crosses is to have no non-trolley wires. In other words, it advocates burying all telegraph, telephone and lighting wires. This is, of course, the correct solution of the difficulty in large cities where the expense of underground wires can be met without serious difficulty. It is no solution of the difficulty in villages and small towns where it is practically impossible to place the non-trolley wires underground. In such cases, however, not only is the danger of accident much reduced by reason of the reduced density of population, but it is possible to minimize the danger of accident by exercising ordinary care in construction.

Modern Commutating Dynamo Machinery.

This is the title of a third paper read at the Glasgow Congress by Mr. H. M. Hobart. This paper deals mainly with the little-investigated subject of the inductance and reactance of coils in a direct-current dynamo armature. The reactance of such coils is of importance when considered with reference to the phenomena of commutation. The experimental data upon which the paper relies for the determination of armature-coil inductances appear to be somewhat meagre, and an excellent field here exists for experimental measurements. The general conclusion is arrived at, however, that the reactance voltage of the coils under commutation in a direct-current dynamo should not exceed 3 or 4 volts. The specifications of three direct-current generators of 400, 800 and 1600 kw capacity are carefully tabulated, and in these the calculated reactance voltage is from 2.8 to 3.9 volts. In these cases the flux density in the teeth is from 21 to 23 kilomaxwells, and in the air-gap from 9 to 10 kilomaxwells. It is quite reasonable to expect that the true limits of sparking in dynamos depends among other quantities upon the reactance voltage. Moreover, it would seem that no accurate formula can be expected to express the sparking limits which does not take this reactance voltage into account.

Electric Power for the New York Central.

The directors of the New York Central Railroad issued the following statement on Wednesday of this week, of which we give the substance below:

The company now confirms the statements made from time to time in the public press that it has been preparing plans for changes in the methods of using the Park Avenue tunnel, so as to meet the demands of a constantly increasing traffic, and provide for the convenience of the traveling public. The best method of improvement, and one which the company desires, would be the abolition of the tunnel, and making in its place an open cut, similar to that south of Fifty-sixth Street, but this, on account of the opposition it has encountered, has been impossible of attainment up to the present time, and, therefore, after a thorough investigation of the subject, it was determined that the mos practicable plan for caring for the enormous passenger traffic concentrated in the Grand Central Station would be the construction of a loop station under the present terminal, so that the suburban trains could be operated by electricity through the existing side tunnels, to be equipped with the most modern appliances for underground traction, and to the accomplishment of this plan the efforts of the company have for some time past been directed. In this way the passenger facilities of the present station would be nearly doubled, and, with the suburban business thus provided for, the through passenger and mail business can be moved through the center tunnel with promptness and regularity, which is very important to the traveling public, the city and the railroad.

Before determining that electrical or some other power shall be substituted for steam on all trains entering the Grand Central Station, it must be demonstrated that the business can be safely and promptly handled in that way, therefore, it is contemplated to make the experiments in the side tunnels and the underground station.

To carry out its plan, it will be necessary for the company to obtain from the Legislature and the city authority to use power other than steam (to which it is now expressly limited by statute) and to obtain changes in Park Avenue, so as to give use of that street south of the tunnel, in order to lengthen the approach to the station, also the right to construct a tunnel underneath portions of Forty-third, Forty-fourth and Forty-fifth streets, Park, Vanderbilt and Depew avenues.

These changes necessitate the purchase of a large amount of property in order to provide a new location for Park Avenue. Considerable of this property has already been acquired or contracted for, but more remains to be purchased, and this somewhat premature announcement of the company's intentions may make the accomplishment more difficult.

The company is prepared to proceed with the work substantially on the plan outlined above when the necessary legislation can be obtained.

Electrical Engineers of the Day—XXIX.

EDWARD P. BURCH.

Edward P. Burch was born in Wisconsin in 1870, and obtained his early education in the public schools at Menomonie, Wis. He began to show marked interest in physics and electricity while in the High School, and after graduating therefrom in 1887 he entered the University of Minnesota. Two summer vacations were spent in active electrical work as a wireman, and later as a draughtsman with the Chicago Edison Company, which practical work operated advantageously to supplement his technical training. In 1891 Mr. Burch was appointed student instructor in electrical engineering at the university, under Professor F. S. Jones, now head of the department of physics in that institution. His graduating thesis at the University was on "Electric Railway Motor Tests," and embraced experimental tests of the now obsolete Sprague commutated field, the Thomson-Houston double and single reduction motors, the old barrel, rheostat and J controllers then in use in street railway systems; also running tests on cars in regular service on the interurban road between Minneapolis and St. Paul, and power house load diagram for 290 cars, all of which were then interesting. At the June, 1892, meeting of the American Institute of Electrical Engineers, a paper was presented in conjunction with Professor George D. Shepardson on the above subject.

After graduation Mr. Burch entered the service of the Twin City Rapid Transit Company, of Minneapolis and St. Paul, then, as now, owning and operating one of the largest electric railway systems in the country. During his more than seven years of service with this company, most important street railway progress took place. In 1892 he contributed largely to the development of a new series-parallel controller, which was used by the company until 1900, and worked on the re-design of the railway motors. He was appointed electrical engineer for the system in 1893. Soon after, he raised the voltage in the company's power station from 500 to 625 volts. He argued that by proper design the motors would have less repairs at the higher voltage, and this was found to be true. The change also prevented additional investment in feeders for a period of five years, during which the car mileage and station output increased 50 per cent. The introduction of a system for equalizing the potential on railway feeders, which he developed in 1894, is now in common use.

About this time Mr. Burch began the study in a most systematic way of power transmission. In 1895 he was engaged in laying plans for a central power station at St. Anthony Falls for the transit company's system, which would utilize water power, direct-connected units, with 3500 and 12,000 volts alternating-current three-phase transmission, in underground cables, and rotary converter sub-stations. This system, now becoming a standard for large railway systems, was put in full service three years later for the entire street railway system of Minneapolis and St. Paul, embracing some 250 miles of track. As early as 1898 six 600-kw railway rotary converters were in use. After having had charge of the operation of this



new system and of the 10,000-hp St. Anthony Falls water power station for two years, Mr. Burch resigned his position as electrical engineer for the company to engage in business for himself, but was retained as its consulting engineer. During his service with the company the construction and equipment of its heavy interurban lines were successfully carried through.

Since Jan. 1, 1900, Mr. Burch has acted as a consulting engineer, specializing on electric railways. Most of his work has been on interurban roads. He believes that street railway systems are not yet perfected, but that future development will be slow. That the perfection of the 100-mile interurban road is the work of the next few years, and that the electrical equipment of the steam roads will follow immediately thereafter. With this in view, his specialization and study have related to standard steam railroad practice and the electrical problems involved.

Mr. Burch has presented at colleges and before engineers' clubs numerous papers embracing such subjects as the economical cross section of railway feeders, an equalizer system for feeders, the synchronizing of alternators, and the utilization of water power for electric railway systems. His latest paper, "Electric Traction for Heavy Railway Service," has attracted much attention from steam railway engineers.

Mr. Burch is an active member of the American Institute of Electrical Engineers, and of the Northwest Railway Club, and is secretary of the Engineers' Club, of Minneapolis.

The Waterside Station of the New York Edison Company—III.

HIGH-TENSION FEEDERS AND SUBWAY SYSTEM.

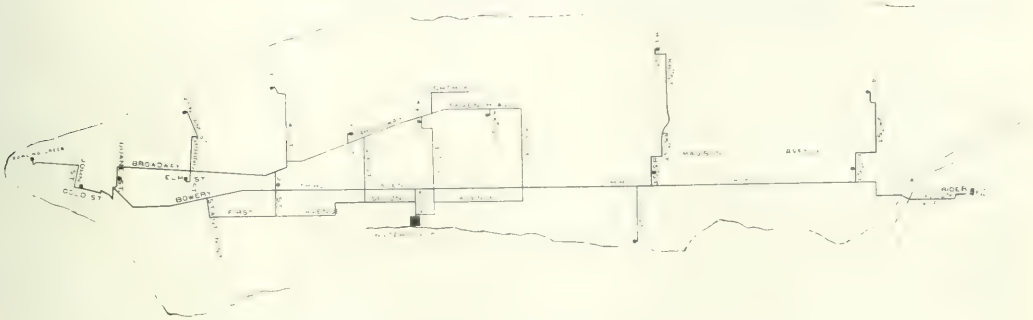


FIG. 37.—DIAGRAM OF THE HIGH-TENSION FEEDER LINES.

RESUMING our description of the New York Edison system and the new Waterside station, we come next to the high-tension feeders and subway system. The three-phase, 25-cycle current at 6600 volts generated at the Waterside station is distributed to the various rotary converter sub-stations by underground cable feeders, leaving the high-tension cable vaults at the Waterside station and following four distinct trunk lines of subway ducts, West on Thirty-eighth Street and on Thirty-ninth Street, and north and south on First Avenue. These main trunk lines make connection with the general subway system of the Consolidated Telegraph & Electrical Subway Company, at the intersection of the main avenues and with the east and west trunk lines on Twenty-ninth Street and Forty-second Street. The ducts of the Subway Company operating the high-tension subways cover practically all of the main avenues of the city, and many of the cross streets, and with the main and subsidiary connections represent a total length of about 1000 miles of duct. The ducts in which the cables are drawn are either made of iron pipe laid in concrete or glazed tile laid on a bed of concrete. Manholes are provided at street intersections and at intervals of 250 ft. to permit the drawing in and splicing of cables, with intermediate hand-holes in the distributing ducts for subsidiary connections to customers. In the manholes all cables are carefully racked and the manhole covers are ventilated to prevent accumulation of gas in the ducts and manholes. The Consolidated Subways, in addition to the high-tension cable of the New York Edison Company, are occupied by the cables for the lighting and power circuits for 60 cycle alternating current distribution and cables for the direct-current high-tension series arc light circuits. As a protection against mechanical injury and interference from other cables the high-tension, three-phase cables are protected in the manholes by a wrapping of asbestos and steel tape. In laying out the feeders for each sub-station, care was taken to have the feeders follow different subway routes so as to ensure continuity of service in case of trouble in a manhole. The size of the cables used for feeders has been selected to secure the best utilization of a 3-inch duct, the size generally used by the Subway Company. The number of feeders to each sub-station was based on the most economical copper section for the observed station load factors, the maximum drop not to exceed in any case 5 per cent, and the maximum carrying capacity for continuous load has been fixed at 250 amperes per phase. To fill these conditions the standard copper section was adopted of 250,000 cm. sectional area for each of the three conductors.

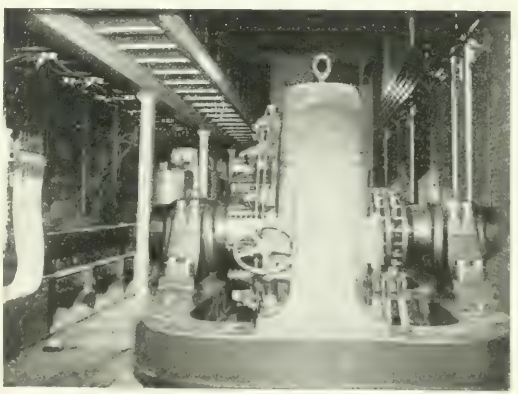


FIG. 38.—1000 KW WESTINGHOUSE ROTARY IN SUB-STATION.

The first three-phase high-tension, 6600-volt cables installed by the company in 1898 were rubber insulated, and this type was used in the early extensions, but in the more recent additions to the high-tension cable system, paper insulation has been used exclusively. The company is now operating about 41 miles of rubber insulated cables and 28 miles of paper insulated 6600-volt cables. The specifications for the high-tension feeder cables call for a 250,000 cm., three-conductor paper insulated, lead-covered cable, each conductor made of 37 strands of copper wire, with a combined sectional area of 250,000 cm., when each wire is laid out straight. The paper insulation is 5/32 inch around each conductor and 5/32 inch for the outside insulating jacket. The lead covering is 4/32 inch in thickness, and contains from 2 per cent to 3 per cent tin. The open spaces between conductors are filled with a dry jute filler, saturated with an insulating compound to exclude air or moisture. The test pressure between copper conductors and copper conductors and lead jacket is 15,000 volts alternating current for one hour, an insulating resistance in subways, including joints of 300 megohms per mile at 60 degs. F. The insulation resistance of each high-tension feeder is tested every week, as required by the rules of the Subway Company. In addition

to these periodic tests, electrostatic volt meters and ground detectors of the General Electric Company type are installed at the Waterside station, and at the several rotary converter sub-stations, furnishing instantaneous indication of any considerable lowering of the insulation of the system.

In Fig. 37 is shown a diagram of the present layout of high-tension feeders. The heavy lines representing the routes followed, the number of feeders in each route is not shown.

The general principle followed in planning high-tension feeders has been to run direct lines from the Waterside station to each sub-station, but in some cases feeders are looped into an intermedite sub-station along the route. In such cases the looped feeder is connected to a high-tension tie feeder panel provided with suitable connection so that the tie feeder may also, if desired, be connected to the local station feeder panels which feed the rotary converters at the station, thus providing an additional feeder in case of an emergency.

A feature of the high-tension feeder scheme is the general tie feeder connecting all stations and sub-stations from Duane to 124th Street. Along its route the general tie feeder is either looped in or teed in, to the sub-stations, and furnishes to them a valuable auxiliary feeder, which can be used to transmit high-tension current between sub-stations, independently of the Waterside station, as it has been extensively used in the past when inverted rotaries have been operated to supply current at night from the downtown steam generating stations to the rotary converter sub-stations uptown.

SUB-STATIONS.

The company has now in operation 16 rotary converter sub-stations on Manhattan Island, as shown on the map in Fig. 5. In several of these sub-stations the rotary converters are operated in connection with existing steam plants; in others rotary converters only are operated. In all of the latter, as well as in several of the former, there is one or more storage batteries, of which mention will be made later.

A brief description of the several stations will be given later, but to illustrate the character of service in the different districts, it may be stated that the section of the city below Eighth Street is exclusively a business section, and has the characteristic load curve of a day load rising abruptly in the morning hours before 9 A. M., and continuing with a practical uniform load until about 5 P. M., with the exception of a heavy dip at the noon time, when the motor load goes off the system and a sharp evening peak between 4.30 and 5.30 o'clock in the winter months, when the motor and lighting loads overlap. After 5.30 o'clock the load falls off very abruptly to a small fraction of the peak load. The district between Eighth Street and Fifty-ninth Street is largely of a commercial character, and including retail stores, hotels, theaters and clubs, as well as some residences. The section above Fifty-ninth Street is essentially of a residential character, with a load curve having a peak lasting from 3 to 4 hours.



FIG. 39.—ELECTRICALLY OPERATED ALTERNATING-CURRENT SWITCHES.

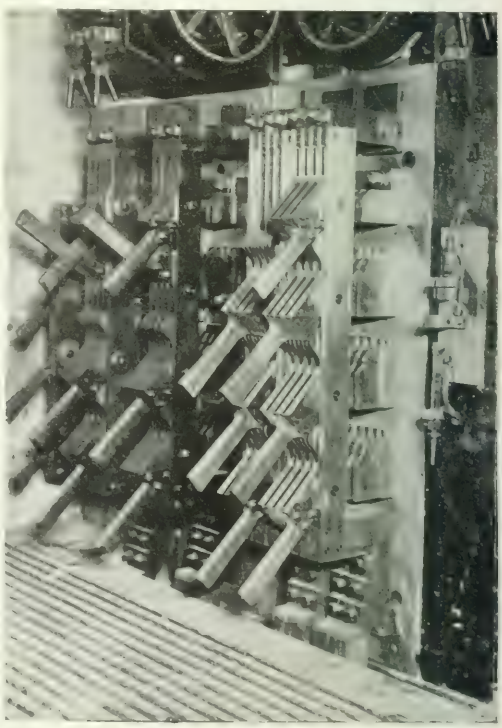


FIG. 40.—OUTSIDE POLE POSITIVE BUS SELECTOR SWITCH.

The three city districts so described are for operating convenience, classified as the first, second and third district, respectively. The development of the company's business has progressed from the first district to the uptown districts in regular succession, and while at the present time the New York Edison direct-current, low-tension mains do not extend above 130th Street, the company is continually extending its territory northward to meet the rapid development of the city in the northern section of Manhattan Island. Fig. 37 shows the location of all distributing stations of the New York Edison Company.

In the first district there are five low-tension distributing stations —in the second district seven (including Waterside), and in the third district four (exclusive of the Eightieth Street station, which generates high-tension current only).

North of the Harlem River the Rider Avenue station supplies the Borough of the Bronx with two-phase alternating current and direct-current series arcs. This station is connected with a high-tension three-phase circuit to the Waterside station and a high-tension transmission line connects with Riverdale and the Yonkers Electric Light Company.

Of the existing generating stations only the Duane, Twelfth and Twenty-sixth Street stations will be operated as combined steam and rotary sub-stations, their existing steam plants being utilized as generating stations supplementary to the Waterside station during the period of heavy loads in the winter months.

All the other stations will finally be exclusively rotary converter sub-stations. The arrangement of the rotary converters, as installed in conjunction with the original steam plant, had to conform with the existing conditions of the building and the uses for which it was originally designed. In the new sub-stations, however, the buildings have been designed with the most suitable arrangement for this particular service. The sub-stations of the company are built on one of three plans, shown in the full-page illustration (Fig. 41), of which the 83d Street and Elm Street stations represent the first type, Horatio Street, 84th Street, 121st Street and 124th Street the sec-



FIG. 41.—THE NEW YORK EDISON COMPANY'S SUB-STATIONS.

1.—E. 83d Street Sub-Station. 2.—W. 26th Street Annex. 3.—W. 84th Street Sub-Station. 4.—500-kw. G. E. Rotary. 5.—Group of Three 200-kw Transformers and Regulator Platform. 6.—High Tension Feeder Panels. 7.—Low Tension Positive Switchboard. 8.—End Cell Switches and Battery Room.

ond, and the Twenty-sixth Street rotary converter annex—occupied also by the company's local offices—the latest type. In the sub-stations of the first group the ground floor is the main operating room containing the rotary converters and static transformers. The high-tension feeder panels and the high-tension rotary converter panels are mounted on a gallery at the height of the first mezzanine floor and running lengthwise the whole length of the station above the static transformers. The floor above the operating room is occupied by a storage battery, and above this again are two sets of comfortable and well-equipped living apartments, occupied by men of the company's operating force.

In the plan of the second type of sub-station the main floor, raised slightly above the ground, constitutes the operating room, but the low-tension rotary and feeder switchboard is placed lengthwise on both side of the station on the front of the main floor and the high-tension apparatus is mounted on the mezzanine floor. In some of these stations the battery is on the floor above the operating room, in others the battery is located in the basement, the top floor being used for living apartments by members of the operating force.

In the new Twenty-sixth Street annex all the rotary equipment is erected in the basement of the building, and the low-tension and high-tension switchboards are located on the two mezzanine floors in the rear of the building. The floor above is occupied by the company's offices for the second district.

The typical equipment of a rotary converter sub-station is:

1. High-tension switchboard for high-tension feeders and rotary converter machine panels.
2. Air-blast static transformers.
3. Low-tension, alternating-current switchboard for the operating of rotary converters.
4. Rotary converter I. R. T. regulators.
5. Rotary converters.
6. Low-tension direct-current switchboard and busses, with instruments and synchronizers.
7. Storage battery and booster set.
8. Compensator for balancing loads on three-wire system.
9. Low-tension feeder panels.

In Fig. 42 is given a diagram of the connection of this apparatus.

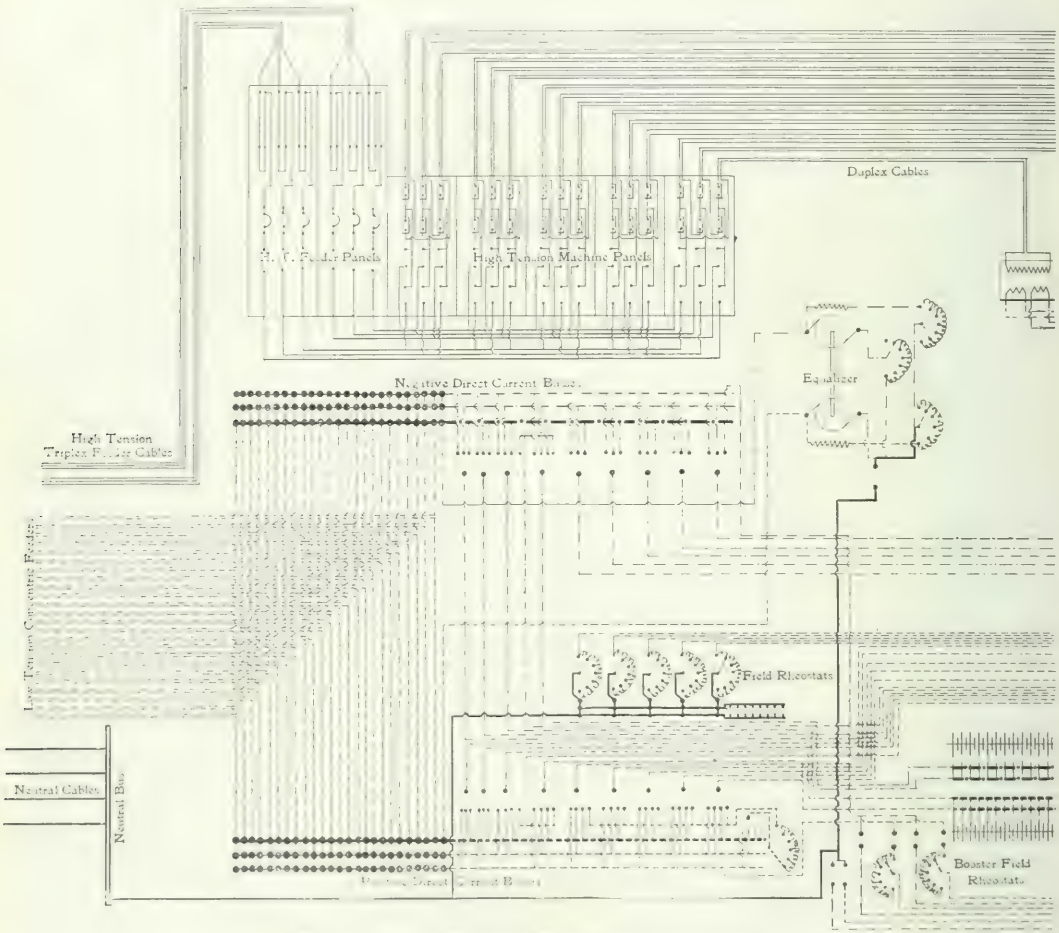


FIG. 42.—GENERAL DIAGRAM OF SUB-STATION CONNECTIONS.

The course of the current through one of the sub-stations is as follows: Coming into the station on the high-tension, three-conductor cable feeder as 3-phase, 6600-volt, 25-cycle alternating current, it passes through the high-tension feeder panels equipped with suitable switches, circuit breakers and transfer cable arrangements, with connections to the busses of the high-tension machine panels. From the high-tension machine panels connections are made by duplex cables to the high-tension primaries of the static transformers, the secondaries are connected through alternating current switches to an I. R. T. regulator and then to the alternating current collector rings of the rotary converter. The direct-current terminals of the rotary converter are wired to the positive and negative switches of the ma-

chine, which can be connected to three sets of bus-bars supplying current to the low-tension direct-current feeders. The rotary converters are all built for a normal potential of 270 volts, which can be raised or lowered 30 volts by the I. R. T. regulators, and the unbalancing of the station load between the two sides of the system is supplied by the storage battery and a compensator.

HIGH-TENSION PANELS.

The three-conductor high-tension feeder cables are brought from the subway ducts to the high-tension gallery and the feeder ends spliced and equipped with cable terminals are connected to the high-tension feeder panel equipped with single blade quick break snap switches mounted on marble slabs and insulated by porcelain insulators and bushings. Receptacles and jumpers located above are used to make connections between different high-tension feeder panels by means of plugs and transfer cables. A set of expulsion air circuit breakers are located at the top, and a set of reverse current relays, overload and time limit relays at the bottom of the panels. The series and potential transformers for the instruments and relays are mounted on the back of the panel. The machine panels are furnished with two sets of bus-bars and a double set of knife blade bus-selector switches, enabling each machine to be connected to either bus-bar, each fed by a high-tension feeder, as above explained. The high-tension machine panels have two sets of knife blade, quick-break bus-selector switches with barriers and six fuse blocks of the expulsion type. The high-tension panels were supplied by the General Electric Company.

STATIC TRANSFORMERS.

The static transformers are all of the air blast type and are in sets of 3-200 and 3-400 kilowatts respectively for 500 and 1000-kw rotary converters. They are mounted on a platform constituting the air duct for ventilation under an air pressure of ½ to ¾ ounce supplied by electric blowers installed at one or both ends of the platform. The primary and secondary transformers are wound for a ratio of transformation of 6300 to 170 volts, but other ratios may be obtained by connecting to intermediate taps to compensate for drop on feeders of different lengths and to facilitate adjustment of A. C. voltage to D. C. voltage required. In the later transformers a thermometer is mounted in a casing between transformer coils to give temperature indications. The transformers are designed to operate at 25 per cent. overload for 3 hours after a 24 hours' full load run, or 50 per cent. overload for 1 one hour without undue heating. The efficiency of the transformers is 97½ per cent for the 200-kw transformer and 98 per cent for the 400-kw, with a regulation of 1¼ per cent and 1 per cent. They are wound with double secondary winding, connected in a double independent delta, the middle points of which are connected to the A. C. electrically operated switches. The static transformers were furnished by the General Electric Company and by the Westinghouse Company.

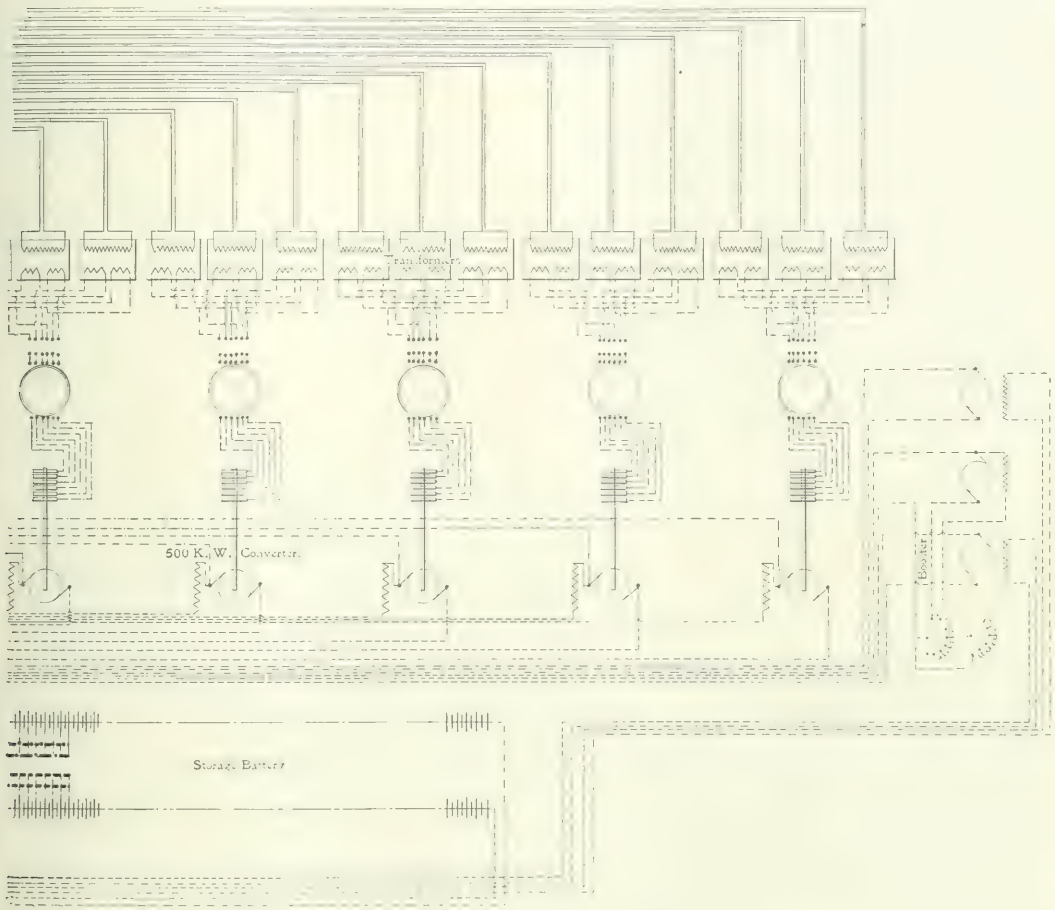


FIG. 42a.—GENERAL DIAGRAM OF SUB-STATION CONNECTIONS.

LOW-TENSION A. C. SWITCHBOARDS.

The use of electrically-operated switches mounted on the transformer platforms and controlled by small S. P. S. T. switches on

the operating board, results in shortening of cables as well as space on the operating switchboard. Fig. 39 gives a view of a set of E. O. switches. On the same panels are also mounted synchronizing and pilot lamps used as indicators.

I. R. T. REGULATORS.

The secondaries of the induction regulators are connected in series between the E. O. switches and the A. C. collector rings of the

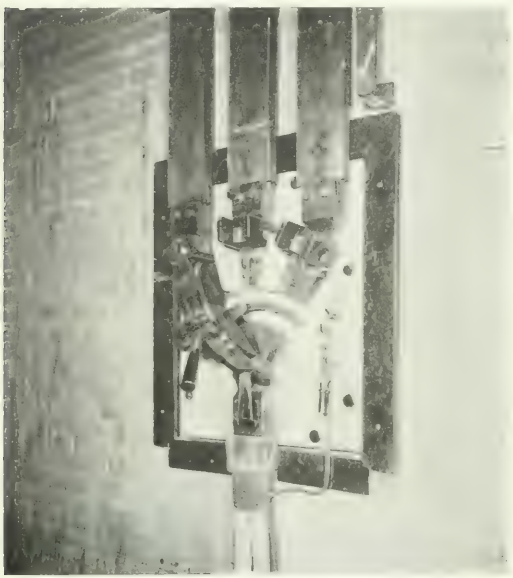
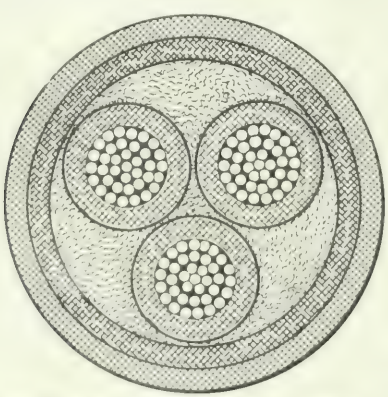


FIG. 43.—OUTSIDE POLE NEGATIVE BUS SELECTOR SWITCH.

rotary. The potential or primary windings of the regulators are connected across the secondaries. The primary windings are wound on the rotor of the regulator, which can be turned through a fixed angle in either direction by a small D. C. motor or induction motor controlled from the operating switchboard. The I. R. T. regulators of General Electric and Westinghouse make have 65-kw capacity for 500-kw rotaries and 130-kw capacity for the 1000-kw rotaries. These regulators are of the air blast type and are installed on the same platform with the static transformers, as shown in Cut 5 of Fig. 41.

ROTARIES.

The rotaries are six-phase and of two sizes, 1000 and 500 kilowatt rated capacity. The 1000-kw rotaries are 270-volt D.C., 187½ r.p.m.; the



[illegible] THREE-WAY HIGH TENSION CABLE.

500-kw rotaries are either six-phase, 270 volts D. C., 375 r. p. m., or six-phase, 300 volts D. C., 375 r. p. m. The latter type are equipped with 130-kw I. R. T. regulators, by means of which the rotary can be operated between the range of 240 to 360-volt D. C., the higher voltage being required in the uptown sub-stations owing to the length of L. T. feeders. The overload capacity of the rotaries is liberal, they are designed to carry 25 per cent overload for three hours after carrying continuously full rated load or 50 per cent overload for one hour.

The efficiency of the rotary converters is high. In the case of 1000-kw converters an efficiency of 96¾ per cent, and in the 500-kw 95¾ per cent has been obtained. The rotary converters were supplied by the General Electric Company and the Westinghouse Company.

THE L. T. D. C. SWITCHBOARD.

The D. C. switchboards of all New York Edison stations are divided into two independent sections for the positive and negative poles, the negative side being used for connecting the machines to the busses. The regulation and switching is usually done from the positive switchboard which is provided with a complete equipment of instruments. The negative switches used as selectors have three poles, one for each set of bus-bars. To economize space and avoid long runs of cables in some sub-stations, three-pole selector switches of the laminated toggle Brush type are used, having an arm pivoted at the center, and having a parallel motion to the base of the switch, as shown in Fig. 43. In other sub-stations the negative cable connections of the rotary converters are brought to the negative switchboard proper, where they make connection to a three-pole switch of the type shown in Fig. 40, where three switches, mounted on a heavy cast copper frame, alive from the machine, enable one to make connection to either of the three bus-bars on the back of the switchboard. These switches are only 12 inches, or 18 inches wide, respectively, for the 500 and 1000-kw rotaries, and reduce the width of the negative machine panel to a minimum.

An outside pole field switch, mounted on the same panel with the negative bus-selector switch, connects to the main bus from which all rotaries are excited.

The switchboard connections of the positive side of the rotary converter are made to a three-pole selector switch similar to the one last described and shown in Fig. 40. In this case, however, there are four switches mounted, the top one being a smaller starting switch for starting the rotary from the D. C. side.

This switch makes connection with a starting bus provided with a starting rheostat and fuse, and a three-bus starting selector switch mounted at one end of the switchboard. Above the machine bus-selector switch is mounted a double dial rheostat frame holding edgewise rheostat dials for two rotary converters. On the same frame are mounted two small S. P. S. T. switches operating the E. O. switches on the A. C. panels previously described, and a small double pole double throw switch operating the motor controlling the position of the I. R. T. regulator. Above the rheostat dials are the indicating instruments, consisting of one A. C. hot wire round type Stanley ammeter, one synchronizing lamp, one direct-current Van Vleck edgewise Weston ammeter and one hot wire alternating-current Stanley voltmeter for each station, this latter instrument being supplied with a sliding contact switch, by means of which it can be connected to any machine.

Wireless Telegraphy.

In a lecture recently delivered before the Royal Institution, London, Professor Fleming considered Marconi's recent Newfoundland experiments with reference to the curvature of the earth. He said that Marconi's transatlantic waves were about 1000 ft. long, which was not very small compared with the obstacles they had to encounter; that is, the hill of water formed by the curvature of the earth, which he calculated was about 110 miles above a straight line joining the Lizard and Newfoundland. The bending required, therefore, was not great compared with the distance, being comparable to a wave one-hundredth of an inch in length bending round an obstacle one-fifth of an inch high. It is an interesting question whether it was conceivably possible to send an electric wave around the world. He did not presume to answer the question, but he suggested that it was an interesting possibility. He had already shown that water is opaque to the Hertzian waves, and he believed it likely that the upper strata of air, being highly rarefied, were also opaque to these waves. He imagined that by internal reflection between these two opacities a beam of rays could always, as it were, be confined between them, and so, provided the impulse was strong enough, it could be made to pass any distance sandwiched between them independently of the curvature of the earth.

Electrical Equipment of the Manhattan Elevated Railway — II.

LAST week a formal run was made with the first train, equipped with the General Electric train control system, and consisting of six cars. These six-car trains will be run during rush hours in place of the five-car trains, thus increasing the carrying capacity of these lines at the rush hours 20 per cent. Each six-car train will consist of four motor cars and two trailers, each of the four motor cars being equipped with two motors of General Electric manufacture, which will easily develop, when starting the train, 300 horse-power, the total weight of motors for each train being 35,000 lbs. and the total horse-power per train 1200. One thousand eight hundred of the new motors have been ordered, aggregating in weight about 75,000 tons and 270,000 horse-power. These motors take the place of about 300 locomotives. A distinguished party participated in the trip and visited the power plant, going from the road to it in New York Electric Transportation stages. In our next issue we shall discuss the train equipment.

The current generated in the central power plant is to be distributed over the entire system of the Manhattan Railway, including 37 miles of road in the Boroughs of Manhattan and the Bronx. The potential at which it leaves the power plant is 11,000 volts, and eight sub-stations have been erected at convenient points along the lines of the road where transforming apparatus is installed to reduce the voltage to proper pressure for use in connection with rotary converters. The uniformity of plans and methods in the Manhattan system is especially noticeable in the sub-stations. The general arrangement of these and the distribution of apparatus are similar, thus enabling an operator familiar with one station to perform duty at another when required without any special training. Fig. 2 is an interior view of sub-station No. 7, located at Third Avenue and Ninety-ninth Street.

The switching arrangements in the sub-stations are similar to those in the power house. An idea of this arrangement may be obtained from Fig. 3, though this actually represents a section of a power-house board. The similar sub-station board is flanked on each side by direct-current panels, and the illustration shows only the alternating current panels and the feeder bench board. On a panel rising above the back of the bench-board are located the alternating-current instruments. Each rotary has an incoming wattmeter with a scale reading up to 300 kilowatts, a power factor meter and a wattmeter, all of which instruments are of the end-on type. On the bench-board there is for each incoming feeder and rotary converter a controlling switch with visual signals, the signals being operated automatically on the face of the bench-board. By manipulating these dummy switches, and by means of a low-tension direct-current controlling circuit, the main switches are operated, and the visual signals indicate the completion of an operation and the state of the circuit.



FIG. 2.—SECOND AVENUE LINE, SHOWING THIRD RAIL.

The rotary converters are arranged in two parallel rows, and the transformers are located in groups of three upon galleries along the sides. There are 26 rotaries and 78 transformers in these eight sub-stations. Each rotary receives current from a group of three 550-kw step-down transformers, connected in delta, at a potential approximately 390 volts. The sub-stations are located at unequal distances from the power station, and as all of the stations are to be supplied with power from alternators operated in parallel, the effective potentials delivered by the high-potential distributing cables to the several sub-stations will differ. In order that the potential of the direct-current delivered by the rotary converters shall be equal, provision for the adjustment of the ratio of transformation of the step-down transformers is made by means of loops brought out from the primary windings.



FIG. 1.—FIRST ELECTRIC TRAIN ON SECOND AVENUE LINE.

The transformers, one of which is shown in Fig. 7, are of the air-cooled Westinghouse type. Motor-driven blowers are installed in each sub-station for supplying the necessary air. The guaranteed efficiency of the transformers for full load is 97.75 per cent. The overload rating of the transformers is proportioned to those of the rotary converters.

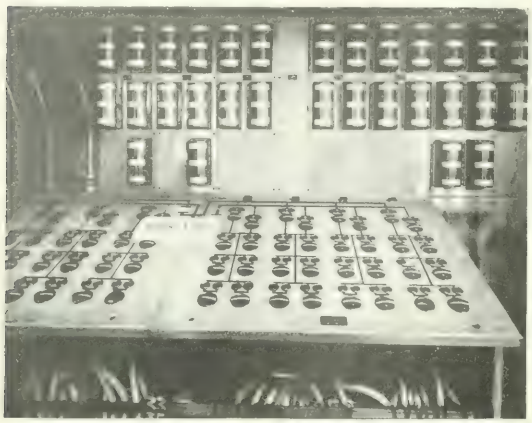


FIG. 3.—ALTERNATING-CURRENT PANEL AND FEEDER BENCH BOARD.

The rotary converters, one of which is shown in Fig 4, are larger than any that have heretofore been constructed, having a nominal rating of 1500 kw and maximum capacity of 2250 kw, or 3000 hp. Each converter is a self-contained unit, the two bearings and the lower half of the field frame being mounted on a common base. The field frame is divided in a horizontal plane to permit access to the windings. The machine has 12 poles, and when supplied with an alternating current of 25 cycles per second will operate at a speed of 250 r. p. m. The field is compound wound, the shunt winding being arranged for self-excitation. The output of the converter is delivered at a normal potential of 625 volts. The guaranteed efficiency at full load is 95.75 per cent. The armature is of the slotted

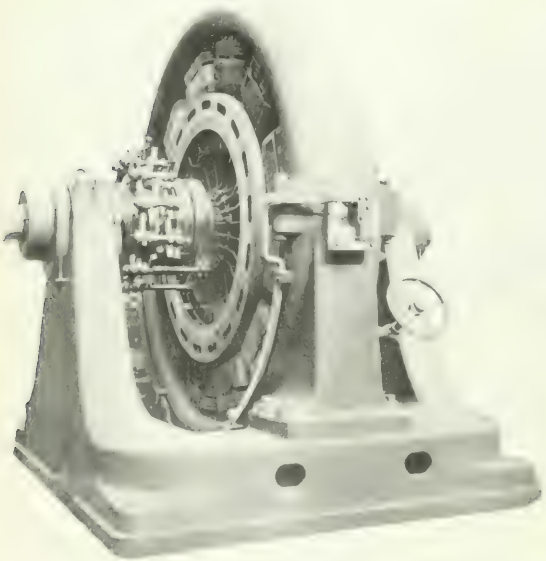


FIG. 4.—1500-KW ROTARY CONVERTER.

drum type, and the poles are built of laminated steel, forced upon a cast-iron spider. The armature winding consists of strap wound coils formed and insulated before being placed in the slots in which they are held by retaining wedges of hard fiber. The winding is of the parallel type, forming 12 circuits, and is cross-connected by balancing rings. The commutators are built of bars of hard copper insulated from each other with mica. The number of bars is such that with a potential of 625 volts across the direct-current terminals the average difference of potential between two bars will not exceed 12 volts. The copper brushes are held in brush-holders of the sliding-shunt type.

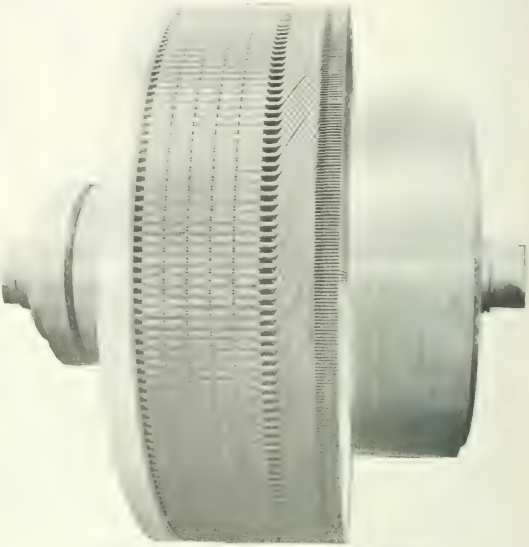


FIG. 5.—ARMATURE OF ROTARY CONVERTER.

The collector to which the alternating currents are delivered from the step-down transformers is of the open type, and is clearly shown, together with other features of this side of the machine in Fig. 4. The armature is shown in Fig. 5.

The field frame is of cast iron, and the pole pieces are of laminated steel. The faces of the latter are beveled at the edges to permit of the use of copper shields. The series field is designed to assist the shunt as the load comes on the rotary converter, and is sufficient to compound the latter from 575 volts at no load to 625 volts full load. The series winding consists of copper, strap-wound on edges. The wave form of these converters is practically the same as that of the alternators. The converters are guaranteed to stand an overload of 100 per cent without "hunting," and may be overloaded to several times the normal full load without falling out of step. In the construction of these converters the flywheel effect has been made relatively small, and the effect of the copper shields powerful enough to have the controlling effect upon the armatures of the converters. The total weight of each converter is 105,000 lbs., the height 13½ ft., and the floor space occupied 13 ft. by 10 ft.

The converters are started by direct current. A motor-generator set (Fig. 6) is installed in each sub-station for furnishing the current for that purpose. The method of starting by direct current derived from these starting sets, rather than by direct current taken



FIG. 6.—MOTOR GENERATOR.

from the main bus-bars of the sub-station, was determined upon to avoid undue magnetic and electrical strains in the converter, such as may easily result from a slight mistake of the operator, for example, in closing the synchronizing switches when the machines are not exactly in step.

The plans of the Manhattan Company provide for handling 200,000,000 passengers during the next year, and the new form of equipment will enable them to put on many more cars and run their trains oftener and at higher speed than could be done with steam locomotives. Another advantage is in eliminating smoke, dirt, cinders and the noise that are always attendant upon the operating of steam engines. Moreover, the company will enjoy many advantages, not the least of which will be the increased economy in operating expenses.

With the new equipment it is estimated that 2,000,000 passengers can be carried in a day. This represents the movement of over two hundred trains daily, requirnig an expenditure of energy varying from 5000 hp at the hours of minimum load to 60,000 hp, at the hours of maximum load.

To the engineer and the railroad expert the electrical equipment of the Manhattan Railway presents many points for consideration and study. The magnitude of the undertaking and the character of the work performed cannot fail to command universal attention. The fact that the conservative Manhattan management had sufficient confidence in the electrical equipment to substitute it for steam locomotives upon all its lines indicates a marked change in the attitude of the company toward electricity. This change of itself is convincing proof that great advancement has been made, and that the Manhattan management believes that electrical engineering for heavy railroad work has at last passed the experimental stage. In this position it has been fully sustained. The equipment of the immense power station at Seventy-fourth Street has been accomplished without the least friction or drawback, and the great generators, although

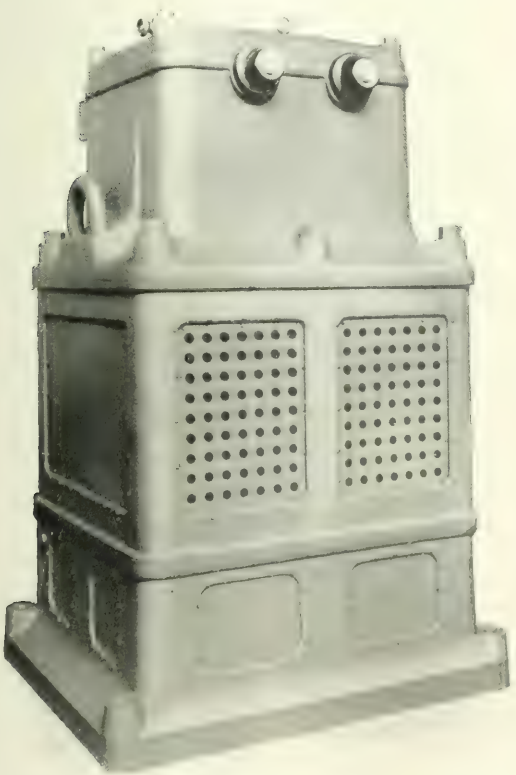


FIG. 7.—550 [illegible]

the first of such magnitude ever attempted, were assembled, erected and operated without the slightest hitch, and immediately pressed into commercial service. The designing and building of these machines, it may be added, marks an important and distinctive advancement in electrical engineering, as did the construction of the original Niagara generators made by the same manufacturing company.

Some Pointers on Induction Motors.

By Dr. Louis Bell.

At the present time the induction motor needs no defence of its general properties, for it has amply proved its capabilities. To a certain extent, however, it does need to be saved from its friends, and brought to the point where the public will look at it as at any other motor and not regard it as in any way a freak surcharged with occult properties. The writer has always rather "had it in for" the rotary pole treatment of the induction motor, not because it did not substantially represent the facts, but merely by reason of its putting a very unfamiliar face on a motor that is strictly comparable with other motors.

The man who uses an electric motor does not worry himself over the permeability of the iron, the magnetic density in the armature teeth or the specific inductive capacity of the insulation. On the contrary, he does not want to be bored with such technical details, but much desires a good, strong, efficient machine that will do his work well and steadily with a minimum of attention and expense. Such a machine he can find in the induction motor when polyphase current is available, but the average man does not know it in this simple fashion, and judges induction motors by canons that are altogether inscrutable. In the early days of induction motors there was, I am sorry to say, a tendency on the part of many of those who sold them to throw a veil of mystery about them, and to convey the idea that some mysterious hocus-pocus in virtue of a magnetic field whisking around like a kitten chasing her tail, induction motors would do strange and wonderful things in an occult and incomprehensible fashion. Like most false impressions, this has eventually led to trouble, and the development of induction motors has thereby suffered.

For example, take the question of starting current, an objection so often raised to induction motors. No rational man would expect to put an ordinary 110-volt, 10-hp shunt motor in his shop and then start it successfully by simply closing the main switch. He realizes perfectly well that he would probably blow the fuses or possibly burn out the motor, and, at all events, would get a tremendous current through it, and, so like a rational being, he puts in a starting box. But if an induction motor is in question he eyes it suspiciously, and hints that he understands that it takes an enormous starting current, and will knock out his lights when it is thrown on. If an auto converter is suggested as a means of easy starting, he intimates that it is a pretty mean sort of a motor that compels him to buy and operate that thing, and that if induction motors were any good they would not require it. A starting resistance in the armature circuit he regards as a thing of evil put there to make the best of a bad matter. The last thing that occurs to him is that if a motor did not permit a considerable rush of current when thrown on the circuit at full voltage, it would be a very bad motor indeed as regards efficiency. I have sometimes threatened to make and publish the current curve of a shunt motor trying to start under a load at full voltage, merely to impress this fundamental fact.

In the matter of variation of speed under load the case against popular superstitions is even more amusing. One of the commonest demands on the part of users of induction motors, and smart little engineers who have learned the equations of the rotary field, is that an induction motor shall hold its speed within, say, 1½ per cent from no load to full load. Now, this is not an impossible requirement, and has many times been met, but what would happen if a demand were made for a continuous current motor to fill this specification? The proposition would either be met by a more or less blunt refusal to supply the thing or by a price for special design that would be hair-raising. Moreover, such a requirement is in most cases simply foolish, inasmuch as only very rarely is such a regulation of the slightest importance. It can be provided more easily in an induction motor than in any other, but it always implies an extraordinary effort to get as much copper as possible upon the armature even at the expense of considerable inconvenience elsewhere. The customer may imagine that with such a specification he will obtain a motor of phenomenal efficiency, since in both shunt and induction motors the fall in speed under load measures the loss in the armature; but unless price is no object he may rest assured that when a motor for any kind of current is fattened with respect to one property it will be pinched in others, and he will get about what he is willing to pay for, and no more. In point of fact, no requirement placed upon a designer produces more trouble and expense with a less valuable result to show

for it than a very close speed regulation. Hence while the induction motor actually can give wonderful results in this direction, extreme requirements hinder the production of good standard all-round machines at a moderate cost, and should never be made unless actually needed.

Another common exhibition of ignorance is in a demand for motors of extraordinarily low speed. Whatever the character of the motor, low speeds means a larger and costlier motor than would serve at higher speed, and induction motors form no exception to the rule. In fact, they are somewhat more troublesome to design for very low speed than are continuous current motors, since they require an exaggerated multipolar construction that makes it hard to retain a good power factor. In certain cases low-speed motors are highly desirable, but they should not be specified to carry out some fine-drawn theory, or for the fun of the thing, unless one is willing to pay for them.

If one looks over the list of standard motors for continuous currents as produced by any manufacturer he will very quickly perceive, by an examination of dimensions and weights, that a low-speed motor is generally merely the next larger size of standard speed motor differently wound. In the case of induction motors such an arrangement is not feasible, and the result is unusually an extreme multipolar design that demands a phenomenally small air-gap if the power factor is to be kept up. The only thoroughly bad induction motors, which the writer has ever of late years examined have been machines hoo-dood, so to speak, by the attempt to get abnormally low speeds in comparatively small motors. A similar attempt in continuous-current motors leads to costly machines of low efficiency, but for some occult reason the average man swallows a low, real efficiency in continuous-current motors without making any fuss, but kicks like a mule at low apparent efficiency in an indication motor.

A high-power factor is very desirable in an induction motor, and should be helped and not hindered whenever possible. Within reasonable limits it is comparatively easy to obtain unless some extraordinary demand for unusual properties in other respects comes in the way. But it is as a matter of design interconnected with all the other features of the motor, and can be crowded out if pushed too hard.

In some respects induction motor design is easy. The absence of the commutator and the elimination of all questions of sparking is an enormous advantage in modifying the machine to suit various requirements, but all design is a series of compromises, and when the property is exaggerated some of the others are necessarily curtailed.

When a freak specification calls for a 10-hp motor of 360 r. p. m at 60 cycles, to vary 2 per cent in speed between no load and a 50 per cent overload, and to have a power factor of not less than .90 at full load, the designer has his work cut out for him, and if he comes anywhere near to filling the requirements, the resulting motor will not be one, the building of which should be encouraged in point of quality or price.

The loudest objection raised against induction motors at the present time is their cost. Built as they are of piles of high-grade laminated iron, they need all that can be gained by the abolition of the commutator, and the simplification of the armature windings to come out even with continuous-current machines, particularly since their field winding is difficult.

But the largest factor in keeping up their price to-day is neither material nor intrinsic labor cost, nor monopoly, but the inherent foolishness of those who continually howl for all sorts of outrageous special designs—designs which imply great added expense. Special machines are sometimes necessary, and can be readily obtained in induction motors, as elsewhere, but I know of no branch of electrical industry that has been so infected by a mania for freaks.

Ordinary continuous-current motors have settled down into fairly regular lines of manufacture, and when anything far outside these lines is required it can be obtained, but as a special machine at a considerably increased cost. The same is true in general machine production. One can buy standard lathes, for example, to meet all ordinary requirements at reasonable prices. But if some long-haired and fussy old personage insists on having one a little different from anything that the mind of man has yet devised, he must have a long bank account. I have had occasion from time to time to get many quotations on special work, and I am bound to say that electrical manufacturers are generally quite less nuts about it and add less cost than those in most other lines.

For the good of the art special machines should be used only when they confer some really material advantage. It is hard to see why the demand for alternating motors should be more diverse than that for continuous-current motors, but it certainly happens to be, and while this condition remains manufacture cannot settle down to the steady lines that ensure low art of production. Users of motors, and engineers as well, ought to realize that specialization is cheap only on a very large scale, that is, when special and regular work merge into each other. And in induction motors this condition is far from being realized, hence the average costs are undeniably high when judged by comparison with standardized continuous-current motors.

Stereoscopic Rontgen Ray Pictures.

By Frank C. Perkins

THE interesting Röntgen ray stereoscopic system of Mr. E. W. Caldwell, described in your issue of Dec. 21, is an indication of the great progress made in recent years in stereoscopic methods for locating foreign substances buried in the tissues of bodies, and a review of some of these methods may be of interest.

In an article in the *Electrical Engineer*, in 1896, Professor Elihu Thomson pointed out the desirability of the stereoscopic method in Röntgen ray surgical examinations. M. Chabaud described an apparatus for stereoscopic radiography in a paper read before the Societe Francaise de Physique in 1898, whereby a foreign substance



FIG. 1.—RONTGEN RAY PICTURE.

may be located in the human body, and its distance from any given point of the skeleton definitely determined. He employs a vacuum tube which gives very rapid records, and utilizes a stand which enables the operator to take two radiographs of the same object from two different but precisely defined foci, and then after development they are examined in a special stereoscopic apparatus.

The accompanying illustration is one of a pair of stereoscopic radiographs taken by Dr. G. P. Girdwood, of McGill College, and consulting surgeon to the Montreal general hospital. It will be noted that not only the bones are shown to perfection, but the skin as well. The pair of prints must be viewed with a reflecting stereoscope, as devised by Wheatstone and described in "The Scientific Papers of Sir Charles Wheatstone," published by the Physical Society of London. This apparatus can be made by putting two mirrors at right angles, as shown in Fig. 2, and then holding the pictures upright and facing each mirror, the observer's nose being at the angle of the two mirrors; then by looking straight into the two mirrors

one picture will be seen with each eye, and if they are correctly placed the hand will be seen as it was taken, with the back to the observer. If, however, the right eye picture is put before the left eye and the left eye picture before the right, the appearance will be as if looking from the other side.

Until recently it was extremely difficult to locate exactly metallic substances, such as bullets, needles, etc., in the hand, foot or other parts of the body, the relative depth being particularly hard to determine. The only evidence at hand was the sharpness of the



FIG. 2.—ARRANGEMENT OF APPARATUS.

shadow. The sharper the outline of the shadow the nearer the object was supposed to be to the surface, but this was not very satisfactory. By taking the intersection of lines from two radiographs taken at right angles, better results were obtained, but it was not absolutely certain that the rays which eminated from the tube terminal were in direct lines at right angles to one another. Cross lines have also been used above the part to be radiographed, the shadows of the wires at right angles indicating the relative position of the foreign substance. In taking the pictures the tube is moved a distance of 2½ inches to the right or left of the original position between the taking of the two radiographs, the subject remaining in the same place. The tube terminal is placed in each case so that a normal from the surface would strike the same spot; the pictures will then present exactly the same differences as the images in the two eyes, the result being a true stereoscopic effect, every part of the picture being seen in proper relation to surrounding objects. Following is a description of the method by Dr. Girdwood:

"In carrying out this idea, a piece of lead was fastened with a little gum on the back of the left hand over the metacarpal bone of the index finger. A second piece was placed and fastened also with gummed paper in the palm of the same hand opposite to the metacarpal bone of the ring finger, and the palm placed down on a plate wrapped in yellow paper in the usual way. The plate was put in the bottom of a cardboard box without a lid, and with a slit cut in one side large enough to admit the wrist, a line of pencil marked on the wrist, so as to put the hand back in the same position and a pencil outline of the hand made on the yellow paper around the fingers. Then a plumb bob was suspended over the center of the hand, and the Crookes tube arranged so that the center of the platinum plate should be 1¼ inches to the right of the pendulum string, and 12 inches from the plate, and the tube was rotated in the clip until a normal from the platinum distributor should strike in the same point as the point of the pendulum bob. With the pendulum moved out of the way and one picture taken, another plate was placed in the same yellow paper, the pendulum bob replaced, and the tube so arranged that the center of the platinum plate was 1¼ inches to the left of the plumb bob line, and so inclined that the normal thereto would strike the same spot as before, and a second picture taken. The pictures developed in the usual way gave two full size, indeed, slightly magnified skiagraphs of my left hand, and when cut in pieces small enough to mount as stereoscopic pictures at once gave the true stereoscopic effect."

Dr. James Mackenzie Davidson gave an account in a British publication of his process for making stereoscopic radiographs, which differs from that of Dr. Girdwood, in not having the normals of the platinum distributor in the ray tube converge in the two positions. These are taken as though seen with two eyes, whose axes are parallel instead of converging on a point 12 inches distant, representing the appearance presented to each eye, when the axis of vision is convergent.

Dr. Davidson used the Wheatstone stereoscope for combining the stereoscopic pictures to get the perspective effect. He also produced stereoscopic effects with the stereopticon, two of these pictures being projected by the lantern alternately upon the screen, with great rapidity, an operating shutter being used by the observer, which permitted only one eye to see the screen at a time. The pictures were in this way made to stand out in bold relief, showing depth and the true space relations of the objects. He also produced a stereo-fluoroscopic apparatus, using a stationary fluorescent screen, having two sight holes and an operating shutter, together with two Röntgen ray tubes, and one or two induction coils. When the apparatus was arranged with a single induction coil, a motor-driven switch was used to alternately excite first one and then the other tube, the shutter operating synchronously with the excitation of the two Röntgen ray tubes.

The interesting Caldwell stereo-fluoroscopic system differs from the above in employing a small double-focus tube having anticathodes separated by 2½ or 3 inches. The fluoroscope has an alternating-current induction-motor driven rotating shutter, which is operated by current from a rotary reversing interrupter, which breaks the current and reverses its direction through the coil twice in every revolution. A small rotary converter is used operating on a direct-current lighting circuit, and delivers two-phase or three-phase alternating currents from its collector rings for operating the shutter.

The fluoroscope shutter may also be operated on an alternating lighting circuit of 60 periods, in which case a speed of 1200 revolutions is obtained, and there are six times this number of shadows on the fluorescent screen, or 7200, one-half of which are seen by one eye and the other half, or 3600 shadow pictures, by the other eye, which practically is continuous vision. The object is thus brought out in relief.

The first stereoscopic radiographs were undoubtedly made by Elihu Thomson in 1896, and he has stated that at this time a number of such pictures were mounted for use with the stereoscope, for locating the position of bones in fractures with entire success.

The Debt of Electrical Engineering to C. E. L. Brown—VII.

BY B. A. BEHREND.

WE call attention to Figs. 36, 37 and 38, representing, respectively, Brown's stations at Petersburg, Russia, at Milan, Italy, and his Kander station, the latter supplying current to the Burgdorf-Thun three-phase railway.

A very beautiful type of revolving field generator is represented by

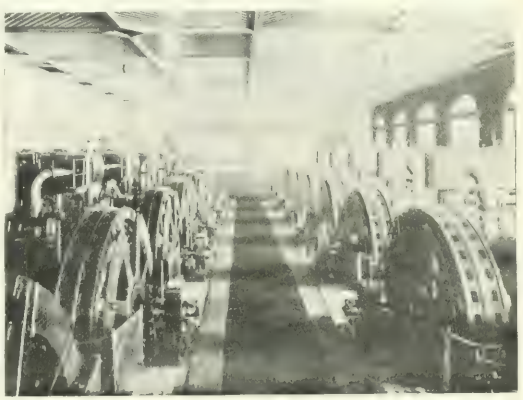


FIG. 36.—ST. PETERSBURG SINGLE-PHASE GENERATING STATION.

Fig. 39, which shows a drawing of one of the five high-tension generators in the Schwyz station. Like the Waedensweil generators, they have a very high surface speed, and they must be capable of giving their full output on a single-phase circuit. They are three-phase generators running at 400 revolutions, giving 8000 volts, and 46 amperes single-phase, and 33.2 amperes three-phase at 40 cycles. This makes them 460-kw generators. They were designed in 1896.

Their performance curves are given in Fig. 40. The rise in volt-

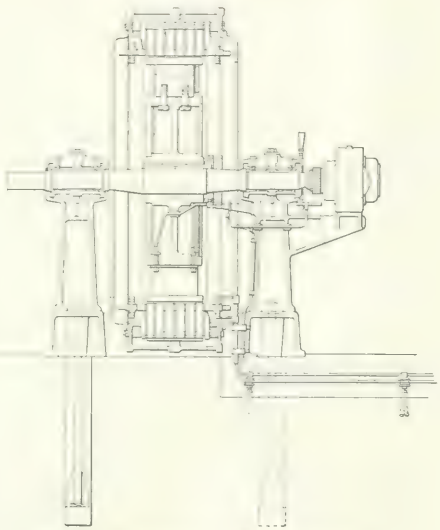


FIG. 39.—SCHWYZ THREE-PHASE GENERATOR.

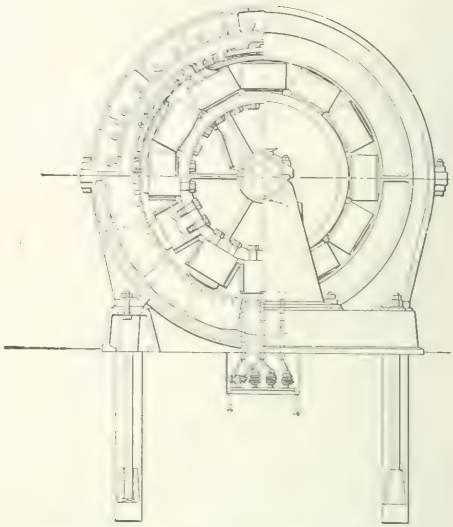


FIG. 39*a*.—SCHWYZ THREE-PHASE GENERATOR.

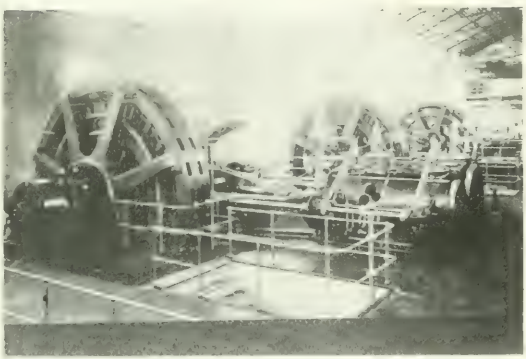


FIG. 37.—MILAN THREE-PHASE GENERATING STATION, PORTA VOLTA.

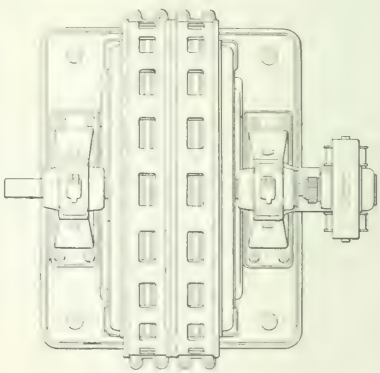


FIG. 39*b*.—SCHWYZ THREE-PHASE GENERATOR.

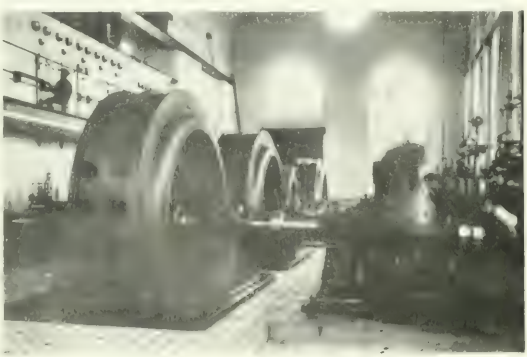


FIG. 38.—KANDER GENERATING STATION.

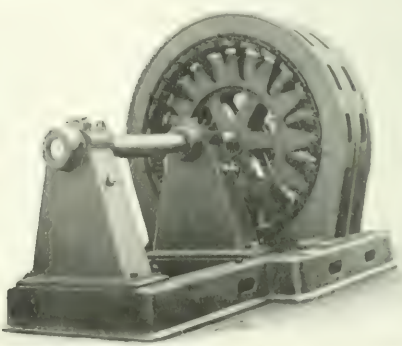


FIG. 41.—REVOLVING FIELD GENERATOR WITH ALTERNATELY-WOUND POLES.

age on a single-phase circuit for 46 amperes of power factor 100 per cent is 600 volts, or 7½ per cent. On a three-phase circuit, if a load of 33.2 amperes is thrown off, power factor 80 per cent, the rise in voltage amounts to 13.7 per cent.

The performance curves here published clearly show that Mr. Brown had worked his generators for the past ten years slightly beyond the bend of the saturation curve, but it is a peculiar psychological fact that men, when they understand an important principle for the first time, only too often imagine that nobody else had known anything about it before, and that the principle must be as new to others as it was to them.

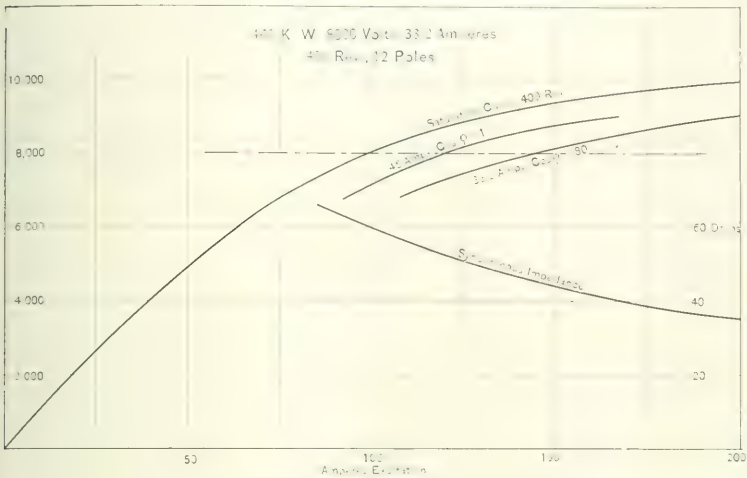


FIG. 40.—PERFORMANCE CURVES OF SCHWYZ GENERATORS.

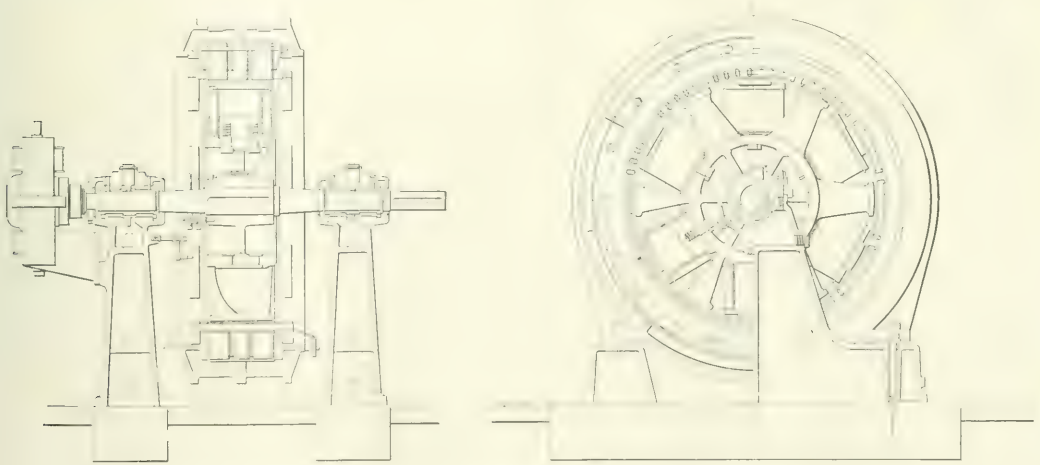
An interesting type of generator is represented in Figs. 41 and 42. Every other pole has an exciting coil. This construction permits the use of round steel poles even for small diameters. It has been copied in Europe by some prominent engineers, which fact may be considered a testimony to its usefulness. The rating of this machine is 130 amperes, at 1200 volts, and 40 cycles and 400 revolutions. The bore of the armature is 129 cm., and the length of the core 34 cm. There are six oval-shaped holes per pole, of which four are wound. The shape of the segments is of interest, as the equal inside and outside curvatures reduce the scrap not immaterially by simplifying the die work, and permitting the use of shears.

Municipal and Government Ownership in Canada.

There are signs of a growing popularity in the Dominion of the proposition of public ownership and control of public utilities, and particularly may this be said of telegraphs, telephones and electric lighting, writes a Canadian correspondent. During the recent civic elections held throughout Oontario, it is to be noted as a sign of the times that Ottawa voted to own and operate its own telephone service, and another city its electric lighting. Another feature in this respect is the apparent trend of public sentiment in favor of public ownership and control of submarine cables and land telegraphs.

Sir Sandford Fleming, of Ottawa, who has been foremost in the all-British Pacific cable project ever since its inception, is now actively promoting the establishment of two very important schemes: First, the desirability of a state-owned cable across the Atlantic, and, secondly, the transfer to the Canadian Post Office Department of the land telegraphs of the Dominion. The contention in favor of the latter proposition is backed by the fact that, since 1870, every part of the British Empire, except Canada, has nationalized its telegraph service. It may be pointed out in this connection that the Dominion Government has had under consideration, for a year or more, the important project of establishing a government postal telegraph system, to be operated by the post office department, as in England. It is quite likely that at the approaching session of the Dominion Parliament, Mr. Mulock, Postmaster General of Canada, will bring forward a bill to enable this policy to be carried into practical effect.

With regard to the proposed Atlantic cable, Sir Sanford Fleming claims that a state-owned cable is necessary over this ocean in order to complete the all-British telegraph line from Australia to England. The cost of such a cable is estimated at about $2,000,000, and the interest, sinking fund, cost of operating and maintenance, would amount to $166,000 a year. It is calculated that the cable would have a capacity of 10,000,000 words a year. At the extremely low rate of 2 cents per word, this amount of business would be sufficient to pay all working and other charges. The rate at present suggested, however, is 5 cents per word for ordinary messages and 25 cents for urgent ones.



FIGS. 42 AND 43.—REVOLVING FIELD GENERATOR WITH ALTERNATELY-WOUND POLES.

The Institute Annual Dinner and Mr. Marconi.

The annual dinner of the American Institute of Electrical Engineers was held at the Waldorf-Astoria, in the Astor Gallery, on Monday evening, Jan. 13, when Mr. G. Marconi was the guest of honor. The affair had to be arranged at virtually forty-eight hours' notice, owing to the unavoidable uncertainty of Mr. Marconi's departure from Canada, and his intention of sailing almost immediately from New York after arrival here. In spite of this shortness of time in which to issue notice to the members and make all the necessary preliminary arrangements, the dinner must be pronounced a brilliant, and even remarkable, success. It was attended by over 300 members and ladies, including the foremost men in the profession, and the hard working dinner committee, which knew little of sleep between Saturday and Monday, had the gratification of seeing every one of its hasty plans and preparations crowned with success. The dinner committee consisted of Messrs. Calvin W. Rice, chairman; T. C. Martin, toastmaster; Dr. S. Sheldon, C. A. Terry, and C. O. Mailloux, who were also assisted greatly by Messrs. R. T. Lozier, J. W. Lieb, Max Osterberg, and, of course, Secretary R. W. Pope, all of whom worked like automobiles to carry out the arrangements. The Astor Gallery was set out with quartette and octette tables, and along one wall under a huge American flag ran a long table upon a dais at which were seated President Steinmetz, Prof. Elihu Thomson, Prof. A. G. Bell, Sir Percy Sanderson, C. B., British Consul General; Cav. Branchi, Italian Consul General; Dr. M. I. Pupin, Prof. F. B. Crocker, Frank J. Sprague, Wm. Stanley, C. W. Price, Carl Hering, Arthur Williams, president New York Electrical Society, and the toastmaster. Among the gathering also were Messrs. C. W. Hunt and Oberlin Smith, past presidents of the American Society of Mechanical Engineers; General Griffin and Mr. E. W. Rice, of the General Electric Company; Messrs. Murray and Brady, of the New York Edison Company; Messrs. Platt, Cuttriss and Clapperton, of the Commercial Cable Company; Messrs. W. H. Baker and F. W. Jones, of the Postal Telegraph Company; Messrs. Mallory, Upton and Hill, of the Edison Laboratory; Mr. J. C. Bayles, scientific editor, *New York Times;* Mr. Julian Ralph, the famous war correspondent, now of the *Mail and Express;* Messrs. Betts, Eugene Lewis and Ewing, of the legal profession; Messrs. D. McFarlan Moore, J. M. Wakeman, C. T. Child, J. F. McElroy; Peter Cooper Hewitt; Gano S. Dunn, Captain S. Reber, U. S. N., representing also General Nelson A. Miles; John Bottomley, T. D. Lockwood, W. D. Sargent, A. L. Rohrer, W. J. Hammer, W. D. Weaver, H. W. Blake, O. T. Crosby, W. Maver, J. Wetzler, M. Osterberg, P. Torchio, etc., etc. In fact, the company's names, if given in full, would be a roster of every well-known member within a couple of hundred miles of New York City. Among the many ladies present were Mesdames Edison, Sprague, Sheldon, Lozier, Hastings, Terry, Martin, Grosvenor, Mailloux, Blake, Wakeman, Bottomley and Hill.

The menu, printed in Italian olive ink on sea foam green card, bore outside a sketch representing an ocean scene, with the two coasts of the Atlantic, and a Marconi staff on two tall lighthouses signaling "ss" in three dots all the way across. In the middle was a medallion with Mr. Marconi's portrait, draped with the Italian flag; above it the Italian national coat of arms, and below it as a pendant the Institute badge. At one side on the left was the American flag and on the right the English. It is stated that the whole thing was designed, sketched, engraved, printed and delivered within thirty-six working hours. Around the room, the Elblight system of flexible conductors, and tablet, into which lamps can be stuck in any form or device, was used by Mr. Spaulding with great effect. On the tables twined great coils of the conductor with small green lamps. At the two ends of the room were large tablets, one reading "Poldhu" in white lamps and the other "St. Johns," in letters about a foot long. Immediately opposite the speaker's table was a similar tablet bearing the name of "Marconi." Between the three signs were strung strands of the conductor, into which were inserted clusters of three lamps at frequent intervals, to represent the three dots, or "s," sent across the Atlantic from the Cornish coast to Newfoundland. At fitting times these were flashed or allowed to stay illuminated, and the success was great. Another feature was the procession of waiters bringing in the ice creams which were incandescent lamps and electric vehicles grouped around wireless telegraph poles, and poles with snapped wires, between which came ships at sea—all in ice—suggestive in a way of the chilly reception that met Mr. Marconi at St. Johns recently. It is needless to say that these *tours de force* were quite heartily applauded.

President Steinmetz greeted the gathering after dinner was over and expressed his pride in the occasion and the success of the annual dinner, extending a cordial welcome to Mr. Marconi. He then turned the conduct of affairs over to the toastmaster, who read the following communications.

To T. C. Martin:

I am sorry that I am prevented from attending your annual dinner to-night, especially as I should like to pay my respects to Marconi, the young man who had the monumental audacity to attempt, and succeed in, jumping an electric wave clear across the Atlantic Ocean.

Yours,
(Signed) Edison.

46 and 48 East Houston Street.
New York, Jan. 13, 1902.

Mr. Calvin W. Rice,
American Institute of Electrical Engineers,
57 Duane Street, New York City.

Dear Mr. Rice.—Replying to your kind letter which was delivered during my absence from the city, I beg you to transmit to the Institute my thanks for the honor proffered.

I feel that I could not rise to the occasion, and regret not being able to contribute to the pleasure of the evening, but I wish to join the members in heartily congratulating Mr. Marconi on his brilliant results. He is a splendid worker, full of rare and subtle energies. May he prove to be one of those whose powers increase and whose mind feelers reach out farther with advancing years for the good of the world and honor of his country.

Yours very truly,
(Signed) N. Tesla.

Newport, R. I., Jan. 13, 1902.

Ralph W. Pope,
Secretary American Institute of Electrical Engineers,
26 Cortlandt Street, New York.

I greatly regret my inability to attend the dinner to-night in honor of Mr. Marconi. It would afford me sincerest pleasure to give my evidence of my esteem and regard for him. I know him well enough to know that his genius is equaled by a modesty and reticence of statement for which I have an equal admiration with the first. When he told me last spring of his hopes I knew that he would do more than he mentioned. The result has more than justified expectancy.

(Signed) F. E. Chadwick.
Captain U. S. N.

Columbia University.
President's Room, Jan. 11, 1902.

Mr. R. W. Pope,
Secretary of American Institute of Electrical Engineers,
26 Cortlandt Street, New York.

My Dear Sir.—I deeply regret that a previous engagement for the evening of Monday will deprive me of the pleasure of accepting the invitation that I have received through Professor Sever, to be present at the dinner tendered by the American Institute of Electrical Engineers to Signor Marconi.

I greatly regret my enforced absence, for I should enjoy being able to join in your tribute to respect to the distinguished inventor, and in felicitating him upon having placed his name on the roll of the great discoverers and the great benefactors of the human race; for there appears to be every reason to believe that the most important practical results will follow in due time from Signor Marconi's successful experiments.

Pray tender to your distinguished guest an expression of my sincerest congratulation and high regard, and believe me,

Very truly yours,
(Signed) Nicholas Murray Butler.

City of New York,
Office of the Mayor.

January 13, 1902.

R. W. Pope, Esq., 26 Cortlandt Street, New York.

Dear Sir: I am sorry that it is not in my power to attend the dinner of the American Institute of Electrical Engineers, to be given this evening, at which Mr. Marconi is to be the guest of honor. The results already obtained by Mr. Marconi mark him as a man who has been a benefactor of the race, and his latest achievement seems to give promise of still greater services to mankind. I wish it were

possible for me to be present, to say to him in person, on behalf of the city of New York, how highly his scientific labors are appreciated here. Asking you to convey to him my regards and best wishes, I am, Respectfully,

(Signed) SETH LOW, Mayor.

COMMERCIAL CABLE COMPANY OF AMERICA.
Geo. G. Ward, V. P. and Gen'l Mgr.
Executive Offices: Postal Telegraph Building, 253 Broadway.
NEW YORK, Jan. 13, 1902.

Dear Mr. Martin: Your letter of January 10th conveying the kind invitation of the American Institute of Electrical Engineers to dine with them on this, Monday evening, was delivered while I was away from the city. I regret to say that I am unable to accept the invitation. I am compelled to return to Washington this afternoon to attend to matters in connection with the Commercial Pacific Cable. I congratulate the Society on its distinguished guest. I am very sorry that I cannot be there to meet him.

Yours very truly,

(Signed) GEO. G. WARD.
(Local Sec. British Instn. Elec. Engs.)

WASHINGTON, D. C., Jan. 13, 1902.

CAVALIERE BRANCHI CONSUL GENERAL OF ITALY, NEW YORK CITY.

Sir: Absent because of previous engagements of importance from the dinner of the American Institute of Electrical Engineers given in honor of Signor Marconi, I beg you to offer my assurance that I am present in spirit and rejoice in the sympathy shown for our illustrious countryman, who adds his own to the other great Italian names of Volta, Galvani and Ferraris in the history of electrical science. The new invention of Signor Marconi, whose development will unite more and more firmly the new and the old world in all their relations, is really an inestimable victory of the human genius over the forces of nature, a noble conquest of civilization and mankind. I salute my glorious compatriot and thank the worthy and highly honorable Association which so fraternally welcomes and lauds him and his achievement.

ITALIAN AMBASSADOR TO THE UNITED STATES OF AMERICA.

Messages of fraternal felicitation were also read by Mr. John W. Lieb, to be sent to the foreign societies to which Mr. Marconi belongs.

The toastmaster then presented to the audience Mr. Marconi, who was received with three tremendous cheers.

Mr. Marconi acknowledged in graceful terms his appreciation of the warm reception he had received during the evening, and of his entertainment by such an eminent body as the American Institute of Electrical Engineers. It is, he said, well known all over the world that Americans stand first in applied electrical engineering, and he felt greatly honored to be in the midst of so many eminent men, whose names are household words in the whole civilized world.

Mr. Marconi then proceeded to give a brief description of what his system has at present accomplished, especially in reference to use on ships, and what he hoped it will accomplish in the future. Wireless telegraphy is now attracting very great attention all over the world, and its progress is not slow. Five years ago the system with which his name is identified was working over a distance of about two miles, but its range has been rapidly increased until a few months ago it was quite possible to communicate by means of an improved and attuned system over a distance of 200 miles. The commercial application of the system has been given serious consideration, and improvements have been made of importance. The commercial application of the system has been tried in Great Britain, its chief base being in England. There are now over 70 ships carrying permanent installations for wireless telegraphy. Of these 37 are in the British Navy, 12 in the Italian Navy, and the remainder are on the large liners, such as the Cunard Line, the North German Lloyd and the Beaver Line. There are over 20 stations in operation on land in Great Britain, and more are in course of construction.

Mr. Marconi regretted the impossibility in a brief address to go into the scientific details and the scientific development of his system, but he wished to correct some of the popular opinions which prevail as to the subject of wireless telegraphy.

It seems to be the general opinion, he said, that when a message is sent into space any one with a necessary apparatus can intercept that message and read it. Of course, this would be very awkward and would hurt the system from a commercial standpoint. No one would wish to have his private affairs made public in that way. For instance, stock quotations or other matters of secret could be found out. By experiments and improvements which have been made, messages can only be read when the receiver and the transmitter are attuned. This perfected system is not, however, at present in use on the ships. It has been deemed necessary that each ship should be equipped with apparatus which will permit of its reading a message sent from any other ship, because of the possibility of aid being required. Therefore, all ships are attuned so that one ship can call up any other ship, but it is practicable to have the apparatus so attuned that the messages transmitted can in no way be received by any other apparatus except that attuned to receive the message.

Mr. Marconi then quoted from Dr. Fleming as to some of his early experiments in syntonic telegraphy. Communication was established between Portland and Portsmouth, a distance of about 60 miles, with intervening hills of 800 ft. in height. Crossing these stations two other stations had been placed in operation, and it had been found that crossing messages did not in any way interfere with one another. Transmission of messages was also obtained between England and Ireland, two stations located a distance of 200 miles apart, and with the use of a very small amount of energy—about as much energy as is necessary to light a small incandescent lamp—messages were transmitted.

Taking up the subject of his most recent work, Mr. Marconi stated that the first experiments on transatlantic wireless telegraphy were to have been conducted between Cornwall, England, and Cape Cod, Mass. Just as the station at the latter place was being completed, however, it was badly damaged by a storm, and not wishing to defer the experiments, it was decided to make the trial with Newfoundland as a base, the shorter distance being also desirable, owing to the intention to install only a temporary station there. It was necessary here to use kites and balloons, which gave a great deal of trouble in getting them at the proper height, because of the wintry gales. But on December 12, for the first time, the kites were raised in a proper position, and signals were received from Cornwall at the right time, and at the pre-arranged speed.

Mr. Marconi said that experiments would have been continued, except for the bad weather conditions, and also the discovery of the fact that the Anglo-American Cable Company claimed to have the monopoly of all telegraphic communication in that colony—not only of all telegraphic communication, but of all experiments in any way connected with telegraphy. It claimed to have the right over the land and the sea. Mr. Marconi said these claims surprised him, and he contrasted the different treatment he received at the hands of the English Government. The British Government claims a monopoly of the telegraph, but encouraged his experiments more than prevented them. Certainly, when it comes to commercial work in establishing communication between the English coast and ships, an arrangement has been effected with Lloyds and suggestions have been made for future plans. He added that the manager of the cable station at St. John's was pleased that during the three days he was there they sent 50,000 words over the wire for the press.

Mr. Marconi then discussed the future of wireless telegraphy at length. He said he had not the slightest doubt that in the near future it would be possible to send many messages over the sea at the same time by instruments properly attuned. He said that he had been very greatly encouraged by the Government of Canada. It will be admitted, he thinks, that one of the greatest features of civilization in all the world is the facility with which people can communicate with each other, living long distances apart. His hope is that at no great distant date he shall bring his system to the point of perfection of allowing friends and relatives to communicate with each other across the ocean at a small expense. At present, by the existing cable system, the sending of messages across the seas is put out of the reach of people in moderate circumstances. The cost of laying the cables is so large that cable companies have to charge a high price for the service. Wireless telegraphy will cheapen the cost very greatly, and do away with all cables and the charge for their care.

In conclusion, Mr. Marconi said that he had built very largely on the work of others, and mentioned Clerk Maxwell, Lord Kelvin, Professor Henry and Professor Hertz. He referred to the fact that the message received at St. Johns was received through a telephone

receiver, and turning to its inventor on his right, added that with the telephone the name of Prof. Alexander Graham Bell is inseparable.

Prof. Elihu Thomson prefaced his remarks by saying that he had received the news of Marconi's great feat from over the telephone from a reporter, who wished to know whether he believed that signals had actually been received by Marconi across the Atlantic. Prof. Thomson asked the reporter if Marconi made such a statement, and upon being answered in the affirmative he said: "If Marconi says that he received the signals I believe they were received."

He paid a glowing tribute to Marconi for the great ability which he had shown in building up his system of wireless telegraphy, which was none the less remarkable because the system as a whole was founded upon fundamental principles discovered by others. While it was true that Hertz had been the first to demonstrate the waves upon which wireless telegraphy is based, yet the utilization of this discovery in such a practical manner was a great achievement and placed Mr. Marconi among the first inventors of the world. It has become a modern habit to make immediate use of new discoveries, and he referred to the rapid manner in which Röntgen rays had been utilized in surgery and now also in the cure of certain skin diseases, with a probability that the great discovery of Röntgen would still yield further benefit to man.

In the case of wireless telegraphy the leap was a remarkable one from a few hundred miles to Transatlantic telegraphy, and the utmost credit was due to the one who had made the bound. Prof. Thomson referred sarcastically to the action of the Anglo-American Cable Company in prohibiting further experiments in Newfoundland by Marconi, saying that the cable company was apparently not satisfied with a monopoly of the sea and the earth, but wished to extend it to the ether which extended throughout all space. Speaking of ether, he said it was a singular fact that while we had no knowledge of it as an entity, yet the great part of modern science was predicated upon its existence. Prof. Thomson concluded by prophesying a great future for wireless telegraphy.

The remarks of Prof. Pupin took rather the form of a lecture, being illustrated by a large number of charts. He first met some of the criticisms that had been made on Marconi's work, and referring to one which insinuated that the cables landing in Newfoundland had an influence on transmitting the signals from Cornwall, he said that it would be a greater feat to transmit through a cable the waves which influenced the receiving apparatus than it would to transmit them through the ether.

Referring to claims made that previous to Marconi wireless signals had been transmitted over short distances, he said that any schoolboy by means of an Hertzian oscillator could transmit such signals over a short distance, but that with this apparatus the limit was one mile. He considered that a phenomenon could be viewed from three standpoints—the mathematical, the physical and the engineering; and that while the work of the mathematician and physicist was undoubtedly of the highest importance, yet it required the engineer to make their work of avail to the world. He deprecated claims based upon general statements of what might be attained, and said that claims were only worthy of consideration as against work accomplished if they were accompanied by engineering specifications whereby any one could test them.

Prof. Pupin gave a lengthy exposition of the principles of wireless telegraphy, using as a first illustration an ordinary cable and then proceeding step by step until the Marconi system was reached. He showed that if in the middle of the submarine cable a condenser were placed, signaling would still be possible. If the condenser was increased in size and the distance between its plates and the diameter of the insulating sheathing correspondingly increased, another possible condition was reached, until finally the sheathing is increased to the size of the earth and the conductors merely entered each end. This he considered to be the ideal condition. The nearest approach to it was to consider that the surface of the earth corresponds to the sheathing, and the aerial conductors of Marconi to the conductor terminals. He said that this theory satisfies the telegraph circuit criterion laid down by Heaviside and explains very satisfactorily the Marconi system.

In conclusion, Dr. Pupin stated with emphasis that he did not consider wireless telegraphy would ever prove sufficient of a competitor to submarine telegraphy to endanger the present investments in that industry.

Cooper Hewitt Vapor Lamp.

We give herewith two views showing types of Cooper Hewitt vapor lamps that were exhibited at the recent meeting of the American Institute of Electrical Engineers. The photographs of the lamps



FIG. 1.—HEWITT VAPOR LAMP.

were taken by the light of the lamps, which was then the only light in the room. The prints from which the engravings were made are poor, but the excellent character of the light for photographic purposes



FIG. 2.—HEWITT VAPOR LAMP.

may be surmised from the reproduction of an excellent photograph taken of President Steinmetz, which appeared in our issue of last week.

The candle-power of the horizontal type of lamp shown was 600.

With the starting device in the line the lamp took .5 watt per candle-power, and with the operating device out of circuit the consumption was less than .4 watt per candle-power. The lamp exhibited over the doorway was of 700 cp, and consumed .5 watt per candle, with the operating device in circuit, and .4 watt without. A lamp similar to these after being run 400 hours and again tested showed an economy of .35 watt per candle and no decrease in efficiency.

The device for putting the lamps in operation is shown in Fig. 3, which is one of a number of arrangements used by Mr. Hewitt and

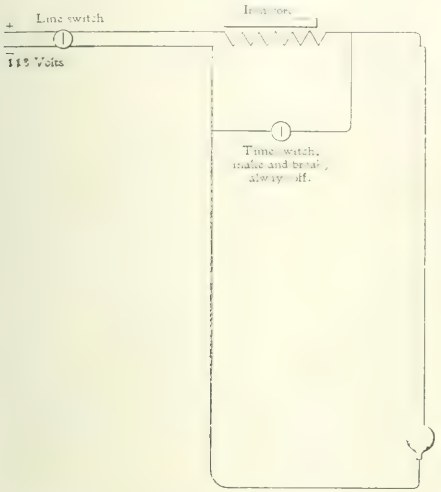


FIG. 3.—METHOD OF STARTING LAMPS.

found satisfactory in practical operation. It consists of an induction coil which is thrown in circuit in starting, its function being to boost the line e. m. f. to a degree sufficient to start the vapor discharge. After the tube has attained a normal state, which occurs in a very short time, the coil may be cut out. In some of the arrangements this latter operation is performed automatically.

Important Telephone Decision in Chicago.

Judge Tuley has rendered a decision in Chicago in the case brought by the Illinois Manufacturers' Association, the city of Chicago and several individual complainants against the Chicago Telephone Company. This case involved the right of the telephone company to charge more than $125 a year to a subscriber for a telephone instrument. The charge under special service contract is now $175 per year. Judge Tuley granted a preliminary injunction against the collection of more than $125 per year, and further held that money which has been paid in the past in excess of that sum by subscribers can be recovered. The suit was based on the ordinance under which the telephone company has been operated, which fixes the maximum rate for a subscriber's instrument at $125.

The telephone company in its answer to the petitioners' bills set forth that the service now being given was a great improvement over that given at the time the ordinance was passed, and that although more than $125 per year was charged for this improved service, those who desired were still able to get the same kind of service which was afforded at the time the ordinance was passed, at the ordiance rate of $125. It was maintained that since the improvements of the art in recent years made possible the giving of a better service by putting in a complete metallic circuit and instruments suited to long distance service, the company had the privilege of giving its customers its improved service at an advanced price sufficient to cover the extra cost of this service as long as it gave its customers the option of taking the old grounded circuit instruments at the ordinance rate.

In the decision Judge Tuley said in part: "When a subscriber cannot obtain satisfactory service, except by entering into a contract by which he agrees to pay a greater rate than that fixed by the ordinance, the rate agreed to be paid so far as it is in excess of the rate prescribed by the ordinance must be held to be an illegal exaction, and not only illegal but forced, a forced agreement, by the company, exacted of the subscriber, and not a voluntary contract, which would stop him from disputing the same. The law does not require objection or protest to be made to the payment of unjust charges for the reason that it would be in vain, being addressed to those who occupy the commanding power to enforce obedience to their requirements. There is no contest made by the complainants as to the right of the company to charge extra for what is called extension service. With that exception, the service rendered under the special contract in question must be rendered by the defendant at the ordinance rate, $125 per annum. An order may be prepared in accordance with the views here expressed for a preliminary injunction as prayed for in the bill."

The Judge has evidently hinged his decision in part on the question of whether the $125 service now offered could justly be called adequate in the light of recent improvements, and in this connection the contentions of the telephone company's lawyers seem to have been used in an unexpected manner against the company by the Judge, for he says:

"The defendant's answer clearly shows the inadequacy and inefficiency of the old service for the changed condition of affairs." Various annual reports of the executive officers and stockholders were cited by the court in support of this statement.

Continuing the court said: "It is admitted that the defendant telephone company is a public service corporation, and analogous in many respects to that of a common carrier; that it must treat all its patrons alike and without discrimination. In that respect it must also be held to resemble a street railway corporation, and an ordinance granting to a street railway corporation the privilege of using the streets of the city for street railway purposes on the condition that it should not charge to exceed a certain rate of fare would be exactly similar in principle to the ordinance in question granting a telephone company the use of the streets, etc., on condition that it should not increase its rates for telephone service above a certain amount. The two ordinances were passed in the exercise of the same power of the municipality. If one is the exercise of the governing power, so is the other."

Reference was then made to a large number of court decisions cited in the trial of the case, regarding which Judge Tuley says: "Under the decisions quoted it became the duty of the defendant as a quasi-public service corporation, by reason of the passage of the ordinance and its acceptance and enjoyment of the privileges conferred thereby, to furnish telephone service with all the improvements thereon to its subscribers at the ordinary rate of $125 per annum, and no acts or acquiescence of its subscribers by signing or accepting telephone service under the special contract can be held to be an estoppal upon such subscribers or to confer upon the defendant a power which it has assumed to exercise in direct violation of the ordinance."

The case will be appealed. If the decision is sustained claims may possibly be made for past charges in excess of $125 per year, which have been collected of various subscribers. This would mean, according to the figures of M. B. Madden, president of the Illinois Manufacturers' Association, that it would cost the telephone company $2,000,000 for the settlement of these claims.

The Scope and Intent of the Carnegie Institution.

The following official announcement of the purposes of Andrew Carnegie in endowing the Carnegie Institution at Washington was made last week by Dr. Charles D. Walcott, secretary of the incorporators of the Institution:

Mr. Carnegie's purpose, as stated by himself in requesting the various trustees to become members of the board, is as follows: It is proposed to found in the city of Washington, in the spirit of Washington, an institution which, with the co-operation of institutions now or hereafter established there or elsewhere, shall, in the broadest and most liberal manner, encourage investigation, research and discovery; encourage the application of knowledge to the improvement of mankind; provide such buildings, laboratories, books and apparatus as may be needed, and afford instruction of an advanced character to students whenever and wherever found, inside or outside of schools, properly qualified to profit thereby. Among its aims are these:

1. To increase the efficiency of the universities and other institu-

tions of learning throughout the country by utilizing and adding to their existing facilities, and by aiding teachers in the various institutions for experimental and other work in these institutions as far as may be advisable.

2. To discover the exceptional man in every department of study, whenever and wherever found, and enable him by financial aid to make the work for which he seems specially designed his life work.

3. To promote original research, paying great attention thereto, as being one of the chief purposes of this institution.

4. To increase the facilities for higher education.

5. To enable such students as may find Washington the best point for their special studies to avail themselves of such advantages as may be open to them in the museums, libraries, laboratories, observatory, meteorological, piscicultural and forestry schools and kindred institutions of the several departments of the Government.

6. To insure the prompt publication and distribution of the results of scientific investigation, a field considered to be highly important.

These and kindred objects may be attained by providing the necessary apparatus for experimental work, by employing able teachers from the various institutions in Washington and elsewhere, and by enabling men fitted for special work to devote themselves to it, through salaried fellowships or scholarships, or through salaries with or without pensions in old age, or through aid in other forms to such men as continue their special work at seats of learning throughout the world.

The board of trustees elected by the corporators to carry out the purposes of the institutions as indicated is as follows: Ex-officio: The President of the United States, the president of the United States Senate, the speaker of the House of Representatives, the secretary of the Smithsonian Institution, the president of the National Academy of Sciences; Grover Cleveland, New Jersey; John S. Billings, New York; William N. Frew, Pennsylvania; Lyman J. Gage, Illinois; Daniel C. Gilman, Maryland; John Hay, District of Columbia; Abram S. Hewitt, New Jersey; Henry L. Higginson, Massachusetts; Henry Hitchcock, Missouri; Charles L. Hutchinson, Illinois; William Lindsay, Kentucky; Seth Low, New York; Wayne MacVeagh, Pennsylvania; D. O. Mills, California; S. Weir Mitchell, Pennsylvania; W. W. Morrow, California; Elihu Root, New York; John C. Spooner, Wisconsin; Andrew D. White, New York; Edward D. White, Louisiana; Charles D. Walcott, District of Columbia; Carroll D. Wright, District of Columbia.

It is understood to be the purpose of Mr. Carnegie to transfer $10.000,000 in 5 per cent bonds to the board of trustees for the purposes above mentioned. The meeting for organization of the board of trustees and the election of officers has been called for Jan. 29, at the office of the Secretary of State, Washington.

Nernst Lamp Lecture in Chicago.

Probably the largest gathering of local electrical men ever assembled in Chicago was on hand to listen to a lecture by Mr. A. J. Wurts on the "Development of the Nernst Lamp in America," delivered the evening of Jan. 10, in the large lecture hall of the Lewis Institute laboratories. This being the first public exhibition of the Nernst lamp in Chicago, many were practically interested in seeing the latest types of lamps and in hearing from the lips of one who had taken part in the work, the difficulties that have been found and overcome in the development of a commercial lamp.

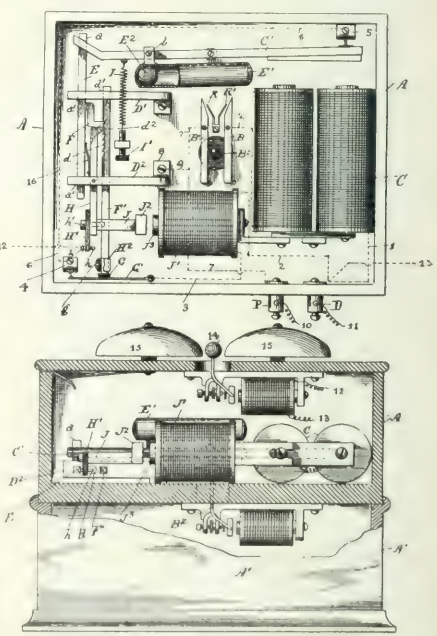
This lecture covered much the same ground as the paper by Mr. Wurts before the American Institute of Electrical Engineers at Buffalo last August, which was reprinted in ELECTRICAL WORLD AND ENGINEER of Aug. 31, 1901. For the main points of the lecture readers are referred to that paper. The lecture brought out some new points, however, and explained perhaps a little more fully the troublesome problems that came up and their solution. One statement made, to the effect that the life of the glowers varies almost directly as the frequency, was of considerable interest to the audience. For example, a glower with a life of 800 hours at 60 cycles will last 1200 hours at 133 cycles.

Much appreciation was shown by the audience as the speaker related the way in which small but important practical troubles had been overcome, such for example as the substitution of aluminum plugs inserted with pliers in place of binding posts for making connection with glower terminals, the embedding of the platinum terminal in the glower and the use of paste to make the removal of platinum black from the heater porcelain easy. The glower terminals, which are of platinum, get so hot that upon the expiration of the life of a glower it was found almost impossible to loosen the screw if the terminal was fastened in a binding post. As a substitute for binding posts the glower terminals are pressed into aluminum tapered plugs which accurately fit holes in the connecting rods of the lamp, into which holes they are tightly wedged with pliers to make the connection.

To illustrate the exact relation of the color of the Nernst lamp to the incandescent lamp, Nernst and incandescent lamps of equal candle power were shown side by side in ground glass globes and also side by side behind screens made up of bars of various colored paper. The room was alternately lit with Nernst lamps and with high candle power incandescent lamps taking an equal amount of energy, making a practical demonstration of the relative efficiency.

New Telephone Patents.

In the first issue of the Patent Office for this year telephony is represented by but two patents, one relating to our familiar friend, the party-line call-signal, the other to the more delicate problem of the service meter. Mr. Henry I. Hauxhurst, of Oakland, Calif., is the inventor of the latest device for supplying the party-line subscriber with one unmistakable ring on his bell when his attention is wanted instead of the confusing succession of rings customary on party lines not equipped with selective systems. Mr. Hauxhurst's device, which he terms a "telephone attachment," is literally such, as it is ararnged to be attached to the ordinary telephone set and to be actuated by the hammer of the telephone ringer, the gongs of the latter being transferred to the bell, which gives the signal when the step-by-step device or selector has done its work. Referring to the diagram, Fig. 1 is a vertical sectional view of the apparatus, and



HAUXHURST'S TELEPHONE ATTACHMENT.

Fig. 2 a cross-section top plan, showing the attachment secured to the box of an ordinary telephone bell. In Fig. 1, B^2 is the hammer of the telephone bell, adapted to vibrate when set in motion the two levers B B^1, and so cause them to close contact with springs K K^1. The magnet C operates on lever C^1, to which is attached a hollow case E^1, in which a steel ball E^2 rolls freely; C^1 is held away from the magnet by spring I, and its rear end bears against a projection a on the end of sliding rod E, which carries a dog F, engaging in the teeth d on sliding rod F^1. A lever H pivotted to the lower frame D^2 through which the sliding rods pass, has a tooth on its upper end, and

being pressed forward by spring 16 holds F^1 in position at any point to which it may have been raised. At right angles to H is attached a rod J carrying the armature J^2 of magnet J^1; an insulating block H^1 attached to the lower end of H carries a platinum pointed contact stud h, adapted to engage in the notch g of the insulating collar H^2 on connecting rod F^1 when h and g are opposite, and H is brought forward by magnet J^1 acting on armature J^2. When F^1 is at its lowest point it causes spring G^1 to break contact at 4; when C^1 is attracted it breaks contact at 5, interrupting the connection between wires 9 and 6. Wires 10 and 11 go to the local battery, and 12 and 13 to the bell magnets. The operation of the instrument is as follows: Suppose three bells indicate the call for the subscriber, to whose telephone the device is to be attached. In such case block H^1 is so adjusted, having a slot opening where it is screwed to H, that point h will be directly in line with notch g of collar H^2, when F^1 has been raised three teeth. When the central operator rings three bells in the ordinary way the hammer B^2 causes three contacts between B B^1 and K K^1, the vibrations of the hammer being so rapid as to constitute practically a continuous pressure while the vibrations last. Circuit is thus closed at each contact of B B^1 and K K^1 through C and C^1 is attracted, ball E^2 rolling down the case and aiding in depressing C^1; the outer end of C^1 raises E and the dog F raises F^1, one tooth in which position it is held by the dog on the top of H. During the pause between signals C^1 is released and E falls back one tooth, but C^1 does not rise far enough to close contact again at 5 before the next signal comes, C^1 is again attracted, and the operation of the sliding rods is repeated. When the third signal has been given C^1 returns to its normal position and closes contact 5; F^1 then having been raised three teeth h is in line with g, and contact 4 having been closed by spring G^1, no longer held down by F^1, magnet J^1 is energized, attracts its armature and so causes h to engage in g, thus making contact with F^1, and so closing circuit between the local battery and the bell. When the circuit is broken by the removal of the receiver from the switch hook, J^1 releases J^2 and spring 16 acting on H causes h to be withdrawn from g, allowing F^1 to drop to its normal position, breaking contact at 4 by pressing down G^1. The bell will not be rung by fewer than three signals, because F^1 will not be lifted up enough for h to be brought opposite g, nor by more, because the pause between signals is not long enough to allow C^1 to return to its normal position and close contact 5 and so energize J^1. In the case of stations not signaled where the signals are either too few or too many to effect the closing of the bell circuit J^1 acts as a restoring magnet after the completion of the signals by moving H so as to release F^1, which then depresses G^1 and breaks the circuit through J^1. The apparatus has been ingeniously worked out, and can claim the advantage of being adaptable to the ordinary telephone set, and the ordinary method of party-line signaling. It has the disadvantage, however, of number of moving parts, requiring very fine construction and careful adjustment to ensure regular performance.

Mr. Frank R. McBerty, of Evanston, Ill., assignor to the Western Electric Company, patents a service meter for multiple switchboards adapted for use in connection with common battery switchboards. It has been found in practice that a meter which registered a call only would be useless, if not worse than useless, since so much confusion would arise from the registry of calls not resulting in completed messages, the completed message or connection with the called station followed by an answer from that station being the unit of telephone charges. Consequently, a meter to be effective must register only when the called sub-station has responded to the call by taking the telephone receiver off the hook, the train of operations culminating at this step constituting a "message," or completed connection as far as the work of the telephone company is concerned. Last week we described an invention which sought to accomplish the same object that Mr. McBerty's device aims at, but in the persent case the solution is arrived at in a simpler manner, with less auxiliary apparatus, and with a delightfully ingenious arrangement of circuits. Briefly put, Mr. McBerty arranges his service meter in series with the cut-off relay of the calling line, and with the supervisory lamp of the answering line, and so fixes the resistance of the meter-magnet that it shall not become energized until, by the closing of the telephone circuit at the answering station the lamp is shunted and an increase of current is thereby produced in the meter circuit. As a safeguard against double registration of the meter, should the called station temporarily replace the receiver, a shunt is applied to the meter magnet, which is broken when the meter magnet is sufficiently energized to attract its armature and thereafter the meter magnet remains energized until the answering plug is withdrawn and the circuit through the cut-off relay broken. The reciprocal arrangement of the answering and calling-plug circuits and their respective supervisory lamps is novel and highly ingenious, and a difficult problem is solved in a simple manner, which is one of the truest tests of inventive ability.

Pacific Cable Before Congress Committee.

At Washington, on Jan. 10, the House Committee on Commerce took up the subject of a Pacific cable. The main question is whether the cable shall be constructed by the Government or by individuals, and this hearing was devoted to a statement by Mr. George G. Ward, vice-president of the Commercial Pacific Cable Company, as to the plans of that organization. He said that contracts had been made for the manufacture and laying of a cable to Honolulu by Nov. 1 next, and that the company intended to extend the cable to Manila within two years thereafter. The manufacture of the cable was now proceeding, he explained, at the rate of 240 miles a month, and this rate would be increased to 630 miles a month. He said that the cost of the project was between $10,000,000 and $12,000,000. The cross-questioning by Chairman Hepburn (Rep., Iowa), and Messrs. Corliss (Rep., Mich.), and Mann (Rep., Ill.), tended to develop the question whether or not the company, by having an exclusive field, would maintain high rates. Mr. Ward said he expected the rate to Manila to be $1 and to Honolulu from 35 to 50 cents a word. The company he represented would be able to make exclusive traffic arrangements from points beyond the Philippines and connecting with China and Japan. He also stated that there would be questions as to the right of the United States to land a cable on foreign shores. Representative Stewart (Rep.), of New Jersey, interposed the statement that Germany's present course against Venezuela showed that the German Government made little distinction between public and private rights, so that a government cable station would have about the same status as a private station.

Chairman Hepburn (Rep., Iowa) asked a series of questions as to the effect of wireless telegraphy on the submarine cable. Mr. Ward replied that the new system presented a serious question. He was not certain that the Pacific cable project would have been undertaken if the long-distance experiments had occurred earlier. As to the claims that wireless signals had been conveyed 2000 miles across the Atlantic, he said that if the claims were made good they would deter people from laying any more cables. When asked as to the effect thus far on the cable business, he replied that it had depressed cable interests.

Mr. Stewart wanted to know if the cable companies had not chased Marconi out of Canada, to which Mr. Ward answered that he believed the cable companies had insisted upon certain exclusive rights they held. Mr. John Foord stated that the American Asiatic Association, representing the firms doing business in the Orient, favored a cable under private control. It was opposed to the Government entering the field of private enterprise.

President Scrymser, of the South & Central American Cable System, made an extended argument favorable to government control of the Pacific cable, citing incidents of the Spanish-American war, showing the importance of governmental control of the cable. In one case cited the Spanish Minister of Marine called Admiral Cervera to leave Santiago. If this dispatch had not been intercepted, Mr. Scrymser said, the battle of Santiago Bay would not have been fought and the conduct of the war might have been changed.

Thomas E. Hughes, representing an American company, stated that as good cable could be made in the United States as in any other part of the world. He asked that American labor and capital have the advantage of doing this work. Chairman Hepburn asked if this American company was prepared to make a definite business proposition to the United States Government, and Mr. Hughes replied that such a proposition would be submitted in due form within the next two days. Mr. Hepburn asked that the formal proposition be in alternative form—first, for delivering a cable of American make at San Francisco; second, for making and laying the cable to Hawaii, Guam and Manila. Mr. Hughes thought the Government better able to do its own cable laying, using the army transports. As indicating the general character of the forthcoming proposition Mr. Hughes said the cost would be within 10 per cent of the stated cost of the Commercial Pacific Company's cable. The additional 10 per cent, he said, was for the protection of American industry.

Francis B. Thurber, president of the United States Export Asso-

ciation, favored private construction as most likely to give the earliest cable advantages to the business world.

William W. Cook, of New York, a director of the Pacific Commercial Cable Company, said that the company, after laying the cable across the Pacific, stood ready to sell it at any time to the United States Government at an appraised valuation.

Mr. Ira W. Henry, civil engineer for an American cable manufacturing company (the Safety), said his concern would furnish the Government a cable at $1,000 a mile, which, to Hawaii, would amount to about $2,200,000, or considerably less than the cost of a foreign-made cable.

The hearings will be continued this week on Friday, when Government officials will be heard on the Government project.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN HIGH LATITUDES.—A dispatch from Copenhagen, Denmark, states that Iceland, Greenland, the Faroe Islands and Canada may soon be in communication with one another by the Marconi system of wireless telegraphy. Iceland, it is said, will spend $45,000 for this purpose, and is already negotiating with Mr. Marconi for the installation of the system between Iceland and the Shetland Islands

WIRELESS TELEGRAPHY IN CANADA.—Before leaving Ottawa for New York last week Mr. Marconi said he had decided to establish his wireless telegraphic station for this side of the Atlantic at a point in Cape Breton to be decided upon later. It is also announced that the Dominion Government will give a very handsome grant toward the initial expense. The Canadian Government will also test wireless telegraphy stations on the St. Lawrence Gulf.

LONG ISLAND SOUND CABLES.—A new cable two miles long is soon to be laid across Fisher's Island Sound. A telephone station is to be established at North Hummock Island, east of New London, which will be a new point for communicating news affecting shipping interests. This will be the fifth point of the kind on the Connecticut shore of the Sound, and a sixth will probably soon be added by laying a cable from Stratford Point to Middle Ground Shoal lighthouse.

LOCATING METAL ORES.—A patent issued Dec. 31 to Fred. H. Brown describes an application of the Wheatstone bridge principle in the location of metallic ores, minerals, etc. The source of current for the bridge arrangement is an induction coil, and a telephone is utilized in obtaining a balance. Two terminals from ends of one arm of the bridge are inserted in the earth at various distances apart, the earth thus becoming the unknown resistance in this arm of the bridge; the value of this resistance is then measured in the usual way.

DETROIT MUNICIPAL TELEPHONY.—Since the recent advance in telephone rentals by the Michigan Telephone Company, the Merchants' and Manufacturers' Exchange has been investigating, through a committee, the desirability of establishing an independent company. The committee has just met and decided upon a report in favor of buying a co-operative telephone plant, but not the People's Telephone Company, which would ultimately be taken over by the municipality as soon as an act could be passed by the Legislature authorizing municipal ownership.

PNEUMATIC TUBE SERVICE.—A telegram from Washington, of Jan. 10, says: Representative Roberts, of Massachusetts, today introduced a bill for the re-establishment of the pneumatic tube service in the leading cities of the country. Its distinguishing feature is its taking away from the Post Office Department discretion in the matter, and the express stipulation by Congress of the places where the service is to be installed and the amounts to be severally paid for it. It is hoped that, as an offset for the rural free-delivery appropriations for the benefit of the country districts, the tube service may be granted to the larger cities, as recommended by the Postmaster General.

BOOSTER PATENTS.—Four patents were issued Jan 7, 1902, to H. Ward Leonard based upon applications filed 1892 and 1895 by G. T. Wood and relating to the control of e. m. f. upon the terminals of a translating device by means of a controllable auxiliary e. m. f. The claims of one of the patents also relate to the form of motor control known as the "teazer system," the application for this patent having been filed a number of years before the commercial introduction of this system. Among the claims of this patent are several which refer to the use of the rotary transformer on an electrically propelled vehicle. The applications for these patents were in interference with the claims of some twelve other patent applications while they were in the Patent Office, which explains the long interval between their date of application and their date of issue.

NATIONAL WEALTH CONDITIONS.—The standing of the United States with her neighbors, and especially with those of Europe, is illustrated by some statements made by the *London Daily Mail Year Book* for 1902, a copy of which has just reached the Treasury Bureau of Statistics. In its various chapters it discusses various features of conditions in the United States. Under the head of Wealth it places the United States at the head of the list of great nations, the figures of wealth being: United States, £16,350,000,000; United Kingdom, £11,806,000,000; France, £9,690,000,000; Germany, £8,052,000,000, and Russia, £6,425,000,000. While the United States heads this list of countries in its wealth, it shows the smallest national indebtedness, the figures being: United States, £221,000,000; Germany, £651,000,000; United Kingdom, £706,000,000; Russia, £711,000,000; France, £1,239,000,000. The percentage of debt to wealth is given as: United States, 1.4 per cent; United Kingdom, 6 per cent; Germany, 8.1 per cent; Russia, 11.1 per cent; France, 12.8 per cent.

A FREAK PATENT.—Predicating the fact that electric currents flow through the earth and are now wasted, Emil Jahr, of Berlin, in a patent issued last week, describes a method for utilizing such currents. He claims that the existence of such earth currents is shown by thrusting two metal plates at a certain distance from each other into the ground in the direction of the magnetic meridian and connecting them above the ground by means of a wire, including a galvanometer. He says that the stronger currents of this kind have been shown to flow from north to south. Notwithstanding that these facts have been known, the earth current has never, he says, been utilized, and he proposes to take advantage of this source of energy. He claims to have discovered that the current produced is at the highest tension when the two metals are most widely separated from each other in the electrical potential series: that which is nearer to the zinc end of the series is thrust into earth or water at the more northerly point, while that which is nearer the negative end of the series is thrust into the earth at the southerly point. In such an arrangement the metals are not, he says, appreciably corroded even when they are in earth saturated with water and are connected together for a long time. The invention consists in using electrodes of this character, the line connecting the same being situated in the direction from north to south and also in the direction of the magnetic dip.

INTERNATIONAL TELEGRAPH UNION.—It is stated that General Greely is naturally interested in the International Telegraph Union, and is anxious that Congress give the War Department authority to join. He is quoted as follows: "As compared with the contracting States the United States is now at a distinct disadvantage in the use of cables and land lines which pertain to the union. In time of war or in exigencies the United States has to yield in priority to the official messages of agents of all contracting States, as under the regulations telegrams of contracting States take precedence. The International Telegraph Union furnishes the contracting States gratuitously all information relative to international telegraphy, such as interruptions, restorations, etc., and the United States has been obliged for years past to obtain such information second-hand and as a favor, if at all. The expense of the maintenance of the international bureau is borne by the different States, and would probably not exceed a few hundred dollars per year for the United States. Prior to the Spanish-American war, Porto Rico and the Philippines participated in the advantages of the union, and there seems to be every good reason why they should continue to adhere to it, especially in view of the fact that foreign cables reaching these islands conform to the regulations of the International Telegraph Union." These remarks confirm those of Mr. G. G. Ward as to the Pacific cable.

THE NEW YORK CENTRAL TUNNEL.—The New York Central authorities have entered into a contract with the New York Edison Company for the installation and current supply of arc lamps for lighting the tunnel. Nothing definite appears yet to have been decided upon with respect to the electrical equipment of the tunnel, though the newspapers daily make statements to the contrary, the non-authoritative nature of which is indicated by their conflicting character.

CANADIAN ELECTRICAL ASSOCIATION.—A meeting of the executive committee of the Canadian Electrical Association was held in Montreal on Jan. 10 for the purpose of arranging the preliminary programme of the annual convention, which is to be held in Quebec in June. At the meeting it was announced that Mr. Fred Nicholls, manager of the Canadian General Electric Compay had offered $500 to the association for the purpose of stimulating electrical study and research. It will probably be spent in the form of prizes for papers on electrical subjects.

LORD KELVIN COMING.—We are enabled to state upon the best authority that Lord Kelvin will visit this country once more early next April, doubtless accompanied by Lady Kelvin. The great physicist is now well advanced in years, and we are heartily glad to learn that he is in such robust health as to be equal to a long ocean voyage. Electrical engineers will, of course, take proper steps to show him honor, but it must once more be a matter of regret that the Institute is still without a home of its own in which to entertain him. In fact, no engineering body here has a building large enough for such a purpose.

FRENCH TELEPHONE RULES.—It is stated from Paris that new regulations issued for telephone girls are causing endless amusement. One clause forbids their ever calling subscribers to converse with them. Another forbids them to answer flatteries, compliments or pleasantries from men subscribers. The telephone girls are forbidden to make appointments over the wire or to permit gentlemen, even though relatives, to wait for them near the office. Juliette Adamson, an American girl, has just been fined $40 for insulting over the wire a tradesman who failed to deliver goods at the promised time. Her defending attorney argued that as long as a subscriber paid the State could not restrict conversation, but the Judge held that the State has the right to enforce an order regarding telephones just as it has regarding streets.

PREVENTION OF TRAIN ACCIDENTS.—A special cable dispatch from Vienna, of Jan. 11, explains the following, which is very like some American plans: An automatic railway accident preventer, invented by an electrician named Rudolph Bartelmus, has been tested by a body of expert railway managers with satisfactory results. The main idea is to put the engineer in direct communication with all the signal boxes by electrical apparatus on the engine, contact being effected by a third rail. The signalman can thus make a red light burn on the locomotive in front of the engineer, while an electrical bell will ring until the engineer switches it off. On the other hand, the contrivance causes a bell to ring in the signal box as soon as the train is within 3000 yards. Finally, if one train approaches another on the same rail within 3000 yards, red lights burn automatically on the locomotive.

USE FOR CHICAGO WIND.—In a lecture before the students in the College of Commerce and Administration at the University of Chicago on Jan. 10, Franklin H. Head suggested a novel method of illuminating the city. He presented as a possibility of the future the use of a belt of windmills, running dynamos which would charge storage batteries with electricity. A series of windmills around Chicago, he believed, say, for 40 miles, could supply storage batteries with enough electricity to light the whole city continually, and possibly to heat it, too. Mr. Head's remarks were made to illustrate the great value to the world of the new storage battery invented by Mr. Edison. In addition to these features, Mr. Head was of the opinion that the invention would be of great value otherwise. To the manufacturer, he said, it would answer all purposes of present facilities, and, furthermore, would be a great saving in power.

AN AERO CLUB FOR BOSTON.—New England is to have a club for aerial navigation, like the one recently formed in London. The name adopted is the Aero Club of New England. The men interested held a preliminary meeting last week in the rooms of the Massachusetts Automobile Club, and those who signified their intention of becoming charter members are Charles J. Glidden, George E. McQuesten, William A. Rolfe, Newton Crane, J. Ransom Bridge, Dr. Joseph C. Steedman, Royal B. Sheldon, Arthur W. Steedman, Dr. F. D. L. Rust, Ernest L. Reuter and Henry L. Howard. The new organization will study the general subject of aerial navigation, but more particularly is intended to make ascent and to own an airship. If this is agreed on, the machine, it is said, will be constructed on the Santos-Dumont principles, and steered electrically.

WIRELESS TELEGRAPHY ON THE ATLANTIC.—On his return home Saturday, in the course of an interview, Senator Depew said: "We had a very interesting experience with the possibilities of wireless telegraphy at sea on our way over. I sailed on the 'Kaiser Wilhelm,' and the 'Lucania' was behind us. Both are equipped with the Marconi apparatus. When we were out about a day we picked up the 'Lucania' and began talking with her. She was about 25 miles astern then. We talked to her every day in this way, and on the third day we were 100 miles ahead of her. We had been running through a dense fog, but had come into bright, clear weather. In a very short time that day we picked up the 'Lucania' and told her what fine weather we were having, and she replied that she had struck the fog and was in the thick of it. It is wonderful to think what all that will mean in the way of diversion in ocean voyages when all the steamers are equipped with the wireless telegraph apparatus, to say nothing of what it will mean in case of danger. Suppose the 'Lucania' had been in distress that morning. She could have told us all about it, and we a hundred miles away."

SIMPLE PHOTOMETRY.—In a paper read recently before the Kansas Gas, Water and Electric Light Association, Professor Lucian I. Blake described a simple photometer arrangement which he said gives excellent results. It is based upon the fact that any ordinary newspaper can be easily and satisfactorily read when its illumination is 1 candle-foot; that is, a candle at 1 ft. distant gives sufficient light for easy reading. Moreover, a room is excellently lighted in every respect if a newspaper can be read at any place in the room, or, in other words, if the illumination does not anywhere fall below 1 candle-foot. The apparatus consists of a box with two openings side by side at one end, one of which is for the eyes and the other to admit the light from the lamp to be tested. The shape of the box cuts off all other light. The side opposite the two openings is about 13 inches distant and a newspaper clipping is placed against this side. If the box is turned toward a single 16-cp lamp 4 ft. distant and the paper is easily read, the lamp is giving a satisfactory light. Lamps can thus be tried rapidly and in succession by the consumer himself. Professor Blake believes that 100 lamps an hour can be tested in this way, and closely enough for all commercial purposes.

THE GERMAN NERNST PATENT.—The current issues of several of our European contemporaries refer to an adverse decision of the German Patent Office on a Nernst lamp patent. The *Elektrotechnische Angeiger* states that the patent in question is the German patent No. 104,872, of July 6, 1897, from which it gives an extract briefly as follows: "A method for making electric light by means of rods, tubes, etc., of conductors of the second class which are insulators at ordinary temperature, but become good conductors at high temperature, and characterized by the feature that the current is started by means of pre-heating the total incandescent body, the conductor being subsequently kept hot and incandescent by means of the current." An official of the Allgemeine Elektricitats Gesellschaft stated that the decision referred to is not final, as the Reichsgericht (Supreme Court) has still to give its decision on appeal. There are altogether 14 patents on Nernst lamps, and the principal ones on the incandescent body and automatic starting cannot be questioned, as they have been granted on the basis of careful consideration and preliminary examinations by the Patent Office. The official stated that it is to be assumed that the courts will confirm these patents should a litigation be instigated, and that the protection to the manufacturer of the Nernst lamp is not affected by the above decision.

MUNICIPAL TROLLEYS.—By the order of Mayor Tom L. Johnson, a bill is being drawn to authorize the city of Cleveland to issue bonds to build or purchase a street railway system. The measure allows the city to issue bonds for not to exceed $50,000 for each mile of single track to be constructed. As drawn, the bill contemplates an affirmative majority vote of the people before the bonds are issued.

TELEPHONES ON COLORADO TRAINS.—Plans are now under way to install telephone instruments on all trains running across the State of Colorado. At all large stations sockets and switches will be located so that when trains stop one of the crew will instantly connect the train system with the Denver exchange, and through it to the long-distance circuits. Connecting switches will be placed at Denver, Greeley, Boulder, Palmer Lake, Colorado Springs, Pueblo, Salida, Alamosa, Durango, Grand Junction, Florence, Cripple Creek and Victor.

METAPHYSICAL METERING.—In discussion of the Wright demand meter principle as brought before the English Institution, the *London Electrician* raises this rather amusing point: "There is one question which we should like to have heard asked of Mr. Wright in regard to his system of charging, viz., Is it legal? After its extensive use for so many years it may, perhaps, seem superfluous to ask such a question. Yet it is a question that may advantageously be followed up. According to the law, as we understand it, preferential charging is illegal. In other words, a supply station manager may not say to a publican: 'You are a most desirable customer, I will charge you only 2d. a unit,' and then say to the dean of a cathedral: 'Your cathedral is an intolerable nuisance, I must charge you 8d. per unit.' We are quite aware that in some few places the tariffs are arranged on these bold lines—preferential charging, pure and simple. Now the Wright demand indicator is really an instrument for automatically making preferences of mathematical exactitude and unimpeachable equity. There can be no element of personal prejudice in its indications, yet, nevertheless, the final result is undeniably preferential charging. It is a refined point, as to whether this automatic preferential tariff is legal, when the balder form of it is certainly not. And if the tariffs obtained when using Mr. Wright's instrument are *sans reproche* in the eyes of the law, are not also the general classifications of consumers which are finally arrived at by means of that instrument? In other words, if general experience over an extensive area indicates that publicans, say, are the best consumers, provision stores the next best, and churches the worst of all, may not the manager of a new supply undertaking arrange his tariffs accordingly without ever using the demand indicator? The net result should be the same as if the indicators were to be installed, except, of course, that in the latter event the individuals would be provided with a means of escape from the invidious consequences of class distinction. It may be that in this element of free will and means of escape for the individual subtly lies the legality of the Wright system—a reflection that conjures up abstract philosophic recollections far enough removed from the business of electric supply. An essay on the Wright system by a modern Kant or Jonathan Edwards would prove curious reading for Christmas."

LETTERS TO THE EDITORS.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—Mr. Woolsey McA. Johnson's communication, published in your issue of Jan. 11, fails to prove anything regarding the main point at issue in our controversy. Mr. Johnson claims that I have "misquoted and misunderstood" him. I deny that I have misquoted him in any way. That I misunderstood him is not my fault, for two reasons.

First, Mr. Johnson uses the term "aqueous tension" in a sense which appears to be original with him. At least, I have looked over quite a number of books on chemistry and physical chemistry, and I have consulted prominent chemists, but I have failed to find any one using the term "aqueous tension" for what is always called vapor tension or vapor pressure. Indeed, there is no reason whatever to give up these good old terms, which signify exactly what they mean, and to replace them by the ambiguous term "aqueous tension." I do not see that it helps Mr. Johnson to refer now to the German term dampfspannung. Dampf is vapor in general, and dampfspannung is vapor tension, not necessarily vapor tension of water.

Secondly, in his original article Mr. Johnson gave his formula as an argument to prove that an increase of the concentration in the pores of the one electrode of the new Edison cell with a simultaneous decrease of the concentration in the pores of the other electrode (the total concentration being unchanged) could not have any great influence upon the e. m. f. of the cell. It is this statement which is the point at issue in our discussion. Mr. Johnson gave his formula with the utmost brevity and without any proof. So I had to consider it in the light of the conclusion which he deduced from it regarding the Edison cell. This I have done, and hence my misunderstanding. The only way in which it would have been possible to use the formula for obtaining the above conclusion regarding the Edison cell (although by a faulty argument) was to consider the formula in the way I believed, at that time, Mr. Johnson meant it. On the other hand, from the theory now given by Mr. Johnson, it is impossible to deduce the above conclusion regarding the Edison cell. Mr. Johnson considers a cell with a reversible metallic oxide electrode, a reversible hydrogen electrode, and a KOH solution, and he calculates the difference of the e. m. f.'s of two such cells with different concentrations of the KOH solution. This is very interesting, but as I have said in my last article—and Mr. Johnson has not replied to this point of my criticism—the hydrogen electrodes in both cells here introduce only complications. The difference of the e. m. f.'s calculated by Mr. Johnson does not give the variation of the e. m. f. between the nickel peroxide plate and the solution alone, but it gives it together with the variation of the potential difference at the hydrogen electrode. Hence, while the difference of the e. m. f.'s of the two cells may be very small, this does not necessarily mean that the difference of the e. m. f.'s between the nickel peroxide plate and the solution in the two cases must be small.

The correctness of my criticism is very clearly brought out by some instructive measurements, described by Dr. F. Dolezalek in the very book to which Mr. Johnson refers: "Die Theorie des Bleiaccumulators," on page 41 to 44. It is there stated there that the e. m. f. of the spongy lead plate in the lead accumulator with respect to a hydrogen electrode increases with increasing concentration of the acid, while the e. m. f. of the same plate with respect to a mercurious sulphate electrode is practically independent of the concentration. Dr. Dolezalek draws the correct conclusion that measurements of the e. m. f. of a separate electrode against such auxiliary electrodes (like the hydrogen electrode and the mercurous sulphate electrode) do not give a clear insight into the variation of the potential of the electrode under test, alone, because the potential of the auxiliary electrode also changes, so that the same plate may appear to behave differently against different auxiliary electrodes.

Finally, Mr. Johnson briefly states that the e. m. f. of a cell of the oxygen-lift type is nearly independent of the concentration. This is also very interesting, but it again does not touch the point at issue. What Mr. Johnson finds to be practically zero, is the difference of the e. m. f.'s of two Edison cells of different total concentration, but the concentration in each cell being uniform. The point at issue, however, is an entirely different one, namely, the determination of the difference of the e. m. f.'s of two Edison cells of the same total concentration, but differing in so far that in the one the concentration is uniform throughout the cell, while in the other the concentration in the pores of one electrode is greater than the total concentration, and that in the pores of the other electrode is smaller to the same degree. Mr. Johnson's calculations—though they are certainly interesting—do not prove anything concerning this vital point.

This is why I still must consider the whole matter as an open question. It will, however, be relatively easy to settle it by experiment, after the Edison cell has been placed upon the market.

E. F. Roeber.

Philadelphia, Pa.

Engine Specifications.

To the Editors of Electrical World and Engineer:

Sirs.—I should like to put a query through your paper on a technical question, which is of much importance to central station men at the present time.

Not a little difficulty is encountered in getting contracts from en-

gine builder and dynamo builder covering the matter of parallel operation of alternators. The engine builder in his specifications guarantees a certain speed regulation for his engine, and the dynamo builder guarantees that the alternators will work satisfactorily in multiple, providing the maximum angular displacement in one revolution of a point on the periphery of the engine flywheels does not exceed 7/100 of an angular degree from the position of a reference point upon the periphery of a wheel revolving with absolute uniformity at the normal generator speed. This departure from uniform rotation corresponds to an electrical phase displacement of 2½ degs.

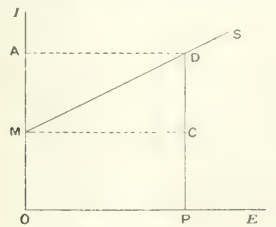
The point which I would like to ask through the columns of your paper, is whether there is a clause which can be stated in plain English which will protect the customer, yet be fair to both the generator and engine builders, and cover the successful operation of engine type alternators in parallel operation. It will be readily perceived that the regulation guaranteed by the engine builder of, say, 2 per cent, from no load to full load, and the requirement of the dynamo builder relative to angular displacement, do not cover the same ground and, consequently, the customer must assume the responsibility for the successful operation of his apparatus.

BOSTON, MASS. CHAS. M. BERTRAM.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Testing Dynamos.—BIENAIME.—The losses in a dynamo are the sum of the Joulean loss in the armature, the Joulean loss in the field and the power required to turn the machine as a motor unloaded in the same flux and at the same speed. This power is found by the method of Swinburne, who runs the machine as motor unloaded so that its speed is the same which it has as generator, and that the counter e. m. f. of the motor is equal to the total e. m. f. of the machine running as generator in order that the flux is the same in both cases. The e. m. f. which is required for this test must evidently be greater than the normal voltage at the terminals of the machine running as generator (at least by the amount of the loss of voltage in the armature). The present author describes the following method for which an artificial source of e. m. f. of lower voltage is sufficient. If a separately excited dynamo is run as a motor unloaded the speed is proportional to the e. m. f. *E* applied at the terminals of the armature. Furthermore, the current *I* is a linear function of the current *I*



TESTING DYNAMOS.

which flows. In the adjoining diagram the ordinates are *I* and the abscissas *E* and the straight line *MS* represents *E* as function of *I*. The length *M O* represents the current required for starting. For a voltage represented by the abscissa *O P*, the hysteresis and friction losses are given by the surface of the rectangle *P O M C*, the eddy current loss by the surface of the rectangle *M A D C*. This diagram can, however, be plotted by making a test at a lower voltage than the normal voltage of the dynamo. At constant excitation, the e. m. f. at the armature terminals of the motor running unloaded, is equal to the speed multiplied with a constant which depends upon the flux and the number of turns. Therefore, in the test the excitation is to be adjusted so that the equation just mentioned is fulfilled, the constant in it being known. The excitation is then kept constant and the current is mesaured for various e. m. f.'s and the diagram is then plotted.—*L'Ind. Elec.*, Nov. 25.

Testing and Management of Motors.—WHITE.—The first part of an article in which he abhors the use of involved algebraical formulas for central station testing, and gives some practical hints. For motor testing the "artificial load" method is the best, and the one most generally used, but when a testing tank is used, the greatest care is necessary. An ammeter in the circuit and proper cutouts are absolutely necessary. It will pay to fit up a properly equipped testing board even when very little testing is done. An important adjunct of any station with pretension to a power load is a small alternator of, say, 15 to 25 hp, having a terminal voltage of 2000 or 3000. With the help of this it is easy to reject faulty machines, as 2000 volts alternating between winding and frame will soon bring to light in more than one way the weak points in a bad machine; of course, several machines can be submitted to this test at the same time. In connection with this, he mentions another method of testing motors, which he would like to see come into use more generally. With the help of a short countershaft having different sizes of pulleys to suit the varying speed requirements of different motors, the alternator can also be used to furnish a load of incandescent lamps through a suitable transformer. He sees no reason why the required load should not be the station lighting load.—Lond. *Elec. Rev.*, Dec. 27.

Cooling of Transformers.—SESSIONS.—In a California power house difficulties were experienced during the summer with transformers which got very hot. It was found that some other means than radiation of the air must be used. The following method proved satisfactory. The oil in the transformers is pumped through long coils of iron pipe, which are placed in the tail race in such a manner that the discharge from the waterwheels plays over them, reducing the temperature well below that of the oil coming from the transformer. These cold pipes cool the oil and return it to the transformers, keeping them much cooler than they would otherwise do. A table is given, showing the results of temperature measurements.—*Jour. of Elec.*, Nov.

Breaking of Shafts in Direct-Coupled Units.—An editorial note stating that the breaking of shafts in direct-coupled units, due to oscillations set up at critical speeds, is not a phenomenon of frequent occurrence, yet on some few occasions shafts have fractured under circumstances which appeared inexplicable, except on the hypothesis of a resonance effect creating cumulative stresses. Reference is made to a recent mathematical paper by Frith and Lamb, read before the Manchester section of the (Brit.) Inst. Elec. Eng. "The moral is that direct-coupled sets should be so designed that there shall be no possibility of the natural period of oscillation of the shaft synchronizing with the pulsations of the engine."—Lond. *Elec.*, Dec. 27.

REFERENCE.

Synchronous Converter.—RUSHMORE.—An illustrated article on the practical use of the synchronous converter and the phenomena of its operation. Hunting is discussed at some length, also the methods of starting. Some notes are given on speed control and on compounding.—*Eng. Mag.*, Jan.

LIGHTS AND LIGHTING.

Crawford-Voelker Lamp.—An anonymous communication referring to the article on this new English lamp, which was recently abstracted in the Digest. It is pointed out that in Holden's report the voltage and candle-power of the lamps tested are not stated, and that, therefore, the comparisons made are unfair. An editorial note says that the lamps tested by Holden were evidently 8-cp, 200-volt lamps, although this is not definitely stated.—Lond. *Elec. Rev.*, Dec. 20.

REFERENCE.

Blue Printing by Electric Light.—REIST.—His illustrated paper in full on the method used by the Gen. Elec. Co. for making blue prints by electric light.—*Transactions Am. Soc. Mech. Eng.*, v 22, 1901.

Incandescent Lamps.—Swinton.—An illustrated article on the methods used in the U. S. for making and testing incandescent lamps. —*Cassier's Mag.*, Jan.

POWER.

Economy of Electric Driving.—Marshall.—An abstract of a paper on "Electricity as a motive power, and its relation to economy." He considers the installation of electric power in a textile factory. He thinks an individual motor for each machine would be too expensive, and, therefore, prefers to install one motor in each department with shafting. He gives an estimate of the power required in the different departments and of the cost of the installation. He estimates the total cost of a complete electric plant for 500 hp with a direct-driven high-speed dynamo at $33,380, while the initial cost of a steam driving plant is only $26,950. Thus there is a difference in capital outlay in favor of steam of 20 per cent less than electricity. The extra annual cost of running and maintaining the electric plant he estimates at $1,650. Steam driving appears, therefore, more economical. But if a new factory were being built, and the supply of electricity for the motive power were got from some outside company and the steam engine, main gearing, and other lines of shafting used in transmission of power as well as the boiler, were dispensed with, a very considerable amount of outlay of capital would be avoided, and in case of a further amount of power being wanted it would only be a matter of putting down another. This is a very important consideration in favor of electric driving.—Lond. *Elec. Eng.*, Dec. 20.

REFERENCES.

Niagara Falls Power.—Barton.—A well illustrated article on the organization of the operating department of the Niagara Falls Power Company.—*Cassier's Mag.*, Jan.

Steam Turbine.—Thurston.—A very long illustrated paper on the steam turbine, "the steam engine of maximum simplicity and of highest thermal efficiency."—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Gas Engine.—Sargeant.—An illustrated paper on "A new principle in gas engine design."—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Flywheel and Angular Variation.—Astrom.—A long illustrated paper on the calculation of flywheels for keeping the angular variation of an engine within a fixed limit.—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Power in Mills.—Walsh.—An article on electricity in Southern cotton mills.—*Elec. Rev.*, Jan. 4.

Electricity in Manufacturing Works.—Aldrich.—His paper in full, together with the discussion which followed, on "Requirements of electricity in manufacturing work, an abstract of which has been mentioned before in the Digest.—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Electric Elevators.—An illustrated article on the electric lifts of the City & South London Railway. They are 26 in number, the capacity ranging from 55 to 100 people, and the ordinary working speed being 180 ft. per minute.—Lond. *Elec. Rev.*, Dec. 13.

TRACTION.

Load Factors and Circuit Breakers in Traction System.—An anonymous article. Observation has shown that the load factor naturally and markedly improves with the number of cars at work. The maximum load that practice has decided upon as allowable, and as really determining the load factor, is that which can be suffered to occur many times daily. Any further maximum is disallowed by the main circuit breaker, for this is set to act in a way to forbid the severe effects of an occasional simultaneous starting of many cars. These simultaneous startings are more apt to occur when cars are fewer, and embrace a larger proportion of the total load, and this is why it is that circuit breakers must be set proportionately higher for few than for many cars. The setting of the main cut-out is a matter of real importance. If set too low, the cut-out will act too often. Cars will constantly find themselves without current. If the circuit breaker is reset quickly the load factor will be improved. On the other hand, when circuit breakers are set unjustifiably high, they will rarely act, and will expose the machinery to unnecessary and undesirably high stresses, at the same time the load factor will be reduced. Between these two extremes there is a point at which the instrument should be set by experiment. It should always be set low to begin with, i. e., it may be set to act when the current is from 50 to 30 amperes per running car, according to the size of the station. If, with the first setting, it acts too frequently for the convenient working of the station, it may be then screwed up to a higher pitch, but not so high that it ceases to work from time to time. While the heavier draughts of current by several cars may occasionally synchronize, all such efforts are preferably to be eliminated by the action of the circuit breaker which cuts off the high peaks of the autographic record, and reduces the maximum flow of current to such a multiple of the mean current as practice has shown to be reasonably consistent with convenience of working, and the safety of the station. The circuit breaker, in fact, seems to effect the best compromise between opposing interests. A circuit breaker is too often regarded simply as a device for taking care of short circuits and cable damages. Quite as important is it that it should cut off what would be the excessive peaks of the load diagram. It is not desirable that on an up-grade of considerable angle a car should be deprived of power. It is, therefore, right that lines of severe gradients should be allowed a higher maximum current than is proper in more level systems. A fairly approximate prognosis of the load factor, and the average current per car, is important not only for the design and provision of the station outfit, but also for the design and copper contents of the distribution system. The rapidly augmenting weight of later cars will materially affect the total current consumption, but will probably have but small effect upon the load factor, as this is dependent upon the number of individual loads, rather than upon the size of such loads. Still, it is desirable that statistics should be kept, and made available for all running systems, showing all the conditions and the power consumption, car hours and mileages, etc., without which knowledge the design must be more or less a matter of guesswork.—Lond. *Elec. Rev.*, Dec. 27.

Accelerometer.—Corey.—An illustrated paper, read before the Am. Soc. Mech. Eng. on a portable accelerometer for railway testing. It may be used for securing direct readings of acceleration and retardation of moving cars and trains. The action of this instrument depends upon the inertia of a small mass of mercury contained in a horizontal passage, the ends of which are in communication with two short vertical columns of mercury. Thus the flow induced in the horizontal passage produces a difference of level in the vertical columns, which difference of level is wholly dependent of the horizontal component of the acceleration in the plane which passes through the axes of the two vertical columns. Upon this difference of level, or rather upon the change of level of either column from a given zero position, must depend the indication of the instrument. In a small instrument, however, this change of level is very small. Therefore, colored alcohol or other liquid of low specific gravity is introduced into the spaces above the mercury columns, to which spaces the reading tubes are connected. The reading tubes are of comparatively small diameter. Thus the ratio of the cross-section of the mercury column to the cross-section of the reading tube, become approximately the multiplier of the changes of mercury levels. The uper ends of the two reading tubes are connected so as to prevent evaporation and spilling of the liquids. The reading scale is provided with vertical adjustment to facilitate the proper location of the zero point. If the accelerometer be set to the zero position when the car is either at rest or moving uniformly on either a level or gradient, the indications will be accurate only as long as the car remains on a track of constant grade. When the grade changes, the accelero meter must be readjusted or the proper correction made. When the resetting cannot be done at the time of testing, it should be set at zero on a level track, and the car run over the road and brought to rest on all grades to be measured. In this way the instrument becomes a gradiometer. The instrument may be combined with a recording device; a record curve thus obtained is reproduced. A feature of the instrument is the accuracy with which it follows rapid changes without excessive and sometimes without perceptible, oscillation due to the inertia of the moving liquids. The best results are obtained when the cross-section of the passage at the bottom of the mercury columns is so proportioned as to give the proper damping effect. (In its principle the instrument is similar to that of Kapp. See Digest, Aug. 11, 18, 1900.)

REFERENCES.

Electric Car Equipments and Maintenance.—Wilgus.—A long paper read before the Newcastle section of the (Brit.) Inst. of Elec. Eng. Under the heading car bodies he discusses the stairway, ventilation and details; he then describes the car equipment, trucks, brakes, sanding gear, life guards route indicators, motor equipment,

trolley heads, trolley standards and controllers. In conclusion, he deals with the maintenance of the cars.—Lond. *Elec. Eng.*, Dec. 27.

Mechanics of Electric Traction.—A summary of formulas showing the relation between the various principal mechanical factors in the movement of cars and trains.—*St. R'y Rev.*, Dec. 15.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Two-Wire and Three-Wire Systems.—A paper by Dean on the power plant of the Mass. General Hospital, of Boston, Mass. The electrical power is used for lighting 2000 incandescent lamps, for operating elevators, a refrigerating machine and various motors. There are two 100-kw and one 50-kw generator. The voltage is 220, and the wiring is on the two-wire system. As the exhaust steam is utilized during most of the year for heating, the extra steam consumption caused by the lower efficiency of the 220-volt lamps compared with 110-volt lamps is not a case of extravagant coal consumption. He says that the following considerations led him to the adoption of 220 volts: "The use of half as many generators as would be required by the three-wire, 110-volt system, with lower cost of installation and less cost of maintenance, etc.; a smaller engine room and, therefore, a less expensive building; a smaller building, which, considering the available space, was a very important feature; cheaper engines and cheaper foundations on account of extending for an outboard bearing only on one side; less expensive wiring." In the discussion which followed, Darling asked what objection could there have been to the use of a 110 or 120-volt, two-wire system. The only serious difference in cost would have been in the copper, and that would be met by the difference in efficiency of lamps during at least six months of the year when no heating is done and the exhaust is wasted. Katte said that for the 300-kw plant of the N. Y. Central & Hudson Railroad at Albany the 220-volt direct-current two-wire system was adopted. The important reason for this "was a consideration of the load diagrams, from which it was apparent that power units in multiple of 75 kw would give the most economical distribution of loads during each hour of the 24, both in summer and winter. It was further considered desirable to install machines of the same size, and thus render the plant more nearly interchangeable, hence had the 110-volt, three-wire system been adopted it would have required the installation of a large number of quite small machines of less efficiency, requiring more floor space and more attendance, which it was believed would fully offset the lower efficiency of the 220-volt lamps. In the West Shore Railroad plant at Weehawken the 220-volt, two-wire system is also used. Henshaw criticised Dean's statement that the use of half as many generators was one of the reasons for adopting the 220-volt, two-wire system. It is not at all necessary to use two generators for the three-wire systems. They may, for instance, be avoided by means of a small motor-dynamo. In regard to the economy of 220-volt lamps as compared with 110, he said that the best present commercial 110-volt lamps consumes about 3.1 watts per candle and the 220-volt lamp about 3.8. For an equal number of lights of the same illumination, one saves about 18.5 per cent in power by using the 110-volt lamp. Assuming a total of 1000 lights and an average illumination of four hours a day for 365 days, and the cost of the kw-hour at 4 cents, there is an annual saving of about $654, which would be the interest on something like $10,000. Therefore, in such a plant about $10,000 must be saved on the original cost to make it pay to use the 220-volt lamp rather than the 110-volt lamps. Bolton referred to installations of 3000 or 4000 lamps in New York, put in on the two-wire, 240-volt system; but the reasons were that there was a specially large motor load, and it was desired to keep the whole system of one character to avoid complication. In another installation with 15,000 lights and a motor load of 100 kw, he uses the three-wire system for motives of economy. He mentioned the following difficulties in connection with 220 or 240-volt systems. The lamps are shorter lived and tender, and cannot be placed with impunity in all kinds of positions. Moreover, "there are so many apparatus of an exterior character which are sold nowadays, designed for use with 110 and 120 volts, which the tenants of a building will bring in and put on 220-volt circuits and break them, and will then charge the owner of the building with the cost."—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Central Station Statistics for France.—SOULIER.—Twenty-nine full pages of statistical tables, giving in different columns, the name of the city or town, the population, the name of the company, the date of starting electrical supply, information about lighting, power, the capacity of the station, the capacity and type of the dynamos, the system used, further information about the distributing network, the rate of charging, etc. A summary of the statistics is not given, but the following general notes are added. In the mountain districts the number of central stations has largely increased. In the valley of Gresivandan there are 50 small towns around a station. Water power plants are found in Savoy, and in the Pyrenees. The city of Limoges is supplied with electricity from a hydraulic station at the falls of the Vezen River, 75 kilometer distant. There is a tendency to increase the direct-current supply voltage to 220. Many cities also use the 2-by-220-volt, three-wire system. The single and polyphase alternating-current systems have become more and more numerous. The three-phase system especially is often used. The transmission voltage of the three-phase plant of St. Georges is 20,000. The 5000-hp plant of St. Etienne distributes three-phase currents at 5000 volts over a manufacturing district, there being 4000 electric motors installed. The series distribution for public arc lighting disappears more and more. The price of electrical energy varies greatly, the limits being 10 and 20 cents per kw-hour. The use of meters becomes more and more general. Several cities have adopted the variable tariff of Brown and Routin.—*Supplement to L'Ind. Elec.*, Dec. 10.

San Jose.—An illustrated description of the system of the Electric Improvement Company, of San Jose, which is representative of recent methods of using steam auxiliaries in the distribution of transmitted power. There is a steam-driven, 400-kw, 2300-volt, three-phase generator which supplies current for the operation of the incandescent lighting and induction motor load, in parallel with transmitted power, while the arc lighting system is similarly supplied by three General Electric constant current transformers, each delivering alternating current for the operation of a series of 50 enclosed arc lamps of 2000 cp. The company holds a contract with the Standard Electric Company for the distribution of electrically transmitted power from the Standard lines in and about San Jose. The sub-station adjoins the power plant and contains 300-kw transformers, having primaries interchangeable from 40,000, 50,000 or 60,000 volts, and delivering 2300 or 4000 volts in star connection, two motor-generator sets of 150 and 200 kw and a storage battery of 270 cells. The motor-generators change three-phase current at 4000 volts into direct current at 550 volts for street railway and direct-current power service.—*Jour. of Elec.*, Nov.

Electric Light Costs and Charges.—An article giving some averages of electric light costs and charges in the Eastern, Middle, Southern and Western States. The summary for all States together is as follows: Lowest cost of coal, $1 per ton; highest cost, $6; average cost, $2.96; highest basic rate of charge, 20 cents per kw-hour; lowest minimum rate, 1 cent; average, 12.3 cents, while the average minimum charge to large consumers is 5.1 cents.—*Elec. Rev.*, Jan. 4.

REFERENCE.

Chicago.—JUNKERSFELD.—An illustrated article on central station expansion in Chicago. The kw-hour output of the two companies which carry on the supply of electrical energy has increased nearly 25 per cent last year. A description is given of the additions in plant. —*West. Elec.*, Jan. 4.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Alternating-Current Transmission Lines.—STARTSMAN.—A long and chiefly mathematical article on the theory and calculation of alternating-current transmission lines. In a general introduction he notices the various factors which are liable to affect an alternating-current transmission line. He then deals at greater length with the determination of the four most important constants: The effective resistance, the effective reactance, the effective inductance due to leakage current, and the effective susceptance due to capacity. The calculation of a transmission line is then given by two methods. First, by the topographical method, and then by Steinmetz's symbolic method. The results are applied to the calculation of a special numerical case and to the construction of a mechanical model of a transmission line.—*Elec. Rev.*, Dec. 28.

Development of the Locke Insulator.—LOCKE.—An illustrated article on the gradual development of his glass and porcelain insulators up to the types used in the systems of the Standard Elec. Co. and the Bay Counties Power Co.—*Jour. of Elec.*, Nov.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Resonance and the Coherer.—KIEBITZ.—In his investigations of the electric oscillations of a straight conductor, he made the observation that a coherer acts most readily when connected up with two wires parallel to the exciter wires, and when the length of the wires attached to the coherer is that of a quarter-wave length each. Hence the coherer shows the maximum action in the node of potential. Slaby, on the other hand, found the explanation of his system of multiplex space telegraphy upon the opposite assumption, that the coherer is best placed in a neutral segment of the variation of potential. The present author has, therefore, extended his observations and confirmed his former result. It is evident that the coherer will give the best indications when the greatest possible difference of potential is produced at its ends. Now, if the cohorer acted as an insulator of very small capacity, the best arrangement would be to attach wires of a length equal to half a wave-length. But if the capacity of the coherer is very great, or if the coherer acts as a conductor, there must be resonance when the length of the attached waves is equal to a quarter-wave length, and this arrangement would be most favorable when placed at the node, although there may then be a minimum potential difference at the ends of the coherer. He concludes, therefore, that the coherer acts as a great capacity or as a conductor. It probably acts as the former in its original state, and as the latter after the impact of the waves. He used coherers made of iron screws.—*Ann. der Physik,* No. 12; abstracted in Lond. *Elec.,* Dec. 27.

X-Light.—ROLLINS.—A continuation of his very long serial in which he gives three different notes. In the first he describes an experiment which seems adverse to the theory that X-light is a flight of particles. The second deals with photographic results with X-light, specially with arrangements for making photographs with a practically instantaneous exposure. The third note refers to the sources of the cathode stream. He describes the following experiment: The cathode of an X-light tube was placed in a glass receptacle with an opening toward the target, which was only large enough to allow the stream to pass through it. When the gases from the cathode had been removed by heat and heavy surges, the tube was of no practical use as a source of X-light, for the free circulation of the gases had been interfered with and the cathode stream had had no time to recuperate.—*Elec. Rev.,* Dec. 28. Another continuation of his serial, dealing with the importance of lowering the initial resistance of an X-light tube.—*Elec. Rev.,* Jan. 4.

ELECTRO-CHEMISTRY AND BATTERIES.

Manufacture of Metallic Sodium.—DARLING.—After a brief account of the former sodium methods, he describes his electrolytic method of making metallic sodium and nitric acid from fused natural, sodium nitrate. The process is used by Harrison Brothers & Co. in Philadelphia, in a 12-cell plant, capable of decomposing from 700 to 800 lbs. of nitrate per day. The first experiments made by him showed the necessity of separating the reduced metallic sodium from the nitrate. This made the use of a diaphragm cell an absolute necessity. A satisfactory diaphragm is a granular body of vitrified magnesium oxide, confined between the walls of perforated sheet iron. This was made by fusing pure magnesium oxide to a vitreous mass in an electric furnace, grinding it and pressing it into a round cup having double walls of perforated sheet steel. As the first cost of the electrically fused magnesia filling for the cup was very high, a cheaper material was looked for and found in a mixture of ground, dead-burned magnesite and Portland cement. The construction of the total cell is as follows: A cast-iron pot set in a brick furnace to contain the nitrate to be decomposed also acts as anode. A 6-inch layer of refractory insulating material is placed in the bottom of the pot, and the porous cup rests centrally on it, leaving a 3-inch space between the cup and the bottom. This space is then filled with sodium nitrate, and the cup itself is nearly filled with melted sodium hydroxide. The cathode consists of a short length of 4-inch wrought iron pipe and is suspended inside the cup, reaching nearly to the bottom. When external heat is applied, the electrolytes melt. When current is passed through the cell, sodium is liberated at the cathode, it rises to the top of the cup and is dipped off with a spoon. At the anode, nitrogen dioxide and oxide are liberated as gases. They are conducted through pipes to a number of receivers or Woulff bottles, containing water; the gases combine with the water and form nitric acid, as a valuable by-product of the process. Each cell takes a current of about 400 amperes at 15 volts. External heat is used only when starting up and when charging the cups which have a life of 425 to 450 hours. At first the perforated sheet steel walls had a very short life, being quickly eaten away by local action caused by the secondary effects of the current. This trouble was overcome by shunting about 5 per cent of the current directly through the metal walls of the cup, making them secondary anodes. This has increased the life of the cup about tenfold. He discusses the use of sodium for making sodium peroxide and for making cyanides.—The same number contains the official report of a special committee of the Franklin Inst. on Darling's invention, for which the John Scott Medal has been awarded to him.—*Frank. Inst.,* Jan.

Aluminum.—MORRIS.—A long abstract of a paper read before the (Brit.) Inst. Elec. Eng., on "Aluminum, notes on its production, properties, and use." He describes the only British aluminum plant which is at Foyers and utilizes water power, there being seven turbines, direct coupled to 700-hp, direct-current generators. All the processes for aluminum production now at work, consist in the reduction of alumina. Other compounds of the metal offer great inducements, notably the chloride and sulphide, their voltages of decomposition, 2.3 and 0.9, respectively, being lower than that of alumina, which is 2.8; unfortunately, however, the two former compounds are difficult and expensive to produce. A description is given of the electrolytic methods of Heroult and Hall. The present world's output of aluminum is estimated at something over 5000 tons per year, whereas the yearly output of the metals with which it chiefly competes—namely, copper and tin—is about 497,000 tons and 79,200 tons, respectively. The properties of aluminum are described. Sheets can be hammered down to 0.000025 inch thick, in consequence of which it has largely replaced silver leaf, and wire can be drawn down to 0.004 inch. According to Wilson's, aluminum 99.55 per cent pure, has a specific resistance of 0.000002762 legal ohms per cubic cm., at 15 degs. C., with a temperature coefficient of 0.00393 per deg. C. The following comparison of copper and aluminum wires is given, the first number always referring to copper wire, the second to aluminum wire: Specific gravity, 8.93 to 2.65; conductivity, 100 to 61; section for equal conductivity, 1 to 1.64; diamter for equal conductivity, 1 to 1.28; weight for equal conductivity, 1 to 0.485; weight for equal section, 1 to 0.297; tensile strength for equal section, 1 to 0.46; tensile strength for equal conductivity, 1 to 0.75. He advocates the use of aluminum wires, especially for high-tension transmission.—Lond. *Elec. Eng.,* Dec. 20.

REFERENCE.

Aluminum.—WILSON.—An abstract of his recent (Brit.) Inst. Elec. Eng. paper in which he gives several very valuable tables, which are reproduced. The first table gives the tests of commercially pure aluminum, two other tables give the tests of various aluminum alloys. —Lond. *Elec. Rev.,* Dev. 27.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrometers.—DUANE.—In most symmetrical electrometers, such as the quadrant, the needle or movable conductor is made of different material from that of the fixed conductors. It is important in such cases to determine the effect, if there is one, of the e. m. f. existing between two metals in contact with each other, or, more strictly speaking, of the difference in potential between two points in the air just outside the two metals in contact, respectively. He has found both theoretically and experimentally that the Volta contact e. m. f. under certain very common experimental conditions, may introduce a large error into the measurement of a potential difference. He has also found that if the needle is suspended on a metal wire by means of which it is charged, and if the instrument is used idiostatically the quadrant electrometer can be used to measure the Volta e. m. f. with great accuracy. The paper is largely mathematical, and cannot well be abstracted.—*Phys. Rev.,* Dec.

A Low-Temperature Thermometer.—PELLAT.—A description of a low-temperature thermometer, based upon the Peltier effect. He uses an iron-zinc couple on account of its great thermo-electric power at low temperatures. The part to be exposed to the low temperature has the shape of a cylindrical bar about 20 cm. or 30 cm. long, with a junction in the middle. This bar is enclosed in a glass tube and brought into the space whose temperature is to be measured. A current is sent through sufficient to produce a measurable Peltier effect, but no perceptible Joulean heat, and its direction is such as to produce a cooling of the junction, and this cooling is compen-

sated by heat supplied by a small heating coil, so that the resulting difference of temperature, as indicated by two auxiliary thermo-couples, becomes zero. He gives the theory of the instrument, and shows that at an absolute temperature of 20 degs. the error would not exceed 1.5 degs.—*Comptes Rendus,* Dec. 2; abstracted in Lond. *Elec.,* Dec. 27.

REFERENCE.

Acceleromcter.—See the abstract under Traction.

TELEGRAPHY. TELEPHONY AND SIGNALS.

REFERENCES.

Johnstown.—An illustrated article on the development of independent telephony in Johnstown, Pa.—*West. Elec.,* Jan. 4.

Wireless Telegraphy.—MAVER.—An illustrated article on the past and present status of wireless telegraphy and its prospects.—*Cassier's Mag.,* Jan.

MISCELLANEOUS.

REFERENCES.

Alloys as Solutions.—MATHEWS.—The first part of a very long illustrated summary. After a historical introduction the following subjects are dealt with: Crystalline growth of metals, the effect of strain, freezing point of metals, binary alloys, solid solutions, behavior of binary alloys during cooling from the fused state.—*Eng. and Min. Jour.,* Dec. 21.

Glasgow Exhibition.—BATHURST.—A continuation of the illustrated serial on machine tools at the Glasgow Exhibition, with special reference to the requirements of dynamo and motor manufacturers. The present part deals with grinding machines and planing machines.—Lond. *Elec. Rev.,* Dec. 27.

Electrical Progress.—ALDRICH.—An article on electrical progress in the United States in 1901, giving condensed notes on the Edison battery, the Nernst lamp, and progress in distributing systems, electric traction, and power transmissions.—*West. Elec.,* Jan. 4.

Wheeler.—DUNN.—A biographical sketch of Schuyler Skatts Wheeler, with a portrait.—*Cassier's Mag.,* Jan.

New Books.

HOW TO BUILD A THREE-HORSE-POWER LAUNCH ENGINE. With a Full Set of Working Drawings and Explanatory Text. By E. W. Roberts, M. E. Cincinnati, Ohio: The Gas Engine Publishing Company. 66 pages, illustrated. Price, $2.50.

The author's purpose in writing this work was to give absolutely all the information required by an ordinarily intelligent mechanic, to enable him to construct the engine named in the title. The subject is treated in an eminently practical manner, giving detailed instructions for the manufacture of each part. One of the principal features of the book is the complete set of working drawings. There are 14 sheets of these drawings, and the size, 10 by 12½ inches, has been adopted for the page, for their accommodation. The drawings are for the most part complete and accurate. There is, however, one omission noted in the text on page 6. and we think the clearness of the drawings would be greatly increased and their value enhanced by the use of shade lines at the bottom and right of all solid parts and at the top and left of all openings. For the accommodation of those who wish working drawings on a larger scale, the publishers state they will furnish blue prints of the original drawings for a moderate price.

The author contends that an engine of the four-cycle type is easier for an amateur to construct than is one of the two-cycle type; he therefore, chose the former for his subject. The engine has been designed with especial reference to building it with small tools. No piece, except the flywheel, which is 18 inches in diameter, requires a lathe swing of over 16 inches, and the cylinder and base are cast separately to facilitate machining, although the total amount of machining is somewhat increased thereby.

Nothing but practical information is contained in this volume, and the reader is referred for all theoretical and even some descriptive matter to the author's "The Gas Engine Handbook."

BOOKS RECEIVED.

ELEKTRO INGENIEUR KALENDER, 1902. By Arthur H. Hirsch and Franz Wilking. Berlin: Oscar Coblentz. 209 pages. Price, 2.50 marks.

A SCHOOL CHEMISTRY. By John Waddell, B. A. (Dal. Coll.), B. S. (Lond.), Ph.D. (Heidelberg), D. Sc. (Edin.). New York: The Macmillan Company. 278 pages, 90 illustrations. Price, 90 cents.

ANNUAIRE POUR L'AN 1902. Publié par le Bureau des Longitudes. Paris: Gauthier-Villars. 656 pages. Price, 1.50 francs.

Novel System of Decorative and Sign Lighting.

Among the recent developments in electrical lighting, to which we called attention on its preliminary introduction here, is the "Elblight" system, which is controlled by the National Electric Improvement Company, of New York. The fundamental principle covered by the system consists in obtaining for incandescent lamps electrical contact by the insertion of pin terminals on the lamps connecting through a self-healing insulating medium into an easily perforated electrical conductor. One form of this system consists in display signs. These display signs—or, as they are called, electric lighting boards—are made up of a number of parallel conductors, properly insulated with a special compound, and the surface then covered with a specially treated cork carpet. When finished this board looks like a cork mat. At any point where a lamp is stuck in on this board, the lamp will engage the two sides of the electric conductor and derive current. It can be readily seen that on this cork surface, therefore, any lettering or design whatsoever can be made, and then outlined with electric bulbs of different sizes, shapes and colors to suit the fancy of the



FIG. 1.—BANQUET ROOM DECORATION.

artist or consumer. The board can be used indefinitely, and the designs or lettering on it can be varied rapidly without any expense beyond that of the time consumed in drawing the lamps out from one place and sticking them into another. This is done with the same ease that a pin is inserted into a pincushion.

Another form of the apparatus made by the National Electric Improvement Company consists in a twin cable. This cable is made up of 300 fine wires that form an aggregate carrying capacity equal to that of a No. 5 B. & S. gauge wire. These fine wires are braided in a peculiar manner which gives the cable great flexibility and permits the free insertion of pin terminals without causing any disruption in the fine strands.

The cable is insulated with a very high grade of rubber compound, such as is used in the United States Navy, and after submersion in water for 48 hours withstands a breakdown pressure of more than 8000 volts. On the galvanometer it shows a resistance of 800 megohms to the mile. It can be twisted and turned into any shape. The ease with which the lamps can be inserted and withdrawn permits the decorative artist to obtain exactly and at once the effects he desires. The company make a special base for their lamps in connection with their cable to preclude any possibility of short circuit, and which renders it possible for the lamps to burn under salt water.

Two notable illustrations of the use of this system are now to be seen in New York City. One is the illumination of the Crystal Palace in the play, "The Sleeping Beauty and the Beast," which is running at the Broadway Theatre. This palace, which was made in Vienna for the Drury Lane Theatre, of London, is composed of 33,000 pieces of crystal. It was sent from Vienna to London where it met with

great success. The palace was then dismantled and shipped to this country and re-erected by Messrs. Klaw & Erlanger for the Broadway Theater. The requirements were that 2,000 lamps were to be put in this Crystal Palace, and the question arose as to how such a thing was possible with the old system. The question was speedily settled, however, by the use of the "Elblight" method. This system was installed and put in operation in three days, 2000 ft. of cable and 2000 4-cp lamps being installed. The play has been running daily since Nov. 4, and the management of the theater say that it is the only part of their electrical installation that has not required any care or attention or given any trouble.

The other illustration of the use of this system was to be seen quite recently in the palm garden of Pabst in Harlem, where 2000



FIG. 2.—CHRISTMAS TREE DECORATIONS.

lights were installed by four men in three days. In the center of the Garden a Christmas tree 55 ft. in height rose to the arched girders. This tree contains 300 4-cp lamps. Directly over it there hung an electric lighting board, 4 ft. wide and 12 ft. long, on each side of which were written the words, "Merry Xmas." The board in all contained 400 lamps, part of these lamps being colored and forming a border around the legend. From 20 different points of the various arches hang straight streamers 32 ft. in length, each streamer containing 32 lamps of different colors, the end of each streamer terminating in a spherical frosted bulb.

Renold "Silent Chain" Transmission Gear.

Among the latest plants to be erected at Niagara Falls is that of the Natural Food Company, makers of shreded wheat biscuit. The plant is driven throughout by induction motors and the power is transmitted to the machines by means of the Renold "silent chain" gear. The several views shown herewith illustrate the convenience and flexibility of this new method of power transmission. The drives vary in size from 1 to 40 hp. and there are nearly 40 of them.

The Renold chain, which furnished the subject of a paper read at the recent meeting of the American Society of Mechanical Engineers, automatically assumes its proper place on the wheel, thus distributing the load equally between all the teeth in mesh. As the chain elongates from use it takes a position farther and farther out on the wheel teeth, forming a larger pitch circle, exactly proportional to the increased pitch. In this way the initial perfection of action, which is lost in the ordinary chain as soon as the gear is started up, is in this case present to the very last.

Each link of the chain comes to its seat by a rolling action, and there is none of the sliding up and down the tooth, which is so

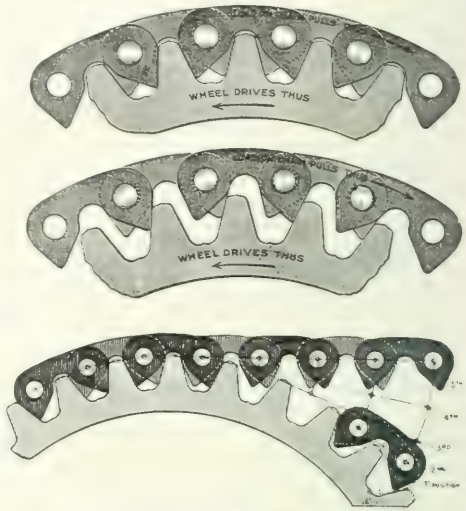


FIG. 1.—"SILENT CHAIN" TRANSMISSION GEAR.

destructive to both chain and sprocket. The action of the chain is shown by Fig. 1. The upper illustration shows the meshing when the chain is new, the one beneath when the chain has lengthened, .6 inch per foot, and the lower illustration shows the action of the chain in coming on and leaving the wheel.

The advantages of chain driving in general are that it has an absolutely fixed velocity ratio, unlike a belt, which will slip more or less. It minimizes loss in journal friction, since the chain does not depend on its tension for its adhesion to a sprocket as a belt does on a pulley; hence the chain is run loose and the only pressure on the journal is that necessary to the performance of useful work. Finally, it is especially adapted to damp and hot places where a belt cannot be used.

The particular advantages of the Renold chain are its unique properties of absolutely silent running and of high speed possibilities.

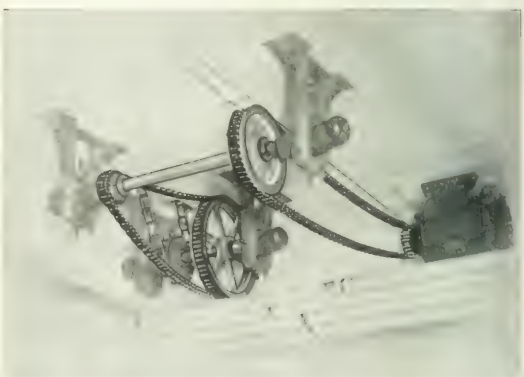


FIG. 2.—"SILENT CHAIN" TRANSMISSION GEAR.

The strength of the chain may be increased indefinitely by increasing the width and without increasing the pitch. This means that the wheel sizes are also kept within limits. A worn chain has the same perfect action of a new one, because it automatically adapts itself to the sprocket. When a chain becomes too wide for convenience in manufacture or in handling, two chains may be run side

by side, and because of the fact that each chain automatically adjusts itself to its sprocket, each chain will bear its proper share of the load. The wear from jarring action when a link passes out of mesh, which has been an objection to ordinary chain drives, and which has limited heretofore the speed of chain driving, is eliminated in the Renold chain, as implied in its noiseless action.

The high speed possibilities of Renold chain make the transmission of power from motors one of its most important uses, and as an evidence of its durability it is stated that a motor car ran 30,000

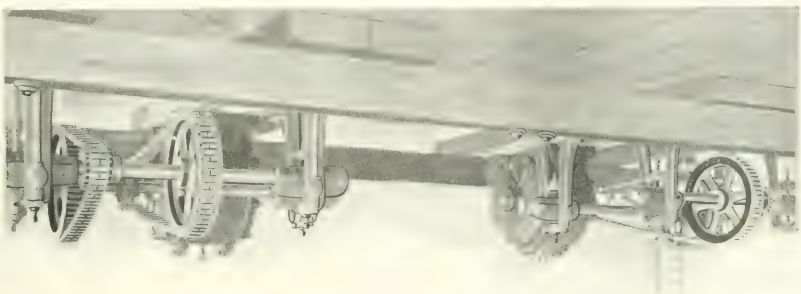


FIG. 3.—"SILENT CHAIN" TRANSMISSION GEAR.

miles and more with a chain of this type, which was in good order and entirely serviceable after this performance. The normal speed of the chain in this instance was 2000 ft. per minute.

Another point of special importance in connection with the Renold's chain for electrical drives is its adaptability to short centers. In this respect it approaches spur-gearing; in other words, approximates to the direct-connection, which in electrical generation has become the rule through the vast saving of space entailed. The use of short centers with this type of gear follows from the high speed at which it can operate, owing to its smoothness of action, which results from every tooth in mesh being in equal contact with the chain, and which continues, regardless of wear or stretch. It goes without saying that this action leads also to a long life of both the chain and sprocket.

The illustrations shown of the Natural Food Company's plant are examples of the application of Renold chain to motor driving.

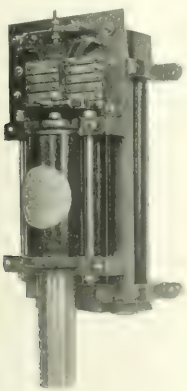


FIG. 1.—AUTOMATIC MOTOR STARTER.

The service is severe because of the sudden start and quick acceleration, under load, of the induction motors used.

The drives in the Natural Food Company's plant were installed by the Link-Belt Engineering Company, of Nicetown, Philadelphia, which, with the Link-Belt Engineering Company, of Chicago, directly control the application of the Renold silent chain to machines and engineering uses in this country. Mr. Hans Renold, of Manchester, England, is the inventor, and to him credit is due for its development into a practical and virtually perfect mechanical device.

Automatic Motor Starter.

The Acme solenoid automatic motor starter illustrated below is one of the latest productions of the Automatic Switch Company, of New York, and is designed to be used with motors that do not require the more expensive forms of motor-driven starters manufactured by this company.

Among the advantages of this starter may be mentioned the simplicity of its construction, which is obtained partially by the form of resistance, known as tubular resistance, and manufactured by this company in this form. The iron clad construction of both resistance and solenoid magnet, and the freedom from lack of adjustment due to placing a resistance arm directly on the head of the solenoid core (thereby doing away with the customary swinging arm), are features of special value. In addition to the above described advantages, attention is called to the patented method of winding the solenoid. There is a heavy coil in series with a fine coil. When the motor is started the fine coil is short circuited by a small switch shown at the top of the starter. This switch is opened after the resistance is completely cut out by the travel of the resistance arm, resulting in throwing the two coils in series with each other across the line. This greatly reduces the amount of current passing through the coils, and prevents overheating of the solenoid windings. This was accomplished by the insertion of a lamp resistance in many of the older forms of starters. The lamp was, however, found to be undesirable, owing to the fact that it was easily broken, or accidentally detached from its base.

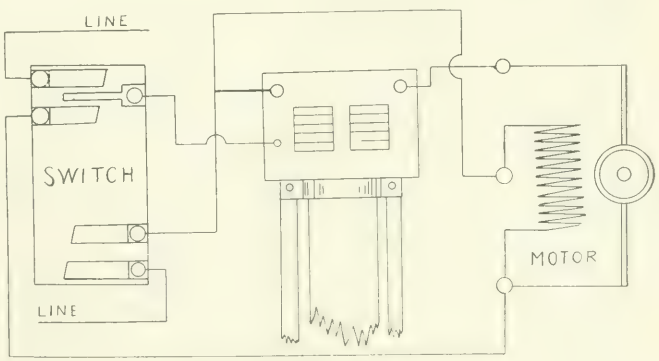


FIG. 2.—DIAGRAM OF MOTOR STARTER CONNECTIONS.

The dimensions of the oil chamber of the oil dash-pot governor are of such ample proportions as to allow a very loose fit of the plunger, which avoids the possibility of dirt or grit interfering with the proper action of the governor. On the resistance arm graphite brushes are used, in conjunction with substantial final contacts of elastic copper, well adapted to carry the full-rated current of the motor.

The diagram of connections illustrates the simplicity of wiring when used in connection with a double-pole quick-acting switch. This form of starter, it is stated, has proved very satisfactory in hevay service.

Automobile Endurance Test.

A severe endurance test of a Toledo steam vehicle is being planned by the automobile department of the American Bicycle Company. Mr. Oliver Lippincott, of Los Angeles, Calif., will make a tour of the West in one of these vehicles, making a circuit of the Grand Canyon of the Colorado, followed by journeys through the Yosemite Valley and Yellowstone Park, as well as other points of interest in and about the mountainous Western country.

The machine selected for this trip is a regular stock model, with



AUTOMOBILE FOR ENDURANCE TEST.

a few slight changes to increase the water-carrying capacity, etc. The total weight of the vehicle, ready for its long journey, including occupants and their baggage, will be 2150 lbs. A feature of the outfit is the trailer, which is shown in the accompanying illustration. This trailer will carry four extra gasoline tanks, an additional water tank, and an extra compartment for photographic material. The vehicle is of 7½ hp.

American Exposition in London.

Alfred H. Post, of Alfred H. Post & Co., foreign freight contractors of the Produce Exchange, New York City, who is the United States Commissioner for the exclusively American exposition, to be held in the London Crystal Palace from May to October, this year, in course of an interview with a representative of ELECTRICAL WORLD AND ENGINEER, said: "The complete success of the exposition, as far as regards an abundance of exhibits, is fully assured, applications having already been received for over 75 per cent of the available space, and promises made for considerably more than the rest. What is desired, however, is a truly representative exposition embracing all sorts of American manufactured goods, and to accomplish this end we can find plenty of room for manufacturers of machinery, etc., not covered in the applications now in hand.

"Applications have already been secured from the following firms: The General Electric Company, Babcock & Wilcox, Niles-Bement-Pond Company, Standard Oil Company, American Waltham Watch Company ,of Waltham, Mass.; the Fairbanks Company, American Soda Fountain Company, Standard Desk Company, of Herkimer, N. Y.; H. J. Heintz Company, of Pittsburg, Pa.; T. W. & C. B. Sheridan, M. G. Thompson & Co., of Buffalo, N. Y.; Johnson Die Press Company, Bissell Carpet Sweeper Company, of Grand Rapids, Mich.; Huyler's Candy & Confectionery Company; Zullers, Limited; Hygienic Optical Company, S. C. Moffat Company, S. S. Wenzell Machine Company, of Philadelphia, Pa.; Hallwood Cash Register Company, of Columbus, Ohio; Mutual Life Assurance Company, Fidelity & Deposit Company, of Baltimore, Md.; Davis, Allen & Co., Peabody & Co., Wedwell Lawn Mower Company, Wellman-Seaver Engineering Company, of Cleveland, Ohio; National Cash Register Company, of Dayton, Ohio; Twentieth Century Introduction Company, T. A. Edison, Jr., Chemical Company, William Simpson & Co., of Philadelphia, Pa., etc.

"Charles Churchill & Co., Limited; Buck & Hickman, John L. Sardy and other prominent handlers of American machine tools, etc., in the United Kingdom have also applied for space, which they intend to utilize for the purpose of exhibiting the products of the Ferracute Machine Company, Bridgeton, N. J.; the Millards Falls Company, Millards Falls, Mass.; F. E. Reed, Worcester, Mass.; Geometric Drill Company, of Westville, Conn.; L. S. Starrett Company, Athol, Mass.; Bullard Machine Tool Company, Bridgeport, Conn.; Morse Twist Drill & Machine Company, New Bedford, Mass.; Norton Emery Wheel Company, of Worcester, Mass.; Springfield Machine Tool Company, Springfield, Mass.; Builders' Iron & Foundry Company, Providence. R. I.; Porter & Johnson Company, Pawtucket, R. I.; Hendey Machine Company Torrington, Conn.; Cushman Chuck Company, Hartford, Conn.; Oster Manufacturing Company, Cleveland, Ohio; E. Horton & Son Company, of Windsor Locks, Conn.; Henry Disston Sons Company, of Philadelphia, Pa.; Armstrong Brothers Tool Company, Chicago, Ill.; Detrick & Harvey Company, Baltimore, Maryland; Charles Parker Company; Fulton Iron & Engineering Works, Detroit, Mich.; Hill, Clarke & Co., of Boston, Mass.; Becker-Brainard Milling Machine Company, Hyde Park, Mass.; Goodall, Pratt & Co., Greenfield, Mass.; Schultz Belting Company, St. Louis, Mo.; Railroad Supply Company of America, Chicago, Ill.; Warner & Swasey, Cleveland, Ohio; Brown & Sharpe Manufacturing Company, of Providence, R. I.; William Sellars & Co., of Philadelphia, Pa.; American Gas Furnace Company, of Elizabeth, N. J.; Westcott Chuck Company, of Niagara, N. Y.; C. E. Jennings; Seneca Falls Manufacturing Company, Seneca Falls, N. Y.; Clayton Air Compressor Works, Brooklyn, etc. In addition to the exhibits which will be made by their London agents many of these people have already signified their intention of making individual exhibits on a much larger scale than a collective display will permit of.

"The complete list of the American advisory committee of the exposition is now to hand, and contains the names of William J. Clark, foreign manager of the General Electric Company, R. W. Blackwell, of Robert W. Blackwell & Co., Limited; J. G. White, of J. G. White & Co.; Charles Churchill, of Charles Churchill & Co., Limited; J. Morgan Richards, manufacturing chemist; D. C. Haldeman, London manager of the Mutual Life Assurance Company, of New York; B. F. Stevens, of the United States Dispatch Agency; F. C. Van Duzer, manufacturing chemist: Frank E. Bliss, of the Anglo-American Oil Company, Limited; Thomas Clarke; R. Newton Crane, barrister-at-law; R. J. Davis, manufacturing chemist; J. Walter Earle, of the Remington Typewriter Company; Thomas L. Field, of the Angle-Saxon Shipping Company; E. Marshall Fox; Colonel Millard Hunsiker, of the Carnegie Steel Company; Frank W. Jones; James McDonald, of the Angle-American Oil Company, Limited; J. G. Meiggs, of Meiggs & Son, contractors for public works; Isaac Seligman, of the banking house of Seligman Brothers; William Hall Walker; A. Bedford, of the American Waltham Watch Company; W. J. Boller, of George Borgfeldt & Co.; F. A. Branion. Dr. F. J. Campbell, Colonel George Earl Church, Samuel G. B. Cock; W. D. Craven, cattle importer; Robert N. Fairbanks, of the Fairbanks Company; W. H. Fassett, manufacturing chemist's agents; Dr. G. W. Field, Charles T. Fox; L. H. De Friese, American lawyer; Henry S. Downe, of the American Radiator Company; J. W. Downer, of the National Tube Company; Thomas J. Farrell, of the American Steel & Wire Company; F. M. Fisk; Clark Harrison, of the United States Cast Iron Pipe & Foundry Company; Louis C. Hay, of the Burt & Bratt Lumber Company; Charles A. Knight, of Babcock & Wilcox; George S. Mahana, A. Parrish; F. C. Poisson, of Poisson & Co.; John L. Sardy; A. B. Scott, manufacturing chemist; Professor S. H. Short, technical director of the English Electric Manufacturing Company, Preston; F. J. Stevens, of Jerome & Co., Limited, and Irving G. Wills, of the Standard Desk Company, Limited.

"The London advisory committee comprises Sir Joseph Druisdale, Lord Mayor of London; the Duke of Sutherland, the Marquis of Tweedale, the Earl Grey, the Earl of Crewe, Viscount Duncannon, Sir Dudley Baines Forwood, Bart., Alderman Sir Frank Green, late Lord Mayor of the British metropolis; Sir Douglas Fox, formerly president of the British Institute of Civil Engineers; Sir Henry Irving, Winston Churchill, M. P., Ernest H. Forwood and Alderman Joseph Lawrence, M. P., president of the Edison Ore Milling Syndicate."

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed nominally at 5 per cent; time money was offered with comparative freedom in amount, but rates remain unchanged and are quite firmly held. The closing quotations are: 4½ per cent for 30 days to six months on first-class collateral, and 5 per cent for good mixed collateral. The stock market during the week was irregular, with a depressed tone. Professional operators furnished the activity, and public interest is lacking in speculation, though bonds and investment stocks are objects of a fair buying demand. The steel stocks have been sold by foreign and local speculative holders, these and Manhattan being among the most active securities dealt in. The rise in Manhattan to 140, it is said, was based, to some extent, on the idea that in consequence of the Fourth Avenue tunnel disaster the New York Central might make arrangements by which the Manhattan will handle part of its passenger traffic. The successful running of the test electric train on Thursday was also considered favorable to the property, although the rise in price was apparently the result of the manipulation by a pool. The industrials generally were neglected, and street railways were comparatively inactive, Brooklyn Rapid Transit closing at 63¾, a net loss of ⅛ point, and Metropolitan Street Railway at 163½, a net gain of ½ point. Manhattan Elevated closed 139⅜, a gain of 2⅛ points on the week's business, the number of shares sold being 267,690. Dullness prevailed in the rest of the electric list, only 1300 shares of General Electric being sold, the closing price being 281, a gain of 1 point. Westinghouse Electric, common, remains unchanged at 177, and the preferred closed at 180, a net loss of 2 points. Western Union dropped 1⅛ points, the closing price being 91¼. Other closing quotations are: American District Telegraph, 36, a net loss of 2 points; American Telegraph & Cable, 90½, a net loss of 4½ points, and Commercial Cable, 160. Following are the closing quotations on Tuesday, Jan. 14:

NEW YORK.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
American Tel. & Cable..	90	90	General Electric	279	276½
American Dist. Tel..	—	34½	General Carriage.....	1¼	1
Brooklyn Rapid Transit..	65⅞	63¾	Hudson River Tel.....	100	100
Ches. & Pot. Telephone..	—	—	Metropolitan Street Ry..	162½	160¼
Commercial Cable	155	155	N. E. Elec. Veh. Tran..	½	—
Electric Boat	24½	25½	N. Y. Elec. Veh. Tran..	½	12½
Electric Boat pfd.....	45	47	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1¾	1¼	Tel. & Tel. Co. America ..	—	—
Electric Vehicle.....	2	2	Western Union Tel.....	91	90½
Electric Vehicle pfd....	4	4	West E. & M. Co.....	177	170
			West E. & M. Co., pfd..	—	—

BOSTON.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
Am. Tel. & Tel.....	161	159	Mexican Telephone	2	2
Cumberland Telephone..	—	—	New England Telephone.	137	*139
Edison Elec Illum..	—	—	Westinghouse Elec.....	90	—
Erie Telephone.....	15⅝	19¼	Westinghouse Elec. pfd..	89¾	—
General Electric pfd....	—	—			

PHILADELPHIA.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
American Railways.....	44¾	44½	Phila. Traction	97¼	97
Electric Storage Battery.	62	60	Philadelphia Electric	4½	3⅜
Elec. Storage Batt'y pfd.	—	60	Pa. Electric Vehicle.....	—	¾
Elec. Co. of America....	6½	5¾	Pa. Elec. Veh. pfd.....	2½	2¼

CHICAGO.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
Central Union Telephone.	—	—	National Carbon pfd.....	84	82½
Chicago Edison	—	163	Northwest Elec. com.....	39½	38
Chicago City Ry.....	188	188	Union Teacheu.....	10½	10
Chicago Telep. Co.....	230	—	Union Traction pfd.....	—	47
National Carbon.....	19	18¼			

*Asked.

CONSOLIDATED LIGHTING & REFRIGERATING.—At a meeting of the board of directors of the Consolidated Railway Lighting & Refrigerating Company, Mr. S. Marsh Young (formerly of the Hall Signal Company, and more lately of the Manhattan Arc Light interests of the Westinghouse Company) was elected vice-president and general manager of the company, and also director. Mr. George Dixon, identified with the United Fruit Company and the Columbus & Hocking Coal & Iron Company, was elected a director. The differences between the board of directors of the Consolidated Railway, Electric Lighting & Refrigerating Company and Isaac L. Rice, the president of the company, which resulted the other day in the board asking for Mr. Rice's resignation, reached another stage last week. The board passed a resolution in the presence of Mr. Rice, demanding "that he transfer and deliver to the said Consolidated Railway, Electric Lighting & Equipment Company forthwith 10,000 shares of stock of this company, which he received at or about the time of the proposition of March 27, 1901, of this company to stockholders of said Consolidated Railway, Electric Lighting & Equipment Company for the purchase of their stock, and which he then received, not under the terms of said proposition or in exchange for any stock of the said Consolidated Railway, Electric Lighting & Equipment Company, but contrary to equity and good conscience." When Mr. Rice was seen in regard to this action, he said that he had been present at the meeting and that the resolution was merely one of a series of steps on the part of F. C. Hollins to obtain control of the funds in the treasury of the company for purposes of which Mr. Rice does not approve, and among which, Mr. Rice said, was the purchase of a bankrupt natural ice car company. Mr. Rice, after reviewing the history of the company and the action that he had taken in regard to its management, added: "I hold only 5500 shares, and these were given to me by the former majority interests in the refrigerator company in lieu of salary, which latter I declined to accept until a time when the shares might be paying a dividend. These shares which I hold are not for sale."

NEW YORK TRANSPORTATION.—At the meeting of stockholders of the New York Electric Vehicle Transportation Company it was voted to reduce the capital stock of the company from $25,000,000 to $5,000,000, and to reduce the par value of the shares from $100 each to $20. It was also voted to change the name of the company to the New York Transportation Company. President Sanderson said: "The company has on hand $1,046,000. The gross earnings for November were $52,000, and the net earnings $16,000. The returns for December will be still better, and the prospects for a good business from now on are encouraging. It will take probably a year to get the express business fairly established. The intention is to increase the number of electric stage coaches on Fifth Avenue and get them running on regular schedule time." The number of shares represented at the meeting was 165,716.

NEW ORLEANS TROLLEYS.—Notice has been given that the Eastern syndicate which proposes to lease the New Orleans City Railway is ready to act at once. The syndicate has the option to purchase the stock at 35, meantime agreeing to pay $2 per share thereon until 1905, and then $3 per share until 1907. Six per cent is guaranteed on the preferred stock. About 50,000 out of 75,000 shares are controlled by the Louisville pool.

RAILWAY BOND COMPANY.—The American Street Railways Bonding Company has been incorporated at Trenton, with a capital stock of $500,000. The incorporators are Warren Dixon, Jersey City; E. Tibbits and Henry V. Brandenburg, of New York City. The company will acquire and hold as investment bonds or other securities and shares of capital stock of corporations.

LAKE SHORE ELECTRIC RECEIVER.—The properties forming the Lake Shore Electric Railway Company, controlled by the Everett-Moore syndicate, have been placed in the hands of a receiver—Albion E. Lang, president of the Toledo Railways & Light Company. That action was taken with the knowledge and acquiescence of the bankers' committee of seven.

DIVIDENDS.—The Standard Underground Cable Company, at Pittsburg, has declared the usual quarterly dividend of 2 per cent, and an extra dividend of 2 per cent out of the earnings of the year, payable Jan. 10. The directors of the Columbus Railway have declared the regular quarterly dividend of 1¼ per cent, payable Feb. 1.

ERIE TELEPHONE.—Over 90 per cent of the shares of the Erie Telephone Company, and over 75 per cent of all the bond issues have been deposited under the reorganization plan. The time for receiving deposits has been extended until 2 o'clock Jan. 15.

EVERETT-MOORE.—Over 70 per cent of all the creditors of the Everett-Moore syndicate have now given their assent to the extension of time asked for. This includes both traction and telephone interests.

CINCINNATI ELECTRIC.—Stockholders of the Cincinnati Gas & Electric Company have voted to increase capital stock from $28,000,000 to $29,000,000, the new stock to be available for improvements

Commercial Intelligence.

THE WEEK IN TRADE.—The advices received by the mercantile agencies exhibited some irregularity due to the weather conditions, or proceeding from the early stage of the season. Stock-taking is now completed, and jobbers are anticipating an active spring business, of which considerable has already been booked. Speculation is likewise exhibiting a broadening tendency, but here also some irregularity is manifested, owing to counter currents and technical market conditions. The industries in the main continue active, iron and

steel setting the pace. The production of the latter is active beyond precedent for this season of the year. The car shortage still continues, although a change for the better is reported. The American rail mills are so crowded with orders that a contract for 105,000 tons for Mexico went to England last week, no American bid being received. Copper, though ostensibly held at 12 cents per pound, has been openly cut, and further reductions are looked for. The business failures for the week, as reported by *Bradstreet's*, numbered 346, as against 270 the week previous, and 322 the same week last year.

WORK IN COSTA RICA.—At a meeting in London of the Costa Rica Electric Light & Traction Company, Limited, President W. F. Leese said there had been a considerable and progressive business done. Two years ago they made £3,800, last year they made £6,800, and this year they had made practically £9,000. They considered from the first that the working capital of £10,000 would very shortly be encroached upon, because, although there was an equipment of the tramway, still there were no spare parts or duplicate machinery in case of a breakdown. In order to comply with the urgent demand for more light and tramway accommodation, certain extensions were carried out. There had been an increase in the business all round. Last year the connections increased from the equivalent of 4951 to 6896 16-cp lamps. The number of passengers carried during the year was 687,616, an increase of 37 per cent. Since the close of the financial year 2½ miles of additional tramway had been opened. With regard to the business itself, it necessarily had not been large, because they had not been able to fully comply with the active demand for light, power and traction. The profit of £9,000 roughly represented over 40 per cent of the total business done. As a matter of fact, they had only touched the mere fringe of the business. In the central valley of Costa Rica there were some 200,000 inhabitants who were all demanding the light and power, and an extension of the tramway. Owing to the nature of the country, the question of providing cheap locomotion and light was one which affected the interest of all the inhabitants. Their company started three years ago to supply those facilities, and it had done so to the best of its ability to the limit of its capital on the one side and its water concessions on the other. Those water concessions represented about 1000 hp. Recently they had a succession of droughts, and the consequence was that during the last two years, and more especially during the past dry season, they had not had sufficient water power for actual requirements. Their tram cars had been standing still during some hours in the evenings for weeks at a time, because they were not able to supply electrical energy to them, and at the same time to comply with their lighting obligations. Luckily, about that time Mr. Boza, who has had an electric lighting plant, from which he supplied the towns of Heredia and Alajuela, obtained the contract for lighting a portion of the street lamps in San Jose. That was the least lucrative portion of their business, and Mr. Boza had unwittingly done them considerable service in taking it off their hands at that particular crisis. The question of further water power had become acute, and it was absolutely necessary for them to consider without delay the advisability of a considerable expansion in that direction. They had put before them a scheme which would enable them to comply with all their obligations for many years to come. The new isthmian canal would probably enable the undoubtedly great resources of Costa Rica to be thoroughly developed, and would have an important influence both on its population and on its wealth.

CONTRACTS FOR THE LARGEST LIGHTING PLANT IN NEW YORK CITY.—R. H. Macy & Co.'s new store, which is now under construction at Broadway and Thirty-fifth Street, New York City, is to be installed with the largest private electric lighting plant in New York City. The plant will have a capacity of 2000 kw, entirely for lighting purposes, as but a very small portion of it will be called into requisition for operating the ventilating apparatus, pneumatic cash carrier system and some small pumping equipments. The elevators to be installed in the building will be worked by hydraulic power. The generators, consisting of four direct-current, 110-volt direct-connected machines of 400 kw each, and two equipments of a similar description, having a capacity of 200 kw each, have been ordered from the Western Electric Company, of New York City. The contract for the engines intended to drive the larger generators calls for Rice-Sargent machines, four compound Corliss type slow-speed, 100 r. p. m., having a nominal capacity of 600 hp each. They will be built at the Providence Engineering Works, of Providence, R. I. The engines for operating the two 200-kw generators will also be of Corliss type single-valve, of 320 hp each. These, however, have not yet been contracted for, nor have the 1500 arc lamps and 6000 incandescent lamps of 16 cp each, which will be required. The contracts for the equipment are being handled by Mr. Comstock, head of the electrical department of the George A. Fuller Company, 137 Broadway, which concern is constructing and equipping the building, in conjunction with Mr. C. O. Mailloux, the electrical engineer of the R. H. Macy Company. The switchboard material will be purchased by the Fuller people, who intend to complete its erection themselves. They will also do the whole of the requisite wiring. The boiler equipment is to be 2600 hp, comprising four batteries of 500 hp each, and two batteries of 300 hp each. This contract has been undertaken by the Babcock & Wilcox Company, of New York City. The pumping equipments are to be of Laidlaw-Dunn Gordon type, the contract having been allotted to the International Pump Company, of New York City. Mr. Quay, the Fuller Company's chief mechanical engineer, in concurrence with Mr. Reginald P. Bolton, the Macy mechanical expert, placed these contracts. A crematory, which is to be utilized for burning all the refuse, etc., in the new store, is to be built between two batteries of the larger boilers, so that the gas it burns while in operation can be used to advantage by way of aiding the boiler heat. The electric plant—which it is expected will be completely installed by Aug. 1—will represent an expenditure of nearly $300,000.

IMPORTANT AUSTRALIAN CONTRACTS.—The central power station of Sydney City & Suburban Tramways, of Sydney, Australia, the initial equipment for which contracts to the extent of over $1,000,000, have already been placed in this country, is to be considerably extended in capacity, and specifications representing an expenditure of some $500,000 have been issued. It will be recalled that when Mr. Charles Oliver, the chief railroad commissioner of the New South Wales Government, which is constructing the Sydney electric traction system, was in the United States in August, 1900, he placed a contract valued at almost $800,000 for the complete equipment of a plant having a nominal capacity of 4500 hp. This equipment, the last of which has just been shipped from this side, consists principally of three 1500-kw General Electric generators; three direct-connected 32 by 64 by 60 vertical cross-compound engines, built at the Allis plant at Milwaukee, and some $100,000 worth of piping, etc., from the Best Manufacturing Company, of Pittsburg, Pa. Prior to the letting of this contract, the Sydney power house was installed with four 850-kw General Electric generators, and Allis horizontal engines of 850 hp nominal capacity. Up to date, therefore, contracts have been let for a plant of 7900 hp nominal capacity. The specifications now requisitioned for are additional equipment of 6000 hp. The boiler plant already installed represents 8000 hp, there being 32 units of 250 hp each. These boilers are water tube ones, of Babcock & Wilcox build. The specifications now ask for 24 additional boilers. The entire plant will, therefore, have a capacity of 14,000 hp. The contract for the steel construction of the power house, which called for some 1200 tons of structural steel, was undertaken by the American Bridge Company. It was the first contract ever awarded for a steel structure in the Antipodes. The power house will be extended shortly. Besides the important installation before mentioned, everything required in the construction of the Sydney system other than the car bodies, which are being built in Australia, owing to the cheapness of wood in that part of the world, will be purchased in the United States, and before the entire system is an accomplished fact some $3,500,000 will have been expended.

STREET RAILWAY PRICES WANTED.—Mr. Joseph Ullo, of 1046 Eighty-third Street, Brooklyn, is desirous to secure catalogues, prices, etc., for electric railway equipment. It is reported that his principals are about to obtain a concession for the construction of a double-track road some 40 miles in length in the south of France. American capital, it is said, has already been secured, and American equipment will be utilized exclusively. The major portion of the route proposed to be traversed is already operated by horse tramways, which will be converted into electric motive power. Mr. Ullo's people anticipate an expenditure of some $200,000 in equipment, etc.

THE BREMER ARC LAMP, which has been described from time to time in these pages, and which uses special carbons carrying metallic salts, etc., and has special features of regulation, has been brought to this country, and is now in the hands of the Westinghouse Company, which has always shown such a progressive policy as to electrical novelties of importance. It is broadly understood that colored lighting effects obtainable are one of the features. We are not informed as to the control of the device in the United States, but it has been studied with much interest by those who have seen it in the Westinghouse offices.

BRILL TRUCKS FOR ENGLISH ROAD.—The J. G. Brill Company, of Philadelphia, is about to make a substantial shipment of trucks which are to be utilized on the Warrington (England) electric traction system, the contract for the construction of which was secured by the British Thomson-Houston Company, Limited, now controlled by the General Electric Company. Mr. Curwen, the European representative of the J. G. Brill Company, of Philadelphia, whose headquarters are in London, is now on a visit to the United States.

CROSELMIRE PLATINUM.—Mr. Croselmire, Newark, N. J., has sold his business to a new company, which will be styled Charles F. Croselmire Company, American Platinum Works, Charles Engelhard, general manager. The latter is well known in the platinum business, and will push actively the old enterprise under the new conditions and the long name, which is quite striking.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Jan. 4, 1902: Antwerp—21 pkgs. material, $818. Argentine Republic —199 pkgs. material, $10,047. British West Indies—32 pkgs. copper wire, $1,570. British East Indies—115 pkgs. machinery, $1,680. Bremen—2 pkgs. material, $20. Bolton—2 pkgs. material, $375. Bristol—14 pkgs. machinery, $470. Cuba—22 pkgs. material, $915; wire, $45. Central America—3 pkgs. wire, $67; 9 pkgs. material, $599. Cardiff—12 pkgs. material, $679. Dutch West Indies—31 pkgs. material, $1,024. Ecuador—1 pkg. material, $26. Florence —17 pkgs. machinery, $500. Genoa—17 pkgs. material, $669. Glasgow—3 pkgs. material, $113. Hanover—2 pkgs. material, $59. Hamburg —19 pkgs. machinery, $450; 31 pkgs. material, $1,502. Havre—7 pkgs. machinery, $75; 4 pkgs. material, $327. Japan—3 pkgs. material, $305. Liverpool—55 pkgs. machinery, $3,692; 1267 pkgs. material, $6,650; 20 pkgs. wire, $424. London—70 pkgs. material, $4,202. Mexico—88 pkgs. material, $1,588; 12 pkgs. machinery, $796. Malta—1 pkg. material, $12. New Zealand—15 pkgs. material, $712; 98 pkgs. copper wire, $23,818; 6 pkgs. machinery, $600; 28 pkgs. wire, $405. Newcastle—8 pkgs. machinery, $1,000. Naples—21 pkgs. material, $550. Nova Scotia—4 pkgs. material, $125. Peru—10 pkgs. material, $445. Plymouth—13 pkgs. copper wire, $600. Rotterdam—2 pkgs. machinery, $120; 2 pkgs. material, $100. Swansea—25 pkgs. wire, $1,200. Santo Domingo—34 pkgs. material, $371. Southampton—3 pkgs. material, $270. St. Petersburg—1 pkg. material, $35. Trieste—2 pkgs. machinery, $151. Torrenton—1 pkg. machinery, $2,000. Venezuela—2 pkgs. machinery, $21.

ACETYLENE CAR LIGHTING has been introduced with apparent good success on the Lackawanna Railroad by a corporation in which Mr. E. C. Benedict is interested. Tanks are used with acetylene gas under pressure and taken up by acetone, a cheap liquid which has the property of absorbing it eagerly, and which can be charged again and again with little loss. The tanks are lined with porous brick, and the safety conditions, as well as the economical, are said to be most promising. The Commercial Acetylene Company has an office now at 80 Broadway. Among its directors are J. S. Seymour, of the well-known firm of Seymour, Seymour & Harmon, corporation and patent lawyers, at 40 Wall Street ,and who was commissioner of patents under President Cleveland; Frank S. Hastings, Martin J. Quinn, treasurer; Edward Beers, secretary, and Eugene Bournonville. Mr. Seymour is vice-president of the company. The subject is one of much interest to electrical engineers, not forgetting the fact that electricity makes the calcium carbide.

ATLANTIC COAST TROLLEYS.—Clement Newbold, Robert W. Leslie and Francis R. Welsh, a committee representing the holders of $507,000 worth of the $800,000 5 per cent first mortgage bonds of the Atlantic Coast Electric Railway Company, have applied to the Chancery Court for a receiver for that company. An order to show cause why the company should not be declared insolvent and a receiver appointed was granted and made returnable at Chancery Chambers, in Jersey City, on Monday next. The bill sets forth that the company has been running at a loss for some time; that the taxes for 1900 and 1901 are unpaid; that the $20,000 interest on the $800,000 outstanding first mortgage bonds, due Nov. 1, 1901, is unpaid; that the rental of the Seashore Electric Railway has not been paid and that there is much other indebtedness. H. H. Rogers and Daniel O'Day, of the Standard Oil Company, are said to carry the entire floating indebtedness of the company.

A GREAT CHINESE RAILROAD is projected from Canton to Hankow, 750 miles, with $42,500,000 of 5 per cent bonds, and an estimated gross annual business of $50,000,000 for the first year. The New York promoters of the road made announcement last week of the organization of the company which is to build the road under the title of the American China Development Company. William Barclay Parsons, chief engineer of the Rapid Transit road for the city of New York, is the president of the company. The directors are August Belmont, Pierre Mali, member of the importing firm of Henry W. T. Mali & Co., of 83 Worth Street; Frederick W. Whitridge, a lawyer, of 59 Wall Street; Charles A. Whittier, of 111 Fifth Avenue, and Colonel Albert Thys and Mr. Joseph de Volder, of Brussels. A large amount of electrical material will be needed.

MASSACHUSETTS TROLLEY OUTLAY.—The management of the Boston & Northern and of the Old Colony Street Railway companies, which are controlled by the Massachusetts Electric Companies, have some very comprehensive plans in view, which, when completed, are expected to add considerable value to both classes of Massachusetts Electric stocks. The plans are somewhat immature at the present time, but in a general way they involve an expenditure of nearly $10,000,000 in double-tracking, extending and equipping the above two properties, and when changes are completed it is anticipated that the increased earnings resulting therefrom will considerably more than pay the charges or dividends made necessary through the increased capitalization.

THE NATIONAL ELECTRIC SUPPLY COMPANY, Washington, D. C., has recently sold a complete power and electrical equipment for the Government printing office at Manila, Philippine Islands. This equipment includes a complete steam plant, consisting of a Harrisburg Ideal engine connected directly to 150-kw Crocker-Wheeler generator. An Erie City boiler is used to furnish the steam. The fuel used is crude oil, for which purpose a W. N. Best oil burner is to be installed. The shipment, which was sent all at one time, also includes 3000 Edison lamps and 50 fans.

NIAGARA GENERATORS.—For the new power house of the Niagara Falls Power Company, a contract was given some time ago for five 5000-hp generators to the General Electric Company. We are now informed that a further order for five more, completing the equipment of the new building, has been secured by the General Electric Company also. The machines are to be built, it is understood, upon G. E. designs rather than the original specifications of the Power Company, to which the big Westinghouse two-phasers in the earlier plant conform.

EGYPTIAN TROLLEYS.—It is reported that Cleveland capitalists, incorporated as the Cleveland Construction Company, have received concessions for electric car lines from Cairo, Egypt to Mecca. We can't quite figure the route out, but the Red Sea has been known to go dry before now, so there may be something in the rumors. The *Philadelphia Record* says: Cleveland and Chicago capitalists have applied for concessions for electric lines from Cairo, Egypt, to Mount Sinai and thence along the coast of the Red Sea through Syria and Arabia to Mecca with a branch to Damascus.

GENERAL ELECTRIC.—It is stated that the General Electric Company continues to report a record breaking business. Net earnings for December again crossed the $1,000,000 mark, the third month in succession when net earnings have reached that figure. President Coffin sails for Europe again shortly, and is paying close attention to the business of the British Thomson-Houston Company, now controlled by the General Electric Company, which he believes is capable of great expansion under the new regime.

EQUIPMENT WANTED.—Mr. S. M. Veil, secretary and treasurer, Kanawha, Glen Jean & Eastern Railroad Company, Chillicothe, Ohio, reports that the company will be in the market in the spring for complete power plant equipment. The Oklahoma Consolidated Railway Company, Mr. G. W. Willis, El Reno, Okla., $2,000,000 capital stock, will be in the market for the equipment of an electric road and telephone lines from El Reno to Kingfisher, Oklahoma City and Guthrie, 100 miles.

WESTINGHOUSE EQUIPMENT FOR NEW PITTSBURG BUILDING.—The new Frick Building at Pittsburg, Pa., which is being constructed by the George A. Fuller Company, whose New York address is 137 Broadway, is to be installed with four 150-kw Westinghouse generator sets for direct connection to the same number of Westinghouse compound engines, having a capacity of 225 kw each.

POWER PLANT FOR SILK MILL.—It is announced from New Haven, Conn., that a large electric power plant on the Hockanum River for the Cheney silk mills at South Manchester, Conn., will soon be completed. Water is carried by a pipe half a mile to the electric power house, whence the current is supplied to the mills, two miles away. The total cost of the plant is estimated at $300,000.

THE INTERNATIONAL STEAM PUMP COMPANY has bought 40 acres of land in Harrison, N. J., and will build shops to give employment to about 2500 men. The company is the well-known combination of some of the largest steam pump manufacturers, including the Worthington Company. The land bought cost about $55,000. Seven brick buildings, 145 by 600 ft., will be built.

ELECTRIC LIGHT EQUIPMENT.—The Superior Water, Light & Power Company, West Superior, Wis., will make extensive improvements to its plant during the coming summer, and will require new equipment, for which it is proposed to expend $35,000 or more. The plans have not yet been completed, however.

THE LAKE ERIE IRON WORKS, Cleveland, Ohio, have recently added to their electric plant a 160-hp engine, built by the Ball Engine Company, of Erie, Pa., and direct connected to a General Electric Company's generator. This is a duplicate of a unit installed a year ago.

ENLARGING POWER PLANT.—The power plant of the Diamond Rubber Company, of Akron, Ohio, will be enlarged and the machinery will probably be driven by electric power. The company has recently increased its capital stock in order to provide for these improvements.

ROGERS ELECTRICAL WORKS.—Notice has been given of the dissolution of partnership between Ulysses G. Rogers and Louis H. Wenzel, in the above works, at 55 Dey Street, New York City. The business will hereafter be carried on by Mr. Rogers.

PITTSBURG LIGHT AND ICE.—It is said the Philadelphia Company, which recently acquired trolley and lighting interests in Pittsburg, is after the ice business of that city.

General News.

THE TELEPHONE.

ATTALLA, ALA.—The City Council granted a 20-year franchise to the Alabama & Georgia Long Distance Telephone Company to operate a local exchange.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company recently gave a banquet at Delmonico's, in San Francisco, to the 200 employees, included among them solicitors, linemen and instrument installers of the local telephone system. Heads of departments feasted with the men, and pledged one another a happy New Year. Mr. John Curran, at the head of the contracting department, made a speech of welcome and read a letter from President John I. Sabin and Vice-President Louis Glass. It congratulated the employees on the fact that through their efforts San Francisco had reached the highest percentage of telephone subscribers of any city in the world. The 30,000 mark was reached and passed during 1901, there being that number of telephones now in use, the population of the city being 342,782.

DENVER, COL.—On Jan. 1 the Colorado Telephone Company reduced its toll rate from a five-minute to a three-minute conversation basis.

COLORADO SPRINGS, COL.—The Colorado Telephone Company is planning extensive additions to its service. About 2500 feet of aerial wire will be put up at once, and a new switchboard will soon be installed. A large amount of wire will be placed underground and the system brought up to the standard, as the company expects a large increase of business over that of last year.

ARRAN, FLA.—Mr. F. N. Duval is putting in a telephone between here and Crawfordville.

DANVILLE, ILL.—The Sidell Telephone Company will extend its lines in the spring.

CARMI, ILL.—The Cumberland Telephone Company has transferred its plant to the White County Telephone Company.

MARSHALL, ILL.—The Wabash Valley Telephone Company, capital stock $30,000, has been incorporated by H. H. Knipe, A. L. Keys and G. W. Fair.

ST. ANNE, ILL.—A number of enterprising farmers west of St. Anne held a meeting and decided to run a telephone line west of St. Anne, a distance of at least five miles.

CHICAGO, ILL.—The Mutual Union Telephone Company, of Abingdon, has been incorporated; capital, $2,500. Incorporators: Leonard E. Cutler, William H. Beaver, Nellie A. Cutler.

EAST ALTON, ILL.—The Kinloch Telephone Company encountered opposition at East Alton last week, when an attempt was made to build a line through the village. A franchise was granted, but the telephone company allowed the time limit to pass without beginning work. When a start was made preparing for the erection of a line of poles by a gang of Kinloch workmen, the president of the village board ordered the work stopped. The company was later granted a 20-year franchise.

DUNKIRK, IND.—The Citizens' Telephone Company, capital stock $10,000, has been incorporated to operate in Jay, Delaware, Randolph and Blackford counties.

PERU, IND.—At a meeting of the directors of the new Home Telephone Company arrangements were made to build at once a line to Mexico and Denver; also a long distance line to Wabash.

SOUTH BEND, IND.—The South Bend Home Telephone Company, capital stock $200,000, has been incorporated by J. E. Neff, E. H. Miller, M. B. Staley, D. D. Bates and H. G. Miller. The company will operate an independent telephone system in South Bend.

INDIANAPOLIS, IND.—The Northern Indiana and Southern Michigan Telephone & Telegraph Company has reincorporated and increased its capital stock from $50,000 to $75,000. The Citizens' Telephone Company, of Zionsville, has filed articles of incorporation with the Secretary of State. The capital stock is placed at $10,000. The company has purchased the holdings of the old company and is arranging to connect with adjacent towns and otherwise extend its lines.

ANDERSON, IND.—The Madison and Delaware County Telephone Company, with a capital stock of $500,000, has been organized at Ft. Wayne, with the following stockholders: J. J. Netterville, G. C. Quick and W. H. H. Quick of this city; A. L. and J. C. Johnson and W. H. Hitchcock, of Muncie; Wayne Leeson, of Elwood; S. M. Foster, G. W. Beers, Max Fisher and W. P. Breen, of Ft. Wayne. Mr. Foster was made president. The company was organized for the purpose of installing a telephone service throughout this and Delaware counties, connecting Muncie, Elwood, Alexandria, Frankton, Summitville, Eaton, Pendleton and Anderson. Franchises have been obtained in all of the places. The prime object of the company, however, is to furnish a service for the farmers. The Gas Belt Construction Company was also organized with a capital stock of $100,000. W. H. Hitchcock, of Muncie, was made president of this company. The stockholders of this company are the same as in the other. The object is to put in an independent telephone service throughout the Indiana gas belt. The work on both services will begin at once and pushed to completion in the early summer.

DE WITT, IA.—The De Witt Telephone Company has been incorporated.

WILTON, IA.—The Wilton Telephone Company has been granted a franchise here.

SPRINGVILLE, IA.—The Springville Telephone Company, capital stock $5,000, has been incorporated by J. D. Graham, L. B. Christman, E. H. Sidwell, T. W. Pollock, W. J. Courtney and C. F. Butler.

SIOUX CITY, IA.—Another independent telephone company wants to get a franchise in Sioux City. C. F. Moody, representing an independent company at Fergus Falls, Minn., states that his company would like to secure a franchise and put in an exchange here.

HANCOCK, IA.—Twenty-four farmers of Hancock Township have formed a telephone company. Articles of incorporation of the Hancock Telephone Company were filed with a capital stock of $10,000. T. J. Armstrong is president; Chas. Warner, vice-president; Adolph Schmidt, secretary, and Fred. J. Boie, treasurer.

KIOWA, KAN.—The Kiowa Telephone Company, capital stock $5,000, has been incorporated.

PITTSBURG, KAN.—The Pittsburg Telephone Company, capital stock $50,000, has been incorporated.

ELDORADO, KAN.—The Butler County Telephone & Electrical Company, capital stock $2,000, has been incorporated.

DAWSON SPRINGS, KY.—The Cumberland Telephone Company is putting in an exchange at Dawson Springs. This exchange will be operated in connection with the Madisonville and Earlington exchanges.

PARIS, ME.—The Paris & Greenwood Telegraph & Telephone Company, of Paris, capital $5,000, has been incorporated by E. H. Herrick, Greenwood, Me.; F. D. Small, West Paris, Me.

BOSTON, MASS.—The Erie Telephone system made a net gain of 1880 subscribers in December. Net gain for the year, 20,085. Total connected Dec. 31, 162,455; waiting connection, 1968.

MILFORD, MICH., will have a telephone exchange, provided the Council will grant a franchise which has been asked for.

PLAINVIEW, MINN.—The Greenwood Prairie Telephone Company, of Plainview, Minn., capital $25,000, has been incorporated.

ST. LOUIS, MO.—The Bell Telephone Company, of Missouri, will pay its quarterly dividend of 2 per cent. on $2,000,000 in January.

ST. LOUIS, MO.—The conduit extension bill now before the City Council Committee is opposed by the Kinloch Telephone Company, and the Western Union Telegraph Company on account of the expense, the necessity for keeping the streets repaired, the right of the city to purchase the subway, and the new conditions arising, and may change materially telephone and telegraph equipment.

NEWPORT, NEB.—The Interstate Telephone Company is extending its lines west to Valentine, Neb.

VALENTINE, NEB.—A company has been organized to put in a telephone system at this place. It is the intention to ultimately extend the line to various parts of the county.

LIBERTY, NEB.—The Liberty Independent Telephone Company, of Liberty, capital stock $5,000, has been incorporated. George Sutter is president, and C. F. Maxwell, secretary.

CONCORD, N. C.—A metallic telephone connection has been completed between Concord and Albemarle, N. C.

MARSHALL, N. C.—The Madison Telephone Company contemplates several extensions, possibly to Hot Springs and Alexander. An exchange for Marshall is being discussed also.

HICKORY, N. C.—The Sunban Telephone Company has been incorporated with $20,000 capital to operate telephone lines in Catawba County. W. R Abernathy, of Newton; J. L. Latta and J. A. Martin, of Hickory, are the incorporators.

CANNON BALL, N. D.—A telephone line has been constructed between this village and the sub-agency. The Indians were afraid of the telephone at first, but now they are getting to use it too much, and call up the sub-agent on every occasion.

ELMER, N. J.—The Pittsgrove Township Committee has granted a franchise to the Interstate Telephone Company to erect its lines through the township.

NEW YORK, N. Y.—Senator Wagner, of Kings, has introduced in the State Senate a novel telephone bill, designed to prevent extra telephone charges for messages between the boroughs in the city of New York. The bill provides that it shall be unlawful for any person, partnership, or corporation operating a public telephone system for the general transmission of messages by telephone in the city of New York to charge an extra sum in addition to its regular rates for any message sent from one borough to another within the limits of the city.

SHREVE, OHIO.—The Ripley Telephone Company has been incorporated with a capital of $5,000.

ST. CLAIRSVILLE, OHIO.—The Belmont Telephone Company has opened a new exchange at St. Clairsville.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Telephone Company has increased its capital stock from $12,000 to $30,000.

NORWALK, OHIO.—The Huron County Telephone Company is preparing to build a number of farmers' lines in this vicinity.

ALLIANCE, OHIO.—The Central Union Telephone Company is preparing to double the capacity of its long distance toll board in this city.

GALLIPOLIS, OHIO.—The Gallipolis Telephone Company has completed an exchange at Chickamauga. Gallia County is fast being covered with farmers' lines.

GERMANTOWN, OHIO.—The Germantown Telephone Company has had remarkable success during the past year, having more than doubled its list of subscribers.

COLUMBUS, OHIO.—H. E. Williard, superintendent of the central division of the American Telephone & Telegraph Company, will remove his head quarters to Columbus.

NORWALK, OHIO.—The Lake Shore Electric Railway and the Central Union Telephone Company are having a lawsuit over a line of poles through Norwalk which each company claims as its property.

TOLEDO, OHIO.—Frank E. Graves, general manager of, and one of the promoters of the Toledo Home Telephone Company, has resigned because of ill health. He is now recuperating in California.

CANTON, OHIO.—Acting under instructions from headquarters, work has been resumed on the Canton exchange of the Stark County Telephone Company, one of the Federal companies. Regular service will be inaugurated within a few days.

CINCINNATI, OHIO.—The Norwood Messenger, Police & Fire Company is applying for a franchise in that village. The members of the new company are Patrick Shortall, Edward P. Mouliner, Samuel J. Murray, William Windhorst and John Rolsen.

MANSFIELD, OHIO.—Work on the exchange of the Mansfield Telephone Company, which is practically completed, will not be delayed through the troubles of the Everett-Moore syndicate. Telephones are all in place and underground cables are being put in.

WAUSEON, OHIO.—E. L. Barber, of this place, has obtained a franchise for an independent telephone system in Kansas City. The company has put up $20,000 cash to insure the building of the plant. Long distance lines will be built throughout Kansas.

AKRON, OHIO.—D. Emil Dorn, of Chicago, has communicated with the City Council asking if a franchise could be secured for a new independent telephone system. The city already has a very large independent system besides that of the Bell company.

WARREN, OHIO.—The Warren & Niles Telephone Company has elected officers as follows: Washington Hyde, president; Jules Vautrout, Jr., vice-president; J. J. McLean, secretary-treasurer, and E. G. Miller, general manager. The above, with C. C. Clawson, M. S. Clapp and C. W. De Voe, are directors.

ZANESVILLE, OHIO.—The School Board has awarded a contract to the Central Union Telephone Company for telephone service in eighteen school buildings at a rate of $12 per year for selective party line. The Zanesville Telephone & Telegraph Company offered full metallic service for $18 per year.

ZANESVILLE, OHIO.—J. B. Rhodes, general manager of the Zanesville Telephone & Telegraph Company, one of the Federal properties, has been notified that the financial difficulties of the Everett-Moore syndicate need not interfere with the construction work on the Zanesville exchange, which is practically completed.

OBERLIN, OHIO.—The Oberlin Telephone Company has elected directors as follows: E. H. Holter, A. S. Root, C. K. Whitney, A. G. Comins, M. M. Squire, J. R. Severance and E. P. Johnson. The company is in a most prosperous condition. A 4 per cent. dividend was declared and a surplus will go toward improving the plant.

CHAGRIN FALLS, OHIO.—The old fight between the village of Chagrin Falls and the Cleveland Telephone Company will be fought all over again. The village granted the required franchise, but specified that wires must be placed underground. The company claims it is impossible to comply with the demand, and has again appealed to the Probate Court.

McCOMB, OHIO.—The McComb Telephone Company, which is owned and managed by Miss Angie Fruchie, will build a number of rural lines in Hancock County. Miss Fruchie has managed the system for a number of years and has made a thorough success of the venture. The Bell Company has been repeatedly defeated in its attempt to secure a franchise in this town.

MANSFIELD, OHIO.—The Mansfield Telephone Company has secured an injunction restraining John and Levi Watson from cutting the line between Bellville and Darlington. The line was formerly owned by the Watsons, and the Mansfield Company now claims it owns a controlling interest in it. It is claimed the Watsons are preparing to cut the line and connect it with the lines of the Central Union Telephone Company.

CINCINNATI, OHIO.—Contract Agent Westlake, of the City & Suburban Telegraph Association, denies the report that the company is soliciting five-year contracts with the stipulation that any competition will be met. "We are using identically the same five-year contract form that we put in effect in 1898, and do not contemplate any change," he says. "The introduction of the nickel-in-the slot service is the only important departure from our regular contract form. We have now a thousand orders on hand for installations and are troubled only because of lack of equipment."

CLEVELAND, OHIO.—In connection with the financial embarrassment of the Everett-Moore Syndicate it is reported that if a fair offer is made for the property of the Detroit People's Telephone Company the committee in charge of the Syndicate's affairs will be willing to sell the property. About $500,000 has already been spent in Detroit, which with the franchise would make the property worth a considerable figure. If cash could be secured it would go a long ways toward relieving the situation of the Federal Telephone Company. On the other hand, no less a person than Judge J. M. Thomas, president of the Independent Telephone Association, who is here assisting the committee in clearing up the telephone situation, says it is very improbable that the bankers or committee would consider a proposition to sell one of the properties singly. He states that as a matter of fact, the committee is daily becoming more favorably impressed with the value of the telephone properties, and he feels quite confident that matters will be speedily arranged whereby the properties will revert to the Syndicate, and the management of affairs be conducted as heretofore.

TOLEDO, OHIO.—The Central Union Telephone Company has closed the option held for the past four months on the property of the Harrison Telephone Company of Toledo. The Harrison company was one of the first independent companies in Ohio. It was organized nine years ago by Henry Cook. It proved a financial failure and four years ago was sold at receivers' sale for $20,000 to George Hill, who later sold it to L. C. Cole, John R. Hankey and others of Bowling Green. The new owners spent $50,000 in improvements, and at present the plant consists of 600 telephones, 8 miles of cable, 60 miles aerial wire and 20 miles of poles. Of late years the company has not been recognized as a strictly independent company, and it has had no connection with the long distance lines of the United States Telephone Company, although it has connected with several independent exchanges in the vicinity of Toledo. The terms of the sale were not announced, but the Bell company will pay a $50,000 mortage against the company. The purchase of the plant is a part of the plan of expansion of the Bell company in Toledo in order to better compete with the new Toledo Home Telephone Company, which will shortly commence operations with a large subscription list.

OTTAWA, ONT.—At the approaching session of the Dominion Parliament, the Bell Telephone Company will ask for an amendment to its charter and for power to increase its capital stock. This means a renewal of the bitter contest that took place before the parliamentary committee last session between this corporation and the municipal authorities of Canada, chiefly of the province of Ontario, when the same powers were sought by the Bell Company, in regard to the question of telephone rates.

HULMEVILLE, PA.—The Standard Telephone Company has been granted a [illegible]

CARNEGIE, PA.—A telephone line from Lawrence to Thomas Station is about to be built.

PHILADELPHIA, PA.—The Keystone Telephone Company has made its first official "call" from the newly equipped "Central" in what was formerly the Commercial Exchange, Second and Sansom Streets.

MADISON, S. D.—The telephone exchange in this city has been sold to the Southwestern Minnesota Telephone Company, which has taken possession. The consideration was $6,000.

CANTON, S. D.—The Lincoln County Telephone Company has let the contract for the construction of thirteen miles of telephone line extending from Beresford in a northwest direction, for the convenience of the farmers comprising the company.

STURGIS, S. D.—The Harrison Telephone Company has secured a charter in Montana and intends extending its system in that direction. It is probable that work will be commenced in the spring which will connect the Black Hills with the telephone system of the Northern Pacific Railroad. The Harrison Company already has a charter in Wyoming and its lines in that State will also be placed in connection with the Black Hills-Montana system.

MILWAUKEE, WIS.—The Calumet Telephone Company filed an amendment to its articles increasing its capital stock from $500 to $1,500.

KENOSHA, WIS.—The Wisconsin Telephone Company is trying to lease the Farmers' Telephone lines, which has strung wires to the city limits.

WAXAHACHIE, TEX.—Work has been commenced on a new telephone system for Waxahachie. The line will be extended from here to Ennis.

MADISON, WIS.—The Wisconsin Central Telephone Company, of Stevens Point, with a capital stock of $200,000, filed articles of incorporation. The incorporators are A. L. Hutchinson, H. G. Slater and E. H. Jones.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—The recent flood in the Tallapoosa River damaged the dam of the Tallahassee Electric Company to the extent of $40,000.

SAN FRANCISCO, CALIF.—The Standard Electric Company, which represents an investment of $5,000,000, has nearly completed its long distance electric transmission line from Amador County to San Francisco.

REDLANDS, CALIF.—The city trustees have under consideration two propositions made by Judge L. Campbell, of San Bernardino, and Prof. C. G. Baldwin, of Pomona, to supply the city with electricity generated by water power in the San Bernardino mountains.

SAN FRANCISCO, CALIF.—The San Francisco Mint is to be electrically equipped during the present year. As far as possible, electricity will be used to supply motive power for machinery, etc., as well as for metallurgical and testing purposes. The changes, which will be made gradually, will cost the Government $150,000. It is the intention, ultimately, to install an independent generating plant to supply current for electrical machinery.

DENVER, COL.—The Denver Gas & Electric Company has notified the Mayor that it will discontinue its service on Jan. 10 and remove its arc lamps from the streets. This will afford the Lacombe Company a clear field. The Denver Gas & Electric Company will continue to press its claim for $65,000 on account of light furnished during the past year, when, it alleges, it had a contract with the city.

GAINESVILLE, FLA.—New machinery for the electric light plant has been received and is being placed in position. A thorough overhauling will also be made throughout the town.

MURPHYSBORO, ILL.—The Murphysboro Water Works, Electric & Gas Light Company's capital stock has been increased from $80,000 to $160,000.

GREENVILLE, ILL.—E. G. Bruckman, of St. Louis, Jan. 2 sold the Greenville electric light plant to a syndicate of Greenville business men for $25,000 spot cash. The Greenville men who compose the syndicate are: Edmond Demoulin, Ulysses de Moulin, J. Seaman, F. P. Joy, E. M. Gullick, Charles Von Weise, C. L. Hoiles, and Guy B. Hoiles. The plant was built by Mr. Bruckman, who is manager of the Imperial Electric Light Company, of St. Louis, and has a twenty-four-year franchise.

MARION, IND.—The Marion Light & Heating Company has been incorporated, with a capital of $300,000. The board of directors is headed by B. F. Burk. The company proposes to establish a heating, lighting and power plant in this city.

NEW ORLEANS, LA.—Sealed proposals will be received until March 24 next for the construction and operation for ten years of an electric street light system, to revert to the city of New Orleans at the expiration of that period. The city engineer will furnish printed specifications and all other information.

YAZOO CITY, MISS.—The contract for drawing plans for the new electric light, water and sewerage systems has been given to Kirkpatrick & Johnson. This is done with a view to obtaining an idea of the cost of the proposed work, which is roughly estimated at $150,000.

ST. LOUIS, MO.—The Laclede Power Company, of St. Louis, has filed a statement of increase of capital from $400,000 to $800,000.

ST. LOUIS, MO.—Bids for supplying the power to drive the World's Fair machinery and supply the electric lights, have been made by a number of electric manufacturing companies. Among those bidding for the power contract is the Citizens' Electric Lighting & Power Company, of St. Louis. The company's new plant will be ready Nov. 1, 1902. The entire plant is guaranteed to be in operation by April 1, 1903. There will be three 4000-hp alternating engine-type dynamos; two 2000-hp vertical cross-compound condensing Corliss engines, running at 75 r. p. m., and two 2000-hp engines of the same description.

MARSHALL, N. C.—The North Carolina Electrical Power Company has executed a deed of trust to the Mercantile Trust & Deposit Company of Baltimore, to secure $80,000 six per cent. bonds, with the privilege of liquidation at the option of the power company.

GOLDSBORO, N. C.—The Board of Aldermen has reversed a former decision which in turn was a reversal of a previous decision to purchase the local electric plant, and now the city will purchase for $25,000 the plant of the Goldsboro Traction & Illuminating Company. The Aldermen decided on this some time ago, but it was developed that the action was contrary to the State Statutes. Now those Aldermen holding interests in the local company have disposed of these and again decided to purchase the plant for the city.

NEW YORK, N. Y.—Assemblyman Adler has introduced a bill for a municipal lighting plant for New York City.

HORSEHEADS, N. Y.—The village Board of Trustees has invited sealed bids for furnishing light to the village on or before Feb. 4.

SOUTHAMPTON, N. Y.—The Suffolk Light, Heat & Power Company, of Southampton, has let contracts for the installation of its plant.

AMSTERDAM, N. Y.—The Edison Electric Light & Power Company, of Amsterdam, has filed with the Secretary of State a certificate of increase of its capital stock from $18,000 to $100,000. The principal stockholder in the company is the Amsterdam Street Railway Company, of which J. Ledlie Hees, of [illegible], is president.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—After some weeks of negotiations, the Colgate and Martin syndicate has obtained control of the North Pacific Coast Railroad, which extends 94 miles northward from Sausalito, Calif. A new corporation will be organized for the purpose of improving and extending the narrow gauge railroad line. The purchasers are R. R. Colgate, R. M. Hotaling, W. M. Pierson, C. A. Grow, E. J. de Sabla, Jr., and John Martin. The capital stock of the company will be $6,000,000. The early improvements will consist of changing the roadbed to standard gauge from Sausalito to San Auselmo, double track throughout, from Mill Valley Junction to Mill Valley and from San Auselmo to San Rafael. These portions of the lines will be changed over to an electric system and electric power for its operation will be taken from the Colgate power station via the Bay Counties transmission line. The ferry connections with San Francisco will be improved.

ANDERSON, IND.—The Anderson Merchants' Association is promoting an electric railway to connect Anderson with Daleville and Middletown.

SOUTH BEND, IND.—Right of way has been secured for an electric road from this city to Michigan City and a line will be constructed into Chicago at a cost of $2,000,000.

INDIANAPOLIS, IND.—The Indianapolis merchants have asked President McCulloch, of the Union Traction Company, to furnish a sufficient number of freight cars to carry their merchandise out of the city to customers in the smaller cities and towns. They say their customers complain when shipment is made over the steam lines.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company has executed a mortgage for $750,000 for the purpose of floating bonds to that amount. The Union and the Security Trust companies of this city are named as trustees. The bonds are thirty-year 5 per cent. bonds. The company expects to be running cars to Mooresville in a short time and have the entire line in operation by May 1.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has filed articles of incorporation to operate a line of electric cars between Indianapolis and Plainfield, and ultimately to Danville. Charles Finley Smith, president of the Indianapolis & Martinsville Rapid Transit Company, is also named as president of the new company. The company has quietly purchased a right of way, paying as high as $150 an acre in some instances.

BLUFFTON, IND.—A combination electric and steam railroad is projected to run from this city to Pennville, Muncie, Selma, Albany and Dunkirk, and possibly to Ft. Wayne. It is announced that this line is to be built for the transportation of passengers by electric power and the transportation of freight by steam. The company title is the Ohio & Indiana Railway Company. W. H. Schott, of Chicago, is president, and says rights of way have been secured, subsidies voted in Jay County, and that $1,500,000 of bonds will be issued to build the road. South Bend, Dunkirk and Indianapolis men are interested with Mr. Schott in the enterprise.

DETROIT, MICH.—The Detroit & Toledo Shore Line Company has filed a mortgage for $3,000,000, given to the Metropolitan Trust Company of New York to secure thirty-year 4½ per cent. gold bonds.

MINNEAPOLIS, MINN.—The Minnesota & Iowa Electric Railway Company has been incorporated to build a line from Decorah, Iowa, to connect with the Minneapolis and St. Paul system. The capital stock is placed at $500,000. H. R. Wells is president, R. E. Thompson, vice-president; H. Kupson, treasurer, and S. A. Langum, secretary, all of Preston. The principal place of business is Preston, Minn.

FINDLAY, OHIO.—Except for two bridges the Toledo, Bowling Green & Southern Railway is complete between Toledo and Findlay.

DOYLESTOWN, OHIO.—The Doylestown Council has granted a franchise through town to the Canton, Lodi & Medina Railway Company.

CONNEAUT, OHIO.—The Millcreek Township Commissioners at Erie, Pa., have granted a franchise to the Conneaut & Erie Traction Company.

PAINESVILLE, OHIO.—Messrs. Goodrich, Tuttle and Stanley, who some time ago proposed building a road through Lake County, have brought suit against the County Commissioners to recover $38,500 damages. Plaintiffs allege that they secured a franchise for the road and deposited $2,000 to commence work by May 15, 1901. They claim the franchise was extended, but in August the franchise was declared void and the money forfeited. The plaintiffs allege work was started in accordance with the terms of the franchise and that the forfeiture spoiled their proposition.

THE AUTOMOBILE.

CHICAGO AUTOMOBILE CLUB.—A telegram from Chicago of Jan. 10 says: In its efforts to perfect a national organization, the Chicago Automobile Club is to ignore the Automobile Club of America, the New York organization. A national meeting will be held here in the first week of March, when the automobile show will be in progress. Invitations have been extended to the Long Island and Boston clubs, but the New York association will not be formally invited to participate. This attitude has been taken by the Chicago men because, they say, the Eastern club is attempting to run the proposed organization without giving the other clubs a fair deal in the preliminary arrangements. The New York club, it is said, has insisted that its racing rules must be accepted and that representation be based upon the population of the respective cities. The Chicago men want equal representation, according to membership, and racing rules that may be agreed upon by the National body, when organized.

NEW INDUSTRIAL COMPANIES.

THE ACME ELECTRIC APPLIANCE COMPANY, with a capital stock of $5,000, all paid, has filed articles of incorporation at St. Louis, Mo. Wm. A. Cowas, H. E. Cowas and J. E. Reid are the incorporators.

THE KNOWLES & TILLMAN TELEPHONE TRANSMITTER MANUFACTURING COMPANY, capital stock $10,000, has been incorporated at Buffalo, N. Y., by W. K. Knowles, B. J. Tillman and A. V. Tillman, of Buffalo.

THE UNITED STATES LIGHT & HEATING COMPANY, capital $3,000,000, has been incorporated at Trenton, N. J. The company is to furnish electricity, light and heat, especially for railways and railway cars. The incorporators are William B. Irwin, Wallace Young and John J. Gilbert, all of Jersey City.

LEGAL.

CUYAHOGA TELEPHONE COMPANY.—The Western Electric Company has brought suit in the United States Circuit Court at Cleveland, Ohio, against the Cuyahoga Telephone Company, Henry Everett and John Sherwin, officers of the company. The suit is over the alleged use by the Cuyahoga company of the supervisory signals on switchboards under patents granted Aug. 20, 1901, to Charles E. Scribner. An injunction is asked to prevent the Cuyahoga company from further use of the appliances and damages are asked for.

OBITUARY.

MRS. T. T. ECKERT.—We regret to note the death, after a long illness, of the wife of General T. T. Eckert, president of the Western Union Telegraph Company.

MR. M. HARTLEY.—The death occurred suddenly on Jan. 8, at a board meeting of the American Surety Company, of Mr. Marcellus Hartley, one of the leading financiers of New York City, who had a great deal to do with the early history and development of electric lighting in New York, and electric manufacturing in general.

MR. O. W. MEYROWITZ.—One of the victims of the tunnel collision on the New York Central Railroad last week was Mr. Oscar W. Meyrowitz, forty-seven years old, secretary of the Meyrowitz Manufacturing Company, optical goods, at 104 East Twenty-third Street, and manager of eleven stores which bore his name in this and other cities. He was a brother of Paul Meyrowitz and E. B. Meyrowitz, prominent opticians, and lived at New Rochelle. He was secretary of the New Rochelle Yacht Club, a member of the Reform Club, the Royal Arcanum, and a veteran of the Twenty-second Regiment, N. G. N. Y. Mr. Meyrowitz was born in Stettin, Germany, and came to this country when sixteen years old, to join E. B. Meyrowitz, now the president of the manufacturing company, with whom he also became an expert optician. The concern is very well known in electrical circles.

PERSONAL.

PROF. F. B. CROCKER, of Columbia University, has returned from his brief trip to Cuba, much improved by the sea voyage.

Mr. O. M. SOUTHWORTH, chief electrician of the Commercial Electric Company of Indianapolis, was a visitor in Chicago recently.

MR. W. FRANK PIERCE has been elected president of the Standard Electric Company, of California, to succeed Prince Poniatowski.

MR. LAMAR LYNDON, the electrical expert, has just returned from the West Indies, where he went to report on an electric railway.

PROF. W. F. GOLDSBOROUGH, head of the electrical engineering department of Purdue University, Lafayette, Ind., has been recommended as chief electrical expert at the St. Louis World's Fair to the Committee on Electricity and Electrical Appliances.

PRINCE ANDRE PONIATOWSKI recently resigned the presidency of the Standard Electric Company, of California, and left San Francisco for a visit to New York.

MR. HENRY C. PAYNE, whose coming East has been delayed by the death of a friend in Milwaukee, will qualify as Postmaster General and assume his new duties this week.

MR. FRANCIS HIRD, of Siemens Bros. & Company, Limited, who was here last spring, has not forgotten a New Year reminder to those who had the pleasure of making his acquaintance on this side.

PROF. S. P. THOMPSON has remembered his many friends in this country with an original Christmas card in his own name and that of his wife, embodying a very apt and charming quotation from Maarten Maartens.

MR. JOHN I. SABIN, president of the Pacific States Telephone & Telegraph Company, and also manager of the Bell companies operating in and around Chicago, recently left for the East after visiting his old home in San Francisco.

MR. W. J. CLARK has been sending a neat New Year personal card to his host of old time friends "at home." He is now settled in London on behalf of the General Electric Company, and extremely busy, but not over fond of the weather.

MR. JOHN L. LIVERS, superintendent and electrician of the Harper's Ferry, W. Va., Electric Light & Power Company, has accepted a similar position with the Chesapeake & Potomac Telephone Company, with headquarters at Cumberland, Md.

MR. M. G. STRATTON, recently connected with the Richmond Passenger & Power Company, of Richmond, Va., has been appointed superintendent of the Meter Department of the Lachine Rapids Hydraulic & Land Company, of Montreal, Canada.

MR. GAYLORD THOMPSON, general manager of the New Castle, Pa., Electric Company, the New Castle Traction Company, and the Lawrence Gas Company, has succeeded Mr. E. E. Hamilton as secretary and treasurer of those properties, the latter having resigned.

MR. J. G. WHITE, head of the firm bearing his name, has had a much more serious illness than is generally known, but is now safely on the road to convalescence at his apartments in New York, and has even been able to see callers. His recovery is a matter of hearty congratulation on the part of a host of friends.

MR. GEORGE A. DAMON, managing engineer of the Arnold Electric Power Station Company of Chicago, lectured before the engineering students of the University of Illinois, Jan. 10, on "How a Power Station is Designed," a subject which Mr. Damon is abundantly able to handle through his extensive experience along that line.

MR. JAMES HAMILTON, U. S. A., retired, has become associated with Mr. Edw. S. Beach, of Boston, Mass., and the two will jointly conduct a law business, making a specialty of patents, trade marks and copyright cases in all courts of the United States, and patent and trade-mark soliciting in all countries. The address of the firm is 53 State Street, Boston.

MR. HAROLD ALMERT, formerly electrical engineer of the Lincoln Park Board of Chicago, and who recently completed the electric lighting of Diversey Boulevard, which is now the best lighted thoroughfare in Chicago, left that position the first of the current year to become associated with the Buckeye and Jandus Electric Companies' western office, 1537 Monadnock Block, Chicago.

MR. W. R. MASON.—The many friends of W. R. Mason will be pleased to hear that he has returned to Chicago and will be connected with the Sprague Electric Company in the Chicago office. Mr. Mason has successfully represented the Walker, Siemens & Halske and Stanley companies in St. Louis for the last four years, but has been anxious to return to Chicago. His long experience in the electrical business, beginning at first with the original Sprague Electric Motor Company, and later in the supply business, has given him a close personal acquaintance with the trade extending over the entire country.

Trade Notes.

THE STANDARD ARM AND PIN COMPANY, Laurel, Miss., expects to have its new manufacturing plant in operation by Jan. 15. It will manufacture crossarms, brackets and pins for telegraph and telephone poles. The company also operates plants at Gadsden, Ala., and in Georgia.

THE ALPHA ELECTRICAL CONSTRUCTION COMPANY, 29 and 31 Gold Street, New York, was recently formed to do a general construction, repair and manufacturing business. It is thoroughly equipped for telephone and telegraph repair work on a large scale. Its clients include some of the largest concerns in this line.

HYDRAULIC VALVES.—A complete line of hydraulic valves and fittings is shown in catalogue No. 63, of the Watson-Stillman Company, New York. The illustrations are very clear, many of the devices being shown diagramatically as well as in perspective. The catalogue is made up from an assortment of sheets selected from the illustrated sheets describing hydraulic tools manufactured by this company.

RAILROAD DINING.—It is stated that the New York Central Railroad, which operates more dining cars as well as more sleeping and parlor cars than any other road in the world, has twenty-eight dining cars and eight restaurants and is now feeding more than 8,000 persons a day. Each dining car costs $15,000. Including the food supply constantly on hand, the Central has therefore about half a million dollars invested in the enterprise of feeding passengers while they are moving.

ELECTRICAL SUPPLIES CATALOGUE.—Messrs. Lowe & Leveridge, 183 Greenwich Street, New York, have just issued a catalogue of electrical supplies. The variety of goods carried by this firm is a very extensive one, as indicated by the catalogue, which has 388 pages, exclusive of the index. The first few pages at the front contain views of plants in which Lowe & Leveridge apparatus is installed, also several views of switchboards installed by the firm in various places. The catalogue measures 5x6¾, and is consequently of very convenient size.

THE NEW YORK SAFETY STEAM POWER COMPANY, 113 Liberty street, New York, will have ready for distribution within ten days its new catalogue of automatic engines, arranged for both belted and direct-connected service, low and high pressure duty, heavy service. These engines are equipped with double ported piston valves. One of the unique features of the engine is the Nichols shaft governor, which has given excellent results in heavy duty electric light work. The duplicate part system of the company whereby any repair part can be promptly identified and furnished upon telegraphic order is an important branch of the business.

THE 1902 CALENDAR issued by the American Electrical Works of Providence, R. I., of which Mr. Eugene F. Phillips is general manager, is well up to the standard of good taste which this company has established by precedent in its calendars of previous years. The illustration is a fine steel engraving of Alessandro Volta, and on the reverse side of the calendar are some historical facts speaking of Volta's experiments and discoveries. A phrase which occurs in this story of Volta which is worth repeating is one calling attention to the work of Volta as somewhat coincident with that of Franklin and Faraday, the "three constituting a kind of electrical F. F. V."

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is sending out to the trade a daily reminder calendar for use on the desk, mounted on an iron frame, and gotten up in a very substantial manner. The company states that on account of the flattering success which it has met with in the sale of its Emerson alternating current ceiling and desk fans, and its Peerless direct current fans, it is endeavoring to contract for fans earlier this year than before, as it expects an unprecedented demand. Last year the entire output of its factory was sold before June 1. The company reports that it has already closed a very large number of contracts. It has gotten up two very attractive catalogues, illustrating current fans. These will be mailed on application.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 7, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

690,059. REGISTERING METER; E. S. Isham, Jr., New York, N. Y. App. filed Nov. 6, 1901. Two supporting thermostats adapted to expand uniformly in opposite directions by variations in atmospheric temperature, means for applying a measurable quantity of heat to one of the thermostats and an index acted upon by both thermostats. (Issued Dec. 31, 1901.)

690,386. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 25, 1898. The automatic switch for throwing the current from the feeder to a section of the sectional conductor, consists of a solenoid magnet having one end of its core immersed in mercury, from which it is never withdrawn, and which forms one terminal; the other end of the core being lifted when the solenoid is energized to make contact with another circuit terminal.

690,387. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. A bare conductor is housed in a sealed conduit, one-half of which is of rigid metal and the other half of flexible material, such as leather or sheet rubber. The flexible side supports, exteriorly, a sectional rod connected through the flexible wall with contact pieces which are carried against the bare conductor when the collecting shoe moves against the rod.

690,406. ELECTRIC RAILWAY; G. Davis, West Kensington, Eng. App. filed Nov. 19, 1900. A trolley running on double rails and consisting of a main and a supplemental contact and an arm connecting the contacts and so shaped as to pass wholly without or wholly within, the arm of another similar trolley running on the same rails in the opposite direction.

690,420. REGULATOR FOR DYNAMO ELECTRIC MACHINES; Chas. M. Green, Lynn, Mass. App. filed May 21, 1898. A regulator for arc light machines. There is a rheostat in shunt with the field magnet circuit, a rotary pump driven from the shafting of the machine, mechanism for actuating a rheostat handle and shifting the brushes proportionately; the mechanism being driven by the pump and there being a controlling magnet in series circuit.

690,427. COVERED STRIP OF SOFT METAL AND THE MANUFACTURE THEREOF; I. W. Heysinger, Philadelphia, Pa. App. filed Aug. 29, 1901. A flat, soft metal strip having a covering of textile fabric cemented thereto and a stitched seam sewed through the strip, cement and covering along the flat side.

690,448. STARTING RHEOSTAT FOR ELECTRIC MOTORS; F. Mackintosh, Schenectady, N. Y. App. filed July 15, 1901. One of the sections of the rheostat is sub-divided and independently variable; a shunt is provided around this variable section to kill the spark at the motor contacts.

690,450. ELECTRIC METER; G. H. Meeker, Media, Pa. App. filed April 27, 1900. A part which is moved to an extent proportional to the passing of current, is so related to a vibratory bar that the extent of the vibrations of the bar are limited by the position of the movable part, and means are provided for giving to the bar successive movements, the time intervals between which are inversely proportional to the electrical pressure of the service line wires. The result is the product of amperes, volts and time units.

690,453. SERVICE METER FOR TELEPHONE LINES; F. R. McBerty, [illegible]

690,469. MAGNETO ELECTRIC MACHINE; F. R. Simms, Bermondsey, [illegible] for a rotating envelope surrounding a fixed armature.

690,479. ELECTRIC SWITCH; E. R. Storm, New York, N. Y. App. filed Oct. 16, 1899. The front plate of a switch box adapted to be set into a plastered wall is adjustable independent of the box, so that it can be set plumb with the face of the wall, notwithstanding the fact that the box itself may be out of plumb.

690,487. LAMP SOCKET; C. J. Tournier, Schenectady, N. Y. App. filed May 17, 1899. A lamp socket having a two-way contact device controlled by the key to permit the lamp to be operated from two points, one at the lamp and one distant therefrom, by the operation of a circuit controller at either point.

690,499. ELECTRIC RAILWAY SYSTEM; H. P. Wellman, Ashland, Ky. App. filed Oct. 9, 1896. A third rail sectional conductor is energized through electro-magnetic switches by means of extra contacts in the road-bed and brushes on the car co-acting to throw the current from the storage battery through the switches.

690,516. COMMUTATOR BRUSH; C. G. Curtis, New York, N. Y. App. filed May 12, 1900. A short carbon block held loosely in a holder so as to be unrestrained in following the irregularities of the commutator, and a spring pressing the block against the commutator.

690,577. SELECTOR; K. Himrod, Chicago, Ill., and J. R. Tucker and C. G. Hinckley, Aurora, Ill. App. filed March 10, 1899. A selector shaft normally maintained under spring tension, a series of locking devices for the shaft adapted when operated to allow movement thereof to different predetermined extents, a magnet for each locking device, a series of selector plates and a contact device carried by the shaft for making contact with any one of the selector plates.

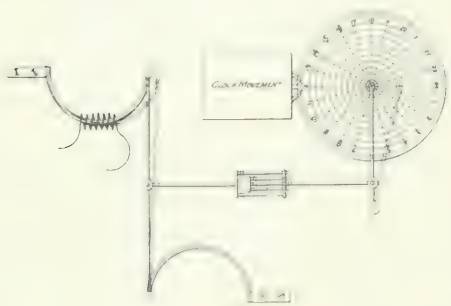
690,589. PLATE FOR SECONDARY BATTERIES; Berthold Kuettner, Woking, Eng. App. filed Aug. 8, 1901. A plate of the Plante type divided into a number of panels by cross bars of diamond shape section, each panel consisting of two sets of ribs of wedge shape, cross section extending from the opposite side to form the depth of the plate and crossing each other at right angles, the sets of ribs being alternately arranged on opposite faces of the plate.

690,594. TRAVELER; A. Lonergan, New York, N. Y. App. filed May 2, 1901. A traveler for threading conduits, having a movable clutch, a bumper connected with the clutch and means for throwing a driver against the bumper to force the traveler along.

690,623. ELECTRICAL CALL APPARATUS; C. Shore, Bolton, Eng. App. filed April 8, 1901. A clock fitted with contacts in connection with a switch-board and call apparatus at various locations, whereby a call can be automatically sent to a particular location by properly plugging-in at the board.

690,639. TROLLEY HARP; F. P. Crockett and O. P. Johnson, Kalamazoo, Mich. App. filed Oct. 21, 1901. Details.

690,649. ELECTRICALLY ILLUMINATED SIGN; J. H. Goehst, Chicago, Ill. App. filed March 21, 1901. A tubular frame surrounding the sign is fitted internally with lamp sockets into which lamps are inserted through [illegible] both sides of the sign to illuminate both faces [illegible]



690,050. Registering Meter.

690,651. TELEPHONE ATTACHMENT; H. I. Hauxhurst, Oakland, Calif. App. filed Sept. 11, 1900. (See page 127.)

690,710. GALVANIC BATTERY; Wilhelm Erny, Halle-on-the-Salle, Germany. App. filed Mar. 6, 1901. A primary battery consisting of a vessel having an inner annular recess; the zinc electrode consists of a slotted cylinder with an outer projection at its upper end, which engages in the above-mentioned annular recess, the zinc electrode thus being freely suspended in the vessel.

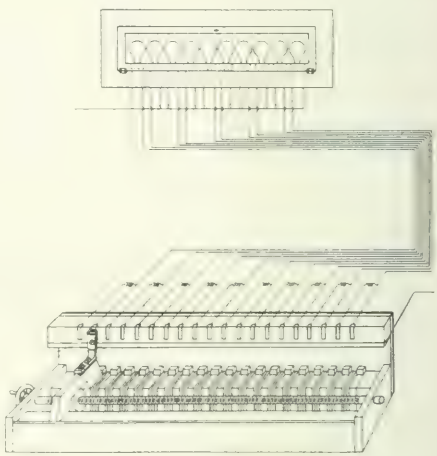
690,750. SPARKING COIL; M. H. Moffett, Cleveland, Ohio. App. filed Feb. 9, 1901. The coil is inclosed in a protective casing having a chamber at one end in which the connections of the terminal wires are made.

690,757. SLEET CLEANING DEVICE FOR TROLLEY ARMS; M. M. Nash, Lowell, Mass. App. filed Nov. 8, 1901. A curved shoe having a scraping blade is adapted to be strapped into the groove of the wheel and held from rotating by engagement with the harp.

690,763. BAG OR SATCHEL LIGHTING DEVICE; W. W. McCormick, Santa Rosa, Calif. App. filed March 2, 1901. A bulls-eye light is set into one end of the satchel and supplied by a battery located in a false bottom of the satchel.

690,770. GALVANIC BATTERY OR PILE; C. J. Reed and M. T. Morrill, Golden, Colo. App. filed July 6, 1899. A dry battery consisting of two or more elements electrically connected in series. The parts are in the form of flat plates superposed one upon the other, and comprised of carbon and zinc electrodes, porous diaphragms are in contact with the zinc, with an electric mixture of smaller area than electrodes between the carbon and the porous diaphragm. The negative electrode of one element is electrically separated from the positive electrode of the adjacent element by an insulating plate or layer.

690,787. INDEPENDENT OPERATING MEANS FOR ELECTRIC SWITCHES; J. H. Spangler, Crafton, Pa. App. filed April 17, 1901. An automatic electric railway switch provided with means for operating by hand when desired.



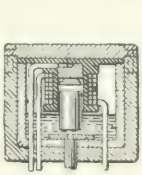
690,800. Battery End Cell Switch Indicator.

690,800. BATTERY END CELL SWITCH INDICATOR; A. C. Walther, Brooklyn, N. Y. App. filed April 19, 1901. An indicator circuit is closed through local lamp circuits successively with an arrangement of resistances such as to reduce the light proceeding from each lamp as the movable part of the indicator reaches certain of its predetermined positions and to permit full candle power at the remaining positions of the indicating device. With this apparatus a ten-lamp indicator will serve for twenty end cells.

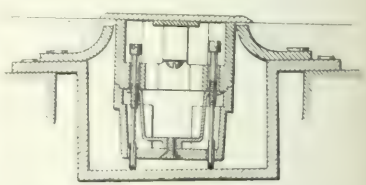
690,807. METHOD OF CONTROLLING ELECTRIC MOTORS OR OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, Parkridge, N. J. App. filed Aug. 27, 1892. (See Current News and Notes.)

690,808. METHOD OF CONTROLLING ELECTRIC MOTORS OR OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, Parkridge, N. J. App. filed March 20, 1895. (See Current News and Notes.)

690,809. APPARATUS FOR CONTROLLING ELECTRIC MOTORS OR OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, New York, N. Y. App. filed March 28, 1901. (See Current News and Notes.)



690,386. Electric Railway.



690,479. Electric Switch.

690,810. APPARATUS FOR CONTROLLING ELECTRIC MOTORS OR OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, New York, N. Y. App. filed March 28, 1901. (See Current News and Notes.)

690,818. ICE CUTTER FOR TROLLEY WIRES; A. Ambuhl, Decatur, Ill. App. filed Dec. 6, 1900. A slidable ice cutter to be fitted against the front side of the wheel of the trolley pole.

690,856. METHOD OF MAKING GLOWERS FOR ELECTRIC LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed June 7, 1900. The glower blank is subjected to an electric arc formed between carbon electrodes, the products of combustion being withdrawn by suction. In this manner a terminal bead is formed on the end of the glower.

690,886. OPERATING MECHANISM FOR ELECTRIC SWITCHES; J. H. Spangler and R. Herman, Crafton, Pa. App. filed April 17, 1901. Electric railway switch mechanism provided with means for preventing backward motion after actuation of the switch tongue.

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THE WATERSIDE STATION.

During the present month a large part of our space has been devoted to the description in detail of the new Waterside station of the New York Edison Company, and the system of that corporation in general. We had hoped to publish the closing installment this week, accompanied by a very elaborate map of the whole low-tension network of the company in Greater New York, but unfortunately our engravers have not quite been able to get their work done in time. The final installment will, therefore, appear next week, and will constitute one feature of an unusually interesting and important Export Issue.

INCOMBUSTIBLE CARS.

Since our publication last week of the preliminary announcement of the general plans of the New York Central Railroad for the use of electric traction in the terminal tunnel and on commuter service as a whole, very little, if anything, has been vouchsafed as to the details of the schemes of the management. Things are, however, in a much more satisfactory shape than they were. Heaven knows, the new capital being raised, ostensibly for the purpose, is far more than adequate, and it would really seem that some other larger enterprise may be afoot, such as acquiring control of the Manhattan Elevated. Time will show. Meanwhile, another gratifying disclosure—no secret to our readers—is that Mr. Bion J. Arnold is now retained in the Central service to deal specifically under the direction of Chief Engineer Wilgus, with problems of electrical operation. As a matter of fact, Mr. Arnold has been studying the situation for some time past, and we can but heartily commend the selection. The Western record in heavy traction of this progressive and earnest young electrical engineer is the best augury for the new work.

Attention is called elsewhere in these pages to the remarkable and interesting discussion stirred up by Mr. George Westinghouse by newspaper correspondence, on the subject of safety in electric traction. That distinguished engineer and inventor suggests an ideal in incombustible cars and generally improved safeguards, toward which every aim must indeed be concentrated. The evils and dangers of fire from electric lighting are still far too great to be viewed with unconcern by any electrical engineer, and the art of electric traction cannot afford to have its progress hindered in the same manner. The discussion started by Mr. Westinghouse does, indeed, open up a large number of such questions of importance to the electrical industry, and, we believe, cannot but help bring nearer the time when electric traction will not only be universal but the safest means of locomotion on earth for all classes of service.

THE NORTHWESTERN ELECTRICAL CONVENTION.

The regular winter meeting of the Northwestern Electrical Association, held at Milwaukee last week, demonstrated more than ever the importance of that convention to the small electric lighting companies, not only of the territory which it covers, but of the whole country. The discussions at the Northwestern convention this year were better than ever, and will appeal to the smaller electric light companies to a degree not as yet attained by the proceedings of any other similar body, even though containing little of value to the professed engineer. The discussions covered such a wide range of sub-

jects that we can but call attention to a few of the notable points here, leaving fuller consideration of them until later.

The competition of small gasoline lighting plants installed by individual consumers received little attention compared to what the same subject did a year ago. The report of the committee on gasoline lighting submitted at the summer meeting did not reveal a very alarming state of affairs for electric light companies. Indeed, aside from this the discussion last week brought out clearly that convenience is what customers want rather than mere cheapness; otherwise electric lighting would never have gained a foothold against the incomparably cheaper light obtained from kerosene lamps. As long as central stations can offer reliable light free from bother to customers they need have no fear of the competition of illuminants calling for care and trouble on the part of the user.

The paper by Mr. Rau outlined a three-phase 4500-volt system for lighting, with delta connection for power transformers and 2000-volt star-connections between the three phases and neutral for light. Indeed, it looks as if such a system might easily become the standard for general light and power distribution in moderate sized towns, it is finding such an increasing number of advocates. With such a system Mr. Rau considers that the depreciation due to the advance of the art will not be nearly as rapid as it has been formerly in the electric lighting business. The discussion of this paper brought out one point upon which there is good reason to expect development the next few years, namely, the perfection of magnetic clutches which will allow polyphase motors to be run continuously on elevator and variable service of all kinds. In such case the manipulation of the clutch would correspond with the ordinary control used with direct-current motors.

Death by Electricity.

In a communication appearing in this week's Correspondence Columns, the question is raised as to whether a shock of electricity, as ordinarily received, really kills, and also the question as to whether in the electrocution of criminals, as practised in more than one State, the electrical execution really kills, as distinguished from the autopsy. In the first place, it is a matter of unfortunate experience that occasionally persons are killed by accidental electric shocks. That is to say, they receive a shock and fall down unconscious, and from this state they never revive, so that in the course of a certain number of minutes or hours there is no doubt in the minds of the most unskilled observer that the person is dead. In some cases, however, persons recover, either with or without the aid of assistants, such as artificial respiration and stimulants. The fact that artificial respiration sometimes restores suspended animation several hours after loss of consciousness by drowning, has raised the question from time to time as to whether similar treatment can restore animation to the electrically shocked.

As regards shocks accidentally received, efforts should always be made to resuscitate the unconscious victim of accident. The question as to whether he can be revived should be settled by trial, and failure not accepted until the case is clearly hopeless. In the case of electrocuted criminals, the conditions are entirely different. When a man receives an accidental shock the muscular contraction usually tends to throw him violently away from the contact. Moreover, the resistance of the accidental path through his body is usually high. The current he receives is, therefore, under ordinary circumstances, neither powerful nor prolonged.

Under the conditions of electrocution, however, the current application is relatively both powerful and prolonged. In fact, it is sufficient, at least in some cases, to raise the temperature of the body appreciably, owing to Joulean effect, and invariably produces lesions fatal to life. Considering the number of electrocutions that have been made since the existing New York State law went into effect, and the fulness with which the subject has been reported upon, there can be no question that the subject dies by the effects of the electric shock, and is dead beyond all hope of recovery before the autopsy takes place. We may remark that a very interesting article on the cause of death by electric shock by Dr. R. H. Cunningham, appeared on page 1003 of the *Electrical World* for Dec. 30, 1899.

The Function of the Condenser in the Induction Coil.

A communication in our Correspondence Columns relating to the changes which are produced in the operation of an induction coil when a condenser is used to bridge the vibrator, raises an interesting subject, the full theory of which has never been thoroughly worked out on the experimental side, owing, no doubt, to the great difficulty and complexity of the investigation.

It is quite clear, from elementary principles, that since the primary and secondary windings of an induction coil are mounted upon the same core, that, neglecting magnetic leakage, the induced e. m. f.'s in both are the same, except in regard to degree. In other words, any variation of magnetic flux in the common magnetic circuit of both induces the same e. m. f. per turn in both primary and secondary windings. If the number of turns in the primary and secondary windings were equal, the induced e. m. f.'s would be equal. Owing to the fact that in the ordinary induction coil the secondary winding has a much larger number of turns than the primary winding, the secondary induced e. m. f. may be very appreciable when the primary induced e. m. f. is relatively small. In either case, however, a primary induced e. m. f. exists. In fact, induction coils employed for exciting muscular stimulus in electro-therapeutic treatment are commonly provided with terminals, from which either the primary induced e. m. f. or the secondary induced e. m. f. can be obtained.

If no condenser is used to bridge the vibrator in the primary or battery circuit, the primary current is cyclically broken through the vibrator arc, and this means that the primary current tapers down to zero rather than falls to zero abruptly. When, however, a suitable condenser is connected across the vibrator, the rupture of the vibrator contact does not, or need not, interrupt the flow of current in the primary circuit. The primary winding may discharge into the condenser until the e. m. f. in the condenser first stops and then reverses the direction of flow. This automatic stopping and reversing usually means a much more sudden change of current than the interruption through the arc provides. Since the induced e. m. f.'s in both primary and secondary depend for their magnitude upon the rate of change of primary current, both induced e. m. f.'s will be magnified by the use of the condenser, and a primary winding, which will not light up a Geissler tube when no condenser is used, may light up the tube after the insertion of the condenser. Similarly, the sparking distance at secondary terminals is likely to be considerably increased by the use of the condenser. Since the magnitude of the induced e. m. f. depends upon the suddenness of change in magnetic flux and of current, the reason for the relatively enormous lengths of sparks supplied by the Tesla induction coil is at once evident. In the Tesla coil the number of secondary turns is comparatively small, but the primary winding is supplied with oscillatory currents of high frequency, i. e., currents which change very rapidly in magnitude.

THE COHERER IN WIRELESS TELEGRAPHY.

In his remarks at the recent annual dinner of the American Institute of Electrical Engineers, Mr. Marconi, in speaking of his work, rendered frank acknowledgment of the fact that it had been built largely on the work of others, and mentioned specifically Henry, Hertz, Maxwell and Kelvin. We believe it was a matter of general surprise, however, to those present, and doubtless to many who subsequently read the report of his remarks, that no reference was made to those who discovered and perfected the coherer. It is not too much to say that entirely upon the coherer the existing art of wireless telegraphy rests, and while none can dispute the credit due to Marconi for his pre-eminent part in perfecting a practical system of radiant telegraphy, no factor which he has incorporated in that system is, we believe, at all comparable in importance with the coherer. Indeed, without the discovery of this device the present wireless telegraphy systems would be as impossible as the electromagnetic telegraph would have been without the electromagnet. None will question the acknowledgment to Henry, who first experimented with rapid oscillations and their effects; to Maxwell, who built up the theory of electric waves, and to Hertz, who demonstrated their existence. But surely to Onesti, the Italian, and Branly, the Frenchman, who independently discovered the filings coherer, and particularly to the latter who as early as 1890 demonstrated its possibilities as a wave detector and generously offered to the world the free use of his work, should be assigned a large share—perhaps the largest—in an allotment of credit for the wireless telegraph system of to-day

AS TO ELECTRIC HEATING.

As time has moved along there has been much comment that the commercial applications of electric heating have not become more extensive. Of course, the actual number of such applications has already become very large, but it is for the most part for very special purposes or on a small scale, although a few of the applications to the arts require considerable energy. The fact is that electric heating as a factor of station load is even now almost negligible. The art of electric heating, particularly in electric furnaces, has, nevertheless, progressed in a remarkable manner, but so far as the station manager is concerned it cuts little figure. Obviously, electric current is a roundabout and not very efficient way of obtaining heat, but it is, nevertheless, so convenient that it has very great merits for many purposes. It has been given a fair trial for cooking purposes, and has shown in that line a reasonable degree of economy. With the cost of current brought to the figures often reached in hydraulic transmission plants, an electric range is quite comparable with a gas range in operating expenses, and, indeed, in many instances would prove to be the lower of the two, for in cities of the smaller class gas is generally relatively higher than electricity. Similarly, electric heating has proved a great success in certain of the arts, saving more in labor than would offset any intrinsic expense in the method. Yet all these uses combined involve no very considerable output in any one place.

The only large use of electricity for low temperature heating is in electric cars, and this, as every one knows, is universal and highly successful. There is no other method of heating cars which can at all be considered a competitor on street railways. Now the essence of success in this instance is the well-known fact that after the car is once heated it can be kept hot with a very moderate expenditure of energy, even under the severe attacks of a Northern winter; and observation indicates that as a matter of fact electric cars are much oftener too hot than too cool. The recent strike in a Western city, when the enraged passengers refused to pay fare until the heat was turned on, is a source of innocent merriment because of its rarity. Now, there are many cases of domestic heating which could be treated electrically with positive economy and very great convenience, if there were a little encouragement given them. In every house, particularly in our smaller Northern cities, where fairly cheap power is available, there are a few rooms which require heat only in a moderate degree at irregular or sometimes regular intervals. Sleeping rooms in particular ought not, merely as a matter of hygiene, to be kept hot, and except in occasional instances a couple of hours a day would cover the time during which a quick-acting and direct source of heat like an electric radiator would be in use. This is a type of a very large amount of purely auxiliary heating that could very well be done electrically, and electrical methods would simplify the work wonderfully. If one started with such auxiliary heating in view the apparatus for warming a house would be improved in various ways. In the ordinary house of modest pretensions a hot-air furnace is the common method of heating with the addition of a few fireplaces, which are very rarely used regularly. If not very carefully planned, a hot-air furnace is notoriously bad in the matter of distributing its heat, and almost every house has at least one room that can only be heated by shutting off most of the other registers and driving the furnace at full power.

Now, with electric heating fairly available one could plan a furnace hot-air or steam so as to do the regular work of winter heating and to do it thoroughly well. A furnace, when driven too hard or not hard enough, is both troublesome to manage and inefficient. When proportioned to take care of moderate and uniform requirements it is both efficient and reliable. With a furnace properly proportioned for, say, eight rooms of a 16-room house, the saving during a winter run would probably provide a material balance to help offset the cost of electricity used irregularly in the other rooms. At ordinary prices electric heating would still be a luxury, but a very convenient and satisfactory one. Nothing else can put up the temperature on so short notice or hold it so steadily. In milder climates, where really cold days are rare, the occasional usefulness of electric heaters would still be greater and would obviate the necessity of other heating devices, or else supplement the simpler ones, like fireplaces, very efficiently. Electric heat is always ready to be turned on, gets to work quickly and is out for good when the switch is turned off. It is, of course, understood that for temporary or irregular heating the walls of a room should not be of low temperature when heat is needed, as otherwise some time will be required to raise the temperature of these, during which period the occupant of the room will not derive much warmth from the heater unless exposed to its direct radiations.

So far as the station manager is concerned the load produced and sold on the basis of motive power would be, for the most part, very desirable in character. It would not be subject to violent fluctuations, would be nearly non-inductive, and except for electrical cooking apparatus would not aggravate the lap load. Even in that case it would tend mainly to lengthen the peak, while in the morning and at noon it would help the load curve materially. The occasional heating of rooms would come at times generally advantageous to the station. Very possibly it may take a long time to bring electric heating into prominence, but we wish some enterprising manager of a transmission plant who can make a fairly low price for current and wants to build up a steady load would try on the electric heating proposition and see in how far it can be made commercially advantageous to himself and to the public.

The Marconi Wireless Atlantic Signals.

Mr. G. Marconi sailed for England on Wednesday by the International Navigation steamer "Philadelphia," to push the development of his work on both sides of the Atlantic. We gave last week his own story of the famous signals, and below is quoted the graphic narrative of Mr. Ray Stannard Baker, to appear in February *McClure's Magazine:*

At noon on Thursday (Dec. 12, 1901) Marconi sat waiting, a telephone receiver at his ear, in the old barracks on Signal Hill. To him it must have been a moment of painful stress. Arranged on the table before him, all its parts within easy reach, was the delicate receiving instrument, the supreme product of years of the inventor's life, now to be submitted to a decisive test. A wire ran out through the window, thence to a pole, thence upward to the kite which could be seen swaying high overhead. It was a bluff, raw day; at the base of ht ecliff, 300 ft. below, thundered a cold sea; oceanward through the mist rose dimly the outlines of Cape Spear, the easternmost reach of the North American continent. Beyond that rolled the unbroken ocean, nearly 2000 miles to the coast of the British Isles. Across the harbor the city of St. John's lay on its hillside wrapped in fog; no one had taken enough interest in the experiments to come up here through the snow to Signal Hill. Even the ubiquitous reporter was absent, but the faith of the inventor in his creation was unshaken.

"I believed from the first," he told me, "that I would be successful in getting signals across the Atlantic."

Only two persons were in the room—Mr. Marconi and Mr. Kemp Everything had been done that could be done. The receiving apparatus was of unusual sensitiveness, so that it could catch even the faintest evidence of the signals. A telephone receiver, which is no part of the ordinary instrument, had been supplied, so that the slightest clicking of the dots might be conveyed to the inventor's ear. For nearly half an hour not a sound broke the silence of the room; then quite suddenly Mr. Kemp heard the sharp click of the tapper as it struck against the coherer—this, of course, was not the signal, yet it was an indication that something was coming. The inventor's face showed no evidence of excitement. Presently he said:

"See if you can hear anything, Mr. Kemp."

Mr. Kemp took the receiver, and a moment later, faintly and yet distinctly and unmistakably, came the three little clicks—the dots of the letter S, tapped out an instant before in England. At 10 minutes past 1 more signals came, and both Mr. Marconi and Mr. Kemp assured themselves again and again that there could be no mistake. During this time the kite gyrated so wildly in the air that the receiving wire was not maintained at the same height, as it should have been; but again, at 20 minutes after 2, other repetitions of the signal were received.

Thus the problem was solved. One of the great wonders of science had been wrought. On the following afternoon, Friday, he succeeded in getting other repetitions of the signal from England; but on Saturday, though he made an effort, he was unable to hear anything. The signals were, of course, sent continuously, but the inventor was unable to obtain continuous results, owing, as he explains, to the fluctuations of the height of the kite as it was blown about by the wind, and to the extreme delicacy of his instruments, which required constant adjustment during the experiments.

Electrical Engineers of the Day—XXX.

Calvin W. Rice

Mr. Calvin Winsor Rice was born in Winchester, Mass., on Nov. 4, 1868. He is of Puritan stock, descended from Governor Winslow, of the Massachusetts Bay Colony. Most of his early life was spent in the vicinity of Boston, Mass., and his education was obtained in the public schools of Massachusetts. Entering the electrical engineering course of the Massachusetts Institute of Technology in 1886, he was graduated therefrom with the class of 1890.

Previous to graduation Mr. Rice, in order to supplement his class instruction by practical knowledge, worked during summer vacations in the shops of the Thomson-Houston Electric Co., of Lynn, Mass., beginning as armature winder. In this manner he gained early in life the practical ideas which have so clearly shown themselves in his subsequent career. Shortly after Mr. Rice's permanent attachment to the Thomson-Houston Electric Company, he was assigned for duty with the motor department, and assisted in the work then being newly undertaken of adapting electric motors to many of the various kinds of work with which we are now all so familiar, but which in those days presented many problems for solution.

When the Thomson-Houston Electric Company consolidated with the Edison General Electric Company in 1892, and the present General Electric Company was formed, Mr. Rice was assigned to duty at the headquarters of the new company in Schenectady. There again he had the rare opportunity of assisting in new developments, as work was carried out on a much larger scale and polyphase apparatus was beginning to receive much more attention than had formerly been the case.

At Schenectady in 1894 he contracted typhoid fever, and after recovery was chosen in 1895 to fill the position of local engineer of the Cincinnati office of the General Electric Company, where he remained until 1896, when he was called to the position of electrical superintendent of the Silver Lake Mines, Silverton, Col. At these mines there was a power transmission system, the power plant situated on the Las Animas River, transmitting over a four-mile line to the mines at an elevation of 12,500 ft. above sea level.

After completing the extensions for the Silver Lake plant Mr. Rice went with the Anaconda Copper Mining Company as consulting engineer to Mr. Marcus Daly. In this position a great variety of work was performed by Mr. Rice, but his chief occupation was that of determining the engineering and commercial practicability of the development of certain water powers near Butte, Mont.

Mr. Rice returned to the East in 1898 and became the electrical engineer of the Kings County Electric Light & Power Company,



Brooklyn, and took part in the equipping of the station and a complete system of feeders and mains for an alternating system. The Kings County system was only partially completed, when a consolidation was effected with the Brooklyn Edison Company, and the two systems were merged. Mr. Rice then accepted a position as electrical engineer of the Consolidated Telegraph & Electrical Subway Company, which owns and operates the high-tension subways of the City of New York. In addition to this responsible position, which he still holds, Mr. Rice was also appointed chief of the meter and testing departments of the New York Edison Company, with headquarters at 53 Duane Street, New York. In these positions Mr. Rice has been assisting in the successful consolidation of several companies into one large system ,and has gathered an experience equaled by few engineers.

Mr. Rice has prepared papers for the National Electric Light Association at its conventions in 1898 and 1901, for the Boston Society of Arts and the Brooklyn Engineers' Club.

Mr. Rice is interested in literature, music and art, and these qualities as well as his never-failing courtesy have endeared him to a large circle of acquaintances and personal friends. He is a member of the American Institute of Electrical Engineers, of which he is at present a manager, a member of the finance and several special committees. He is the very efficient chairman of the Institute Committee on Papers and Meetings. He is also a member of the American Society of Mechanical Engineers and a corporate member of the Brooklyn Engineer's Club.

Electrical Equipment of the Manhattan Elevated Railway.—III.

(Concluded.)

TRAIN EQUIPMENT.

IT is needless to say that the train equipment of the Manhattan system presented many problems of a magnitude not heretofore encountered in electric railway work necessitating for their solution an exhaustive study of the particular conditions of the road's traffic, and lengthy investigations of engineering factors and details of design. The motors are required to supply an enormous accelerating effort, and the high accelerating rate and frequency of stops imply an abnormal generation of heat, the dissipation of which must be provided for in the design. In addition are the vital questions of train control and braking. The preliminary trials demonstrated that the various problems presented by the conditions of service, and in the design of the apparatus had been most successfully solved in all of their details. In fact, the train equipment of the Manhattan may be considered to represent one of the most important pieces of engineering work of recent years, and reflects the highest credit on the engineers concerned.

In the study for the Manhattan equipment, the first point determined was the train weight. In place of the present five-car maximum for trains, it was decided to run six-car trains on the more crowded lines at the time of heaviest traffic. The next point determined was the schedule speed, this, with the number of stops, as already fixed by the location of existing stations, being the controlling factor in the size of motors and through them of the complete sub-station and main station electrical equipment, engines and boilers.

After investigating a large number of train characteristics with different rates of acceleration and braking, and different durations of acceleration, drifting and braking, a schedule of 14.7 miles per hour, theoretical was chosen for the local service, based on an average of three stops per mile. This schedule was found to give best economy of power per ton-mile consistent with a moderate cost of electrical equipment; due regard being paid to an improvement of service over and above that given in the past by the steam locomotives, which, with five-car trains, only average a schedule speed of about 12 miles per hour.

The weight of a six-car train completely equipped with proper motors and controlling apparatus for this schedule, and with a standing load is about 154 tons. The train characteristic, or speed time curve, was based on an average run of 1775 ft. between stations, which run was to be made in about 68 seconds. The curve was laid out with power on for some 30 or 35 seconds, and with brakes on between 10 and 12 seconds; the balance of the 68 seconds' time being spent in drifting. The acceleration required before reaching the motor curve was 1.3 miles per hour per second, this acceleration remaining constant up to a speed of about 16 miles per hour, where it was assumed that the resistance would be all cut out, further acceleration being at a decreasing rate. The rate of retardation while braking was assumed at about two miles per hour per second.

With an average stop of 14 seconds at each station this train characteristic gave the required theoretical schedule speed of 14.7 miles per hour, with an estimated power consumption at the car of 77 watt-hours per ton-mile. From this train characteristic a cycle of duty for the motor equipment was developed, due regard being paid to the friction losses, which are estimated about 12 lbs. per ton, and to the rotary acceleration of the rotating parts, which worked out a value equivalent to the addition of 20 tons to the 154-ton train. It was found that the required effort would call for about 800 hp of motors per train.

At the time these calculations were made it was proposed to operate each train with two motor cars, one on each end of the train, and four trailers, each motor car to be equipped with four motors. The motors were, therefore, designed each to have sufficient power for the operation of ⅛ of the 174 effective-ton six-car train on the characteristic speed time curve outlined above.

After very exhaustive tests the motor designed by the General Electric Company, and termed the "GE-66," was chosen. Subsequent to the design of this motor the distribution of the motors through the train was somewhat altered. The original two motor car plan, which has been styled "double ended," was an admirable arrangement on the score of simplicity, and the utilization of well-tried controlling arrangements. But one single main conducting wire was to be run between the front and rear cars, the four motors in the rear car being connected in parallel with each other between this conducting wire and ground. The controller in the forward car was to operate in the usual series parallel way, connecting the four motors of the rear car first in series and afterward in parallel with the four motors in the forward car. For reversing, an electrically actuated reverse switch was to be used in the rear car, connected by small controlling wires with the forward car. Each of the two motor cars was to have a controller at one end, each of the two controllers on the six-car train being capable of handling all eight motors. While this was, undoubtedly, at the time considered the best method of handling this amount of power, a change was finally decided upon which would do away with the following disadvantages of the double-end system.

First.—The two large 800-hp controllers occupied valuable seating space above the car floor. Second.—Each motor car was obliged to carry sufficient rheostats for the control of all eight motors, half of these rheostats being normally out of service. Third.—More complicated switching when making up trains.

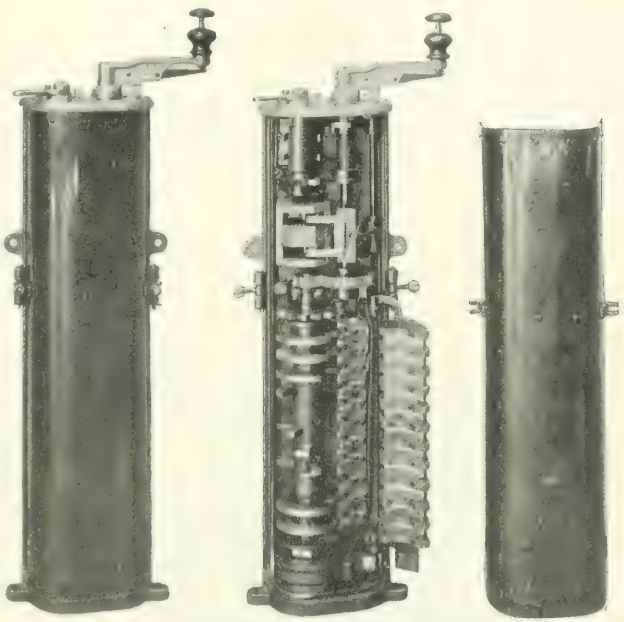


FIG. 1.—MASTER CONTROLLER CLOSED AND OPEN.

On proof being obtained from extended trial on the Brooklyn Elevated system that this system of train control was sufficiently perfected for its safe adoption on such heavy and important service as that of the Manhattan Elevated, the double-ended system was given up, and the General Electric "Type M" system of control was chosen.

Eight motors being sufficient for a schedule of 14.7 miles, it was decided to redistribute them two on each of four motor cars. The make-up of trains will, as a rule, be as follows:

1. Motor car; 2. trailer; 3. motor car; 4. motor car; 5. trailer; 6. motor car.

Under this new arrangement each motor car is fitted with rheostats for its own pair of motors and with third-rail shoes for the collection of the current for its own pair of motors. The main controllers are all beneath the car floor, occupying no seating space.

In case a six-car train is split at its middle point into two three-car

trains, each component has a motor car at each end and no switching is necessary at terminals. The distribution of load on the structure and the possible tractive effort is also somewhat better than that of the double-ended system.

The motor weighs, complete with gear and gear case, nearly 4300 lbs. Structurally, it is of the unsplit box frame type, which has been found so successful in the 150-hp and 75-hp motor of the General Electric Company. The field frame consists of a single elongated cubical steel casting, into which the armature is inserted through a round opening of sufficient diameter in one end. To one side of this casting are bolted the axle boxes.

Eighteen hundred of these motors were ordered for 900 motor cars, making practicable the use of a number of special tools in the construction. The general appearance of the finished motor is shown in Fig. 5.

This type of motor has the advantage of a very rigid frame and the armature bearings are exceptionally large and long without sacrificing the length of the armature or commutator. The frame is fitted with unusually large ventilating openings, for which cover plates are provided, but which will, undoubtedly, be run open in the service of the Manhattan Company, on account of the dustless nature of this service, thus considerably reducing the temperature of the motor.

The armature is built on a hollow spider and fitted with spacers between the laminations, giving ventilating ducts exactly similar to those of a direct-current generator of similar size. It has 39 slots and 195 commutator segments, there being one turn per segment and ten conductors in each slot. Otherwise, the motor resembles the latest standard designs of General Electric railway motors, with certain refinements warranted by its size, the importance of its service and the quantities in which it is turned out.

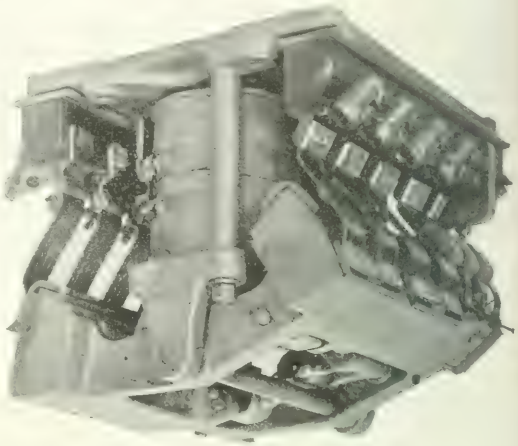
The insulation is fireproof, the fields being insulated with asbestos wound on metal frames, and the armature bars with mica in spite of the fact that in the Manhattan service the temperature rise of the motors will be very moderate, giving an exceptionally low cost of maintenance. The gear reduction is 3.94, the ratio of teeth being 18 to 71. The efficiency is over 90 per cent between 140 and 200 amperes at 500 volts.

With 200 amperes per motor, eight motors will give the Manhattan train of 174 effective tons an acceleration of 1.5 miles per hour per second in place of the 1.3 called for by the train characteristic.

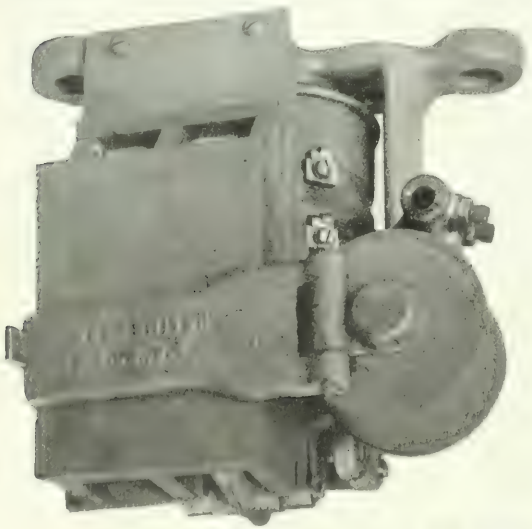
If the express trains are equipped with the same number of motors, they will reach free running speed of about 40 miles per hour on a level track with 550 volts. It is interesting to note, however, that the train control system allows the express trains to be made up of six motor cars, if desired, instead of four motor cars and two trailers, thus running up both the acceleration and the maximum speed.

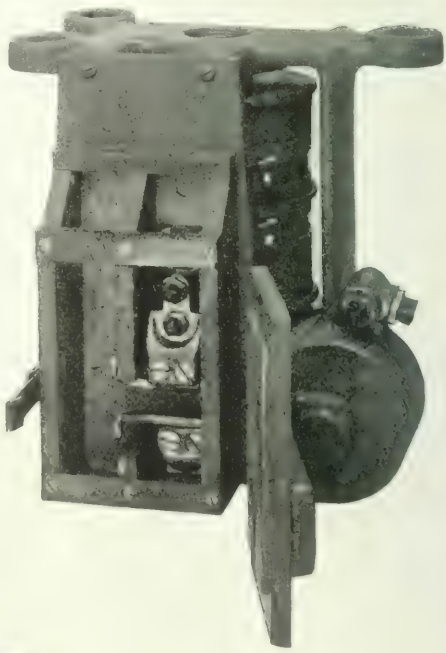
Although the type M control system of the General Electric Company has been described several times heretofore in print, a brief resume of its principal features as built for the Manhattan Rail way Company may be of interest here.

Each motor car is equipped with a series parallel controller, consisting of a number of separate magnetically actuated reversing switches. These contactors (Fig. 2) and the reversing switch take



the place of the usual controller cylinders, but are distinctly separate devices, which can be located at any convenient points without material reference to each other, and do not have to be combined in one case, as do the parts of one hand-operated controller. The contactors and reversing switch are distributed in most convenient locations under the car floor. The operation of these contactors accomplishes the same connections of motors, resistances, etc., as the operation of the usual controller.





FIGS. 2 AND 3.—CONTACTOR.

There are 13 contactors on each Manhattan motor car, giving the various "notches" or separate connections, five in the series and five in the multiple position

The contactors are fitted with powerful magnetic blowouts, and with knuckle jointed moveable contacts, which give forcible rubbing contact on the closing and a large spring pressure to start the opening of the circuit when the contactor is released by its actuating magnet, the remainder of the opening movement being accomplished by gravity.

The contactors and reverse switch are conveniently arranged along the under side of the car body, with their doors opening out for convenient inspection from the side of the car.

The magnets actuating these contactors are connected to nine wires in a train cable, which is made continuous by means of couplers between the motor cars and trailers. Into these nine wires there are attached branches to a small master controller at each end of each motor car. These master controllers (Fig. 1) are connected to third-rail shoes and ground, and the operation of any one of them introduces current successively into different combinations of the nine wires in the train controlling cable, and thereby energizes the magnets of the contactors throughout the train. As the magnets of similar contactors in each of the motor cars are connected in parallel to the same wires in the train controlling cable, the similar contactors on each motor car act simultaneously with each other, making synchronous connections throughout the train. The motorman, therefore, has as perfect control of his entire equipment, from one to any number of motor cars, as has the motorman of an ordinary trolley car, the physical exertion of operating the one small master controller being even less than that of the usual surface street car.

The master controllers are fitted with so-called "dead man handles," of such a design that in case the motorman removes his hand from the handle a spring-operated auxiliary controller contact cuts off all power from the train-controlling cable, thus allowing all contactors throughout the train to open by gravity, cutting off power from all motors.

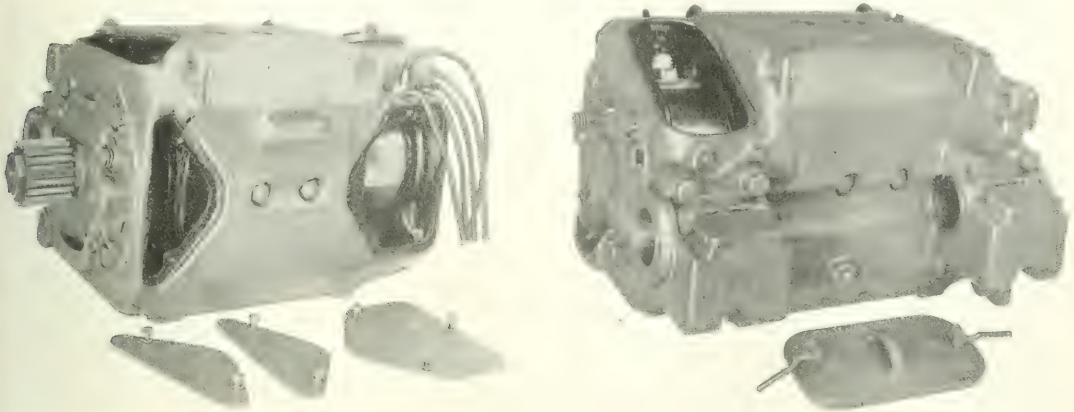


FIG. 5.—FRONT AND REAR VIEWS OF MOTOR.

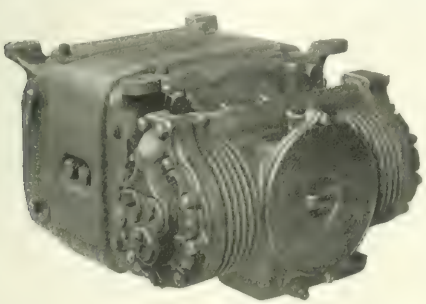


FIG. 6.—AIR COMPRESSOR AND MOTOR.

The cars are equipped with air compressors and governors also built by the General Electric Company. This consists (Fig. 6) of a two-cylinder pump direct coupled to a series-wound four-pole motor, the motor resembling in general construction the large one for operating the cars described above.

The two pump cylinders are horizontal and in line with each other on opposite sides of the crank, the plungers being one piece, thus giving a long plunger fit in the cylinder. The connecting rod connects one end of the double plunger to the crank. The piston displacement is 20 cu. ft. per minute at a speed of 300 r. p. m.

Each motor car is fitted with an air pump governor, designed to operate between any pressure between 80 and 100 lbs., and which will close the circuit on a reduction of about 10 lbs. from the opening pressure.

The Cape Town-Cairo Telegraph Line.

Some interesting details are made public as to the construction of the British telegraph line from Cape Town to Cairo, planned by Mr. Rhodes, and giving an alternative land route to England over the Egyptian system. The line has now been completed as far as Ujiji on the eastern shore of Lake Tanganyika, so that messages may now be sent from Cape Town about 2500 miles north. The wire has been strung on insulated iron poles sent out from England. Of course, the wild nature of the country has made the work difficult, for it has been necessary to transport all material by human or animal portage for hundreds of miles. Five parties are engaged in the work, the total force averaging 10 white men and about 1200 blacks. The advance party, consisting of 2 whites and 200 natives, has charge of surveying the route and clearing a path for it about 15 ft. in width.

The second party follows two or three days after and widens the path to 60 ft., more or less, according to the nature of the country. It is easy to see why so wide a path is necessary. There will be no linemen every few miles, to keep the service in repair, and it will be far more costly than in civilized lands to mend a broken wire or repair other damages. Every preliminary caution, therefore must be taken.

Then comes the third party, which digs the holes; it is closely followed by the fourth detachment, which plants the posts, and finally come the wire stringers, who complete the work. None of the iron posts weighs less than 160 lbs., and most of them are 14 ft. high.

For some time the work has been carried on in German territory, as the line passes completely through the western part of German East Africa. It was necessary, of course, to secure the consent of Germany to build the line through its territory, and the Trans-African Telegraph Company, as it is called, agreed as a part of the bargain, to build a separate line across German East Africa from north to south, to be the property of the German Government and to be used wholly for the telegraph traffic of the German colony. The Government will connect its ports on the coast with the Ujiji station of the line.

This great enterprise will now be pushed northward into British East Africa and down the Nile as far as Fashoda, which is connected by wire with Khartum and Alexandria.

The Dry Cell.

By C. F. Burgess.

THE term "dry" cell, as applied to a certain class of generators of electrical energy, in common with the names applied to commercial product signifying eternal life and absolute perfection, calls to mind that familiar phrase, "what's in a name." It is a piece of apparatus occupying a place of no insignificant importance, and in spite of its faults, and by reason of some admirable qualities, it is extensively used. As a generator of electricity, its efficiency is low and its cost is high as compared with other open-circuit cells. The cost, however, is subservient to convenience, simplicity and portability.

The charm which the commercial names given and the claims made by some manufacturers might inspire are quickly dispelled upon use of the cells, and in some to a much greater degree than in others. The materials of which the dry cell is made are well known, and are the same in most of the types. The construction of the various cells is similar, and we might expect, therefore, the product of the different makers to be somewhat alike, as regards efficiency and durability. To determine whether this was actually the case some tests were made in the Applied Electro-Chemistry laboratory of the University of Wisconsin by Mr. A. A. Radtke, of the class of 1900. Six or more cells were obtained from each of a number of the principal manufacturers, and a summary of some of the results obtained from tests on the same are given herewith.

From the results of such tests some interesting conclusions may be drawn regarding the range of efficiencies which exists in different makes of cells, and we may also draw conclusions as to what service may be expected from a first-class cell.

The batteries were obtained as far as possible directly from the manufacturers, and those were selected for comparison which were the most comparable in size. The measurements extended over a range of about three months, and in order to compare the cells in different kinds of service they were submitted to continuous, intermittent and open-circuit duty. It was the object to make the tests commercial rather than scientific, and no chemical analyses were made to determine what action took place within the cells.

For the intermittent test the cells were all connected in series, there being three from each of eleven different manufacturers. By means of a clock the circuit was closed intermittently through a resistance, and

TABLE I.

Make of cell.	Internal resistance. Ohm.	No. of days test.	Open cir. e.m.f. after test.	Watt-hours delivered.	Watt-hours per cubic inch.
1	.28	76	.8	46.7	2.30
2	.28	76	0.	43.04	2.28
3	.18	76	1.18	58.39	2.74
4	.30	76	.95	47.72	1.96
5	.31	76+*	.84	37.86	1.98
6	.28	76+*	.91	46.96	2.55
7	.48	55	0.	22.68	1.38
8	.54	0	0	3.28	.22
9	.41	76	0	32.94	1.30
10	.48	76	0	21.07	.92
11	.64	10	0	10.61	.90

the current allowed to flow for one minute out of every ten. The current was maintained between one-tenth and two-tenths of an ampere. Measurements were made at frequent intervals for a period of 76 days, at which time the majority of the cells were out of service and the remainder showed signs of rapid deterioration. When measurements of e. m. f. showed that the cell while delivering current had dropped to zero, that cell was taken out of the circuit.

When first set up the highest open circuit e. m. f. was 1.55 volts and the lowest 1.16 volts. The lowest internal resistance was .17 of an ohm and the highest .68 of an ohm. The polarization with .2 ampere flowing varied from a negligible amount to .08 of a volt. Table I. will show the principal characteristics of the different makes of cells, each figure being the average readings on the three cells of each make tested. The cells of the different manufacturers are numbered 1 to 11, inclusive. Those marked by a * show that at the end of the test these cells were not completely exhausted, though the open circuit [illegible] in the downward path. In figuring the efficiencies, however, for these cells some allowance should be made for this fact.

It was noticeable that the three cells of each manufacture showed a considerable degree of uniformity between them, and in only one instance was there a marked discrepancy. The column giving watt-hours per cublic inch of the cells is perhaps the best one for comparison, though this is not absolutely so from the fact that the larger cells seem to have a higher efficiency or output per cublic inch of contents than the smaller size. The exact influence of the size of the cell on the capacity was not especially investigated. From this table it is evident that there may be a very large difference in value received for a given expenditure of money in dry cells, depending upon the choice of the cell used.

From polarization measurements it was evident, as would be expected, that the cells which polarize least are the cells which have the largest carbon area, and those having the fluted or corrugated carbon of good size usually showed the highest efficiency. The cells having the highest internal resistance were found to have a layer of strawboard next to the zinc and interposed between the two electrodes. This use of the strawboard seems to be objectionable from its effect on the internal resistance and in causing a very uneven corosion of the zinc and low energy output.

TABLE II.

Make of cell.	Open cir. e.m.f. after 27 ampere-hours output. Volts.	E. M. F. after 18 hours recovery. Volts.
1	.57	1.03
2	.08	.80
3	05	.02
4	27	.78
5	...	...
6	.8	.92
7	.52	.89
8	04	.19
9	.20	.85
10	.0	.0
11	.0	.0

Defective workmanship was apparent in a number of the cells, as illustrated in one case where the pitch used in sealing the top had been allowed to run down inside the zinc cylinder and protected most of this electrode from action. This caused the zinc exposed to become perforated at an early stage of discharge, allowing the electrolyte to escape and greatly reduce the output.

Amalgamation of the zinc seems to have a beneficial action in making the corrosion more uniform, and thus preventing puncture. About one-half of the cells tested showed evidence of having been amalgamated.

The continuous test to which the cells were subjected consisted in connecting 22 cells in series, there being two of each make. The current at the beginning of the test was .275 ampere, which steadily decreased in value, and the test was discontinued when 27 ampere-hours had been delivered. The circuit was then opened and the recovery of the cells was observed. Table II. shows the relative values of the different cells on continuous service.

TABLE III.

Make of cell.	Beginning. Volts.	After 70 days. Volts.
1	1.54	1.51
2	1.43	1.40
3	1.42	1.40
4	1.47	1.42
5	1.20	1.16
6	1.44	1.42
7	1.52	1.48
8	1.56	1.52
9	1.44	1.40
10	1.40	.90

The effect of standing on open circuit for a considerable length of time upon the e. m. f. of the cell is indicated in Table III., where each cell shows a slight decrease in pressure when allowed to stand for two or three months. This gives only an approximate indication of the deterioration of the cell, for the capacity of the cell may

have decreased to even a greater extent than the figures show. It is evident that the time for this test was not sufficient to show any marked decrease in the value of the cell when not in use.

Another test was made to determine the effect of the temperature on the e. m. f. of a dry cell, and it appeared that the ordinary variations of the temperature to which it is subjected in use does not change the pressure more than a few hundredths of a volt, and that an extreme rise of 70 degs. C. increases the e. m. f. about one-tenth of a volt. The two cells which were tested resumed the original e. m. f. when allowed to cool to atmospheric conditions.

Before and after the intermittent life test each cell was carefully weighed, and the majority of them showed a slight increase in weight after discharge, somewhere between three to ten grams, while a few showed a slight decrease. Three cells of one make showed a loss of over 100 grams each. An explanation of this loss or gain of weight during discharge was not attempted, and it would require a careful consideration of the chemical changes within the cell and the methods of construction to afford such explanation. The change of weight seems to have little or no relation or bearing on the efficiency or durability of the cells.

From the results of this work it is shown that where any considerable amount of money is to be invested in the purchase of dry cells, tests of efficiency are of much greater value than in most forms of electrical apparatus. It is true that the tests which have here been outlined may not show the absolute relation of the different makes for an entirely different class of service, but they at least give an approximate relation. A good cell on intermittent operation should give an output of 2.25 watts or over per cubic inch of contents, and inasmuch as the internal resistance of the cell has an important bearing upon its output, a cell of ordinary size should not have an initial internal resistance greater than .3 ohm, or, preferably, not greater than .2 ohm.

The Economic Design and Management of Telephone Exchanges—VI.

By ARTHUR V. ABBOTT, C. E.

III. DETERMINATION OF THE TELEPHONIC CENTER.

THEORETICALLY, it is easy to imagine that the various subscribers in any group could be connected to the office by air lines, and under this supposition the problem of determining the telephonic center is that of ascertaining the position of such a point, within a group of given points, as will make the sum of all the straight lines drawn from the desired point to each of the given points a minimum. If this sum be assumed to be wire mileage, it is impossible to further reduce the quantity of wire needed to reach all subscribers. The mathematical solution of this problem is possible for a few points, but when a considerable number come under consideration the necessary equations become too complicated for solution. Under all usual circumstances, it is impracticable to design subscribers' wire routes so that they shall fall along air lines drawn between the telephonic center and the premises of each of the various subscribers. On the contrary, in all towns and cities, it is necessary to follow the general highways (streets or alleys), for it is impracticable to obtain any considerable right of way in other locations. In most cases, particularly in all of the more modern cities, the majority of streets, alleys and other highways, are laid out, approximately, rectangularly with reference to each other, at least, so far as pertains to such a group of subscribers as is usually placed in a single office. For the practical solution of the problem, it is, therefore, sufficiently safe to assume that the wire routes *will* follow existing streets, and that these *are* rectangular to each other, so the problem is reduced to the location of such a point within a group of given points as will make the sum of the distances from the desired point to all the given points, measured parallel to a pre-determined set of rectangular co-ordinate axes, a minimum. Mathematically, it might be possible to select some other direction for the axes which would further minimize the necessary wire mileage; but, as it is impossible to change the arrangement of the streets, and impossible to obtain other rights of way, the only feasible solution of the problem lies in the assumption of such axes as are indicated by the direction of the streets, and it is unnecessary to consider the saving in wire mileage that could theoretically be made by the consideration of other axes.

Diagonal streets are of occasional occurrence, particularly in the older towns. The possible availability of such diagonal streets must not be lost sight of, and must be considered, as far as it is cheaper by their employment to reduce wire mileage. The solution of the problem will, however, be simplified by at first considering the determination of the telephonic center in a case with purely rectangular streets, and then afterwards ascertaining the effect which the introduction of one or more diagonal routes would have upon the previously ascertained wire mileage.

Let Fig. 2 represent the plane of any city, and let s_a, s_b, s_c . . . . . s_n represent the number and location of the various subscribers. The subscripts $a, b, c \ldots\ldots n$, denote the number of subscribers at the locations $a, b, c \ldots\ldots n$, and may be varied in value in each from 1 to n, at pleasure. The distribution of s_a, s_b, s_c .. s_n over the plane may be in any manner whatsoever. Let T be the desired point from which the sum of all lines to s_a, s_b, s_c . . . . s_n shall be a minimum, then T will by definition be the telephonic center. Let the lines $X\ T\ X^1$ and $Y\ T\ Y^1$, drawn rectangularly through T, indicate the prevailing direction of the streets or highways that are available for wire routes, so that $X\ T\ X^1$ and $Y\ T\ Y^1$ become the co-ordinate axes with origin at T, parallel to which the distances of all subscribers shall be measured; then, by hypothesis, T must be such a point as will make the sum of all the distances to all subscribers a minimum.

Symbolically, this condition is expressed as follows:

$$s_a(x_a + y_a) + s_b(x_b + y_b) + \ldots\ldots s_n(x_n + y_n) = \text{a minimum.} \quad \text{(Eq. 3)}$$

in which x_a, x_b ..... x_n and y_a, y_b ..... y_n are the co-ordinate distances from the point T to each of the points s_a, s_b ..... s_n.

Also, let

$$s_a + s_b + \ldots\ldots s_n = U + V \quad \text{(Eq. 4)}$$

in which U and V are, respectively, the number of subscribers on one

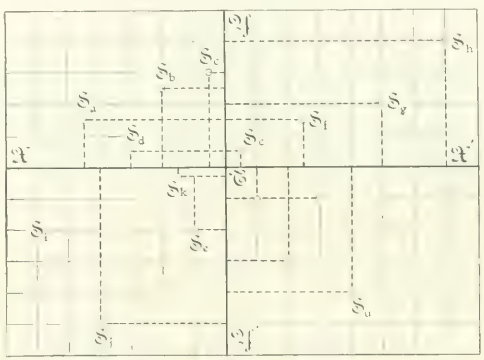


FIG. 2.—DETERMINATION OF TELEPHONIC CENTER.

side and on the other side of either of the co-ordinate axes (taken singly) through the desired point. If there be $a, b \ldots\ldots n$ subscribers at the points s_a, s_b ..... s_n, it is legitimate to replace each term in Equation 3 by the corresponding x's and y's repeated as many times as there are units in $a, b \ldots\ldots n$. Or, Equation 3 may be written

$$x_a + x_a + x_a + \ldots\ldots a \text{ times} + x_b + x_b + x_b + \ldots\ldots b \text{ times} + \ldots\ldots$$
$$+ x_n + x_n + \ldots\ldots n \text{ times} + \ldots\ldots + y_a + y_a + y_a + \ldots\ldots a \text{ times} + y_b + y_b + y_b + \ldots\ldots$$
$$b \text{ times} + \ldots\ldots + y_n + y_n + \ldots\ldots n \text{ times} = \text{a minimum} \quad \text{(Eq. 5)}$$

The following theorem will aid in obtaining the solution of Equation 5:

Let $z = f(x, y)$ Eq. 6,

in which x and y are independent variables as in the present problem, then

$$dz = f'(x + \Delta x, y) - f(x, y) + f(x, y + \Delta y) - f(x, y) \quad \text{Eq. 7.*}$$

Equation 7 is the sum of the partial differentials with respect to both x and y.

*See Todhunter's Calculus, p. 172.

The partial differential with respect to x is

$$\text{Eq. 8.}$$

and the partial differential with respect to y is

$$f(x, y\,dy) - f(x, y) = \qquad \text{Eq. 9.}$$

For brevity let $= M$ and $= N$ then

$$M\,dx + N\,dy. \qquad \text{Eq. 10.}$$

This indicates the complete differential of z with respect to both x and y. The symbol $\frac{\partial z}{\partial x}$ indicates the partial differential of z with respect to x, and the symbol $\frac{\partial z}{\partial y}$ the partial differential of z with respect to y.

Differentiate M with respect to y obtaining,

$$\text{Eq. 11.}$$

and differentiate N with respect to x obtaining,

$$\text{Eq. 12.}$$

If any expression, such as $f(x, y)$ be differentiated first with respect to x and y, and then with respect to y and x, it is evident that the results will be equal, for the results of the same process applied to the same function must be the same, irrespective of the order in which the variables are taken, hence

$$\text{Eq. 13.}$$

and this equation determines the condition which must exist in Eq. 10 in order that a differentiation shall be possible.[2]

To apply this theorem to the problem in hand suppose $f(x, y)$ in Eq. 6 to be the sum of the series of Eq. 5. This sum is the total wire mileage to all subscribers, which by definition must be a minimum. Let x and y (without subscripts) stand for the *average* ordinate and *average* abscissa; as U and V are the number of subscribers on each side of either axis, respectively, then $(U + V)$ $(x + y)$ is the total wire mileage, and

$$= f(x, y) = (U + V)\ (x + y) \qquad \text{Eq. 14.}$$

This expression must now be differentiated, equated to zero, and solved after the usual method applicable to problems in maxima and minima. By equations 6 to 13 it has been shown that the differentiation is possible only when the condition expressed in Eq. 13 hold true; therefore, differentiate Eq. 14 by differentiating first with respect to X and then with respect to Y, and add the two so obtained partial differentials, thus:

$$\text{Eq. 15.}$$

This expression corresponds to Eq. 10,

representing M, and

representing N

Now, to determine the possibility of differentiation according to the condition of Eq. 13, differentiate M with respect to y, and N with respect to x, and test for equality, thus:

$$\text{Eq. 16.}$$

Performing the operations indicated

$$\text{Eq. 17.}$$

But,

; therefore,

$U + V = U + V$, Eq. 18, and it is proved that Eq. 15 *can* be differentiated. For the final solution the first differential coefficient must be placed equal to zero and the resulting equation solved, thus:

$$+ \qquad = 0. \qquad \text{Eq. 19.}$$

Differentiating,

$$\text{Eq. 20}$$

$$\text{Eq. 21}$$

$$\text{Eq. 22}$$

There are many problems in maxima and minima, of which the solution indicates not a numerical conclusion, but a certain and very definite *condition* that must obtain in order to produce the desired result. Such is the case in the problem under consideration. U and V are the *number of subscribers* on each *side* of either one of the co-ordinate axes, and the expression $U = -V$ of Eq. 22, means *that if there are an equal number of subscribers on each side of one axis the sum of the perpendicular distances from that axis to all subscribers will be a minimum.* The same relation must obviously hold true with respect to another axis drawn at right angles to the first one. Therefore, Eq. 22 shows the *relation which the subscribers sustain to the co-ordinate axes when the sum of all their perpendicular distances to the axes is a minimum.*

In other words, if a line be drawn parallel to the prevailing direction of the streets, in such a position as to place numerically one-half the subscribers on one side of the line, and one-half on the other, the sum of the perpendicular distances from this line to all the subscribers will be less than the sum of the perpendicular distances from all the subscribers to any other line. Having thus located one axis, it is evident that the same condition will define the position of the other one to be drawn at right angles to the first, and as the telephone center must be on both axes simultaneously it must lie at the intersection of the two lines.

A New Pigment.

A patent issued Jan. 14 to Dr. Alexander S. Ramage, of Cleveland, Ohio, discloses a method of producing a remarkable iron pigment, with an old formula and new properties—the hydrated basic ferric oxide $Fe_2O_3Fe_2(OH)_6$. The method is in no sense electrolytic, yet possesses a particular interest for electricians, since it presents one of the first commercial applications of those physico-chemical theories which have been developed largely by the study of dilute electrolytes. In outline the process is as follows: The waste ferrous liquor derived from iron-pickling—generally ferrous sulphate or chloride with some free acid—is neutralized, and then oxidized by the joint action of air and steam. As the oxidation proceeds an alkali, as sodium carbonate in solution, is added in quantity sufficient to maintain substantial neutrality, and simultaneously therewith a large volume of water, which, as will appear, is the true precipitating agent.

The effect is that known as *hydrolysis*, or the decomposition by water of a salt composed of a base and acid between which there is a great disparity of strength, in the present instance a compound of a weak base with a strong acid. By the oxidation of the ferrous sulphate, basic ferric sulphate is formed, and this salt in the presence of the large volume of water is hydrolyzed, yielding sulphuric acid and basic ferric hydrate—the pigment in question. A reaction of this character would, of course, soon reach an equilibrium, and the yield of pigment would be but small, wherefore the gradual addition of the alkali to combine with the acid as it is liberated and to insure the continuance of the reaction to complete precipitation of the iron.

The pigment is light yellow in color, but is readily converted by heat into the several iron oxide reds, and affords also a suitable base for mixed pigments. Its absorptive capacity for oil greatly exceeds that of the standard pigments, being 2½ times that of standard French ochre, and 7½ times that of white lead. Its covering power as compared with these pigments is almost proportionately high. These figures sufficiently indicate its great technical value.

Convention of the Northwestern Electrical Association.

THE Northwestern Electrical Association held its tenth annual convention at Hotel Pfister, Milwaukee, Jan. 15 and 16. The convention was called to order by the president, Mr. E. L. Debell, of Sheboygen, at 12.15 P. M., when, after some routine business was transacted, adjournment was taken until 2 P. M. The afternoon meeting was opened by an address by President Debell. After referring to the increasing prosperity of the association and the benefits it conferred on its members, he said that the work of the legislative committee for the past year has been confined to the State of Wisconsin, where very strong efforts were necessary to prevent the enactment of numerous laws adverse to electric lighting interests. These efforts have been entirely successful, and reflect much credit on the committee. He impressed upon all Wisconsin central stations the necessity of greater support and co-operation in this important work. Every company in the State, he said, should share in the necessary expense and work, and also become members of this Association, in order to insure complete co-operation and harmony. It has been necessary each year to send representatives to the State capital to defend their interests, and while the successful results hav been enjoyed by all alike the labor and expense has been borne by a few.

Secretary-Treasurer Mercein's reports, which followed the president's address, submitted the convention programme as part of the report and touched briefly on the assistance rendered the legislative committee by having all bills presented in the Legislature which were harmful to electric lighting interests, printed and sent free to all central stations in the State, accompanied by a circular urging personal influence with the senators and assemblymen to defeat the bills. Other work of the year was briefly taken up.

The following new members were elected: A. W. Grabe, superintendent Plankinton estate; C. H. Williams, superintendent electrical department Madison Gas & Electric Company; Beloit Electrical Company; George L. Smith, superintendent municipal plant, Harbor Springs, Wis.; Robert D. Crawford, superintendent electric light plant, Castleton, N. D.; Irving Butterworth, general manager Denver Consolidated Gas & Electric Company; A. P. Lathrop, president and general manager, St. Paul Gas Light Company.

Professor D. C. Jackson, as chairman of the committee on correspondence schools, reported that during the past six months he had been too busy to carry on the correspondence which he had started with the correspondence schools. As a result, however, of the action taken by the Association in appointing a committee to get the correspondence schools to revise their courses to make them more adaptable to central station men, some of the correspondence schools had greatly improved their courses. The result aimed at was, therefore, accomplished and the Association decided that it was unnecessary to continue the committee longer.

The next business was the report of ex-Governor Upham, chairman of the legislative committee. He reported five days' work put in at Madison during the last Legislature, and that all of the large number of objectionable bills that were introduced were defeated. This list of bills was of the most vicious character, and had the bills passed the electric light companies of the State would have been mostly annihilated as corporations. Mr. Kountz mentioned one bill that did go through, which was a bill to tell electric light men how to wire houses with No. 14 wire, automatic cut-outs, and a mass of other stuff in which there was no sense. The bill provided a penalty of $25, but no one could tell whom it was against, whether the company or the consumer.

The first paper presented to the convention was by O. M. Rau, of Milwaukee, on "Reconstructing and Modernizing Central Stations," an abstract of which is given below:

Mr. Rau pointed out that a proposition of the kind presented by an old plant with an assortment of varied apparatus present a difficult problem, but that a short time ago the solution would have been more difficult than now.

The recent development of the alternating current has demonstrated that for the average central station (and isolated plants might also be included), the flexibility of alternating currents leaves little to be desired, and for covering the unlimited demand that may come within the scope of a modern central station it is perfectly suited. The efficiency of all apparatus in connection with alternating currents has reached a stage of perfection where no other class of service can equal it, and its application for commercial purposes is universal, with the exception of direct charging of storage batteries, which, at present, is not a defect to be seriously considered.

To-day the solution of reconstruction problems is a relatively simple one, and has none of the questionable points to cause delay in obtaining its proper solution that confronted the manager formerly.

A single generator, covering all classes of service desired, takes the place of the former assortment, and either direct connected or direct belted solves the shafting problem. If the generator is obtained large enough so that the engine is the weaker part of the unit, in case of a heavy overload or short circuit, this excess of capacity is a valuable safeguard against its destruction.

Reconstructing a plant on these lines means abandoing all generators and installing one or two (preferably two) direct belted (in the latter case from separate engines), three-phase alternating-current generators of the four-wire type having 2000 volts potential to the fourth or neutral wire.

This generator can be used for various classes of service from the separate phases, taking, for instance, the commercial incandescent and arc lights in the business district from phase No. 1 to neutral, installing at a convenient location close to the center of load a large transformer or bank of transformers, preferably placed in a manhole underground instead of attempting to hang the enormous weight of the larger transformers on poles where they are a continual source of anxiety and danger, as well as unsightly.

These transformers are to be connected to a secondary three-wire distribution system, and if the plant was previously operated on the direct-current three-wire system, no better network could be desired to which to connect the transformer. The primary side of transformer would receive the current at approximately 2000 volts through a feeder from phase No. 1, as before stated.

The outlying commercial business would be taken care of by phase No. 2, similarly to the present method of single-phase distribution, by placing separate smaller transformers at such points as will serve the largest number of customers, or when distance becomes too great, a transformer for a customer. But in all cases the three-wire secondary should be strictly adhered to, so that as the city expands and the business district grows, each secondary network may become part of the main secondary distribution system. All service should be three-wire wherever practical, and care should be taken to keep those that are two-wire alternately on each side of the system. This will maintain as near as practical a balanced load on the transformer.

From phase No. 3 the city arc circuits through constant-current transformers can be served, and with the alternating-current series enclosed-arc lamp the highest economy as well as the most satisfactory street lighting can be obtained. These transformers can be located in the main power house, or at transformer station, centrally located in the lighting districts. In the latter case any shed, store or basement space could be utilized, as they require very little room. Or if desirable they could be placed in underground manholes similar to the transformers for the commercial circuits, although especial attention must be paid to thorough ventilation and drainage, so as to prevent trouble from the high voltage of the circuits.

The trimmer of the route centering at these transformer stations should be held responsible for this station and be required to start the lights by closing the circuit on these transformers at the proper time. This will insure reliable service and avoid any difficulties that are encountered if started from the main plant, from where they can readily be shut down by opening the primary circuit.

The expense of trimming and maintenance of the enclosed over the open arc system is very much reduced, while the usual deduction for lights out, with its disagreeable controversy with the city officials, is practically eliminated.

For the power circuits a separate three-phase feeder would be required, from which power for motors would be taken, using a group of three transformers with a Y connection on the primary side and a delta connection on secondary side, reducing the approximately 4000-volt primary to 220-volt secondary. These transformers should be located so that the three-phase secondary circuit would reach a number of power customers, as the installation of transformers for single customers becomes very expensive. By the use of three-phase motors all trouble from excessive starting currents is overcome, and motors of any capacity within the range of the generating station can be successfully operated without any material effect on the incandescent circuits.

The most important feature of this method of distribution is the absolute control of each system, and the perfect regulation which can be obtained irrespective of the unbalanced condition of the load.

The series arc system being automatically taken care of by the constant-current transformer, the three-wire power circuit is not materially affected by variable loads, while on the commercial lighting

circuits, regulating transformers giving a range of 10 per cent above or below the generator potential, can be placed in each feeder, and by means of a hand wheel constant potential can be maintained under all coditions of load.

In some instances a source of revenue is available at a considerable distance from the station. Perhaps a neighboring town, too small for an independent plant, a manufacturing plant, or some institution too far distant to be reached economically by the ordinary 1000-volt system. In this case a feeder of two wires from one of the phases is used, giving a potential of approximately 4000 volts, at which pressure the feed wire becomes a small factor, and a considerable distance can be economically reached. By using two standard 2000-volt transformers, with primaries in series and secondaries connected for standard voltage using the three-wire secondary distribution system, such business can be successfully taken care of.

In advocating the three-wire secondary distribution system many points of advantage are obtained, the most important being the availability of 220-volt current at all services. Not only is the tendency to increase the voltage of incandescent lamps little by little, but the time is not far distant when a 220-volt lamp will be as efficient as those of lower voltage, and with the supersedence of the multiple enclosed arc lamp by the Nernst lamp, the advisability of providing 220-volt secondary service cannot be questioned.

Mr. Rau stated that the object of his paper was to point out a plan of reconstructing the many smaller central stations which are operating with old, inefficient apparatus, the value of which is so rapidly depreciating that most of it can only be appraised at scrap value, the owners of which have been delayed in taking action due to the rapid change made in electrical apparatus.

In the discussion, Mr. Rau, in reply to a question by Mr. Gille, as to electrically-driven elevators, said that as to the regulation of the three-phase motor, there are a number of devices in the market accomplishing that object very economically, but a controlling device in the form of a magnetic clutch solves the problem. The motor is attached to a magnetic clutch, and as the fields of this clutch are energized it transmits the power at a variable speed to the shaft it drives. He had experimented with this device and found it very satisfactory. Mr. Gille inquired if in the case of a city where they do considerable heating and have a great many small, isolated plants running in the winter time, and during the summer time a large percentage of that business is obtainable by the central station on account of its load being very light, how it was proposed to handle that class of business. In reply, Mr. Rau said he did not believe that there is an isolated plant that can exist where there is a properly managed central station. Mr. Gille rejoined that Mr. Rau will agree with any one that an isolated plant of considerable size where they have a great deal of heating to be done, can operate in the winter cheaper than they can buy their current from a central station. Mr. Rau said that in Milwaukee they are from time to time closing down an isolated plant because his station can furnish the power cheaper than they can. There are a number of plants that have been shut down that way very recently, which have been very modern. His company is furnishing heat at the same time, which, of course, ought to be considered when a central station undertakes to do that thing. Inquired as to the matter of rates, said that the time is not very far distant when the question of a specific rate to any consumer will be a thing of the past; that, in other words, we will be obliged to have the same rate for all. It may be possible that we will be able to maintain a differential rate, such as a quantity rate, or something of that kind, but the tendency of legislation would seem to be to cut us off from even that option.

Mr. Rau said that in the case of the isolated plants he has dealt with so far, he has been able to make a kw-hour rate based on their annual consumption, and that rate is open to anybody else that can come up to it. If a plant has a consumption of $5000 worth of light a year, a certain price is made and a less price for less light. The ordinary consumer gets the regular rate, of course, but the low rate is open to any one that wants to get a great amount of current a year, and that consumer gets the same rate as his neighbor who uses the same amount. In reply to a question as to whether he would advocate changing over a direct-current underground system to an alternating-current system, where there is a large investment in storage battery, Mr. Rau said in his paper he had more in mind the smaller overhead central stations. When it comes to a large proposition, for instance, one like Milwaukee, the paper would apply. The alternating current would be generated from very large generators, and there would be direct-current sub-stations.

The question of storage battery auxiliaries coming up later in the discussion, Mr. Rau expressed the opinion that the storage battery is at present out of the reach of small central stations. For cases where it is desirable or in taking on isolated plants having storage batteries already installed he would put in a rotary converter set.

The next paper read was by Mr. Van Rensslaer Lansingh, of Chicago, entitled "Best Use of Electric Lights for Desirable Illumination," an abstract of which is as follows:

Mr. Lansingh pointed out that perhaps no engineering subject of equal importance has in this country received as little attention as the subject of illumination, especially of interiors. While the majority of buildings have perhaps sufficient candle-power per square foot, but little attention has been paid to the proper diffusion and distribution of light. Any diffusion which will save 10 per cent of a station's coal bills is greatly sought after. At the same time the light when once obtained will be so used as to waste anywhere from 20 to 70 per cent. After referring to the literature on the subject, and the importance of a steady light, absence of glare and sharp contrasts, he said that as the ideal is daylight, the units of artificial lights should in general be distributed as much as possible, at the same time placing them out of the direct line of vision. Curves and figures were given on illumination and diffusion obtained in street lighting with different kinds of globes, attention being directed to the good diffusion with the holophane globe. The diffusion obtained with various kinds of globes most common in incandescent interior lighting was then discussed.

In closing, the author called attention to the important question of keeping incandescent globes and bulbs clean. From tests made by Messrs. Legg & Townsend, of the Chicago Public Library, it was found that the increase in light after cleaning the bulbs and shades varied from 15 to 75 per cent, with an average of 28 per cent.

Wednesday morning's session was opened by the "question box" part of the programme. The first question put to the convention and the one which took the entire time assigned to that part of the programme was that of Mr. Gille, who inquired whether any of the members had had any experience with the Nernst lamp the past year in a practical way, and if so, with what results. Professor Jackson, of the University of Wisconsin, reported that they had had some of the lamps in service, and they give the most charming, soft light to be had from any artificial source of illumination. The illumination from the Nernst lamp is of almost the same quality as that on a summer day when the sky is partly covered with white clouds. No difficulty had been experienced with them in practical operation. No efficiency or life tests had been made, but he had no reason to doubt the figures of the company in regard to them. The lamps in regular operation are six of the two filament type and three of the three filament, and they have caused us no trouble. Professor Swenson has a single filament 110-volt lamp in his library at his house for a reading lamp. Those that are in use by the university in the engineering laboratories are all 220-volt lamps. In the lamps a few glower holders have been changed, but there is no difficulty about that whatever. Of the lamps that came to the university every one ran perfectly from the start, without any adjustment whatever or any examination, with the exception of one, which for some reason did not change over, and this was turned over to a wireman, who fixed it, and it has not been heard from since. Professor Jackson said he had come to the conclusion that so far as the mechanism of the lamps is concerned, they are thoroughly reliable devices; they always start all right, and the only question he has in mind at all is with respect to their life, though he has no reason to doubt the statements of the company. Replying to a question as to low-voltage lamps, Professor Jackson said that the objection he understood the company has to putting out 110-volt lamps is that they are not quite so economical as the 220-volt lamps.

In response to further questions, Professor Jackson said they had had no occasion at all to clean the porcelain of the heaters, as they did not seem to need it. He had examined them recently and they were clean. This, notwithstanding the fact that they had been desperately overrun (at over 230 volts) and each had consequently burned out a glower.

Mr. Gille said that the only serious trouble he had had was in getting all the glowers started when the lamp is turned on. If a lamp, a three-glower lamp, for instance, is put up to take the place of an arc light, and only one glower gets started, there is a pretty strong kick right off. He has not had the lamps long enough to know what the maintenance charge will be. Four or five glowers have been

burned out so far, but they tried to run the lamps at as near 220 volts as possible.

President—How many have you had in service?

Mr. Gille—Only two so far, one a single-glower and one three-glower. I would like to ask the professor if they have turned the lamps on and off very much.

In reply to a question as to the use of the lamps, Professor Jackson said they are turned on every day and turned off. They average being turned on and off a couple of times a day, with an average of an hour and a half, or two hours' burning per day. The glowers did not always come on at the same time; that is, first one glower would come on and then its heat would bring the other glower into operation.

Mr. Gille said that by jarring the lamp slightly, the glowers being seated on spring wires, they jump out of position, and that is probably the reason the glowers do not all start at once. Professor Jackson said he has noticed that the glowers that sag a little bit very often do not come on immediately, but come on after being subjected to the radiation of heat from the working glower. The fact that the illumination is so magnificently satisfactory makes a very great future for that type of lamp.

Mr. Harding said he has had one of the three-glower lamps in use something over a thousand hours, and three of the single glowers. The trouble of the glowers not starting, he has found to be due to evident carelessness in putting the glower in connection with the holder. In one case the leading wire from the glower down to the base and the plug had been sprung or bent. On the three-glower lamp that has been in use somthing over a thousand hours the glowers were changed once, but instead of changing all the glowers in the holder originally in the lamp, a new holder with the glowers complete was put in; these have been in about a hundred hours now, and the other one ran fully 900 hours without the loss of a glower. An unfavorable point is that the glower or holder becomes black, but by using a paste of some description that will scrape off readily this difficulty is overcome. He suggested sending out the holders from the central station to the customers and let them make the change, a central station man gathering up the burned-out holders at reasonable times, one man going over them to put them into shape. He has been more than pleased with the lamp. By substituting for the heavy sand-blast shade sent with the lamp a light alabaster shade a much better light was obtained for commercial use.

In reply to a question, Mr. Harding said he has furnished the customer with the lamp at the cost price, and maintains the lamp and glower free of charge, which includes the replacing of worn-out parts. There is much less expense for the unit of light than with the enclosed arc. Mr. Gille said there are some very delicate parts liable to get broken, and if the building vibrates a great deal there is liable to be trouble. He believes that when many Nernst lamps are put in it should be with the understanding that the customer should pay for the repairs. Mr. Bowen said that in using the Nernst lamp there is a decreased revenue per candle. The question is whether the central stations should furnish the means to their customers for dcreasing that revenue or increasing the light for the same revenue, which is the same thing. Gas companies do not furnish Welsbachs or other incandescent mantles. The customer furnishes these.

Mr. Almert said that in one lamp that he saw burning the cut-out hummed considerably. He asked the cause for the difference in the life of the glower in operating it on a greater or less number of cycles, the guaranty of the lamp on the life of the glower being 800 hours on 60 cycles and 1200 hours on 125.

The report of Irving P. Lord, of Waupaca, Wis., was then received as chairman of the committee appointed to consider the advisability of a summer meeting. The report was to the effect that the sentiment of the members seemed to be largely in favor of a "Summer Convention and Outing," with the two words "Convention and" in small letters, the place to be Grand View Hotel, Chain o' Lakes, Waupaca, Wis., June 25, 26 and 27, 1902. The committee recommended the wives, daughters and lady friends of the members be especially invited, and that sociability and innocent amusement be made one of the prominent features. After a lengthy discussion, it was decided to hold the summer meeting as recommended.

Elton J. King, of Fort Wayne, then read a paper entitled "Some Important Points in Commercial Measurement of Electrical Energy." An abstract of this paper will be published in a subsequent issue.

Mr. H. C. Wirt, of the General Electric Company, read a paper on the subject of "Transformers," which paper he said was the same that was read before the Ohio Electric Light Association, but on the advice of Professor Jackson he also presented it here.

In acknowledging some complimentary remarks by President Debell, Mr. H. L. Doherty brought up the subject of the National Electric Light Association, of which he is president. In certain work the National Electric Light Association is doing, the co-operation and assistance is wanted of every man interested in central station work. One purpose is to combat the growing tendency in favor of municipal ownership. In spite of the fact that statistics demonstrate beyond a doubt that the municipally-operated plants are not successfully operated, do not give the satisfaction that other plants do, either charge more for their service, or lose money, and are in all ways disadvantageous to the people of any city, over a long period of years, although for a year or so they may make a remarkable record. The National Electric Light Association has raised $2500 to be devoted to an investigation of the municipally-operated electric plants of this country. This money was raised, hoping that the League of American Municipalities would join in an attempt to investigate the true conditions of the various municipal plants. The League not accepting the proposition were informed that if they felt they could not raise the money the Association would raise the entire fund for them, but we wanted them to come in and make the investigation with us, to see that we were fair, and we would see that they were fair, and when we got that report perhaps the people would accept it, while they would not accept a report that came from either. This offer was not accepted.

Another work which the National Electric Light Association is trying to carry on is an investigation of arc lamp photometry. The work is not yet on a commercial basis, but the next report of the committee will be more satisfactory to the central station men of the country than former reports, and will give them a concrete knowledge on which to base their value of arc lighting and their value of different kinds of arc lighting. That particular work is being carried on by voluntary subscription, and Mr. Doherty suggested the subscriptions would be welcomed from anybody who feels interested in arc lamp work.

At the last session of the convention, held Thursday afternoon, the following officers were elected:

President, Irving P. Lord, of Waupaca; first vice-president, E. K. Korst, Janesville, Wis.; second vice-president, George D. Westover, Cadillac, Mich.; secretary and treasurer, Thomas R. Mercein, Milwaukee. Board of Directors: F. W. Bowen, of Kenosha; A. M. Barron, of South Bend, Ind.; E. C. Hay, Springfield, Ill.

Professor Warren S. Johnson and C. S. Fortier, of Milwaukee, gave a short talk on wireless telegraphy, in which these gentlemen have done much original work.

"A High-Power Factor System of Arc Lighting" was the subject of a short paper by W. A. Layman, of St. Louis, which described a new constant-current alternating system of arc lighting recently designed by the Wagner Electric Manufacturing Company. After viewing some of the developments that led up to the design of this system, Mr. Layman said that the system is the outgrowth of the St. Louis experiment in series lighting work. Its advantages are that the regulation is entirely automatic; the current demand from the dynamo is practically proportional to the lamps burning; the power factor is high at all loads down to a very few lamps on circuits of from 25 to 100 lamps.

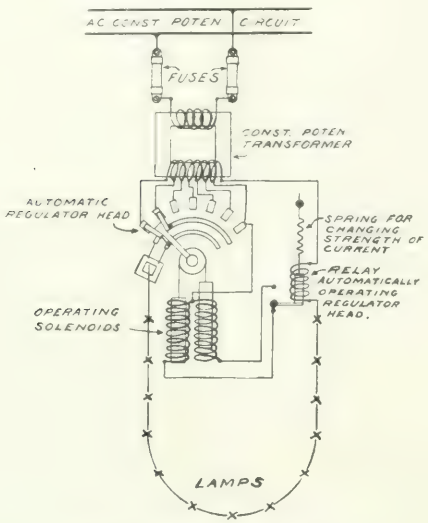
Referring to the accompanying illustration (page 162) a constant potential transformer having stationary, primary and secondary windings, and designed for high efficiency and close regulations, is employed. Such a transformer does not appreciably affect the power factor of any load applied to it. This transformer has its secondary provided with a large number of taps brought out.

An automatically operated switch has a number of steps corresponding to the taps brought out from the transformer. The mechanism of this switch is such that its lever arm is moved by an electrically actuated ratchet, either positively or negatively, so as to cut in or out portions of the secondary winding of the transformer to such extent as may be necessary to maintain for the lamp circuit a working pressure proportional to the lamps burning.

A relay in the lamp circuit is so connected as to operate the automatic switch solenoids for positive or negative rotation of the switch arm as the lamp circuit current falls below or rises above the normal required by the lamps. In the lamp circuit lamps of either the differential or shunt type are connected in series in such number as the maximum voltage of the transformer will permit. These lamps do not require an auxiliary impedance or resistance to take the place of

the arc in the circuit, and, therefore, it is possible to work the lamp circuit at the highest possible efficiency.

In response to inquiries as to the power factor and regulation of the system, Mr. Layman said that the full load power factor is 85 per cent with either kind of lamp, and that the regulation varied .2



ALTERNATING SYSTEM OF ARC LIGHTING.

ampere at the outside. The normal variation is .15 ampere. The spark at contacts is barely visible as the voltage between steps is about 100 volts. In case of short circuit the lever arm moves very quickly, and, in addition to that, an emergency choke coil is cut in by the relay.

In a paper entitled "Inspection of Hazards of Modern Plants," H. H. Hornsby, of Chicago, described a long list of examples of construction which had proved defective after a few years' use and had caused fires. A table full of relics was presented with this paper. Much of this paper, owing to the descriptive nature of the matter persented, needs the samples at hand for a clear understanding, so that its publication here would be without interest. However, the following paragraph from the paper is of such practical and universal interest to central station men at the present time, when defective transformers are proving entirely too frequent, that it is herewith quoted:

The transformer breakdown or crossing of primary and secondary coils is worthy of more than passing comment, and it should be the aim of each and every manufacturer of this particular class of device to first make absolute provision against such a condition. The grounding of the neutral wire, or the center of the secondary coil, in the event of a two-wire secondary, will undoubtedly be the means of some material protection against accident caused by the crossing of the primary and secondary coils.

At the close of the last session some time was given over to a general discussion of methods and policy. This was introduced by Mr. Doherty asking (in the interests of the programme for the next National Electric Light Association Convention) what matters the members considered of the most importance to the electrical fraternity at this time.

Mr. Gille said he thought that one of the greatest questions before electrical people to-day, and has been for a good many years, is the lightning question. A great many engineers have battled with this question a great many years, and it is still in a very primitive state, and he should like to see that question taken up and thoroughly gone into. This is especially true with respect to transmission lines all over the country.

Mr. Grier spoke of the advantage in inducing people to advertise by means of illuminated signs, which is being done in Chicago to a great extent, and in several other cities.

Replying to a request for a suggestion as to how to get more all-day business, Mr. Wirt said the single-phase alternating motor offered one solution. Many central station companies have polyphase machines, and there must be a great opportunity to install single-phase motors. Mr. Layman said he knew of a station at Whitehall, Ill., where they have a 90-kw single-phase generator, and during the daytime they operate about 45 hp of motors from that. They have one motor of 30 hp which is started with a loose pulley, and the countershaft has a good sized flywheel on it; by this means they eliminate the fluctuations in the circuit that would arise from variations of load on the motor. The motor is driving a clay-crushing plant, which is a pretty severe service. Sometimes the load in the crusher is so heavy that the driving belt slips, but the variation is not sufficient to affect the lighting that is on the machine at the same time. That same plant operates the city water system, pumping into a water tower at night. When the lighting load goes off they start a 30-hp motor, which is a mile away from the station. That motor is started, and there is a tell-tale in the water tower which indicates when the tower is filled, and then they cut the motor off at the station. In reply to a question, Mr. Layman said that the matter of the starting current of a single-phase motor can be regulated through quite a range if one cares to introduce auxiliary devices, just as would be done with the direct-current motor. The motor can be started with a succession of steps of increasing voltage, bringing the motor up without very largely increasing the current above the full load. It is good practice with all motors of large size to start them on idle pulleys, and also in small generators to put on a flywheel. Small motors are arranged to start without any auxiliary apparatus at all, and in the majority of cases there is no call for it.

In response to a question as to the progress of competition of gasoline Welsbach lights, the president said that the report which the committee on that subject presented at the summer meeting (see ELECTRICAL WORLD AND ENGINEER, July 6, 1901, page 16), did not show any very imminent danger of gasoline lighting taking the business. One member pointed to the very cheap rates that gas companies had made for so-called Welsbach six-burner, arc lamps. Therewith the point was made by another member that for absolute cheapness nothing could compare with kerosene oil, and that it was convenience of electric light and good service, not cheapness, that kept electric light companies in business.

Mr. Doherty said that as far as oil lighting is concerned, people will not bother with it. The nearer you can come to giving people a light where they have simply to press the button and you do the rest, the more likely are you to retain their patronage. If the business that the electric companies have lost be checked, it will be found that many of them have lost as much or more business to isolated plants than they have lost to Welsbach burners, although at one time Welsbach burners were very generally used.

People do not want to be bothered in taking care of their own lamps, and the one thing to aim at is to give customers convenient service. To-day there are not so many incandescent gas lamps proportionately as there were in 1896.

The question of isolated plant competition was brought up, especially as to whether lighting of factories that shut down at 6 P. M., was a desirable class of business. President Debell said he believes that the alternating-current station, as at present constituted, is better off without that class of business, for the very reasons that they run only until 6 o'clock P. M., or perhaps only until half-past 5, and that for only about three winter months, and just during the hours of maximum demand. Transformers and motors, etc., have to be kept on hand the year around, and, furthermore, if the shops on any one circuit are of any considerable extent, we have to either make this circuit larger to accommodate that transient trade, or else regular customers suffer from poor light during the hours, factories are using that service. While formerly quite a number of such customers were supplied in Sheboygan they have been let go. All-night customers form the most valuable kind of business that an electric station can get, whether it is a direct or alternating-current station, and his station has made extremely low rates to get all-night lighting business, while 6 o'clock lighting is allowed to go.

Mr. Harding said he has had an entirely different experience with 6 o'clock business. His town is small, and a good, big proportion of the business in lighting is for residence purposes. Taking the load curve for, say, December, the peak load is usually reached at very close to 4 o'clock; often it is much earlier than that, but taking the average for the month it would probably run 4 o'clock. Now the factories all run on sun time, which is 15 minutes ahead of standard time, and he finds that the peak load will come up long before the

hours of residence lighting, and stay there without possibly any increase on that peak during the hours that the factories begin to come off, and the time that the residences begin to come on. The factory business has thus been very profitable. If only all-night business were procured, he might not find the factory business so profitable, but in making a rate for 6 o'clock business he incidentally tumbled onto some 600 or 800 incandescent all-day lights—business that never existed before. As the station is also in the heating business, it wants the daylight lamps and not the lamps that run in the darkness, and the station has enough of the latter. In reply to a question, Mr. Harding said that about 80 per cent of his business is on meter, and all new business is on meter rates, and that the peak of his load is due to heavy factory work. There are two large woolen mills and some five or six other fair-sized factories on the circuits that take from 150 to 500 or 600 lights, and those lights are all on by 3 to 4 o'clock; very little of the residence lighting is on at that time, which accounts for the fact that the peak load remains uniform as long as it does.

President—I have in former times talked with quite a number of central station people from different localities, and, excepting in the very large cities, I had never heard before, I think, of the peak of the load coming on much before, if ever before, 5 o'clock.

He added that we should consider the total load on the electric as well as on the steam machinery, because that is what is to be provided for. The capacity for supplying these factories running up to 6 o'clock for a period of two or three months in a year has to be cared for not alone by electric machinery, but by your steam plant. Generally speaking, where a station has to maintain a considerable capacity, both in its steam and electric plant, and in the circuits on which those factories are connected, including transformers, etc., for the time that service is required by such customers—say, not to exceed three months in the year or thereabouts—such business is not profitable at the ordinary rates; and, on the other hand, the all-night customers constitute really the most valuable business that a station can get. Mr. Harding reminded the preceding speaker that he also runs a 24-hour service, which is due primarily to the heating plant, and that he has been able to connect up a factory lamp for practically every residence lamp put on the circuit, because there will be enough of the factory lights not turned on to make up the few that come on early in the residences.

The committees appointed for the coming year were as follows:

Committee on Uniformity in Advertising Pamphlets—H. J. Gille, St. Paul; F. W. Bowen, of Kenosha, and A. M. Barron.

Committee on Legislation—Mr. L. B. Livermore, Winona, Minn., chairman of the committee. The first of the following names from each State will be the chairman of the committee in that State:

Mr. C. E. Hay, Springfield, Ill.; Mr. W. H. Schott, Chicago; Mr. F. P. Maxwell, Dixon. For Michigan—W. Worth Bean, St. Joseph; W. F. Kingan, Sault Ste. Marie; E. D. Daniell, Menominee. For Wisconsin—Mr. H. C. Higgins, Marinette; Mr. T. F. Grover, Fond du Lac, and Mr. C. H. Williams, Madison. For Minnesota—Mr. S. B. Livermore, Winona; Mr. H. J. Gille, St. Paul; Mr. G. D. Shepardson, Minneapolis. For Indiana—Mr. J. H. Harding, Laporte; Mr. A. M. Barron, South Bend, and Mr. H. W. Frund, Vincennes. For Iowa—The manager of the Cedar Rapids Electric Light & Power Company, of Cedar Rapids; Mr. C. C. Hammond, of Mason City, and the manager of the Eagle Grove Electric Company, of Eagle Grove.

The following central station men in attendance at the convention: Irving P. Lord, Waupaca, Wis.; E. L. Debell, Sheboygan, Wis.; H. J. Gille, St. Paul, Minn.; P. H. Korst, Janesville, Wis.; W. H. Schott, Chicago, and Bloomington, Ind.; A. M. Barron, Franklin, Ind.; C. H. Williams, Madison, Wis.; W. W. Rod, Appleton, Wis.; W. H. Upham, Marshfield, Wis.; A. J. Hamacek, Sturgeon Bay, Wis.; W. J. Greene, Cedar Rapids, Iowa; C. F. Freehauf, Cresco, Iowa; R. Trumball, Kenosha, Wis.; H. F. Pearce, Negaunee, Mich.; George L. Smith, Harbor Springs, Wis.; George H. Kuelthan, West Bend, Wis.; J. S. Allen, Beloit, Wis.; O. M. Rau, Milwaukee; H. C. Higgins, Marinette, Wis.; W. F. Collins, Wausaw, Wis.; M. Weeks, Wausaw, Wis.; G. E. York, Portage, Wis.; F. G. Rodolph, Mascoda, Wis.; G. H. Strang, Richland, Wis.; W. P. Bragg, Monroe, Wis.; F. W. Bowen, Kenosha, Wis.; Irvin Butterworth, Denver, Colo.; A. P. Lathrop, St. Paul; O. B. Williams, Whitewater, Wis.; H. L. Dougherty, Denver, Colo.; T. P. Carrier, Edgerton, Wis.; Sinclair Mainland, Green Bay, Wis.; George B. Wheeler, Eau Claire, Wis.; M. E. Malone, Madison, Wis.; J. H. Harding, Laporte, Ind.; A. Kuhlman, Elkhart, Ind.; Bradford D. Viles, Chippewa Falls, Wis.

The Question of Safety in Electric Traction.

The public and technical interest in the announcement last week of the intention of the New York Central Railroad to adopt electric traction for the Park Avenue tunnel where the collision occurred recently was greatly stimulated by the immediate subsequent appearance in the *New York Times* of a letter from Mr. George Westinghouse, which, owing to its construction, was at once taken by that journal and evidently by a great many of its readers as a warning against the use of electricity for such places and under such conditions; and was, therefore, resented with much sharpness and surprise, in view of the quarter from which it came. That a great electrical manufacturer should discredit electricity seemed unbelievable, and in a second letter Mr. Westinghouse endeavored to make his views and his attitude clear, namely, that he is advocating such plans as will prevent the cars from burning up, should an accident happen, and such methods as will reduce to a minimum the chance of an accident. It is impossible for us to find space for all the matter born of the controversy thus aroused, but as will be seen we give the two Westinghouse letters, and that of Mr. Frank J. Sprague.

Mr. Westinghouse's first letter, of Jan. 11, runs as follows:

It may prove useful at this moment to direct the attention of the press to certain features incident to the use of electricity for the operation of trains or cars.

From the comments which have already been made in regard to the accident which is now uppermost in our minds, it seems to be assumed that such accident would in all probability not have occurred if the colliding trains had been propelled by electricity, and also that the absence of steam would have lessened the risk to the occupants of the telescoped cars.

As a matter of fact, with an electrically-operated train the risk of accident will, judging by experience, be increased rather than diminished because of the presence of the heavy electrical machinery which it is proposed to attach to several cars of each train. Already there have been many serious collisions with great loss of life between electric cars, while there have been numerous cases in New York and other places in which cars have been quickly destroyed by fires which have resulted from some derangement of the electrical apparatus or circuits, and in some instances so quickly that passengers have had scarcely time to escape to the street.

It should be borne in mind that the electric energy required to operate a heavy train is sufficient to melt a considerable bar of iron, or to start a dangerous fire, if anything goes wrong upon a car of ordinary combustible construction, much more readily than the car stove, the use of which has been abolished by law. Therefore, if a collision were to occur between two electrically-fitted trains, each having several combustible cars thereof fitted with electrical apparatus and carrying electrical circuits throughout, there could be an accident of so serious a character as to start an agitation having for its purpose the abolition of the use of electricity altogether, or at least to compel the railway companies to abandon the use of combustible cars fitted with electric motors.

The destruction by fire of a car or train upon a street or upon a level is one thing, but such an occurrence upon an elevated railway or in a tunnel can have consequences the contemplation of which should lead to wise regulations governing the construction and use of electrically-propelled trains and thereby insure to the public the rapid development of electric traction.

In Liverpool, during the past month, an electric train, while running in a short tunnel, was set on fire by the electric current and totally destroyed, with considerable loss of life.

Upon this Mr. Sprague offered the subjoined comment:

Your editorial in yesterday's issue, deservedly rebuking Mr. Westinghouse for his pessimistic and ill-advised letter, is in error in stating that it will be read with consternation, or even with surprise, by electrical engineers, notwithstanding Mr. Prout's indorsement.

Mr. Westinghouse has a habit, which I fear is almost chronic, of tendering advice to those contemplating advanced methods in electrical transportation, to do nothing unless it be to wait until his particular plans have materialized. Because of his prominence and much good work in the engineering world, over-much importance may be attached to his dictum on electrical subjects, in the advanced arts of which Mr. Westinghouse, however, is less apt a student and less qualified a judge than he is in the matter of air brakes.

An unhappy accident in the New York Central tunnel has, because of its appalling consequences, appealed most strongly to popular feel-

ing and prejudice. It is not my present purpose to discuss the causes of this accident, to try the apportionment of blame, or to point out what I may think are the proper remedies, but Mr. Westinghouse's comments are properly subjects for criticism and correction.

His letter is dated Jan. 11, some four days before the apparently premature announcement of tentative plans, which, it is reasonable to assume, have for some time been and still are under serious consideration by the railway company.

I have, in common with many others, definite ideas as to what may be accomplished for the betterment of the existing state of things, formulated with knowledge of many well recognized responsibilities and difficulties. Appreciation of the serious character of any problem is not, however, excuse for shirking its solution, nor sufficient warrant for men whose word may be given undue weight committing themselves to unwise alarmist comments, which may act to delay needed improvements.

Although the official announcement of the company's plans, as far as described, details no specific method of electrical operation, Mr. Westinghouse assumes that it is proposed to move all trains by motors attached to "several cars of each train." The plan thus indefinitely referred to is what is now known as the "multiple unit system," was first introduced by me on the South Side Elevated of Chicago, four years ago, and is now the generally accepted method of train operation for certain classes of service. It is a method of train control and operation by means of which locomotives or cars, each equipped with motors and controllers individual to these motors, can be aggregated at will, with or without other cars unequipped with motors, into train combinations of any length, and controllable from any desired point.

The system has found in Mr. Westinghouse a persistent opponent, although obliged by the advance of transportation methods to yield it some measure of approval, and he takes the present opportunity to first assume what the railway company itself is not yet ready to announce, and then condemn its possible adoption by criticisms based on false premises, and supported by misleading statements. That the multiple unit system, already indorsed by 300,000 hp of equipment within four years, is an essential in any general solution of many railway problems of to-day, goes without saying, but it is equally certain that modified or alternative plans must be applied to other problems.

Mr. Westinghouse declares that already there have been many serious collisions on electric cars, with great loss of life. It would have been more to the point if he had explained that almost invariably these have been with single cars on single-track roads, where no adequate signals were in operation, or where they were ignored. Where there have been collisions between trains on electrically-operated elevated roads, the cause has been fog and absence or disregard of signals, and the loss of life has been a minimum. In no case has such a collision caused a conflagration; this last, when it has occurred, having been on account of defective work. There is less reason why fires should occur on well-equipped multiple unit operated trains than on single cars in the streets, for it is undeniably true that much greater care has, at least in some cases, been exercised to create fire-and-fool-proof apparatus.

The statement is also gravely advanced that the amount of current necessary to operate a train would melt a large bar of iron. So, too, would the amount of current necessary to light an ordinary building, but an essential of the multiple unit system is the localization on any motor car of controlling apparatus individual to its motors, and limited in current to their capacity. No controlling device in this system carries the entire current of the train; heavy currents are especially prohibited being carried from one car to another, and the controlling currents are less than those in an ordinary lamp circuit.

Ignorance and carelessness of motormen is largely discounted, in that the current in-put in each motor equipment is, where the system is properly installed, automaticaly limited to absolutely safe amounts. Where derangement of a circuit occurs, causing an abnormal increase of current, safety devices of reliable character provide against its continuance.

Mr. Westinghouse makes reference to an accident, the first of its kind on that road, although in operation for 11 years, which recently occurred on the tunnel section of the Liverpool Overhead Railway. This equipment had the very objection which the multiple unit system was designed to avoid, in that main currents were carried from the regulating apparatus at the head of the train to motors at the rear end. Whatever the actual cause of trouble, the presence of creosoted wood in the tunnel largely contributed to the serious character of the disaster.

Evidently Mr. Westinghouse is apprehensive that the multiple unit system may be found advantageous in some proposed equipment on the New York Central, but it is safe to assume that any well-matured plans will not be stopped because of objection from a manifestly interested source, and that if it be satisfactorily demonstrated to the railway company that electrical operation will prove advantageous, it will be adopted, whatever the system or cost.

Mr. George H. Benjamin came out in the *Evening Post* and "indorsed Mr. Westinghouse in every particular." He would, he said, go further and say that the problem which now confronts the New York Central could not be solved by the aid of electricity, at any rate, not by electrical devices of the present day. It will be seen from the following second letter of Mr. Westinghouse that Mr. Benjamin misunderstood him seriously. The letter is as follows:

Permit me to thank you for the prominence you have given to my letter of the 11th and the discussions thereon. Your editorial of to-day invites more discussion of this subject, and possibly further criticism in the line of the unexpected interpretation of my letter. The controlling paragraph of my letter, to which I again invite your attention and that of railway managers who have the first responsibility to the public and of electrical engineers, is as follows:

"The destruction by fire of a car or train upon a street or upon a level is one thing, but such an occurrence upon an elevated railway or in a tunnel can have consequences the contemplation of which should lead to wise regulations governing the construction and use of electrically-propelled trains and thereby insure to the public the rapid development of electric traction."

From questions which have been asked, it is evident that the word "combustible," which obviously should be read into this from the preceding paragraph, has been quite overlooked.

No one can have a stronger belief than I entertain of the advantages to be derived from the use of electricity in the operation of trains. A lifelong experience, however, in connection with safety appliances upon railways has caused me to view the subject from quite a different standpoint from that usually taken, especially by inventors and promoters, and in some cases by manufacturers of electrical apparatus, who evidently dislike to emphasize the dangers attending the application of so much electrical machinery beneath the ordinary combustible cars now generally in use and the utilization of which has been contemplated in order to keep down the total cost of installation.

I believe a further useful purpose will be served by particularizing some of the dangers to be guarded against in the fitting of trains with electrical apparatus:

1. A great advantage of electric traction is the possibility of a much higher speed. This, however, while not extending the vision of the engineer in charge of the apparatus, will require a greater distance within which to stop the train.

2. When many tons of electrical apparatus are distributed beneath several cars of a train, and of necessity more or less loosely supported, and between which and the rails and roadbed there is but a small clearance, it is evident that much greater precautions will have to be taken than is ordinarily the case with the running gear of the present steam cars, derangements in which have often been the cause of accident.

3. Electrical apparatus supported beneath the car can develop by means of a short circuit heat energy sufficient to instantly ignite cars of wood construction, and this has occurred repeatedly, notwithstanding the presence of safety appliances intended to guard against such occurrences.

4. When a total wreck results from an accident, and experience has shown that accidents are inevitable whatever the mode of propulsion, the debris scattered over the "live" and other rails would render useless the ordinary circuit controlling devices which may be located upon the cars. This emphasizes the importance of a non-combustible construction of cars.

The public announcement that Mr. Yerkes, who has had so many years of experience in matters of this kind, proposes to construct his cars for the underground railways in London of non-combustible material, is a corroboration of the views I sought to bring to the attention of the public through your columns.

I am not elated by personal criticisms based upon a misappre-

hension of my motives, which are entirely in the interest of the public and not in the slightest degree governed by my personal interests. It may be to my credit to render a public service.

On the same page with this was a letter from Mr. Benjamin asserting that electricity "is not only unsafe but impracticable." Mr. Harry Alexander also had a letter in the same issue, taking up the cudgels warmly for electricity and the multiple unit system.

Important Arguments on Taxing Franchises.

At Albany, on January 12, important arguments on the franchise tax in New York State, were delivered before ex-Judge Earl by Frank Platt, Professor Charles A. Collin, William N. Dykman, Henry Hemmens, John C. Tomlinson and W. H. Page, Jr.

Mr. Platt was the first speaker, and argued that the Legislature had imposed an impossible task in directing special franchises to be valued as real estate. He did not deny that the power existed in the Legislature to lay a franchise tax upon a "public franchise," but he held that in imposing such a tax the method of arriving at the amount must be prescribed. He contended that there is no method by which the value of a right to use streets can be ascertained, and that when the Legislature attempted to levy a property tax on special franchises, and directed the assessing officers to value such rights as real estate, such direction could not be carried out. In support of that proposition, Mr. Platt directed attention to the statute's definition of a special franchise. It is a right to use the streets and the tangible property connected with that use. The State having conceded that the tangible property is to be valued according to the cost of reproduction, the dispute is only as to the valuation of the right to use the streets. This right, he said, must, if it can be assessed at all, be assessed at its intrinsic value, as property, and not according to the extent to which it may have been used by its owner, nor according to the earnings or profits which its owner may have made from its use in his business. Unlimited rights may be granted, for example, to two gas companies to lay pipes in all of the streets of a city, and each may use its right only partly. If each company is taxed according to the extent of use of its franchise, the tax is then laid upon the pipes and not upon the franchise granted. One of these companies may by establishing relations with more customers, or by better economy, make more profits than the other, but to assess these franchises according to the respective profits would be to tax management and good-will, not franchises.

Professor Charles A. Collin, who followed Mr. Platt, for the Brooklyn Rapid Transit system, elaborated, with great detail, the alleged Federal unconstitutionality of the Ford act. He made four points, any one of which, he said, was fatal to the assessment. In the first place, it impaired the obligation of the contract between the company and the city or State. Again, the absence of any standard of a valuation in the statute itself made the operations of the State Board mere guesswork. The taking of property on any such basis for taxation, or otherwise, was, the Professor explained, the taking of property without due process of law, and, therefore, unconstitutional. He explained that if the property were not real estate, it contravened the fourteenth amendment of the United States Constitution. The personal property of all citizens is taxed only after the debts of the owner have been deducted therefrom. The special franchises are treated as real property. The special franchises of the relator are not allowed this deduction; consequently, if they are personal property, an unlawful discrimination is provided, and the scheme of the Constitution, giving equal protection of the law to its citizens, falls to the ground.

Dealing particularly with the street surface railways of Brooklyn, Mr. Collin showed that the charter of Brooklyn, for many years, had contained a provision that the licenses paid by street railway companies to the city were to be deemed in full compensation for the use of streets. It was in acceptance of the public offer of the city, authorized by the Legislature, that the elaborate Brooklyn Rapid Transit system had been built up. The inducement to the company was that if it acquired a franchise, except in so far as it might voluntarily submit to further conditions, the only additional taxation which could be imposed upon it for the privilege of operating its cars in streets was to pay the city a specified sum per car. If this sum were to be increased, as the Ford franchise act contemplated, then the contract created by the company's acceptance of the city's proposition to give it improved transit facilities on the basis of existing law amounted to nothing.

The power of the Legislature to violate, or authorize the violation of any such contractual relation, Mr. Collin explained, contravened the decisions of the courts of the United States from beginning to end. These rights of the company had been interpreted judicially by the Court of Appeals in the case of People vs. O'Brien, and the law of that case had been adopted and applied in all other States of the United States where similar questions had arisen, and it applied conclusively to the cases now before the referee.

W. N. Dykman, representing the Coney Island Railroad and Flatbush Gas companies, who was the next speaker, showed that the special franchise tax tracks of the Coney Island & Brooklyn Railroad begin a block from the Brooklyn Bridge and ends at Prospect Park, but under contracts with the Brooklyn City & Newtown Railroad the Brooklyn City Railroad and the City of New York, the route of the railroad had been extended to Park Row, Manhattan. No one, he argued, could determine how much of the income comes from the special franchise tracks and how much from the Bridge and the tracks of other railroads. In speaking for the Flatbush Gas Company he said the gas franchise and the electric light franchise were granted at different times and to different companies, the electric light franchise having been purchased from the Knickerbocker Electric Light Company. Yet the State Board of Tax Commissioners assessed and valued these two utterly dissimilar and competing special franchises as one, which he contended was illegal.

Henry J. Hemmens, of counsel for the Consolidated Telegraph & Electrical Subway Company and the consolidated New York Edison Company, contended that the unconstitutionality of the special franchise act was illustrated particularly in the case of the companies he represented, by reason of the fact that the franchises which the companies had acquired were first secured by agreement with the city, and the terms of this agreement were then ratified by the Legislature.

John C. Tomlinson, on behalf of the New Amsterdam Gas and other companies, said in part that there seems to be a public impression that the corporate reorganizations and their large capitalization which have taken place in the last few years had been due to the value of the franchises possessed by those corporations, and such legislation as the special franchise tax act in question is directed to the taxation of those franchises, upon the theory that they are of great and growing value. In point of fact, however, the incentive to the great corporate reorganizations has been the chance of profit which would inure to the parties in interest by the introduction of more efficient management and more economical methods; and what has been capitalized and what has given the value to that capitalization has been the increased earnings which better management could and has secured. In point of fact, it is impossible either for the tax officers or the court reviewing their action to value the corporations' right to lay, maintain and operate its pipes in the streets.

William H. Page said that admitting the act of 1899 to be constitutional and possible of administration, it must be applied so that each separate franchise of the Metropolitan system was assessed for its sole and particular value. To show these values, he took the testimony of President Vreeland, that "if all the properties controlled by lease by the Metropolitan system were taken by their owners, leaving only the Metropolitan system, there is not a single line in the Metropolitan system that would pay its operating expenses." Mr. Page referred to the statistics in the case, proving this statement and proving that the earning power of the company, which the Commissioners admitted they had taxed, was produced by the economies in management and operation. He pointed out that the Commissioners had admitted also that they had made their valuation on the earning power of the company derived from its ability to carry the passenger over the whole of its route, and yet the law told them to value only the four franchises that the company owned, and not at all the three franchises which it leased, the value of which was assessed against the other companies owning them. President Roosevelt, Mr. Page said, in conclusion, in his recent message to Congress frankly recognizes the position taken by the plaintiff companies in this litigation when he stated that "the slightest study of business conditions will satisfy any one capable of forming a judgment that the personal equation is the most important factor in a business operation; that the business ability of the man at the head of any business concern, big or little, is usually the factor which fixes the gulf between striking success and hopeless failure."

Trolleys in the English Midland Counties.

Mr. S. C. McFarland, United States Consul at Nottingham, England, has made a very interesting report to the State Department on the trolley systems and plans of the Midland Counties. In the course of it he says:

The development of electric railways in the midlands has been, from an English point of view, phenomenally rapid. When, in recent reports I prophesied a quick growth to a scope of operations not then contemplated, the idea must have seemed optimistic to American electricians having experience with English methods; but more than partial realization of those prophesies seems imminent. The Nottingham corporation is just completing the fourth section of its city system, and is applying to Parliament for other extensions, demanded by a public which a year ago scoffed at the general idea, but which has, through the operation of the lines already established, received a quick and practical education. These proposed extensions are all within the corporate limits, and by action of the City Council this week the costs have been cut below the original proposals, because of the financial condition of the city, which is heavily in debt, owing to the many enterprises undertaken by it within recent years under the policy of municipal ownership, the last statement placing the indebtedness at about $23,500,000. But while the city appears to have reached a present limit, private capital is now prepared to undertake a very large system of suburban and interurban traffic, to be operated in connection with the local systems in the several larger towns involved; and for several of these schemes, which are outlined below, parliamentary powers are being requested. The two principal plans are promoted by Sir James Kenneth Douglas McKenzie, and by Sir Bache Cunard, and the first embraces a large portion of the county of Notts and part of Derbyshire, while the latter relates mainly to establishing a connection of light railways between Nottingham and Derby. If the application is granted, something like a revolution will take place in means of communication between large rural districts and the principal centers of population. The scheme of McKenzie will connect Mansfield with Alfreton, Ripley, Belper and Ilkeston, and Ilkeston with Nottingham, and also throw out another line between Nottingham and Derby, passing through Beeston and Long Eaton, and giving a connection from a suitable point between Ilkeston and the Derby route. There is further a proposal to carry a line to Arnold; also to Carlton, and eventually to Burton Joyce. By a third proposal, Hucknall Torkard is to be connected with Bulwell. The scheme embraces a distance of about 70 miles, including the section at Mansfield covering 12 miles, which has already been sanctioned; and the total population to be served approaches 500,000.

One matter in connection with the McKenzie scheme possesses an educative interest. It is proposed to inaugurate a service of workmen's cars from one town to another over the whole system. These, of course, would have to be run at cheap rates, and the suggestion is that half—or less—of the ordinary fares would be charged—say, 1d. (2 cents) for four miles.

At present the means of supplying current for the working of the railways does not exist, but this will not present any difficulty. The promoters are willing, where local authorities generate their own current, to make terms with those bodies to supply what is required, but failing that, it is likely that arrangements will be made with the proposed Derbyshire & Nottingham Power Company. This company, it may be added, already proposes to establish generating stations at Ilkeston, Colwick, Trowell and Warsop.

As to the carrying out of the works, the general engineering of Sir Douglas McKenzie's scheme will be under the control of Mr. John Fell, a well-known tramway expert. The work, as already indicated, is divided into two sections. That which embraces the southern portion, including the lines which touch Nottingham, is in the hands of Mr. C. H. Gadsby, of Westminster, who has carried out many important railway works; while the northern section has been intrusted to the Birmingham firm of engineers (Messrs. A. Dickinson & Co.), who have done a good deal of work of this character in this country, and have carried out many large schemes in Spain, Cape Colony, etc.

Altogether, this proposed linking of city with private enterprise, thus suddenly covering a large territory in the conservative midlands with a network of modern electric lines, is an astounding development for England. The scheme, however, is only the forerunner of what will follow elsewhere in the provinces, as well as in London. The effect of this electrical development upon existing railway lines, whose earnings are already at the maximum and whose dividends are yearly decreasing, will soon present a serious question.

Hearings on the Commercial Pacific Cable.

Last week we made note of the hearings on the Pacific cable before Congress, up to the time of our going to press. The hearings were carried on later and a special telegram from Washington, of Jan. 17, says: The advantages of government control of the projected Pacific cable were presented to-day before the Commerce Committee of the House. Admiral Bradford, who has had charge of the cable soundings; General Greely, head of the United States Signal Service; Captain Russel, who has done much of the cable work in the Philippines, and Mr. Thomas F. Clark, vice-president of the Western Union Telegraph Company, were among those present. Mr. Clark said the plan presented by the Commercial Cable Company contemplated exclusive arrangements with the lines in the Far East, the effect of which would restrict the business to this one line, preventing competition and such advantages to the Government and public as would accrue from competition. He emphasized the prospective commercial development of the Orient and likewise the disadvantage that would accrue from private control, which would tie up the business for an indefinite period and place the Far Eastern links of the cable system entirely under foreign control.

General Greely stated that about 10,000 miles of cable and telegraph were now under Government charge. He favored Government control of the Pacific project, and showed the extent to which governments were extending their control of cables. One of the recent extensions was by Germany on the China coast, while France and other countries were making similar cable extensions. General Greely said an American cable to the Philippines would do much good in the Americanizing of the islands. He cited instances of the current Philippine news that was reaching the islands by foreign cables, presenting the affairs of Germany and other countries, but not mentioning the most important developments in the United States. During the Spanish-American war, said the General, it became necessary for him to secure control of the Haitian cable for 30 days at $2,000 a day. In time of war, he explained, it was impossible to observe due secrecy when cable lines were under foreign control. He had discussed the subject with President McKinley, who was favorable to an "American cable under American control, in peace and war."

Admiral Bradford was favorable to having the cable laid, operated and controlled by the Government, not for commercial considerations, but as a naval and military necessity. He said the British Navy had great advantages over other navies by reason of being linked by cable with all insular possessions. If there were a war with Great Britain to-morrow, he said, it would be impossible for us to communicate by cable with the Philippines. The Navy Department had made all soundings, said the Admiral, and had found a practicable route, which was all ready for the Government to begin operations. It started from Monterey, Calif., which he considered a better point than San Francisco. He did not recommend a cable of American make, as the industry was not developed here, and it was essential to get the best the world produced.

It would appear that hearings before the Senate and House committees on the Pacific cable question have developed two widely divergent lines, between which the Government will have to choose if cable legislation is to be a part of the programme for the present session of Congress.

From present indications the sentiment in the House is favorable to Government ownership. On the other hand, some of the most prominent members of the Senate, both in the majority and minority, declare against Government ownership. They say that a private corporation can purchase material and fill contracts cheaper than the Government. Opinion in the Senate seems to be shaping itself in favor of Senator Hale's position that the laying of the cable should be encouraged and permitted by a private corporation with the provision that after a stated period the property shall be obtained through purchase by the United States without further formality than its appraisement.

Senator Hale, who will be a controlling factor in legislation relative to the cable because of his position as chairman of the Naval Affairs Committee, insists upon definite provisions being included in any cable legislation obtaining reasonable and equitable rates to the

public and nominal rates to the Government. The company which is seeking with such energy to obtain the rights from Congress to construct the cable has indicated that it will build a cable under these conditions.

Dr. Perrine Before the New York Electrical Society.

The combination of science and audacity which characterizes much of the long distance transmission work done during the last few years in California was strikingly brought out at the well-attended 220th meeting of the New York Electrical Society—held Jan. 15—by Dr. F. A. C. Perrine, who lectured on "The Power Plants of the Pacific Coast." Dr. Perrine said that one of the objects of his lecture was to show the men in the East that the far Westerners were no mere rough-and-tumble engineers, and it was generally admitted that this point was abundantly proved. A more wonderful series of pictures of brilliant engineering feats than that thrown on the screen by Dr. Perrine has seldom been presented to a scientific audience. Dr. Perrine's work has been such as to make him a recognized authority on the subject of long-distance electrical transmission. As consulting engineer he had much to do with the pioneer work of the great Standard Company, and he is now president of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., the designing engineers and manufacturers of the electrical apparatus used in the standard plants.

During the discussion, Mr. T. C. Martin suggested that the present week was one which would be notable in the history of the American Institute of Electrical Engineers and the New York Electrical Society, inasmuch as on one of its evenings the Institute learned the details of the achievement seen in the transmission of a wireless signal across the Atlantic, from the lips of the man who had done it, and on another evening the Society listened to a description of the longest power transmission in the world, that from Colgate to San Francisco, 215 miles long, by one who had taken a most active part in the work.

Dr. Perrine's paper, which was most entertaining as well as being of notable technical value, is to be published by the Society, by which it was greatly enjoyed.

New Telephone Patents.

Four telephone patents emerge from the issue of Jan. 14, three relating to party-line systems and the fourth to no system at all—since it is a device for converting a metallic circuit into a grounded circuit in the event of the two wires of the metallic circuit becoming crossed or one of them being grounded or broken.

Mr. Isidor Kitsee, of Philadelphia, is the inventor of a party-line system of the step-by-step contact maker and three-line-wire family. Mr. Kitsee, in his specification, disclaims the three-wire impeachment, and points out that his third wire is only required to double back from the last station on the line to the first. In illustration of what a simple matter this is, he supposed a party line carried five miles from the central office with all the sub-stations in one block or house at the end of the line; the third wire would then, of course, be required only in that convenient block or house containing all the sub-stations. Most party lines, however, are not built that way. In practice, the third wire would entail a three-wire line for the greater part of the party-line circuit. In his system Mr. Kitsee sets out to provide an arrangement by which when one station calls the central office, or when a station is called by the central office all the other stations are locked out and can neither call nor listen in; further, the central office can selectively signal each station, and, if a station wants another on the same party line can throw a shunt around the lockout device and so enable the called station to connect with the line.

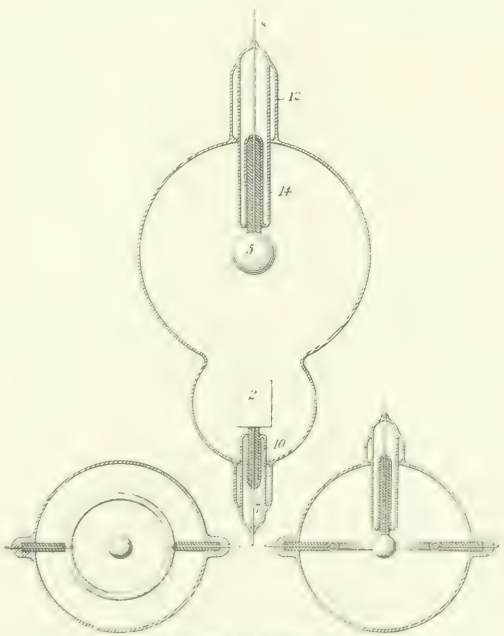
Mr. Frank E. Mayberry, of Medford, Mass., patents and assigns five-eighths to two gentlemen residing as far apart as Hoosick Falls, N. Y., and Chicago, Ill., a party-line system which in all respects fairly earns the record for complications. Eleven pages of specifications and claims and six sheets of the most complicated drawings to set forth this device, while no fewer than 49 paragraphs of claims are needed to protect the product of Mr. Mayberry's ingenuity. To attempt to do justice to such an invention in a mere abstract is to attempt the impossible, and the most painstaking investigator is driven to the verge of nervous prostration by drawings in which all wires and connections are shown in meandering lines with innumerable irritating spurs that remind one of the rivers and railways on a very small scale map. Mr. Mayberry's invention purports to supply a system by which any station on a party line can call the central office and lock out all the other stations, and reciprocally the central office can selectively signal and connect any station on the line and lock out all the others. A step-by-step selector and various other electrical and mechanical devices are required at each station to effect the purposes of the invention. Only one pair of line wires is used for both signaling and telephone apparatus, but the complication of the apparatus at each sub-station is so great that it is open to doubt whether the system could ever give satisfactory service in the hands of the ordinary user.

Messrs. Albert K. Andrians and Hermann Herbstritt, of San Francisco, patent and assign to the Automatic Interconnecting Telephone Company, of the same place, an individual telephone switch and lockout mechanism for interconnecting lines. This device is to enable any station on a party line to call up any other station on the line without the intervention of a central office, and to lock out of circuit all the stations but the one called. This is another complicated selective device involving separate circuits for signaling and for talking; and while it may be adapted to a purely interior system its scope would appear to be practically limited to that narrow field.

Mr. Walter K. Cook, of Mason City, Iowa, patents a "telephone circuit" which consists of an arrangement of switches and connections for the purpose of converting a metallic into a grounded circuit in the event of the two wires of the metallic circuit becoming crossed, or one of them being grounded or broken, the other remaining intact. As an impracticable idea, this caps the climax.

New Type of Vapor Lamp.

Two patents were issued last week to Peter Cooper Hewitt on a vapor lamp which differs considerably in detail from the type of lamp with which the name of the same inventor has heretofore been associated. Referring to the accompanying illustrations it will be seen that the lamp is of much smaller dimensions than the former lamps of the same inventor, approximating more nearly to the size



NEW TYPE OF VAPOR LAMP.

of the ordinary incandescent lamp. The main feature of the lamp is the use of a cathode consisting of a light-emitting material, such as one of the rare earths, or mixtures thereof.

Referring to the upper figure of the accompanying illustration, 2

represent the anode 6 and 5 the cathode. The anode is sealed within the glass column 10, which surrounds the leading-in wire 7. The cathode is seated in the tube 14 of porcelain or other suitable material, which is a non-conductor, and which retains this property when hot, and is inert to electrical or chemical actions at the temperature to which it is subjected in the lamp. The cylinder 14 is carried by a stem or column 12 of glass, through which the leading-in wire 8 passes. The joints between the electrode and the porcelain and between the porcelain and glass are sufficiently tight to prevent the electric current from passing through them and reaching the metal parts within, thus forming an electrically-tight insulation over the leading-in conductor.

As stated before, the material of the cathode consists of one or more of the rare earths. The high resistance of this material when cold is not objectionable, since there will be sufficient electric leakage into the lamp from the conductor leading into it, to start the current, and when the current is started it will heat the material by reason of its position at the negative electrode. In normal operation the cathode will be heated to a very high temperature, becoming thus a light-emitting body. Gas of the proper density is placed within the globe, and when the current traverses the lamp considerable heat is generated at the cathode, and the surrounding gas being in a measure a non-conductor of heat, the temperature cathode is maintained sufficiently high to be light-emissive.

The inventor states that with attenuated nitrogen contained within the chamber and with iron electrodes separated a distance of about 1½ inches, the lamp may be started with a direct current having a pressure of 750 volts or less; and the resistance which the gas offers to the passage of the current and the resistance which is offered between the gas and the cathode will render the lamp self-governing and pass a definite amount of electrical energy and convert it into light and heat, the heat being sufficient to maintain the cathode in a state of incandescence. It has been found that the resistance of a vapor varies inversely with the current; but with this lamp, in the case of an increase of current the consequent reduction of resistance in the vapor-path is compensated for by an increased resistance at the cathode, and vice versa. This particular form of resistance is a phenomenon that takes place under proper adjustment when there is no chemical or physical action at the negative electrode.

The feature of self-regulation is important whether the lamp be constructed to yield light merely through the instrumentality of the gas, or by reason of the incandescence of the negative electrode, or both. In this lamp the resistances at different points may be different at the time of starting from what they are when the lamp is running; but by properly adjusting the gas density the lamp may be made to start on the same current that it is designed to operate on.

A lamp of the character described will regulate its resistance so as to be operative under wide fluctuations of e. m. f. Under increments of current the resistance of the heated cathode may increase; but this increase is compensated for by the change in resistance of the conducting gas or vapor through wide limits. In this way a balance is brought about between the elements composing the luminous portions of the lamp, whereby the lamp is made self-regulating. When the lamp is operated by alternating currents, both electrodes may be regarded as cathodes. It is desirable that the material in the lamp should be such that there shall be no chemical action or physical change in the lamp while in operation.

The two lower figures of the illustrations show a modified form of the lamp, in which the cathode is surrounded by an anode made in the form of a ring.

Long Telephone Lines.

Mr. R. Guenther, U. S. Consul at Frankfort, Germany, says: Paris is the center of an international telephone wire net; its extreme ends are London, Hamburg, Berlin, and (in connection with the French-Italian line about to be opened) Turin and Milan. The Paris-Berlin line is the longest, with about 625 miles of wire. The Paris-Hamburg line is about the same. The distance from Paris to Turin, measured by an air line, is about 375 miles, and that between Paris and Milan about 470 miles. But all these lines are eclipsed in length by that between Paris and Cologne, not by the direct line, but by indirect connection, often rendered necessary by breaks in the other service. In such cases, a person in Paris desiring to speak to Cologne is connected via Berlin. This roundabout way increases the wire distance about 375 miles, making the total about 1000 miles.

CURRENT NEWS AND NOTES.

FIRE IN SOUTH LONDON SUBWAY.—On Jan. 16, according to a London dispatch, a locomotive on the South London tube railway caught fire, owing to defective insulation. The fire spread to the sleepers on the roadbed, but as it was near a station it was soon extinguished.

ITALIAN FELICITATIONS.—President Cremona, of the Italian Societa Scienze dei Quaranta, has sent the American Institute of Electrical Engineers a hearty response of thanks to the cable message sent on the occasion of the annual dinner at which Mr. Marconi was the guest of honor on Jan. 13.

INSTITUTE MEETINGS.—The American Institute of Electrical Engineers will hold its next meeting at 12 West Thirty-first Street, New York, on Friday evening, Jan. 24. A paper will be presented by Dr. Cary T. Hutchinson on "The Relation of Energy and Motor Capacity to Schedule Speed in the Moving of Trains by Electricity." At the meeting of Feb. 28, the subject will be "Electro-Chemistry and Electro-Metallurgy." Dr. Samuel Sheldon will then present the opening paper.

FRENCH AUTOMOBILE TAX.—The incidence of an automobile tax is sometimes heavier than it seems. The French owner of two moto-cycles is in a predicament. He is obliged, according to law, to pay indefinitely annual taxes, despite the fact that the moto-cycles were stolen from him two years ago. His protest was rejected because of his failure to comply with the formality of bringing back the plaques attached to the moto-cycles, but which were stolen with them. Thus, as long as he does not return the plaques the law assumes that he still has the moto-cycles and must pay taxes thereon.

A NEW METHOD OF ELECTRICAL CONDUCTION.—A singular method of electrical conduction is the subject of a patent granted Jan. 14 to A. A. E. Sterzing, the object of which is stated to be to obviate the losses that occur when electric currents are transmitted through metallic conductors. The system consists of a pipe line lined with insulating material in which, after the air has been partially exhausted, vapor is admitted, the combination supplying a means whereby electric current may be conducted from a main supply station by various branches. An apparatus is described in detail, the function of which is to maintain the rarefied air and vapor in definite proportions at a definite pressure. The kind of vapor used, the proportion of air and vapor, and the amount of rarefaction are not mentioned, nor are figures given for the specific resistivity of the conducting medium whereby it may be compared with metallic conductors.

CHANGES IN MANHATTAN RAILWAY PERSONNEL.—The official opening of the Manhattan Railway as an electrically-operated system, which occurred two weeks ago, has been followed by a number of changes of considerable importance in the company's officers and staff. Mr. Hugh Hazleton, who has been assistant electrical engineer under Mr. W. E. Baker, has been made electrical engineer of the company. Mr. Baker, who has held the position of electrical engineer and general superintendent, will have charge of the operating department. Mr. M. M. Dorlan, who has been associated with Mr. Baker in his office at 32 Park Place, has been appointed supply agent, vice Ashbel Green, who retried from that position about two months ago to go into other business. The office at 32 Park Place has been abolished, all downtown business of the company being transacted at the main office at 195 Broadway, and Mr. Hazleton having his office in the main power station. Mr. H. G. Stott, who has been in charge of the work at the new Seventy-fourth Street power station and also of the distribution and substation work, retains the position of superintendent of motive power with full charge of the steam and electrical plant at Seventy-fourth Street. He will be assisted on the steam engineering side by R. D. Tomlinson, until recently assistant engineer of the Ninety-sixth Street power station of the Metropolitan Street Railway Company. L. B. Stillwell will remain as consulting engineer of the Manhattan Elevated Railway as well as of the Rapid Transit Subway Construction Company.

"LORD KELVIN'S SON."—A youngish man with one or two upper front teeth gone, has been calling upon electrical engineers in this vicinity and elsewhere as the son of Lord Kelvin, who is generally understood in this country to have no children at all. Among those favored with recent visit is Mr. T. A. Edison and Mr. Joseph Wetzler. A gentleman answering closely the above description has also been favoring street railway people with calls as the son of Mr. G. F. Milnes, of the Milnes Car Company, of Salop; and of Mr. Paget, of the Portsmouth municipal tramways. We understand from Mr. John Bottomley, Lord Kelvin's nephew, that he has not the honor of the young man's acquaintance.

RICHMOND, VA., TROLLEYS.—A special telegram from Richmond, of Jan. 14, says: This city, the scene of the first successful electric railway in the United States, built by Frank J. Sprague, will in a few weeks at most be connected with Petersburg by an electric line that will compete in speed and carrying with the steam roads. This road connecting the two cities is constructed substantially. Speeds of 50 miles an hour are talked of. The passenger fare between the two cities will be less than half what it is on the steam railroads. The electric line will carry express and freight. The original pioneer line in Richmond is owned by the Passenger & Power Company, which will operate the new system.

MUNICIPAL PLANTS.—Mayor [illegible]'s new Commissioner of Water Supply, Gas and Electricity, Mr. Dougherty, says: A bill introduced at Albany provides for the acquisition by the city of the various gas corporations in this city. I do not believe in the acquisition of these private properties because of their great capitalization, and consequently the tremendous expense involved in their purchase. The bill which I have referred to I have returned to Corporation Council Rives, together with a communication embodying these views. No doubt the control of lighting facilities by the city government will eventually be earnestly considered, but at this time it would hardly be judicious to recommend such an undertaking, owing to the proximity of the debt limit.

THE PHILADELPHIA ELEVATED RAILWAY.—A Philadelphia dispatch states that John L. Mack and President A. J. Cassatt, of the Pennsylvania Railroad, have come to an agreement, and that as a result an elevated railroad will be built on Market Street, running from the Pennsylvania Railroad station at Fifteenth Street westward to Sixty-third Street. Mr. Cassatt is said to have obtained the principal interest in the projected road, and there is a probability that in order to relieve the congestion of traffic on Market Street east of the City Hall there will be a subway built from Broad Street to the Delaware River. Nothing definite has been decided relative to Broad Street, but the rapid transit franchises provide for the construction of an elevated railroad on that thoroughfare, and it is probable that one will be built.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—The directors of the Southwestern Gas, Electric and Street Railway Association held a meeting in San Antonio on Dec. 22 last for the purpose of perfecting arrangements for the fourth annual convention of the Association, which is to be held in San Antonio April 18, 19, 20 and 21 next. Papers will be read on the following named subjects: "Fuel Oil," by H. F. MacGregor, of Houston, Texas; "Flat Rate Evil," by T. D. Miller, of Dallas, Texas; "Progress Clubs of Texas," by E. H. Jenkins, of San Antonio, Texas; "Office Management of Street Railways," by F. H. Stuart, of Waco, Texas; "Inspection and Inside Wiring," by W. B. Reed, of New Orleans, La.; "How to Increase the Business," by A. E. Judge, Tyler, Texas; "Personal Injury and Damage Cases," by F. E. Scovill, of Austin, Texas.

TESLA'S WIRELESS TELEGRAPH.—When Mr. Tesla was asked last week by the *New York Sun* whether there was any similarity between his own and other wireless telegraph systems, he is reported to have said: "I respect rigorously the rights of others, and when I give my system to the world I shall ask the entire technical profession to point to any feature of my system—the transmitter, the receiver, the means and methods of recording, the means and methods of producing the requisite electrical energy, and the means and methods of securing absolute privacy and non-interference which is not of my own creation. I admire skill and enterprise, and my best wishes for success accompany those who sell ready-made shoes; but I myself prefer not to use them. They are cheap, but they raise corns and bunions." The *Sun* adds: The Tesla patents in connection with instruments and principles involved in the transmission of wireless messages, or wireless electrical energy, date from 1896 and 1897.

LIGHTING THE VATICAN.—In a letter from Rome to the *Chicago Record-Herald* Mr. W. E. Curtis writes: "Cardinal Rampolla, the papel secretary of state, and, next to the pope, the greatest man in the Catholic Church to-day, lives at the top of the Vatican, and his visitors are required to climb 463 marble stairs. There are no elevators in that venerable building, although it has recently been fitted with electric lights at a cost of $45,000. It looks queer to have a clutser of electric bulbs hanging over an altar, but you can see this anomaly at the headquarters of the Catholic Church. The pope, whose apartments are immediately below those of Cardinal Rampolla, is carried up and down stairs in a sedan chair by four of his guards, who handle him as tenderly as if he were an infant. Everybody else has to walk, and it is a long, hard journey. When I suggested to an eminent prelate that the climb to the top of the Vatican ought to be counted as a penance, he smiled and said that he knew of a good many people who would be glad to get rid of their sins that way." American electric elevators would seem to be in order, all the same.

USE OF MARINE SEARCHLIGHTS.—It is stated from Washington that the complaints filed with the United States Treasury Department against the temporary blinding of the steamer pilots by the searchlights of other steamers, have become so numerous that an order fixing a penalty for it has been issued. These complaints came mostly from the Great Lakes, where the pilots allege that the searchlights of some steamers were often maliciously used against vessels of opposition lines, and the pilots of the latter vessels, blinded by the intense glare, were unable to see beacons or lighthouses for some minutes thereafter. When this happened in a narrow channel or where navigation was otherwise difficult, the complaining pilots assert that their steamers and passengers have been endangered, and in some instances they have been compelled to stop the engines. There being no regulations which would reach the offenders the Board of Supervising Inspectors of Steam Vessels, at its last meeting, adopted a rule prohibiting the practice. This rule has been embodied in the steamboat regulations by the following order issued last week by the Treasury Department: "That masters, mates and pilots of all vessels be required to exercise due caution in the use of their searchlights so as not to throw the rays of light into pilothouses of passing steamers. A wilful violation of the above requirement will subject the offender to a suspension or revocation of license."

ELECTROLYTIC SEPARATION OF TIN.—A curious parallelism is presented between the well-known Hoepfner process for the extraction of copper from its ores and compounds, and a method just patented to Paul Bergsoe, of Copenhagen, for the electrolytic recovery of tin from scrap and waste alloys. The Hoepfner process, it will be recalled, depends upon the varying valence of copper, and consists in bringing a salt of copper in its higher state of oxidation into contact with the ore, whereupon copper passes into solution and the solvent is reduced from the cupric to the cuprous condition; this solution is then electrolyzed with insoluble anodes to deposit one-half of its metal, restoring the remainder to its original valence and reconstituting the solvent. Bergsoe reacts upon tin-bearing materials with stannic chloride, and subjects the stannous salt formed to electrolytic treatment as above, restoring its valence and solvent power, and recovering an amount of metal equivalent to that dissolved. Both methods are simple, and indeed identical, in theory. The Hoepfner process has encountered in practice the very serious obstacle of a low-reaction velocity—a solvent action so slow as to render its application to the most commonly occurring ores of copper, the sulphides, of doubtful practicability. From this defect the new process is free, for the stannic salts are energetic solvents. The successful treatment of tin scrap, however, has proven in the past a difficult problem, not only on account of its very low tin content, but because of the tendency of the iron to pass with the tin into solution. As applied to this purpose, therefore, the industrial value of the new process is yet to be demonstrated.

LETTERS TO THE EDITORS.

Engine Specifications.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the communication by Mr. Bertram in your issue of Jan. 11, on engine specifications, there ought not to be any difficulty between the engine builders and the electrical people in regard to the driving of alternating-current generators in parallel operation. This whole question is simply a question of flywheel, and so long as the requirements of the generator do not necessitate impossible or impracticable flywheels, it seems to be merely a question of furnishing a wheel to meet the requirements of the case, and of making the price of the engine cover the extra cost of flywheel. The terms used by the electrical people in describing their requirements cannot be misunderstood, and if the engine builder uses his mathematics correctly he knows just what flywheel is necessary for any given result.

The governor of the engine has nothing whatever to do with this periodic displacement of the wheel, which occurs twice in each revolution while passing the centers. Of course, the governor must perform its function and must regulate the mean or average speed of the engine, and must prevent fluctuations or waves of speeds commonly called "racing" or "hunting"; but isochronism, or uniform speed, not only is not necessary in this case, but it is absolutely impracticable to divide the load between two engines satisfactorily unless the governors of both engines permit a moderate drop in speed with increase of load. All that is necessary in this case is for the governor to be stable in its action and not too near isochronism, and the flywheel must be depended on to maintain the uniform rate of rotation while passing the centers. It is, of course, desirable not to load the engine bearings with unnecessary flywheels, and, therefore, to decide the matter intelligently as to the weight of flywheel, it is necessary to know just what the requirements of the generators may be, and then not use any heavier wheel than is necessary to come safely within these requirements.

AMERICAN ENGINE COMPANY.
BOUND BROOK, N. J. F. H. BALL, *General Manager.*

The New York Tunnel Accident.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the conditions that led to the recent accident in the New York Central tunnel, it appears to me that the following system might prevent a similar occurrence.

Install a trolley bell circuit and supply each engine with a small trolley and a vibrating bell, one side of the latter being "grounded" on the engine. When on a "block" the bell will ring, and at the same time ground the wire behind it so that another engine entering that block will not get sufficient current to ring its signal bell—a warning of danger being thus given.

BRONXVILLE, N. Y., CYRUS PROSCH.

Death by Electricity.

To the Editors of Electrical World and Engineer:

Sirs—I read with great interest the two articles in the issue of Jan. 11 on the grounding of secondary circuits, and on a 10,000-volt shock. In connection with the latter article the question arises to my mind, "Does a shock of electricity, as ordinarily received, really kill?"

Some years ago I received a shock from a 2000-volt alternator, one side of which was grounded, and although I made a direct "ground" from the opposite side to a steel nail and was rendered unconscious for some hours, still I revived under artificial respiration and stimulants. Aside from a bad shaking up and a severe burn, I was none the worse for my experience.

Again, while I was in the testing department of a large electrical concern, I saw many students badly shocked and burned by voltages of various strengths, yet no case during my time failed to respond to the proper treatment.

In the course of my experience in the electrical profession of over 20 years, I have never lost a man, although I have had several so badly "shocked" as to be to all appearances "dead" in the accepted term, yet they all recovered after more or less prolonged treatment by the methods I have mentioned. The question to my mind, therefore, still remains an open one, whether a shock, as ordinarily received, i. e., from one path of potential, does "kill" a person who has not an organically weak heart. Indeed, is the criminal pronounced "dead" by electrical execution, *really* "dead," or does the autopsy kill him? though in this case he receives the full difference of potential. In view of the varying resistance of the human body this seems to me an open question, and I should be glad to hear other opinions on the subject.

LORAIN, OHIO. C. H. HINES.

(There is no doubt that the criminals executed by electricity in New York State are killed, the strength of current and the time it is applied producing lesions fatal to life.—EDS.)

Induction from the Secondary Into the Primary of an Induction Coil.

To the Editors of Electrical World and Engineer:

Sirs.—Having read the highly interesting article of Lord Rayleigh on the induction coil published in the *Philosophical Magazine*, December, 1901, which was printed in abstract in the Digest of ELECTRICAL WORLD AND ENGINEER, of Jan. 4, 1902, I attempted some experiments on induction from secondary into primary. I have been well aware for a long time that where a condenser or an earthed wire is used in the secondary circuit of a coil, under certain conditions, there is induction from the secondary into the primary circuit of the coil, and I have frequently had shocks when I touched any part of the primary when such an arrangement was used and the coil was in operation.

The experiment I performed was as follows: I connected a Geissler tube across the poles of a cell. There was a spark-gap in the secondary of the coil and a condenser consisting of a piece of mica with tinfoil glued on each side, one piece of the foil earthed and the other piece attached to the spark-gap in secondary of the coil on the one side. With this arrangement I found that the Geissler tube lighted up (discharged from one electrode to the other) with every spark discharge at the gap in the secondary. An earthed wire acted in the same manner on the condenser when substituted for it.

Without the condenser or the earthed wire I obtained no light in the Geissler tube. It is evident that the Geissler tube so arranged prevents the most part, if not the whole, of the high potential superinduced discharges from passing in or through the battery cell; and the tube does not allow any of the battery current to pass through it.

BALTIMORE, MD. A. G. DELL.

The Deterioration of Insulated Cables.

To the Editors of Electrical World and Engineer:

Sirs—In your issue of Jan. 4, under heading of "Deterioration of Insulated Cables," I note a letter to you from Mr. E. W. Stevenson, of Wilkesbarre, who quotes Mr. Paul Lincoln as attributing the deterioration of rubber insulated cables to the generation of ozone in the cables.

This subject is of much interest to me, as I have had the same experience as Mr. Lincoln; not only on rubber insulated cable, but also on saturated paper insulation. In my high-voltage testing work I have noted often a heavy static effect on the cable. This, of course, is due to capacity, and is especially strong on rubber covered conductors. I have also noted the process of a break down near the ends of the conductors where the leads of the transformer were connected, and in almost every case a static spark or, rather, a continuous discharge resembling an arc takes place at the point of break down. When this point has been examined, it was found to be circular and about 1/16 inch in diameter. The static discharge seems to bore its way through the insulation. I have checked this often by placing a

piece of soft rubber tubing around the conductor. If in any way we can discharge the cable, the deterioration will, it is safe to say, be greatly reduced.

Trusting that this will at least be a suggestion, I await with interest any new development of the subject.

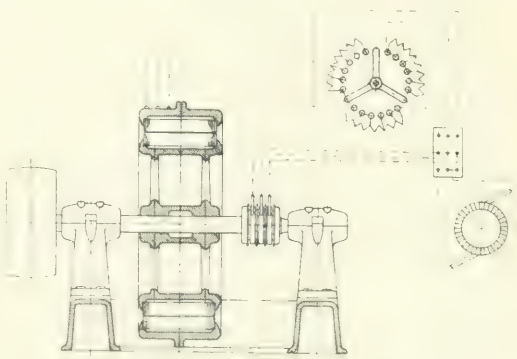
PERTH AMBOY, N. J. W. S. BREWSTER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Heyland Induction Motor.—HEYLAND.—An illustrated article on the first results of tests of his compensated induction motor. All properties, theoretically deduced by him before, have been substantiated by the test. The motor under test was a normal 12-hp, 330-volt, three-phase motor, with 6 poles, the speed being 1000 revolutions, the number of alternations 100. For the tests, however, it was connected up as a single-phase motor, two phases of the star connection being connected in series. The third phase was disconnected and a part of it was used for excitation. In this way it was possible to vary the connections and to connect in parallel and in series various windings of this phase, in order to obtain different voltages and currents, to adjust the compensation and to determine the most favorable conditions. The rotor was a direct-current series-wound armature, with 71 slots and 2 bars per slot, with a small collector for the exciting current, the segments being connected together by joints of low resistance and without inductance. The collector is thus a closed ring. The armature windings are closed through the collector rings, so that the rotor has the characteristic feature of the squirrel cage armature. In spite of very severe tests, not the slightest sparking of the brushes could be observed. This collector ring operates just as successfully as a slip ring. It is thought that experience will show that a very small number of segments is entirely sufficient. The excitation was produced with simple alternating currents, which were taken from the third phase of the stator and supplied to the armature through the diametrically opposite brushes. The excitation by single-phase current had the disadvantage that between the voltage at the brushes and the current of brushes there existed a phase difference. This was calculated exactly, and will be taken into account in the further calculations. The voltage was 2 volts, the current 200 amperes. This phase difference disappears with polyphase excitation. In the new motors polyphase excitation will always be used. In the experiments with the compensated motor the position of the brushes was first adjusted in such a way that the phase difference became a minimum, the brushes were then held fixed in this position and the number of windings was so adjusted that the phase difference became zero. For the motor, used as an ordinary induction motor without compensation, the power factor was 0.75, and the no-load current 15 amperes. With compensation the power factor was unity, and the no-load current 3 amperes. The greatest interest lies in the tests of the motor used as generator. The motor when mechanically driven and disconnected from the supply network, excited itself just like a direct-current dynamo, and supplied current to a number of incandescent lamps. As generator it shows the characteristic features of the self-exciting direct-current shunt-wound dynamo. As in the direct-current dynamo, it was found that a certain minimum speed was necessary for starting self-excitation. But this minimum speed was found to be 1100 revolutions, or 100 above normal as motor. The principal difference between this generator and the direct-current dynamo, is that the former has no fixed poles and no remanent magnetism. In the direct-current dynamo, the excitation increases with the speed, first on account of remanent magnetism and later by self-excitation. The Heyland generator has no remanent magnetism, and, therefore, after it has been brought up to the proper speed, the magnetization must be started from an outside source. A brief current is sufficient, taken from another source of alternating current. With proper arrangements it may be small, and and if there is no other generator available, it may be obtained from a small Siemens inductor. As soon as the machine is once excited, it continues to excite itself. The generator was then loaded with incandescent lamps, in groups of three in series, corresponding to a voltage of 330. The load was about one-fourth the normal load, and the voltage drop was only 2 per cent, although the air-gap between rotor and stator was very small, 0.5 mm., and the ratio of the armature ampere turns to the field ampere turns was 0.6. Apparently the armature reaction at the non-inductive load was entirely annulled by the induced short-circuit currents in the rotor, and the voltage drop corresponded entirely to the straying. For full load the voltage drop would, therefore, have been 8 per cent. He believes that not only for large generators but also for smaller ones his type of generator will be useful, as for the latter it is a great advantage to dispense with a special exciter.—*Elek. Zeit.*, Jan. 9.

Induction Motor Used as Synchronous Motor.—DANIELSON.—An illustrated article on a method for avoiding the production of the inconvenient phase difference of an induction motor. The principle is as follows: The non-synchronous induction motor operates in general with a phase difference in the primary circuit, the power factor being about 0.8 to 0.9 at full load. There is a double reason for this phase difference: First, that one component of the primary current must magnetize the total magnetic system, and, second, that there is magnetic straying in the motor. If it would be possible to obtain the magnetization in a different way and to regulate it at will, it would be possible to diminish the primary phase difference and even to annul it or make it negative. Theoretically, there are possibilities of obtaining this kind of magnetization, while the motor remains a non-synchronous motor; but in practice this would result in inconvenient complication. It is, however, possible to obtain the same result regarding the phase difference, by supplying a suitable direct current to the secondary winding of the motors. He considers the case of a three-phase winding of the rotor, connected in star. If a direct current is supplied through one collector ring and taken off from the two others, as indicated in the adjoining figure, then the current in one-third the winding is exactly double that in the rest



INDUCTION MOTOR USED AS A SYNCHRONOUS MOTOR

of the winding. The distribution of the current is therefore exactly the same as though the winding were fed with three-phase currents at the instant when the current in one phase is a maximum. The motor is then changed into a synchronous motor, provided the direct current in the rotor is strong enough to yield an acceleration up to synchronism. Experiments with this method have been made by him in the plant of a Swedish electric company with an ordinary 20-hp induction motor, the normal voltage of which was 390, the magnetizing current 12 amperes, the ratio of the primary to the secondary winding 2.86, and the normal primary current 29.5 amperes. When it was desired to annul entirely the phase difference in the primary circuit, a current of 120 amperes had to be used. But under these conditions the operation would be uncertain, as no overloading

would be possible. The tests were, therefore, made with an excitation of 150 to 160 amperes, and the following results were obtained. The load could be increased up to 50 per cent above normal, before the motor fell out of step and began to run as non-synchronous motor, perceptible fluctuatins of speed and secondary circuit being observed. At constant excitation it was necessary to reduce the load to about one-half the normal, in order to bring the motor engine to synchronism. The negative phase difference at normal load corresponded to a power factor of 0.86 to 0.9. As the magnetic conditions of such an induction motor, running as synchronous motor, are about the same as in an ordinary induction motor, the ordinary formulas of the induction motor can be used with only slight modifications for calculating phase difference, overload capacity, etc. But it does not seem possible to calculate the load at which a certain excitation can bring the motor to synchronism. The author believes that this method may be successfully used in many cases, to remove troublesome phase differences. (The general idea of using a direct current in the field of an induction motor, is not new, however, as it is used on the Jungfrau Railroad for descending on grades when connection with the trolley wires, or between these and the station, is interrupted.)—*Elek. Zeit.*, Dec. 26.

Stability of Operation of Converters.—Leblanc.—An illustrated article on some peculiar unstable conditions in the running of converters. The first experiment described by him was made with a converter which was supplied with direct current from a storage battery that also furnished the exciting current. It gave out three-phase alternating currents which were raised in voltage by a transformer and then lowered again in voltage by a second transformer, and were then consumed in three rheostats. When the load of the converter was gradually raised, by varying the resistance of the rheostats, a time was reached when the speed of rotation ceased to be constant and began to vary between limits, which were the greater, the greater the load on the machine was. The second experiment described by him is as follows. A converter was used for converting alternating current into direct current for charging a storage battery. The converter operated well at full load, when its transformer was directly connected to an alternating current supply circuit. When it was desired to vary the voltage of the direct current an alternating-current booster was connected in series with the primary of the transformer. Oscillating movements of long period then arose in the converter, when the load attained half the value which had been obtained without difficulty without the converter. He gives the explanation, with the mathematical theory, of these phenomena. He shows that the critical limit of the load at which the oscillations arise, depends upon the coefficient of self-induction of the circuits through which the alternating currents flow. The armature reaction of the tested converter was very high.—*L'Eclairage Elec.*, Nov. 16.

Measuring the Slip.—Simek.—A brief communication on a stroboscopic method of demonstrating and measuring the slip of an induction motor. He observes marks on the rotor in the light of a Geissler tube, which is supplied with current from a small Ruhmkorff coil operated in parallel with the stator by a Wehnelt interrupter. He recommends the use of a Geissler tube, as it requires a small amount of power and lights up very precisely at every interruption.—*Elek. Zeit.*, Dec. 5.

REFERENCES.

Arrangement of Slots in Dynamos.—Corsepius.—An article on the properties of dynamos, from the point of view of the arrangement of the slots. The paper is highly mathematical and very long, and cannot well be abstracted.—*Elek. Zeit.*, Nov. 28, Dec. 5, 12.

Operation of Alternators in Parallel.—Franke.—A communication in which he makes some critical remarks on special points in a recent article of Meyer on this subject.—*Elek. Zeit.*, Nov. 28. There is a reply by Meyer in *Elek. Zeit.*, Dec. 19.

Theory of Commutation.—Punga and Wagner.—Two mathematical communications concerning the calculation of the reactance voltage.—*Elek. Zeit.*, Dec. 12.

Eddy Currents in the Pole Pieces of Direct-Current Machines.—Two further communications, one by Picou and the other by an anonymous writer, on this subject.—*L'Ind. Elec.*, Dec. 10.

POWER.

Motive Power from Blast Furnaces.—Donkin.—An abstract of a paper read before the (Brit.) Inst. Civ. Eng. The chemical constituents of the gases produced by smelting iron ore in blast furnaces varies according to the ores and fluxes used, the fuel burned and the temperature of the furnaces. On the average, they contain about one-third by volume of combustible gases, chiefly CO, the remainder being inert carbonic acid gas and N. With the present methods of utilizing these gases, about 10 per cent is lost by leakage, 28 per cent is applied to heat the air blast, 40 per cent to the boiler and 22 per cent is wasted. If the latter percentage is utilized in gas engines it would yield about 12½ hp-hour per ton of iron melted, while if all the gases were burned in gas engine cylinders to procure power, about 28 hp-hour per ton of pig iron would be available after deducting the power required for compressing the air. When burned under boilers they give a very poor heat efficiency, because the CO is of comparatively little value as fuel. At least four times as much power can be obtained when the gases are treated in an engine cylinder, the method of utilizing them being more suitable. The difficulties of this treatment and the method of overcoming them are discussed. He gives a sketch of the history of this new development in engineering science. The results of several tests are given. At the iron works of the Cockerill Company at Seraing, a trial has been made with a 650-hp single-acting and single-cylinder engine. The consumption of gas was 101 cu. ft. per brake hp-hour, and the thermal efficiency 26 per cent per brake-hp.—Lond. *Elec.*, Dec. 27.

Sault Ste. Marie.—A long illustrated article on engineering and industrial enterprises at Sault Ste. Marie. The three water-power plants, when completed, will develop about 100,000 hp. The combined industrial enterprises at the Canadian side alone will include a mill for "mechanical" paper pulp; a caustic lime plant operated by the Canadian Electro-Chemical Company; the Algorna iron works; a "chemical" or sulphite pulp mill; a nickel ore reduction plant, producing sulphur for the pulp mill and nickel for nickel steel; a complete steel rail plant with blast furnaces; a by-product coke oven plant; a by-product charcoal plant; an iron and steel pipe and tube plant. On the American side there will be a 20,000-hp carbide plant of the Union Carbide Company, and also alkali works. Brief descriptions are given of the different plants. At the nickel ore reduction plant sulphurous acid gas is produced from the pyrrhotite ore. The residue contains a combination of nickel and iron which, when treated by an electrolytic reduction porcess, produces an alloy of nickel steel of such quality that the Krupp works of Germany made a contract for a supply for five years. There will also be operated a new process for reducing copper pyrites. In this process sodium is required, and this is manufactured in the alkali plant. In the alkali works the Rhodin process is used, with a mercury cathode. Nine tons of bleaching powder and five tons of caustic soda are made daily. Electric power is used throughout the works.—*Eng. News*, Jan. 9.

Electric Crane.—An illustration, with brief description, of a three ton electric traveling crane. There are 17 of its kind used by a British railway company at its dock in Middlesbrough. A load of three tons is lifted at 150 ft. per minute, while half loads can be lifted at 225 ft. per minute. These speeds can be reduced at will. The crane mechanism is contained in the cabin of the attendant, who controls all the motions with one hand, his other hand being always on the brake lever. There is an automatic arrangement which puts on the brake when the current fails.—Lond. *Eng'ing*, Dec. 27.

REFERENCES.

Cost of Power.—Gray.—A long investigation of the cost of power. He discusses man power, animal power, wind power, water power, steam power, tests of steam boilers, engine tests, gas engine tests, oil engine tests. Finally, he discusses electric power. He gives a table of the cost of electric power in different places, deals with the efficiency of various electrical apparatus, the use of electric power for lighting, traction and transmission. The article contains many numerical tables.—*Jour. Frank. Inst.*, Oct., Nov., Dec.

Electric Steering Apparatus.—Heubach.—A detailed, well illustrated description of the electric steering apparatus of the Russian cruiser "Diana."—*Schiffbau*, No. 22, 23; *Elek. Anz.*, Dec. 12, 15, 22.

Machine Tools.—Littledale.—An illustrated paper, with several tables, on the speed of machine shop tools.—Lond. *Eng'ing*, Dec 27.

TRACTION.

Electrolysis of Gas and Water Pipes by Tramway Return Currents.—Larsen and Faber.—An illustrated account of measurements made in Copenhagen. The main results are as follows: On the line which was tested and which has a length of 1210 meters with the rail joints in good condition, the stray current for cars in the center of the

line was about 10 per cent and for cars at the terminal of the line about 15 per cent of the supply current. The sum of the currents passing through gas and water pipes is in both cases about one-half the total stray currents. The total stray currents, as well as the currents in the pipes, are proportional to the supply current. During the service the currents in the pipes follow exactly the route of the cars. —*Elek. Zeit.*, Dec. 19.

Installations, Systems and Appliances.

Maximum Demand System.—Wright.—A very long paper, with many tables and diagrams, read before the British Inst. Elec. Eng. on "Some principles underlying the profitable sale of electricity." The several items of the cost of supplying electrical energy from a power station are closely analyzed, and the different systems of charging for electrical energy are critically discussed. At the end of the paper he proposes what he believes to be the best tariff, in two forms. First, a charge of x cents per unit for that part of the consumption which is equivalent to the use of the consumer's demand, for n hours a year—or quarter, or month, as the case may be—and z cents for any further consumption within the said period; x is taken as high as possible, and is preferably the maximum rate authorized; z is reduced as low as possible consistent with the cost of giving supply. Second, a yearly or monthly charge per lamp demanded, and a charge of z cents per unit for the energy consumed.—Lond. *Elec.*, Dec. 20, 27, Jan. 3. A good review of the main points of the paper in Lond. *Elec. Rev.*, Dec. 27.

An editorial review of the discussion which followed Wright's paper. Speakers attacked or defended both the principle and the expediency of the Wright system, the utmost diversity of opinion being expressed. The majority agreed that the Hopkinson theory, and the application made of it by Wright, are sound in principle. A notable exception was afforded by Mordey, who attacked the very foundations and ridiculed the practice of the system. He argued the system was wrong in principle, because when people go to church their house lamps are turned off, while the church lamps are turned on. It is, therefore, erroneous to suppose that any capital is locked up in plant specially allowable to the church installation. If the Wright system was right for electricity supply, why not for other lines of business. When we go on a railway journey "we ought to pay a shilling to go on the platform and a farthing a mile for the journey." On the question of expediency there was far greater diversity of opinion. Patchell led a minority who favored a simple system of charging. He claimed to have been able to develop an average load factor of 28.5 per cent on the Charing Cross and Strand system, adopting an ordinary level tariff with graded discounts. There appears to be in extensive favor a partial rather than a strict application of the Wright system. Andrews at Hastings goes back to the primitive Hopkinson tariff and charges a rental of $2.50 per lamp plus a level rate of 3 cents per unit consumed, but he recommends this tariff only to long-hour consumers. For the other consumers he has a simple fixed price per unit.—Lond. *Elec.*, Dec. 27.

Charging for Electricity.—Wilkens.—An article giving suggestions on the reform of central station tariffs for charging. He suggests using, besides the ordinary meter, another meter which registers the consumption of energy from October to February during the time of the maximum load of the station. By dividing these kw-hours by the hours, the average kilowatt during the maximum load of the station is known. It is preferable not to have two separate meters, but to combine them, by providing the main meter with a second counting device which is connected and disconnected at cetrain times by means of a watchwork. He suggests having this device count for two hours every day, which two hours are to be chosen, depends, of course, on the load curve of the station. He claims that such a system enables a simple and just tariff to be employed. A numerical example is given for a cigar store. A table gives in the first column the monthly consumption of kw-hours for the 12 months of a year; the second column gives separately the kw-hours consumed between 4.30 and 6.30 P. M. (maximum load of station) from October to February; the third column gives the cost of the kw-hours on the basis of 3.75 cents per kw-hour; i. e., the total kw-hours of the first column multiplied by 3.75; the next column gives the additional charge for the kw-hours consumed during the time of maximum load in the winter months from October to February, on the basis of 35 cents per kw-hour, the numbers of this column are, therefore, obtained by multiplying the numbers of the second column by 35; the next column gives the sum of the regular charge and the additional charge, i. e., the sum of the two preceding columns. As in the summer months there is no additional charge, and as the additional charge is much higher than the regular charge, the bill is considerably higher during the winter than the summer. Not only this, but the charge per kw-hour is also much higher in the winter than in the summer, about 20 cents against 3.75. But the average cost of the kilowatt during the year is nearly that which would follow from purely theoretical considerations given by him. It comes out at 12 cents.—*Elek. Zeit.*, Dec. 5.

The Future of Electricity Supply.—Barstow.—An article in which he calls attention to the fact that while the introduction of polyphase currents for transmission has greatly modified and simplified the details of the generating station, it has, up to the present time left undisturbed the distributing systems. The direct-current, three-wire, low-tension system, without any general modifications whatsoever, is to-day in the same position that it was 15 years ago as to its being the most economical and efficient system of distribution for compact territory. He believes that the most economical system of electricity supply for many years to come will be generation of polyphase currents in a generating station and transmission to sub-stations which supply the distributing systems already in use. He appears to believe in possible further consolidation of generating plants, by erecting a large plant of many hundred thousand horse-power capacity, located in close proximity to coal fields.—*Cassier's Mag.*, Jan.

Electricity Works Load Factors.—J. G. Scott.—The term load factor is used to express the ratio existing between the actual work done by a plant in a given time, and the possible work done by the same plant, if worked over the whole period at the maximum load recorded. This is the load factor of the load, as distinct from the load factor of the plant, which is the above ratio in which, however, the capacity of the plant is substituted for the maximum load recorded. It must be the aim of the station engineer to so adjust the charges for energy as to encourage consumers who will so influence the load for the improvement of its load factor. A diagram is given showing how the load factor varies for various classes of consumers. Probably the load with highest load factor met with in ordinary practice is that of a tramway system, on which cars are running more or less for, say, 16 hours daily, giving a load factor of about 66 per cent. Next in order comes public lighting, where lamps are burned on an average of 10 hours daily, giving a load factor of about 41 per cent. Then comes an ordinary motor load, say, for workshop purposes, which is in use, say, 50 hours weekly, giving a load factor of about 30 per cent. Motors in intermittent use will probably not give a very high load factor, but these will combine to favorably influence the load factor of the plant at the station. The best ordinary lighting consumer is probably the hotel or public house, but his load factor does not exceed about 12 per cent. The worst lighting consumer is a small office, with a load factor of about 1 per cent. He discusses at length different systems of charging, and especially the Wright maximum demand system, which he believes will come more and more into gerneral use.—Lond., *Elec. Eng.*, Dec. 20.

Explosion of a Transformer Box.—Kuebler.—An article on a peculiar accident which recently happened in Dresden. In a transformer box (of about the shape of the round boxes or booths used by policemen for telephonic reports in several cities of this country) a new 5-kw transformer had been installed for supplying current to arc lights. In the night the transformer box exploded with very great violence. Several primary windings of the new transformer were found to be short circuited. He can give no other explanation of the explosion except that a workingman using a benzine soldering lamp may have left a bottle of benzine in the box.—*Elek. Zeit.*, Dec. 12.

Hellmann.—A communication referring to this accident. He does not believe that Kuebler's explanation is the only possible one. It is quite possible that the transformer after having gotten hot, on account of the short circuit, had itself generated the gas required for the explosion. The materials used for insulation and impregnation are such that a combustible gas can be formed. He concludes that great care should be taken to have good ventilation in such transformer boxes.—*Elek. Zeit.*, Dec. 26.

Electro-Physics and Magnetism.

Geometrical Loci in Alternating-Current Diagrams.—Schenkel.—An illustrated mathematical article. Geometrical loci are useful in the graphical investigation of alternating-current phenomena. They

reduce complicated diagrams to a few characteristic lines. An example is the circular diagram of the induction motor. He gives a simple method of determining the geometrical loci in alternating-current diagrams in an easy way by means of a simple calculation based upon Steinmetz's symbolic method and the well-known rules for the addition, multiplication and division of vectors. An example is given.—*Elek. Zeit.*, Dec. 19.

Magnetism of Electrolytic Deposits.—MAURAIN.—An illustrated account of experiments in which he tested the magnetic properties of thin electrolytic layers of iron, while they are formed electrolytically under the influence of a magnetic field. He measured the magnetization of the deposits for different values of the magnetic field, and studied the action exercised upon the formation by a variable magnetic field. The magnetic properties obtain a definite value only at a certain distance from the surface. When the iron is deposited upon an electrode of a magnetic metal, which had been magnetized before, the magnetization of the electrode causes a magnetization of the deposit of the same sense. He also studied this magnetizing action of the magnetized electrode when the deposit was not made directly upon it, but upon a thin non-magnetic layer with which the electrode was covered.—*Rev. Gen. des Sc.*, Dec. 15.

REFERENCES.

Discharge of Electricity from Glowing Platinum.—RUTHERFORD.—An illustrated account of an experimental investigation of the discharge of positive electricity from a glowing platinum plate. He investigates the variation of the current with the voltage, and of the current with the distance between the plates, and determines also the velocities of the ions by different methods.—*Phys. Rev.*, Dec.

Energy Dissipation in a Weak Magnetic Field.—PUPIN.—An abstract of a paper read before the N. Y. Acad. of Sc. on energy dissipation in a weak magnetic field. The substance experimented was a toroid of square cross-section, made up of iron plates 0.01 inch thick.—*Science*, Jan. 10.

Notes on Magnetic Curves.—LAWRENCE.—A brief and purely mathematical article.—*Jour. Frank. Inst.*, Oct.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Formation of Peroxide of Lead from Metallic Lead.—PETERS.—The first parts of an account of a long series of experiments. The electrolytic formation of peroxide of lead from metallic lead is of special technical interest for estimating the value of the methods proposed for the Plante formation. He investigated the physical properties of the active mass formed on the positive pole plates—especially the adhesion to the core—and also the quantities of lead peroxide obtained by the different methods. He made experiments with a large number of different electrolytes. In the following the numbers in parentheses after each electrolyte give the grams of peroxide which he obtained for 100 ampere-hours, with a current of 0.6 ampere and a surface of 144 sq. cm.: Sulphuric acid, 2 cc. acid to 1 liter water (0.7683 gram); 24 cc. acid to 1 liter water (0.7066 gram); 24 cc. concentrated sulphuric acid and 50 cc. methylalcohol to 1 liter water (1.1566 gram); 500 cc. sulphuric acid of spec. grav. 1.152 and 50 gram absolute ethylalcohol (5.6654 gram); 24 cc. concentrated sul- (28.5079 gram); 24 cc. concentrated sulphuric acid and 20 cc. formic acid of spec. grav. 1.06 to 1 liter water (21.3258 gram); 6 cc. conphuric acid and 10 gram hydroxylamine sulphate to 1 liter water centrated sulphuric acid and 4 cc. acetic acid of 90 per cent to 1 liter water (102.0218 gram); 24 cc. concentrated sulphuric acid and 10 cc. acetic acid of 90 per cent to 1 liter water (124.1715 gram); 24 cc. concentrated sulphuric acid and 14 cc. acetic acid of 90 per cent to 1 liter water (139.4303 gram); 2 cc. concentrated sulphuric acid and 2 cc. nitric acid of spec. gr. 1.18 to 1 liter water (0.8369 gram); 12 cc. concentrated sulphuric acid and 10 cc. nitric acid sp. gr. 1.18 to 1 liter water (108.6538 gram); 3.5 gram chlorate of potassium and 50 gram crystallized sulphate of ammonium and 70 gram sulphuric acid of 50 per cent to 1 liter water (100.5851 gram); 0.1 gram chlorate of potassium and 15 gram crystallized sulphate of sodium and a little dilute sulphuric acid (121.6361 gram); 6.6 gram of chlorate of potassium and 50 gram bisulphate of potassium to 1 liter water (117.4536 gram). (Theoretically, 100 ampere-hours could form 222 grams of lead peroxide. Comp.)—*Centralblatt. f. Accum.*, Nov. 15, Dec. 1, 15.

Carbon Electrodes for Electrolysis of Chlorides of Alkalies.—SPROESSER.—Continuations and the conclusion of his very long article, the first part of which was recently abstracted in the Digest. The author investigated the subject very extensively, and the results are given in a large number of tables. He found that the destruction of the carbons in the electrolysis of chlorides of alkalies is essentially due to an oxidation. Only exceptionally with special carbons is there a partial attack by chlorine, which, however, is of no great importance for the destruction of the carbons. The main product of the oxidation of the carbons is carbonic acid. Besides the loss by burned carbons, there is also a loss by carbon falling off unchanged. With some carbons this loss is great and may be greater than the chemical loss. The influence of temperature and current density are also investigated. Regarding the testing of the quality of anode carbons for practical use in the electrolysis of chloride of alkalies, he remarks that this examination can only be made by using them as anodes in a chloride solution. In no other electrolyte are there the same phenomena. The simplest way of making such a test is to electrolyze the pure chloride without a diaphragm. The output of oxygen then shows how far the carbon is similar to platinum as anodes. The higher the output the more suitable is the carbon to be used as anode for electrolysis of chloride.—*Zeit. f. Elektrochemie*, Nov. 14, 21, 28, Dec. 12, 19.

Capacity of Aluminum Cells.—FRANCHETTI.—An account of measurements of the electrolytic capacity of cells composed of two aluminum electrodes in a 20-per-cent solution of the double tartrate of sodium and potassium. He determined the lead of the current with respect to the pressure, by the three-ammeter method and also by plotting the curves obtained from a Joubert contact maker. At a constant frequency of 42, the capacity of the cell per sq. cm. of electrode was 0.058 microfarads at 87.5 volts; 0.083 at 162.5 volts; 0.127 at 171.5 volts. At about 200 volts the current rose very rapidly and increased as the electrode surface was diminished. The capacity is independent of the frequency, but the ohmic resistance decreases more rapidly than the frequency increases. The cell does not sensibly change the forms of the current and pressure curves.—*Rivista. Sci. Ind.*, Aug. 15; abstracted in *Science Abstracts*, Dec.

REFERENCES.

Measuring the Mobility of Ions.—ABEGG.—An illustrated description of an apparatus for demonstrating and determining the mobility of ions. The method, which is the one used by Steele in his experiments, has been described before in the Digest.—*Zeit. f. Elektrochemie*, Nov. 21.

Alkalies and Chlorine.—A continuation of the illustrated review, mainly from patent specifications, of new inventions in the alkali and chlorine industries.—*Zeit. f. Elektrochemie*, Nov. 28.

Dimensions of the End Cell Leads.—HUNKE.—A mathematical article, illustrated by diagrams, on the calculation of the dimensions of the end cell leads for batteries.—*Elek. Zeit.*, Dec. 5.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A New Electric Teletachometer.—HOSPITALIER.—The simplest device used at present for transmitting to a distance the indication of the angular speed of a revolving axle, consists in mounting a small magneto on the axle and connecting the armature to a voltmeter. As the e. m. f. generated in the armature is proportional to the speed the reading of the voltmeter is also proportional to the speed. For this purpose it is necessary to determine the resistance of the connecting wires; the mounting of the small magneto sometimes also adds to the inconvenience. The new tachometer which he describes gives an exact reading of the angular speed, practically independent of the distances. It is in principle an extension of his ondonograph, noticed before in the Digest. A condenser of the capacity C is alternately charged from a battery of the e. m. f. E and discharged through a voltmeter by means of an oscillating contact maker, operated by the axle, the angular speed of which is to be determined. Each discharge of the condenser sends through the voltmeter a quantity of electricity $C\ E$, and if a is the frequency of the charges and discharges, the average current is aCE. The deflection of the voltmeter, the resistance of which is known, gives the value of this average current I, and the frequency a is the ratio of I to the product $C\ E$. Some details are given regarding the practical arrangement of the apparatus.—*L'Ind. Elec.*, Nov. 25.

Isochronic Measuring Instrument.—LOWY.—An illustrated description of an instrument in which an iron wire oscillates under the influence of an electromagnet, which is supplied with the alternating current, the frequency of which is to be measured. When the natural

period of the iron wire is equal to the period of the alternating current, there is a resonance phenomenon which can be easily observed whether by acoustic or optical means. The length of the iron wire is adjustable. The theory of the instrument is given and the construction is described and illustrated.—*Zeit. f. Elek.*, Dec. 8.

A Mechanical Slip Counter for Asynchronous Motors.—ZIMMER. An illustrated description of an instrument for measuring in an easy way the slip and the number of revolutions of an induction motor, and at the same time the number of revolutions of the rotary field. By means of two revolution counters coupled together the relative speed between rotary field and motor is directly measured. One of the two revolution counters gives directly the number of revolutions of the rotary field, while the other gives the slip. The difference of both is the number of revolutions of the rotor.—*Elek. Zeit.*, Dec. 12.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Influence of Leakage on Overhead Long-Distance Telephone Lines of the Pupin System.—BREISIG.—A mathematical article. In Pupin's mathematical theory the insulation is assumed to be perfect, the damping constant decreases continually with decreasing inductance per unit length. The present author takes into account a new constant of the line, which represents the reciprocal value of the resistance of the insulating material. Its value per unit length may be a. He shows that for a given frequency the damping constant becomes a minimum when the inductance per unit length equals the product of capacity and resistance per unit length, divided by a. In this case the currents of all frequencies are damped to the same degree. It would not be beneficial to diminish the self-induction below the limit given by this equation. A numerical example is given which shows that the constant a is of great importance for the practical application of Pupin's system on overhead lines.—*Elek. Zeit.*, Dec. 12.

Test of a Telephone Cable with Self-Induction.—BREISIG.—An account of a test of a telephone cable between Duesseldorf and Elberfeld. It contains 28 double conductors, seven consisting of wire of 2 mm. diameter, the others of wire of 1.5 mm. diameter. In the design of the cable it was desired to give it a relatively small capacity and a certain amount of self-induction, by keeping the twin cores of each pair in a certain distance, and by using insulated iron wires in connection with the conductors. The copper wires are first enveloped by iron wires in spiral form, they are then covered with paper, and two such cores are then twisted. The result is quite satisfactory. Elaborate tests were made by engineers of the German telegraph office, in order to investigate to what degree the distribution of self-induction in the cable had been accomplished. A full account of these tests is given, from which it appears that the distribution of self-induction has been successfully accomplished to the following degree: For the 2 mm. wires it is about 0.0038 to 0.004 henry per kilometer.—*Elek. Zeit.*, Dec. 19.

MISCELLANEOUS.

REFERENCES.

French Electrical Engineers in the United States.—A very full and complete report, by Janet, on the visit last summer of several members of the Internat. Soc. of Elec. Eng. to the United States and to the Buffalo meeting of the A. I. E. E.; descriptions by Courbier and David, of the principal installations visited; plants in Philadelphia and in New York, the Schenectady Works of the General Electric Company, the installations at Niagara and transmission to Buffalo, the MacGill University of Montreal, several Canadian water-power plants, stations in Chicago, and the Westinghouse plant at Buffalo. The report comprises 74 pages.—*Bull. Soc. Internat. des Elec.*, Aug., Sept., Oct.

New Books.

ELECTRICAL ENGINEER'S POCKETBOOK. A Handbook of Useful Data for Electricians and Electrical Engineers. By Horatio A. Foster, with the collaboration of eminent specialists. New York: D. Van Nostrand Company. 987 pages, illustrated. Price, $5.

Until this long-promised book made its appearance, all the important pocket reference books for electrical engineers came from abroad, and it will, therefore, be a great relief to American engineers to have at last one of American origin, by an American author, and based on the practice in this country. The author needs no introduction to Americans. As an engineer who has had an experience in many branches of work, he has enjoyed excellent opportunities to know the needs of the profession, and this book evidently embodies the result of many years of compilation. A very valuable feature of the book is that each section or chapter has been revised by one of a number of specialists, many of whom are well known authorities. This makes the book to a certain extent the work of a multiplicity of authors, and as no one man can be an authority on all the many branches covered by such a book, this adds very greatly to its value.

Necessarily, the first edition of a work comprising such an enormous amount of detail as the present one, is particularly open to criticism, and what criticism follows should, therefore, be viewed in light of this condition. On the whole, the work is highly creditable, and will, without doubt, eventually occupy the place in its field that Trautwine and Kent do in their respective fields. Indeed, the defects of this first edition scarcely affect its value in general, and we can unhesitatingly recommend it to all who have to deal with matters electrical.

The classifications of a work like the present dealing with a great diversity of subjects is a matter on which doubtless no two persons could agree. The author appears to have decided upon a classification by the more important subjects, under each general subject placing other subjects having relatively the closest relation to that particular one. As a result of this arrangement, the table of contents in the present case is limited to a mere list of 30 section headings. The objection to this arrangement is that it compels one to look over as many as a hundred pages in some cases to find the specific part of a section that he is looking for, or to locate it by means of the index, which should be unnecessary. Since almost all of the details of transmission of power, for example, are thus allotted to other sections, this subject is limited to only three pages, which is devoted to general references to other parts of the book, and as the page references are omitted through a blunder in proof-reading, and the sub-headings are not in the contents, one is apt to be compelled to start on another search. The very important subject of the calculation of a transmission scheme is not given there, and the reference to another part of the book where it is given is omitted

The index in the back of the book, which next to the data itself is the most important feature of a reference book, might be considerably extended. More numerous cross references are desirable, as one is often compelled to look up many synonymous terms before he happens to find the one under which the desired data has been placed by the author. The index, indeed, does not do the book justice, as many things will be found in the book to which one would not be led by the index.

Referring again to the system of classification, the data concerning heat energy is scattered through many parts of the book, from near the first to near the last page. Batteries are not under electro-chemistry where they naturally belong, at least in a scientific classification. Measurements are scattered all through the book, notwithstanding that there is a separate section for them, though this appears to be intended only for general methods. It may be justifiable to put dynamo measurements, for instance, under dynamos, but in such cases, however, there should be a cross reference. Throughout the whole book, the author seems to have shown an aversion to multiplying cross references, notwithstanding the extreme importance of this time-saving means in a work of reference. In this way the author has indeed not done his own book justice, for it will be found to contain more information than one would suppose in looking up a subject, owing to the want of proper facilities for finding the greatly scattered and arbitrarily classified matter.

There are in the book some evidences of carelessness, sometimes even of gross carelessness. In several cases abbreviations and symbols are used in the book which are not explained, nor are they in the table of symbols on the first page. In that table definitions of symbols are given, and a few lines below in the very same table different symbols are used for the same things. The symbol for intensity of magnetism is wrong, and different from that given elsewhere in the book. In one instance, the term "magnetic force" is used for "magnetomotive force." Formulas are sometimes given in which the meaning of the characters or the units of measurements to be used are not stated. The word "sum" is used when it should have been "algebraic sum." The letter I is stated to be the symbol for current, yet C is occasionally used elsewhere in the book. Those most important units, kilowatt-hour, horse-power-hour and horse-power, are not mentioned in the table on the first page, which is supposed to contain the symbols of all the units employed in prac-

tice. Different terms are used for the same units in different parts of the book. From the definition of e. m. f. one might suppose it ceases to be one when no current flows. The internal resistance of a cell is given without stating the dimensions of the cell. The terms energy and work are at times used as though they were different. Electrostatic voltmeters are separate from other voltmeters and placed under condensers. Ohm's law is given only under measurement of resistances, and the rules for determining the direction of a current are under dynamos. Although there is a section under coefficients of inductance (which term is itself incorrect) the term coefficient of self-induction is defined elsewhere. The allowable insulation resistance of house circuits is under measurements. Measurements of e. m. f. are partly in one place and partly in another. In general, the methods of measurements by the plan of the book are widely scattered. The subject of wiring is also scattered over many sub-sections, without cross references. In some cases no rules or laws are given, there being only a numerical example. Much will be found under miscellaneous that would be looked for under section headings. In short, the reader will have to master the author's system of classification before he will in all cases be able to refer rapidly to information sought.

A disproportionately large and valuable part of the book is devoted to the construction of electric railways, or in general, to traction, as it contains much that is not electric, but belonging to civil and mechanical engineering. Electro-chemistry as a subject is, on the other hand, limited to a few pages and only one of the many laws is referred to, even that is not actually stated, but is merely illustrated, and in the example the important subject of valency is not even mentioned, although a neglect of it may cause errors of several hundred per cent. Storage batteries are treated at considerable length in a separate section, quite removed from electro-chemistry; but it is devoted chiefly to their installation and contains numerous diagrams of methods of connecting them which are of use to the installing engineer as distinguished from the constructor of batteries.

The section on lightning conductors, though short, seems to be one of the best prepared. It was revised (probably written almost entirely) by Professor McAdie, one of the best American authorities on this much-neglected though very important subject. Two long sections on electricity in the Army and Navy, revised by Messrs. Powell and Crain, also contains good matter, though the information might have been classified and included in the various sections where each part belonged. The National Electrical Code is reproduced at length. There are two sections on miscellaneous matters (one of which is not mentioned in the table of contents) separated by another section placed between them, and finally a very long section—the longest of all—comprising nearly 200 pages, called the mechanical section, and containing non-electrical matter which, though indispensable to the electrical engineer, belongs more properly and is contained more fully in existing pocketbooks on mechanical and civil engineering.

From the publishers' standpoint, the book, though well bound and on good paper, is open to some criticism. The printing is not always clear, and some of the lines are broken and shifted, and there are a number of annoying typographical errors.

To summarize, the book as a whole contains a large collection of compiled matter from good sources, most of which will be of direct value to the electrical engineer, more especially to the contractor and practicing engineer; but the arrangement of the matter is open to question, while the fact that it is not of a general encyclopedic nature will be regretted by many who are in need of such a pocketbook of reference.

BOOKS RECEIVED.

[illegible] By Alex. D. Adams. New York: Wm. T. Comstock. 102 pages. Price, $1.

POWER AND POWER TRANSMISSION. By E. W. Kerr. New York: John Wiley & Sons. 356 pages, 264 illustrations. Price, $2.

New Telephone Apparatus for Hotels.

The Kellogg Switchboard & Supply Company, of Chicago, is now making a high-grade telephone set for hotels, residences and such places where a small compact set is desirable, one of which is shown in the accompanying illustration, introducing its new transmitter. The equipment of this set is standard, and has the same type hook [illegible] central energy apparatus. The latter contains a condenser manufactured by this company, which is known for its prominence as manufacturer in the United States of condensers for telephone purposes. There are no binding posts or any other parts exposed that can in any way get out of order. The bell tapper is covered with a small guard to prevent people from changing the adjustment or in any other way getting the ringer out of order. The instrument is warranted to give satisfaction and may be used for as long distance work as the company's regular standard central energy sets. There is no doubt that this new line of apparatus will meet with success and be much appreciated.



HOTEL TELEPHONE

Northwestern Convention Notes.

THE EXHIBITS at the Northwestern Electrical Association winter convention at Milwaukee this year, while not extensive, comprised some of the recent improvements in small apparatus most interesting to electric light central station men. About half the parlors on the second floor of Hotel Pfister were occupied by supply men as exhibition and reception rooms.

THE FT. WAYNE ELECTRIC WORKS introduced to notice its new Wood arc lamp for series alternating-current or direct-current circuits, which bore many refinements of detail appreciated by the practical man in care of arc lamps. Mr. Wood, by his long experience in designing arc lamps, has been able to produce a lamp which is remarkably easy to get at for renewal or adjustment. The wearing parts are ingeniously designed so as to be very simple and cheap of manufacture. If any prospective purchaser fears that cost of repair parts will be high, he can be given a pocketful of wearing parts—enough to last years. The clutch is simply a brass ring, which is tilted to draw up the carbon. It bears on three surfaces around the ring. The clutch acts directly on the carbon rod. The gas cap is cast in one piece with the bottom plate of the part which contains the mechanism, but ribs are provided on the top of the gas cap so that the heat of the gas cap is radiated away. All the bushings for electrical terminals in the gas cap are placed in bosses, which make it difficult for carbon dust to accumulate around the bushing. The globe holders have springs in the clamps, which reduce the danger of breakage if a globe is dropped the length of the chain. A tiny ball prevents the bottom carbon from dropping out, while the lamp is being trimmed after it has been unclamped. The feed is accomplished by series and shunt coils acting on opposite ends of a pivoted armature. When the voltage of the arc reaches the feeding point the shunt coils suddenly draw up their end of the armature and allow the carbons to come together, after which the series coils instantly strike the arc anew. The arc is always struck at a definite length. There is nothing likely to cause sticking in this feeding [illegible] Another novelty

this company was showing is a revolving fan motor. The fan is of the ordinary high-speed type, driven by a spherically incased motor suspended from an incased ball bearing, so as to revolve around a vertical axis. The fan being inclined so as to throw air down, the effect is to cause the fan and motor to revolve because of the greater distance from the center of rotation of the top blades. If the fan is hung from a chandelier it puffs air by rotation at all parts of the room. It is claimed that in this way the bad effects of sitting in a continuous breeze from a fan motor are eliminated, while the cooling effect is obtained not only in one direction, but in all parts of the room. The company's induction meter, with aluminum disk and case, was also shown in several styles. E. J. King, of the meter department, was present, and read a paper at the convention. W. C. Knight and Walter S. Goll were in charge of the exhibit.

VAN RENSSELAER LANSINGH & Co., illuminating engineers and agents for holophane globes and pagoda reflectors, with stores recently started both in Chicago and Milwaukee, set up an improvised dark room in one of the hotel parlors, where passers-by could easily compare the useful downward illumination obtained with a 16-cp holophane covered lamp and a 32-cp bare lamp, much to the credit of the former. A large number of holophane globes were shown, both in this parlor and around the meeting room and hotel lobby. Mr. Lansingh, of Chicago, was assisted by A. A. Ernst, manager of the Milwaukee branch. Mr. Lansingh has begun an active campaign for the better use of illuminants in the Middle West, and already has important contracts under way.

THE BELDEN ARC LAMPS, made by the Dayton Fan & Motor Company, were the prominent feature of the M. B. Austin & Co. exhibit. E. H. Belden, the designer and inventor of this line of lamps, was among the convention visitors, and many central station men took opportunity to have Mr. Belden explain fully to them the many refinements in the design of these lamps. As they have been described before in these columns, extended mention of their features will not be necessary. It suffices to note again their extreme simplicity and accessibility, and the placing of the coils and mechanism high above the heat of the arc. There are two general styles, large and small, the former for outdoor use and the latter for indoors, both being of the same capacity. The latter is very small, are very neat in appearance. These lamps feed by differential coils and clutch acting directing on the carbon rod.

M. B. AUSTIN & Co., of Chicago, received callers in parlor 21, where A. Meinema, A. H. Friend and W. W. Geisse were on hand. Mr. Geisse, formerly of the Central Electric Company, is a recent aquisition to the Austin ranks, and will travel in Iowa and Nebraska. This company is agent for the Belden arc lamps.

THE FEDERAL ELECTRIC COMPANY, of Chicago, represented by Jas. M. Gilchrist, made an exhibit of one of its patented illuminated electric advertising signs, with the lights flashed on and off by a New Reynolds flasher. This was a suggestion to the central station men as to a possible way of securing a profitable all-the-evening load. In some cities the electric light company furnishes advertising signs free to storekeepers for the sake of the additional revenue they bring.

THE DEARBORN DRUG & CHEMICAL WORKS, of Chicago, represented by James W. Harkins and Elborn T. Ward, entertained and distributed loaded cigars at one of the Pfister parlors.

THE VISCOSITY OIL COMPANY, of Chicago, received its friends at parlor headquarters and gave away souvenir bottles of pure petroleum cream. Samuel A. Johnson, president, and Frank Travers did the honors.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, was represented by W. P. Upham and J. B. McMullin, who exhibited the Gutmann wattmeter and other appliances, and distributed souvenir pocket calendars.

THE MECHANICAL APPLIANCE COMPANY, of Milwaukee, had the largest exhibit in the hotel, which consisted of a number of unassembled and completed small motors, such as it makes for the Northern Electrical Manufacturing Company, which it represents. These are claimed to be the only motors of ¼ to 2 hp, with form-wound coils and ventilated armatures. F. H. Ford, district manager, had charge of the exhibit, assisted by F. W. Trayeer.

THE COLUMBIA INCANDESCENT LAMP COMPANY was represented by James B. Coale, manager of the Northwestern office at Minneapolis, who brought along his photometer and testing instruments.

THE ILLINOIS ELECTRIC COMPANY, of Chicago, occupied one of the parlors with a few specialties and was represented by C. W. Bacon.

H. T. PAISTE COMPANY, represented by Edward A. Jenkins, Western manager, Chicago, had a novelty in the shape of a socket and lamp for variable light called the "Pinkard Tri-Light." The lamp for a 110-volt circuit contains two 8-cp, 110-volt filaments. When the lamp is full on the filaments are connected in parallel, giving 16 cp. By turning the key of the socket one filament is cut out, giving 8 cp. A third turn of the key connects the two filaments in series, making a very dim light.

THE GENERAL ELECTRIC COMPANY, as usual, had an able corps of representatives present—Thomas Ferris, Milwaukee; S. F. Dibble, O. E. Turner, Richard Swain, D. H. Beardsley, Chicago; H. C. Wirt and F. G. Vaughen, Schenectady.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY exhibited its transformer construction and had a full supply of bulletins of interest to electric light men. Thomas James, Charles G. Burton and W. R. Pinchard, of Chicago, were in attendance.

THE BRYAN-MARSH COMPANY had its interests well looked after. Converse D. Marsh, of New York, was present one day, in addition to whom were L. P. Sawyer, E. H. Haughton and George Keech, of Chicago, and Guy V. Williams and Richard N. Young, of Minneapolis. This company had a photometer and dark room for the instruction of members.

JULIUS ANDRAE & SONS COMPANY, of Milwaukee, had an extensive display of the various electrical supplies for which it is agent, looked after by F. T. Andrae.

NON-EXHIBITORS.—In addition to those supply houses making exhibits or receiving visitors in the Hotel Pfister parlors there were, of course, many companies represented at the convention, some of which were as follows: Goltz Engineering Company, Chicago, William Goltz; Electrical Supply Company, Madison, Wis., L. W. Burch; Evans-Almirall Company, C. L. Etheridge, Chicago; Adams-Bagnall Electric Company, J. G. Pomeroy, Chicago; Pass & Seymour, Crouse Hinds Electric Company, John W. Brooks, Chicago; Warren Electric Manufacturing Company, J. Holt Gates, Chicago; W. H. Schott, engineer and contractor, Chicago; Chicago Insulated Wire Company, J. M. Graves, Chicago; Standard Underground Cable Company, W. A. Caldwell, Chicago; Western Electric Company, Harry Byrne, Milwaukee; George Cutter, Chicago; Peru Electric Manufacturing Company, George Searing, Chicago; McRoy Clay Works, E. F. Kirkpatrick, Chicago; W. P. Crockett, manufacturing agent, Chicago; Manhattan Electrical Supply Company, H. M. Pierce, Chicago; Wagner Electric Manufacturing Company, W. A. Layman, St. Louis; George B. Foster, Chicago; O. S. Norton & Sons Company, Sparta, Wis., G. M. Norton; O. C. Little Pulley Covering Company, O. C. Little; Guarantee Electric Company, Chicago, Charles E. Gregory; American Circular Loom Company, Thos. G. Grier, Chicago; General Incandescent Arc Light Company, Francis Raymond, Chicago; Sprague Electric Company, W. R. Mason, Chicago.

Tool for Electricians and Linemen.

A tool for electrical work, such as telephone, telegraph or any work where side cutting pliers, of a high-grade quality are required, is being introduced by the Smith & Hemenway Co. and the Utica Drop Forge & Tool Co., of 296 Broadway, New York City. It is a Swedish side cutting and splicing plier, made from the Swedish electro boracic steel, which has been tested for years, and found to be everything that is necessary to make a first-class article that will



SIDE-CUTTING PLIERS.

stand cutting the hardest kind of steel and iron wire without affecting the cutting edge.

It has their patent round edge, which is a great advantage, as it can be carried in the pocket without wearing or tearing the clothes. It is also very desirable where the workmen are liable to drop the pliers on the wire where they are working. Square edges will generally break the scale, thereby injuring the conductivity of the wire, while the patent round edge will not. It has polished head and jaws, and is finished half polished, polished or nickeled, in six different sizes.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4 per cent on call, 4 per cent for 30 days to six months on ordinary mixed collateral. In the stock market there was greater strength, despite the prevalent inactivity and the lack of public interest in speculation. There were a number of incidents during the week calculated to interest and stimulate activity, but their influence was not wholly favorable. The New York Central plans for the improvement of the Grand Central Station and the adoption of electric power in the Fourth Avenue tunnel, with the accompanying issue of $17,250,000 of new stock at 125, also failed to make any favorable impression on the Street. In the industrial list the principal activity centered in the United States Steel shares, which were rather heavy at the first of the week, but later there was a rally on the common and preferred, the former reaching 43⅜ and the latter 94⅞. Amalgamated Copper declined from 71¼ to 67⅝, but recovered to 70⅛, and was strong in the face of the further cutting of copper prices. In the traction list quietness prevailed; there were no marked changes, Brooklyn Rapid Transit closing at 65¼, a net loss of 1½ points, the sales aggregating 42,510 shares. Metropolitan Street Railway made a net gain of 1 point, closing at 164½, the sales aggregating 18,990. Manhattan Elevated closed at 136⅜, a net loss of 2¾ points. Inactivity and weakness characterized the electric list, General Electric closing at 279, being a net loss of 2 points. The sales aggregated 1400 shares. Westinghouse Electric common remained steady at 177; Western Union closed at 91, which is ¼ point less than the closing price of the week previous. Other closing quotations are as follows: American District Telegraph, 33½, a net loss of 2½ points; American Telegraph & Cable, 90½; American Telephone & Telegraph, 160¾. Following are the closing quotations of Jan. 21:

NEW YORK.

	Jan. 14.	Jan. 21.		Jan. 14.	Jan. 21.
American Tel. & Cable	90	90	General Electric	279½	279½
American Dist. Tel.	32	33	General Carriage	1	1½
Brooklyn Rapid Transit	63⅞	65¼	Hudson River Tel.	100	100
Ches. & Pot. Telephone	—	—	Metropolitan Street Ry.	160¼	162½
Commercial Cable	155	161	N. E. Elec. Veh. Tran.	—	3
Electric Boat	25½	26	N. Y. Elec. Veh. Tran.	12½	11
Electric Boat pfd.	47	48	N. Y. & N. J. Tel.	—	—
Electric Lead Reduction	1½	1¾	Tel. & Tel. Co. America.	—	—
Electric Vehicle	3	3	Western Union Tel.	90½	91
Electric Vehicle pfd.	4	4	West. E. & M. Co.	170	174
			West. E. & M. Co., pfd.	—	172

BOSTON.

	Jan. 14.	Jan. 21.		Jan. 14.	Jan. 21.
Am. Tel. & Tel.	159	158	Mexican Telephone	2	2
Cumberland Telephone	—	—	New England Telephone	139	139
Edison Elec. Illum.	280	280	Westinghouse Elec.	176	176
Erie Telephone	19¼	19¾	Westinghouse Elec. pfd.	—	—
General Electric, pfd.	—	—			

PHILADELPHIA.

	Jan. 14.	Jan. 21.		Jan. 14.	Jan. 21.
American Railways	43½	43½	Phila. Traction	97	97
Electric Storage Battery.	60	60	Philadelphia Electric	3⅜	3⅜
Elec. Storage Batt'y pfd.	60	60	Pa. Electric Vehicle	¾	¾
Elec. Co. Amer.	7½	7½	Pa. Elec. Veh. pfd.	2½	2½

CHICAGO.

	Jan. 14.	Jan. 21.		Jan. 14.	Jan. 21.
Central Union Telephone	180	180	National Carbon pfd.	82½	83
Chicago Telephone	163	163	Northwest Elev. com.	38	38
Chicago Edison	280	280	Union Traction	10	10
Chicago Pneu. Tool Co.	98	98	Union Traction pfd.	47	47½
National Carbon	107½	108			

* Ask.

CHICAGO TELEPHONE COMPANY'S REPORT.—The annual report of the Chicago Telephone Company shows a gain of 17,007 instruments or stations for the year, the total being 53,511, with 95 exchanges. This gain, which was equal to the whole number of instruments in use in the company's exchanges at the end of 1897, speaks for itself as to the success of the measured-service plan. Gross and net earnings were by far the largest in the company's history. Although the amount of capital outstanding at the end of the year was more than twice as large as that outstanding at the end of 1898 the surplus over dividends was larger than in that year. Thirty thousand shares, or $3,000,000 of new stock, will be issued this year to provide for extensions planned. The gross earnings were $3,775,001; the net $1,083,872, and the dividends $960,000. The balance sheet shows assets of $10,655,470, and surplus of $300,103, with a reserve of $343,471 for renewal of switchboards, etc. At the end of the year, 24,341 telephones were operating on the measured-service plan universal for some time past in New York.

BOSTON EDISON.—The steady advance in Edison Electric Illuminating stock has called attention, says the Boston News Bureau, to the commanding position of this company. Six months have elapsed since the merger of the Edison, Boston and Suburban companies, and while earnings of the combined companies for this period have made it clear to the leading interests that 10 per cent dividends can be indefinitely maintained, the real earning capacity has not as yet been determined, as the business has not been fully systematized. At a price of $259 per share the net return to the investor is 3.85 per cent, but considering the fact that for five years previous to this year, stockholders have received an average of $2 per share per annum through rights, and since the formation of the new company have received rights which sold between $3 and $4, it is figured that the actual return to the investor is between 4½ and 5 per cent per annum. While no increase in the dividend is expected, it is believed that stockholders will continue to benefit through the growth of the company, by rights to take new stock.

PHILADELPHIA ELECTRIC FINANCES.—President J. B. McCall, of the Philadelphia Electric Company, says: "The present needs of the company require an assessment of $2.50 per share and nothing more. The assessment will bring in $2,500,000. Of this $750,000 will be used to cover the expense of the acquisition of the Kensington Electric Light Company, which was a cash transaction. The balance, $1,750,000, will all be needed in connection with our new power plant which is to be erected at Christian Street Wharf on the Schuylkill River. In compliance with our agreement of Oct. 12, 1899, with the Land, Title & Trust Company, trustee, we have purchased and canceled $2,000,000 worth of the old Philadelphia Electric (so-called) bonds which were issued before we acquired the Pennsylvania Manufacturing Light & Power Company. We shall have no trouble in meeting our semi-annual interest payments on our own $15,000,000 issue of 4 per cent bonds. Three hundred thousand dollars of interest will be due on these next July."

BIRMINGHAM, ALA., IMPROVEMENTS.—Gordon Abbott, of Boston, president of the Old Colony Trust Company, met with other members of the executive committee of the Birmingham Railway, Light & Power Company, of which the Trust Company is trustees for bonds issued, last week, and the committee agreed upon the continuance of the development policy of the Birmingham Company. Street railway extensions and improvements to cost $1,000,000, the enlargement of the electric light and power plant at Bessemer at a cost of $200,000, the building of a $100,000 car barn at Birmingham, the doubling of the capacity of the electric light plant and the one-third enlargement of the gas plant at Birmingham were all agreed upon. Total expenditures will approximate $1,750,000.

PRODUCTION OF ALUMINUM.—It is said that the Pittsburg Reduction Company, of Pittsburg, is at the present time the only American producer of aluminum. It has three factories, one at New Kensington, Pa., one at Niagara Falls, N. Y., and one at Shawinigan Falls, Canada. The company has $600,000 6 per cent preferred stock, and $1,000,000 common stock paying 10 per cent, for which $250 per share has been bid in Pittsburg without effecting any purchase. In fact, no public sale has ever been noted. It is understood the company is earning more than it is paying in dividends, and is putting such surplus earnings into construction.

CLEVELAND TROLLEY MERGER.—At a joint meeting of the directors of three interurban electric railway lines, known as the Cleveland & Eastern, Cleveland & Chagrin Falls, and Chagrin Falls & Eastern railways, it was decided to merge the properties into one company. The new title will be the Eastern Ohio Traction Company. The capital will be $2,500,000.

SIEMENS & HALSKE ELECTRIC COMPANY.—Suit has been brought in Superior Court, Chicago, asking for the appointment of a receiver for the Siemens & Halske Electric Company, and to set aside the sale of the company to the General Electric Company. It is claimed that the merger was accomplished without the consent of the directors of the Siemens Company.

DIVIDENDS.—The trustees of the Worcester Railways & Investment Company have declared a semi-annual dividend of $2.25 per share, payable Feb. 1. The directors of Milwaukee Electric Railway & Light Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Feb. 1.

ERIE TELEPHONE.—A notice has been issued to Erie stockholders for a special meeting to vote on the sale and transfer of the property to American Bell interests.

NEW HAVEN VS. TROLLEY LINES.—It is understood by the Boston News Bureau that the officials of the New York, New Haven & Hartford Railroad are making plans for a more determined competition with the trolley lines in Southern Massachusetts, particularly with the Taunton & Providence and the Providence & Fall River street railway companies. The competition with the former of these roads has hitherto proved quite costly for the New Haven. The fare on the trolley line is only 25 cents, against 60 cents on the steam road. The trolley road, moreover, from the center of Taunton to the center of Providence is 15 minutes faster. The competition with the Providence & Fall River has, however, been more successful. In this case both are electric lines, and both trolley systems. The time between Market Square, Providence, and City Hall, Fall River, is slightly in favor of the Providence & Fall River Company, and the fare on the latter is 5 cents less. The street railway has the advantage in that it meets converging lines both in Providence and in Fall River, making a transfer of passengers the mere stepping from one car to another, while in the case of the New Haven, an additional fare is usually paid in each city to reach one of its terminals. In summer, between these two cities, there is business enough to keep both roads in profitable operation. This winter, however, the New Haven is running, on practically half-hour schedule, trains which are almost empty. The people of the district, moreover, seem to favor the street railway. They say its officials are more easily approached, and that favors are more readily obtained. Besides this, many are financially interested in the street railway. This winter the New Haven has began to make extensive improvements, with a view of meeting this competition more successfully.

TELEPHONE CONSOLIDATION.—It is announced from Hagerstown, Md., that the Cumberland Valley Telephone & Telegraph Company has been purchased by the United Telephone Company, which is aiming at a system to compete with that of the Bell company. The combination of which the Cumberland Valley Telephone & Telegraph Company is now a part is to be known as the Cumberland Valley Telephone Company, and includes the Dauphin County Telephone Company, the Hanover Telephone Company, the Adams County Telephone Company and the lines for the most part as far south as Washington, D. C., as the underlying and constituent companies. In addition to these companies it has bought out many local companies in other sections, especially along the line of the Pennsylvania Railroad between Harrisburg and Altoona. The Cumberland Valley Telephone Company is but one branch of the United Telephone Company.

SAN FRANCISCO TROLLEYS.—The expected consolidation of all the San Francisco street railways will be announced shortly. Brown Brothers obtained options on all the principal street railways in that city and their experts are now looking into the proposition to determine whether the firm will supply funds for the consolidation. Brown Brothers say that they have nothing to give out in regard to amount of capital necessary for consolidation.

SOUTHERN NEW ENGLAND TELEPHONE.—The annual meeting of the Southern New England Telephone Company will be held Jan. 28 in New Haven, Conn. At the meeting a vote will be offered that the capital stock of the corporation be increased from $3,000,000 to $5,000,000. The company last year added 3316 new telephones in Connecticut, a much greater gain than the previous year, and increased the number of stations by 366 to 17,324.

Commercial Intelligence.

THE WEEK IN TRADE.—Coincident with the "January thaw" prices of securities, food products and copper, among the metals, all weakened and closed lower. The causes for this movement, according to *Bradstreet's*, have been in many cases technical, and the general trade situation has not on the whole been weakened, if anything, in fact, improvment may be expected to follow. In distributive trade the situation has improved. Among the industries, iron and steel lead in the volume of new business and in production, although the car shortage has materially reduced the December output of pig iron. Prompt deliveries command a premium, and the same is true of steel billets. The car shortage trouble has, however, been somewhat improved, but a number of furnaces are still banked, owing to insufficient supplies of coke. Finished products show an advancing tendency, and the advance in wire products is confirmed. Copper was deeply cut, 11 cents being now the nominal price, but claims are made of sales as low as 10½ cents without any particular improvement in demand reported, although exports are large. The United Metals Selling Company has decided not to announce "official" prices hereafter, but is selling at figures to meet the market. Since this announcement was made the cutting of prices continued steadily. The business that was transacted was on the basis of 11 cents for Lake, 10⅞ cents for electrolytic and 10¾ cents for casting. The amount of this business, however, was very small, transactions being only of a retail character. The New York Metal Exchange quotes Lake 11⅛ cents, electrolytic 11 cents and casting 10¾ cents. According to *Bradstreet's*, last year was the best ever experienced by the railways in this country. Partial returns give a total of $1,423,283,295 as the gross earnings for the year, an increase of 10.4 per cent over 1900. The gains are general, the coal roads sending in one of 18 per cent; for the Southwestern, 13.8 per cent, and the Pacific Coast lines one of 13.3 per cent. The Granger lines show an increase of 9.5 per cent, trunk roads one of 9 per cent, and the Central Western carriers an increase of 8.8 per cent. Southern roads show the smallest ratio of gain, being 6.3 per cent. The business failures for the week, as reported by *Bradstreet's*, numbered 291, as against 346 the previous week and 290 the corresponding week last year.

THE WAGNER AND BULLOCK ELECTRIC COMPANIES, of California, have closed several important contracts in Southern California. The contract with the Edison Electric Company, of Los Angeles, calls for four Bullock 750-kw revolving field, three-phase generators. These machines are of the three-bearing type, direct-connected to waterwheel on the same base. Current is generated at 750 volts and raised by means of twelve 250-kw Wagner transformers to 33,000 volts. This apparatus will be installed in Station No. 3, and the distance of transmission to Los Angeles is 88 miles. An elaborately constructed switchboard will be installed. The Edison Company is a consolidation of all of the electric light and power plants tributary to Los Angeles, with the single exception of the San Gabriel Electric Power Company. The Los Angeles Traction Company has closed contracts, through the Wagner-Bullock Electric Companies, represented in San Francisco by Messrs. Cook, H. C. Wybro and R. H. Elder, for two 400-kw engine type, three-phase generators for railway use. Also for the necessary raising and lowering transformers, switchboard apparatus, etc. The San Bernardino Valley Traction Company has closed a contract for a Bullock 200-kw motor generator set, consisting of a synchronous motor and a railway generator direct coupled.

MACHINERY AND APPARATUS FOR JAPAN.—K. Sida, a representative of the Japanese Imperial Navy, was the guest of the Niles Tool Works at Hamilton, Ohio, a few days ago. He is in this country for the purpose of placing contracts for machine tools and electrical machinery for a new shipbuilding plant which the Japanese Government is preparing to establish. He will visit Pittsburg, Philadelphia, New York and other centers, and will then go to Washington, where he will be the guest of the Japanese Minister. Later he will go to Europe. He says Japan proposes to build shipyards which will render her independent of the rest of the world in this respect.

COPPER FIGURES FOR 1901.—Mr. John Stanton, the American copper authority, figures out United States production of copper in 1901 at 594,171,200 lbs., and exports at 213,619,840, leaving a home supply 140,000,000 lbs. greater than in 1900, and showing a decrease in production here of 1.3 per cent and in exports of 40 per cent. The European production in 1901 was 224,539,840 lbs., or 12 per cent larger than in 1900, and the largest on record.

STORAGE BATTERY.—Philadelphia papers last week quoted a director of the Electric Storage Battery Company as saying that they were going to have a large new factory so that they could compete with the General Electric and Westinghouse companies. Mr. Charles Blizard writes us that the item and report were entirely unauthorized.

CINCINNATI CONDUITS.—The Cincinnati (Ohio) Gas & Electric Company is going in for a very expensive and complete underground system, and Manager W. F. White telegraphs us that it has awarded a contract to Mr. Guy M. Gest, of that city, for about 1,000,000 duct feet of American Vitrified Conduit Company's multiple duct, laid complete.

INSULATED WIRE.—Conferences have been in progress in New York City during the past week between the associated supply dealers and the insulated wire manufacturers, as to a basis of prices on coated wires. It is understood that black core and white core have both been under very brisk discussion. Conclusions, if any have been reached, are not announced publicly.

LIGHTING PLANT BIDS.—The management of the new Hotel Rogge, at Zanesville, Ohio, has called for bids on a 500-light incandescent plant.

LARGE ORDER FOR CASTINGS.—The Craig Foundry Company, Toledo, Ohio, has received an order from the Westinghouse Electric & Manufacturing Company for 1800 tons of castings to be used in large generators. The contract price of the castings is $80,000.

THE STROMBERG-CARLSON TELEPHONE COMPANY, Chicago, has recently installed a direct-connected engine and generator in its plant, the Ball Engine Company, Erie, Pa., furnishing the engine and the Western Electric Company the generators.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Jan. 14: Valencia—17 pkgs. material $782, 2 pkgs. machinery, $117. Azores—2 pkgs. material, $25. Argentine Republic—41 pkgs. material, $331; 27 pkgs. machinery, $278. British Guiana—54 pkgs. material, $1,925. Bristol—2 pkgs. machinery, $600. Brazil—69 pkgs. material, $3,974; 15 pkgs. machinery, $5,026. British East Indies—281 pkgs. material, $4,286; 12 pkgs. machinery, $1,352. Berlin—5 pkgs. machinery, $411. British Australia—1 pkg. machinery, $205; 39 pkgs. material, $1,088; 82 pkgs. wire, $1,819. Bremen—4 pkgs. material, $214; 1 pkg. machinery, $350. British West Indies—35 pkgs. material, $1,434; 1 pkg. machinery, $50. Chili—11 pkgs. material, $736. Copenhagen—1 pkg. material, $11. Christiania—1 pkg. material, $131. China—2 pkgs. material, $30; 2 pkgs. machinery, $129. Cuba—220 pkgs. material, $3,796. Dutch West Indies—1 pkg. material, $18. Ecuador—4 pkgs. material, $135. Glasgow—4 pkgs. machinery, $973; 50 pkgs. material, $457. Hamburg—2 pkgs. machinery, $384; 39 pkgs. material, $405. Havre—65 pkgs. material, $2,175. Hong Kong—8 pkgs. machinery, $1,875. Hayti—1 pkg. material, $27. Japan—309 pkgs. material, $41. London—32 pkgs. material, $3,319; 59 pkgs. machinery, $1,214. Liverpool—8 pkgs. machinery, $1,521; 39 pkgs. material, $912; 6 pkgs. wire, $398. Manchester—1 pkg. wire, $37. Milan—4 pkgs. machinery, $201. Mannheim—7 pkgs. material, $400. Mexico—50 pkgs. material, $581. Newcastle—2 pkgs. material, $500; 2 pkgs. machinery, $705. New Zealand—1 pkg. machinery, $58; 1 pkg. material, $44. Portsmouth—16 pkgs. material, $861. Perth—25 pkgs. machinery, $1,800. Philippine Islands—19 pkgs. material, $900. Peru—2 pkgs. material, $36; 2 pkgs. machinery, $480. Southampton—12 pkgs. material, $947. Stockholm—2 pkgs. machinery, $75. St. Petersburg—6 pkgs. material, $262. Siam—1 pkg. material, $28. U. S. Colombia—2 pkgs. material, $97. Venezuela—34 pkgs. material, $372. Walsall—35 pkgs. material, $1,420.

TROLLEYS AND THE MERCHANTS' ASSOCIATION.—The annual meeting of members of the Merchants' Association, of New York, was held on Jan. 14, at which five directors of the board of fifteen were elected to succeed those whose terms expired at that time. The new elected directors are Mr. George F. Crane, of Baring, Magoun & Co.; Adolph Openhym, of William Openhym & Sons; George L. Duval, of Beeche, Duval & Co., each to succeed himself, and Mr. George Frederick Vietor, of Vietor & Achelis, to succeed Mr. Allan Trowbridge, and Herbert L. Satterlee to succeed Hon. John H. Starin. There were also three vacancies in the board, and these were filled, under the provisions of the by-laws, by the board of directors, who elected Henry R. Towne, president Yale & Towne Manufacturing Company; W. A. Marble, vice-president R. & G. Corset Company, and W. E. Curtis, formerly assistant secretary of the treasury under Mr. Cleveland. The president was authorized to appoint a committee to consider a number of subjects concerning the conditions existing in the city, among which were the question of street railway franchises, and the taxes alleged to be due the city in excess of taxes paid by the corporations enjoying these franchises. The question of unused car tracks still remaining in a number of streets. The laying of asphalt pavements in the business parts of the city; the question of the proposed franchise on Elm Street to the Metropolitan Street Railway Company.

DECEMBER TRADE STATEMENT.—According to the trade statement published, December saw a slight reduction in our balance of trade, owing to smaller foreign demand. October, November and December are the months that always show the largest totals in foreign trade. It is notable that the excess of exports for December, 1901—$57,162,000—is, with three exceptions, the smallest for any of these months in the past four years. Compared with a year previous, last month's exports of $137,076,000 show a falling off of $8,813,000, and are $10,800,000 below the average of the months mentioned for the past two years. In fact, they fall so far below expectations that the confidently asserted prediction of $1,500,000,000 exports for the year fails of being reached by $34,500,000. Meanwhile the December imports—$79,914,000—are, with two trifling exceptions, the largest in many years, and exceed those of December, 1900, by $11,217,000. It is in the last six months that our balance of trade has suffered most by these tendencies. The exports in that time of $742,670,000 show a decrease of $23,238,000, and the imports of $446,447,000 an increase of $56,718,000. The excess of exports for this period is but $296,223,000, a falling off of $79,956,000—a total greater than the loss for the whole year, in which the excess of exports is $585,108,000, a decline from 1900's figures of $63,088,000.

THE ELECTRIC FURNACE COMPANY, of 52 William Street, New York City, is reported in the market for generators, transformers, turbines, etc. It was formed recently with a capital of $200,000, for the production of steel ingots from ore by an electric process invented by M. R. Conley, of Brooklyn, N. Y. It has secured the water rights in the Watuga River and a large tract of land near Elizabethton, Tenn., where it will erect two or three electric furnaces operated by an 8000-hp electric plant. Through a subsidiary company, under the name of the Electric Crucible Company, with a capital stock of $500,000, the furnaces are to be placed on the market for use in foundries and machine shops. The parent company is building a small furnace in the vicinity of New York City. The officers of the Electric Furnace Company are M. R. Conley, president, and Thomas T. Seelye, treasurer. W. B. Hutchinson is attorney.

MR. GEORGE BENDER, 137 Center Street, N. Y., reports that there is a large demand for first-class second-hand electric motors. Among last month's sales Mr. Bender reports the following: Mr. Charles Cooper, Bennington, Vt., one 10-hp and one 15-hp three-phase; Forsyth Iron Bed Company, Winston-Salem, N. C., one 10-hp two-phase; Prentiss Tool & Supply Company, New York, one 15-hp two-phase; William F. Mangles Carousal Company, Coney Island, one 10-hp two-phase; Briar Cliff Farm, N. Y., one 5-hp two-phase; E. Heller & Co., New York, one 2-hp two-phase; Moline Elevator Company, New York, one 10-hp direct current; Acme Manifold Company, one 7½-hp direct-current; Langer & Nagel, New York, one 6-hp direct current; Alex. Campbell Milk Company, Brooklyn, one 3-hp direct current; also several small motors. Mr. Bender is also overhauling 20 motors that went through a fire for the Collins Jute Company, New York City.

BIG ORDER FOR ELECTRIC WINCHES.—The two monster steamships which are now under construction at the Eastern Shipbuilding Company's yards near New London, Conn., for President Hill, of the Great Northern Railway Company's proposed Oriental freight service, are to be equipped with 76 electric winches—60 of 3000 lbs. capacity each, 12 of 5000 lbs. and 4 of 7000 lbs. These winches will be supplied by the Lidgerwood Manufacturing Company, of 96 Liberty Street. The 3000-lb. machines will be operated by 25-hp motors, and the remainder are to be direct connected to 40-hp motors. The electrical portion of the contract has been undertaken by the General Electric Company. The value of the contract is said to be about $65,000.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., reports business as very good at the opening of the new year. The company is in receipt of an order from the British Westinghouse Electric & Manufacturing Company for 60 of its noiseless pinions for the equipment of the British Company's new plant. These pinions are to be used on motors for driving machine tools, electric cranes, etc., and are for transmitting from 5 to 40 hp. Orders from other sources are coming in fast, and the outlook is promising for a good business year.

PENNSYLVANIA ELECTRICAL CONTRACTORS.—The electrical contractors of the State of Pennsylvania held meetings in Pittsburg during last week and organized the Pennsylvania State Electrical Contractors' Association. The following officers were elected: President, G. F. Mathieu, of Pittsburg; vice-president, T. C. Smith, of Philadelphia; secretary and treasurer, F. F. Howe, of Pittsburg. Upon the completion of the organization the Association of Electrical Contractors, of Pittsburg, tendered a banquet to the guests at the Hotel Henry.

ST. LOUIS ELECTRICAL CONTRACTORS.—The following-named officers for 1902 were elected by the St. Louis electrical exchange at the last meeting: President, E. T. Cooke; vice-president, C. J. Ermer; secretary, William Murdock; treasurer, F. E. Newberry; sergeant-at-arms, C. J. Sutter. Directors: William Corrao, C. Smith, J. Masson, A. Eyeschenstein, E. C. Van Nort and F. E. Adam. It was decided to change the name of the organization to the St. Louis Electrical Contractors' Association.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY has secured the contracts for machinery and other equipment to be placed in the extension of the Cincinnati Gas & Electric Company's plant at Plum and Charles streets, Cincinnati, Ohio. All the machinery will be built at the Norwood plant of the Bullock Company. The Wagner Company, of St. Louis, will furnish the transformers.

FRED M. LOCKE, Victor, N. Y., the well-known manufacturer of high-voltage porcelain insulators, writes us that his plant was nearly destroyed by fire on Jan. 5, and is now being rebuilt in much better shape. He has on hand a stock of various sizes to fill small orders, and will be in a position to fill all orders promptly by the first of March.

WAGNER ELECTRIC MANUFACTURING COMPANY.—At the stockholders' meeting held Jan. 13 of the Wagner Electric Manufacturing Comapny the following directors were elected: S. M. Dodd, James Campbell, J. C. Van Blarcom, James W. Bell, Ferdinand Schmedtmann, W. A. Layman and S. B. Pike. S. M. Dodd was re-elected president and S. B. Pike secretary and treasurer.

DRIVER-HARRIS WIRE COMPANY.—A new factory is to be built at Harrison, N. J., by the Driver-Harris Wire Company, of Newark, N. J. As our readers are aware, the company manufacture at present resistance wires and fine wires of all metals. Other lines of wire manufacture will now be taken up.

General News.

THE TELEPHONE.

OPELOUSAS, ALA.—The Cumberland Telephone Company has just completed an exchange at Opelousas.

GLENDORA, CALIF.—The Farmers Mutual Telephone Company has taken steps towards the installation of independent telephones [illegible] their lines. The farmers in the vicinity of Covina and San Dimas are expected to [illegible] similar telephone systems which will connect with the Glendora system.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company is about to install an improved switchboard in the East Oakland exchange, Oakland, Calif. About 10,000 names will appear in the forthcoming telephone directory, which will include the subscribers of Oakland, Alameda and Berkeley.

ATLANTA, GA.—The Southern Bell Telephone Company will make arrangements at once to construct long distance lines connecting with Sumter, Florence, Darlington, Newberry, Union, Clinton, Laurens and Greenwood.

BUDA, ILL.—The Buda-Bradford Telephone Company has been incorporated with a capital of $5,000. The incorporators are George A. Carper, Parker N. Mason and John J. Gungrich.

PLAINFIELD, ILL.—The Northwestern Telephone Company has been merged into the Interstate Independent Telephone Company, with the same officers at the head. H. H. Evans, of Aurora, Ill., is president.

NEW PARIS, IND.—The New Paris Mutual Telephone Union, capital stock $100, has been incorporated. Directors: D. J. Whitehead, J. W. Rowdabaugh, F. J. McClure, Daniel Fisher and D. M. Weybright.

NEW CASTLE, IND.—Henry County, of which this city is the capital, now has 2303 rural independent telephones in use, and [illegible] Each independent company in New Castle has begun work on its plant.

ROCKVILLE, IND.—Exchange of telephone service between this city and Marshall has been resumed by mutual concession. The directors of the two companies have entered into a new contract, by the terms of which tolls will be charged both ways. Thus the patrons of the Park County Telephone Company will pay in addition to the regular toll to Marshall 10 cents for the use of the lines of the Marshall system.

CADIZ, IND.—This village, with its 300 inhabitants, enjoys unsurpassed telephone facilities. Nineteen rural telephone lines, each with from 10 to 25 subscribers, center here, and the twentieth line is now building. All are controlled by one organization and have free connection with all towns within a radius of twenty-five miles, besides with rural lines in other sections. Long distance lines are being arranged for.

LOGANSPORT, IND.—During the summer the City Council granted a new telephone company franchise privileges in this city, and notified the Bell Company that its franchise, expiring Jan. 3, 1902, would not be renewed. The company has paid no attention to the notification, and continues business as of yore, and the City Council is apparently powerless to prevent its operation. The Council is now determined to prohibit extensions or improvements requiring a permit. Litigation is likely to follow.

LOUISVILLE, KY.—The Cumberland Telephone & Telegraph Company (Bell) has begun the distribution of 5000 free telephones as a result of the cutting of rates by the recently organized Home Telephone Company.

MONROE, LA.—The City Council of Monroe has refused permission to the Cumberland Telephone Company to stretch its long distance wires across the traffic bridge.

ST. JOSEPH, MICH.—The poor night service and the advance in rates have lost the Bell Telephone Company 300 out of its 700 subscribers in the twin cities during the first week of the year. A petition is being circulated among the Bell subscribers asking that the old rate be charged. The independent companies are putting in many new telephones.

SHREVE, OHIO.—The Ripley Telephone Company, capital stock $5,000, has been incorporated.

SATER, OHIO.—The New Baltimore & Venice Telephone & Telegraph Company has been incorporated.

CRESTLINE, OHIO.—The Crestline Telephone Company has increased its capital stock from $10,000 to $25,000.

SONNENBURG, OHIO.—Farmers hereabouts recently held a mass meeting and will organize a telephone company to build a farmers' community system.

OHIO CITY, OHIO.—The Ohio City Home Telephone Company, capital stock $10,000, has been incorporated by A. C. Bush, S. L. Ashton, J. A. Swovel, W. M. Smalley and Jesse Smith.

TOLEDO, OHIO.—The Toledo Home Telephone Company has received a large shipment of Stromberg-Carlson instruments which are being installed. The company will start with over 4000 subscribers.

MT. GILEAD, OHIO.—The Morrow County Telephone Company has bought up the system of the Sayers Telephone Company, which includes a large number of farmers' lines in the western part of the county.

WARREN, OHIO.—Citizens of Greene Township are organizing a telephone company to build a farmers' system. A committee has been appointed to secure estimates and arrange for connections with existing companies.

MARION, OHIO.—The Marion County Telephone Company, which was granted a franchise some months ago, has had the grant amended so as to permit it to place pole lines in all alleys instead of being forced to lay conduits.

LONDON, OHIO.—The Madison-Clarke Telephone Company has filed a mortgage covering all its property to the Cleveland Trust Company, Cleveland.

SHARON, OHIO.—A new telephone system is being is being installed in this place.

ASHLAND, OHIO.—The Central Union Telephone Company has commenced action in the Probate Court to secure a franchise in Ashland. The Council has [illegible] The Star Telephone Company [illegible] phone [illegible] the town.

CINCINNATI, OHIO. The City & Suburban Telegraph Association is building a number of lines in the vicinity of Hughes to make competition for the Hamilton, Hughes & Monroe Telephone Company, which is building a system in that territory.

URBANA, OHIO.—The Urbana Telephone Company held its annual meeting a few days ago and declared the usual dividend. The company is building lines to Kingscreek and is planning to build a system in North Lewisburg. Other improvements will be made.

WARREN, OHIO.—The directors of the Warren & Niles Telephone Company have authorized an expenditure of $25,000 for improvements to the exchanges at Warren and Niles. The company has 1200 telephones in operation, an increase of 160 during the past year.

BATAVIA, OHIO.—The Citizens' Telephone Company, of this place, has organized by electing B. W. Griffin, president; J. W. Ranson, vice-president, and W. H. Baum, treasurer and general manager. The company operates several hundred farmers' telephones in this county.

BELLAIRE, OHIO.—The Ohio Valley Telephone Company, of Bellaire, the Belmont Telephone Company, of St. Clairesville and the National Telephone Company of Wheeling, have arranged to give through service by connecting their lines on the bridge between Bellaire and Benwood.

FINDLAY, OHIO.—T. B. Stackhouse, of the Hotel Benton, has placed an order with the Findlay Home Telephone Company for forty telephones, one to be put in each room of the house. Each will be a regulation long-distance telephone with direct connection to the central exchange.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has elected the following officers. E. R. Taylor, president; H. L. Beatty, secretary; W. S. Drake, treasurer, and George Wilson, manager. The officers and C. G. Fisher, C. C. Byers and C. H. Pitkin constitute the board of directors.

GUYSVILLE, OHIO.—The Guysville Telephone Company has been incorporated by H. S. Hoskinson, V. O. Satlder, E. D. Harper, O. L. Strahl, S. A. Wilson, J. H. Finsterwald and Jefferson Perry. The company will build a farmers' community system, connecting with other systems in this county.

RIDGEVILLE, OHIO.—The Ridgeville Telephone Company has elected new officers as follows: James Sayers, president; Frank Biggs, vice-president; J. P. Riedinger, secretary-treasurer and general manager. The above, with Frank Rollin and E. F. Allen, are directors. The company will build two new toll lines.

HILLSBORO, OHIO.—The Hillsboro Telephone Company has elected directors as follows: I. McSmith, M. F. Carroll, Frank Durnell, John Evans, John Horst, Charles Brown and George L. Garnett. The company has spent $13,400 in improvements the past year, but it was decided to make further improvements and extend the system to all parts of the county.

NEWTON FALLS, OHIO.—H. H. Porter has been re-elected president and C. F. Gardner, secretary of the Newton Falls Home Telephone Company. The company has just finished a very prosperous year. It has been decided to issue additional stock for the purpose of buying a new switchboard and making other improvements. The directors are calling for figures on a new board.

MECHANICSBURG, OHIO.—In order to settle a controversy between stockholders of the Mechanicsburg Telephone Company, Messrs. D. J. Burnham, H. C. Rogers and P. J. Burnham have submitted a proposition to buy out the other stockholders. The company has in operation 430 telephones. Its earnings for 1901 were $4,838, and total expenses $2,535, leaving a profit of $2,303.

FINDLAY, OHIO.—Judge Taylor, of the Common Pleas Court, has granted an injunction against the Findlay Home Telephone Company restraining it from charging more than $1 per month for residence service. The company's franchise provides that it furnish "regular exchange service" for $12 per year, but the company claims that it is furnishing long distance apparatus and demands $18 per year. If the company continues the high rates other injunction suits will be brought.

CHILLICOTHE, OHIO. The recent increase in rates made by the Central Union Telephone Company has been a good thing for the Chillicothe Home Telephone Company. The Home Company started in 1895 when the Bell Company was charging $4 per month and serving 148 subscribers. At present the Home company charges $1.50 and $2 per month and has over 1000 subscribers. The company has recently ordered a new multiple switchboard of 1200 drops capacity, and at the rate orders are being taken it is expected this will be filled within a few months. About March 1 the company will institute a selective four-party service, and this service will be furnished at $12 per year. The Home Company also has an extensive farmers' system covering practically the whole county. Branch exchanges have been established as follows: Frankfort, 90 telephones; Kingstown, 60; Roxable, 60; Bainbridge, 80.

OTTAWA, ONT.—The city of Ottawa, Ont., at the civic elections which were held on Jan. 7, took a plebiscite vote on the question of municipal ownership and control of its telephone service. By a majority of 1344 votes the ratepayers declared in favor of a municipal telephone system. The Bell Telephone Company's charter for Ottawa expires next year.

PITTSBURG, PA.—At a meeting of the board of directors of the Pittsburg & Allegheny Telephone Company, which was held a few days ago, Mr. G. R. Webb, of Baltimore, Md., the president of the company, resigned, and he was immediately succeeded by Mr. E. H. Bouton. Mr. S. H. Browne has been made the resident general manager of the company. Mr. Webb will not relinquish his interests in the company, and it is stated by those in authority that these changes in the official personnel of the company are indicative of the fact that the management recognizes the great field its company has in this district, and the intention is to push the interests of the company to the greatest extent.

UNION, S. C.—The Southern Bell Telephone Company is completing a new system in Union, with a capacity of 100 subscribers.

NASHVILLE, TENN.—The Board of Aldermen of Statesville, N. C., has unanimously refused a franchise to the Bell Telephone Company to build a system in that city.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has increased its capital stock from $[illegible] to $[illegible].

MADISON, WIS.—The Calumet Telephone Company has increased its capital stock from $500 to $1,500.

MENOMONEE FALLS, WIS.—The village board has passed a franchise granting to M. A. Schmoyer & Company the right to erect poles and maintain a telephone system in the village limits.

OSHKOSH, WIS.—The Wisconsin Telephone Company is expected to spend $90,000 on its system in this city. It is very likely that a $20,000 exchange building will be built and $70,000 spent on underground construction and placing wires in conduits.

MERRILL, WIS.—At the annual meeting of the stockholders of the Merrill Telephone Company a proposition from the Bell Telephone Company to lease the local company was considered, but as similar offers have been declined by the local companies at Rhinelander, Grand Rapids and other Wisconsin Valley points, no action was taken, nor will be until it can be ascertained what the companies at Wausau and other cities will do. The Wisconsin company agrees to give up its local exchange in this city, which has been recently re-established, providing the Merrill company becomes a lessee of the Wisconsin Company.

ELECTRIC LIGHT AND POWER.

LA CROSSE, WIS.—The La Crosse Gas & Electric Company is spending about $100,000 on improvements, including new generators, new gas engines, etc.

BIRMINGHAM, ALA.—E. J. Oberne, of Birmingham, has secured the contract for constructing a water works system and electric light plant at Gloster, La. His bid was $22,538.90.

BIRMINGHAM, ALA.—The Birmingham Railway Light & Power Company has closed a contract with the Birmingham Machine & Foundry Company for two large Corliss engines, and new apparatus has been purchased from the General Electric Company, making all improvements cost $240,000. The capacity of the plant will be increased about one-third.

SAN FRANCISCO, CALIF.—The Mountain Power Company's preliminary work on the new hydraulic electric power plant in the Santa Ana Canyon in California, is progressing rapidly. Tunnels are being driven and hydraulic work is well under way for the No. 3 electric power house on Upper Mill Creek. These two plants will be arranged so as to be operated together whenever it is desirable.

SAN FRANCISCO, CALIF.—Mr. J. B. Crockett has resigned as president of the San Francisco Gas & Electric Company. Rudolph Spreckels, the son of Claus Spreckels, who founded the Independent Electric Light & Power Company, has been very active in securing proxies for the forthcoming annual election. Yet it is is said that he does not aspire to become president, but will practically control the affairs of the company with his present power as a director.

SAN FRANCISCO, CALIF.—The citizens of Cloverdale, Calif., recently took action for the formation of a stock company for the purpose of supplying the towns of Cloverside, Geyserville, Asti and Lyttons with electric light and power. Water rights have been secured at a point four miles from Cloverdale. It is purposed to construct dams at the junction of the two forks of Sulphur Creek, where sufficient water power can be developed. The Italian-Swiss colony of Asti will subscribe for half of the capital stock of the company.

CHRISMAN, ILL.—The Light & Water Company of Chrisman, with a capital of $10,000, has been incorporated by Geo. W. Farr, A. K. Hartley and Oscar Jones.

SPRINGFIELD, ILL.—The Cosmopolitan Power Company of Jersey City, N. J., has been licensed to do business in Illinois; capital stock, $40,000,000; capital in Illinois, $5,000.

VERSAILLES, IND.—A new electric light plant has been completed here and the tests are highly satisfactory. Business houses and many private residences are patrons of the new company.

BRAZIL, IND.—Interested parties have brought suit against the Mayor and City Council to break the contract recently made with the Brazil Power Company to furnish the city with electric light. It is alleged that the members of the Council are financially interested in the contract.

INDIANAPOLIS, IND.—The inside electric workers of this city and South Bend are now on a strike, with the exception of two firms, which have signed the new scale. The strike has practically tied up all the inside work in these cities, and there is no indication of an early settlement. The new scale calls for 32 cents an hour and eight hours a day. The contractors say they will not give but 30 cents an hour for nine hours a day.

ST. LOUIS, MO.—Contracts have been signed by the General Electric Company, of Schenectady, N. Y., and Chancellor W. S. Chaplin, of Washington University, for the power plant for the University's new buildings, which are included in the World's Fair site. Geo. D. Rosenthal, St. Louis representative, states that the plant will consist of three generators, one switchboard and twelve motors, to be used for lighting, power, ventilation, and for the laboratories. It is stated that after the expiration of the exposition other power will be supplied from plants down town for the University. The present plant will be used for the buildings during their occupancy by the Exposition Company, and later will be retained for the benefit of the students in their studies.

MARTIN'S FERRY, OHIO. An issue of $8,000 bonds is being offered to provide for a new lighting plant.

ADA, OHIO.—The Ada Water, Heat & Light Company has been incorporated with $25,000 capital stock by local people.

ASHLAND, OHIO.—Postle & Barber, of Columbus are asking for a franchise in Ashland to furnish light, heat and power.

CLEVELAND, OHIO. Director Dunn, of the police department, is having estimates prepared of the probable cost of a lighting plant for the central police station.

CINCINNATI, OHIO. Bids have been asked for an engine and generator for the public library lighting plant. Wm. E. Hopkins has charge of the proposals.

CUYAHOGA FALLS, OHIO.—The water works trustees have sold $5,000 in bonds to purchase equipment for a municipal lighting plant, to be operated in connection with the water works.

WILMINGTON, OHIO.—Recently the town advertised for bids for an electric light and water works franchise, but no bids were received. Another attempt to secure proposals will be made.

CIRCLEVILLE, OHIO.—The Circleville Light & Power Company has been incorporated by William Heffner, W. E. Christ, Frank Millspaugh and others for the purpose of erecting an electric light plant.

ZANESVILLE, OHIO.—The Citizens' Light Company, of Zanesville, has been incorporated with $1,500 temporary capital stock by C. G. Griffith, Mrs. C. G. Griffith, O. S. Palmer, C. G. Barnell, John F. Murphy and E. J. Walsh.

HUBBARD, OHIO.—The village is still undecided whether or not to rebuild the municipal lighting plant which was destroyed by fire some time ago. It is probable that a proposition made by the Youngstown Electric Light Company will be accepted.

COLUMBUS, OHIO.—It is stated that the directors of the Panhandle Railway have appropriated $500.000 for improvements at its shops in this city, including an electric light and power plant. It is intended to use electric power in driving the shop machinery.

PORT CLINTON, OHIO.—The village contract with the local lighting company expired some months ago, and since then light has been furnished under a temporary arrangement, the Council declining to make a long time contract unless the company decreased its rates. The company has declined to make any concessions and the Council has ordered the service discontinued, so the town will be in darkness unless an amicable settlement is made.

EL RENO, OKLA.—The El Reno Electric Light Company has sold its plant and franchises to Mr. Henry Larsen, president of the Canadian Milling Company, and Mr. John A. Masters, formerly president of the Jamestown Electric Light Company, of Jamestown, N. D., and lately connected with the South Carolina Interstate & West Indian Exposition Company as assistant engineer in the Bureau of Light and Power. It is the intention of these gentlemen to organize a new company and replace the present plant with a modern plant of about 300 kilowatt capacity.

OTTAWA, ONT.—A by-law was carried, a few days ago, by the ratepayers of the town of Annapolis Royal, N. S., to enable the town to borrow $12,000 for the purpose of extending the electric light system of the town and to operate the plant by water power.

HAMILTON, ONT.—It is stated that the Cataract Power Company, of Hamilton, Ont., has reached the limit of the capacity of its present water power development, and the company is now considering the question of the construction of a canal and other works to furnish additional power. The cost of the necessary works will be about $80,000.

OTTAWA, ONT.—An order has been promulgated by the British Columbia government granting certain rights at Coquitlam Lake, B. C., to the Vancouver Power Company. Thus the company is in a position to commence work at once on the development of electric power there. It is proposed to develop 5000 horse-power, with an ultimate increase to 15,000 horse-power. In connection with this power scheme, a tunnel, two miles long, will be built.

WRIGHTSVILLE, PA.—The Wrightsville Hardware Company proposes to establish an electric light and power plant, to be operated by water power. The new plant will adjoin the company's present lumbering plants south of Williamsport on the Susquehanna River.

ABBEVILLE, S. C.—The plant of the Abbeville Electric Light & Power Company has been totally destroyed by fire.

ANDERSON, S. C.—The Anderson Water, Light & Power Company has awarded a contract to the Flynt Construction Company, of Massachusetts, to rebuild the dam at Portman shoals, recently washed away. The work will cost, it is stated, $125,000. The company has ordered a 300-horse-power engine and will, it is said, be ready to turn on lights on Feb. 1.

ROGERSVILLE, TENN.—The recently burned electric light plant of Rogersville will be rebuilt.

ESTILL SPRINGS, TENN.—The Tullahoma Electric Light Company has completed its line from Tullahoma to the new plant now in process of completion, on the south bank of Elk River, about two miles below Estill Springs. This plant will furnish power to light Tullahoma, Winchester, Dechard and Estill Springs.

NACOGDOCHES, TEX.—The Nacogdoches Light & Power Company of Nacogdoches has been incorporated with a capital stock of $20,000. The incorporators are E. C. Brauch, I. A. Sturtevant, K. P. Brauch and O. E. Hubbard.

DALLAS, TEX.—The Magnet Light, Heat & Power Company, of Enid, with $100,000 capital stock, has been incorporated. The incorporators are: H. E. Havens, W. S. Whittinghall, M. A. Kelso, J. A. Hill, J. W. Steen, E. B. Weatherly, O. J. Fleming, H. N. Horner and Charles H. Peters, all of Enid.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company has been troubled this winter with the source of its water supply being frozen up.

SALT LAKE CITY, UTAH. The State Board of Correction, of Utah, will ask for bids for a lighting plant to light the State prison at Salt Lake. Address W. B. Gowles, clerk.

SALT LAKE CITY, UTAH.—By Feb. 1 the mines and smelters of Butte, Mont., will be receiving electric power furnished by the Missouri River Power Company from its plant on the Missouri River. The dynamos and other machinery at the claim are all in place, and a trial run has been made.

SALT LAKE CITY, UTAH.—The Clark Electric Power Company has been incorporated at Los Angeles, Calif., by Edward W. Clark, of Ophir; Edwin M. Clark, of Los Angeles; Frank Pierce, E. B. Critchlow and W. J. Barrette. The chief business of the new company will be the impounding of the waters of Settlement Canyon Creek in Tooele County, and conveying the waters five miles by flumes to an electric power plant. The principal offices of the company will be in Salt Lake City. The capital stock is $50,000. The directors are Edward W. Clark, president; Frank Pierce, vice-president; W. J. Barrette, secretary and treasurer; Edwin M. Clark and E. B. Critchlow.

NORFOLK, VA.—An application has been received from the Geo. A. Williams Company of Jersey City for the appointment of receivers for the Consumers' Light, Heat & Ice Company, of Newport News, Va. The Williams Company has also filed mechanics' liens for various supplies, amounting to over $80,000, claiming that the defendants have made no payments for these supplies.

MENOMONEE FALLS, WIS.—The Wisconsin Beet Sugar Company has been granted a ten-year franchise to erect poles and string wires for electric street lighting purposes, also for heating and power purposes.

SUPERIOR, WIS.—The Superior Water, Light & Power Company will install a new gas plant in case an extension of its franchise is granted. It is also proposed to expend $60,000 in installing new machinery in the electric light station.

MILWAUKEE, WIS.—South Milwaukee may have an electric light system of its own. At a recent council meeting the subject was favorably discussed. The prices and attitude of the Milwaukee Electric Railway & Light Company are responsible for the agitation in favor of municipal ownership.

THE ELECTRIC RAILWAY.

HARTFORD, CONN.—The opening of the new street railway line between this city and Springfield took place on Jan. 13. The line connects this city with Springfield, Northampton, Westfield, Holyoke, Worcester and Boston. It forms a continuous line between Boston, Worcester, Springfield, Hartford and Meriden, where there is the first break in the proposed route to New York. It gives a total stretch of 135 miles of trolley road.

SPRINGFIELD, ILL.—J. B. Hanna, president of the Central Illinois Traction Company, which is preparing to build an extensive system radiating from Springfield, states that he is thoroughly satisfied that the financial embarrassment of the Everett-Moore Syndicate will have no effect upon the Illinois enterprise. Plans are going forward as though nothing had happened, and it is believed that operations will not be even temporarily suspended.

ELIZABETH CITY, N. C.—The corporators of the Electric Railway & Power Company have asked for a franchise for a local system. The lines will not be extended to Norfolk, Va., as previously contemplated.

NEW YORK, N. Y.—All of the employees in the power plant of the New York & Staten Island Electric Company at Livingston, Staten Island, struck work a few days ago. The cars were stalled all along the lines. The strikers stated that they would not work in the plant under Alexander Bain, who took the place of general foreman of the steam plant. J. H. Swinarton, the president and general manager of the company, secured from the officers of the Midland Electric Railway Company consent to connect with the feed wires of that company where the lines intersect, and the stalled cars were moved and the regular service was soon restored.

WELLSVILLE, OHIO.—The East Liverpool & Wellsville Street Railway is extending its line in Wellsville.

WOODVILLE, OHIO.—The Woodville Council has granted permission to the Lake Shore Electric Railway to double track its line through the town.

MT. VERNON, OHIO.—C. D. Smiley, promoter of the Mt. Vernon, Mt. Gilead & Western Railway, has applied for a franchise in Knox County.

TOLEDO, OHIO.—The Toledo City Council is preparing an ordinance to require the local traction companies to pay a license for cars operated in the city.

LODI, OHIO.—The Council has granted a franchise to the Canton, Lodi & Medina Traction Company. Several other franchises have recently been secured.

TREMONT, OHIO.—Citizens of Addison, Dialton, Dibert and Tremont have submitted a proposition to the Dayton, Springfield & Urbana Railway to build a spur line through these points.

DAYTON, OHIO.—The capital stock of the Dayton, Lebanon & Cincinnati Railway, which has recently been bought up by the Appleyard syndicate, has been increased from $500,000 to $2,000,000.

UPPER SANDUSKY, OHIO.—Residents of Upper Sandusky, Nevada and Bucyrus are projecting an electric railway to extend from Bucyrus to Lima by way of Nevada, Upper Sandusky, Forest, Ada and other towns.

NEW WASHINGTON, OHIO.—The Village Council has granted a 25-year franchise to the Buckeye Traction Company, which proposes to build a line from Bucyrus to Norwalk. Franchises have been secured in other towns.

CANTON, OHIO.—The Stark County Commissioners have granted a new franchise to the Stark Railway Company enabling it to build over a private right of way instead of along the highway as was originally intended.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is again considering the building of a new line through the "flats." It would touch two railway passenger stations and provide a shorter route to the South Side.

CLEVELAND, OHIO.—At the recent meeting of the Sharon Street Railway Company, Sharon, Pa., John H. Dynes and Fayette Brown, both of Cleveland, were elected secretary and member of the board of directors respectively.

XENIA, OHIO.—The Xenia, Cedarville, Jamestown & Wilmington Traction Company has been incorporated with $1,000 capital stock by J. E. Lowes, J. H. Wolford, H. C. Dean, M. J. Hartley, R. R. Gruire, W. H. Manning and D. E. Peddicort.

YOUNGSTOWN, OHIO.—The Mahoning Valley Electric Railway has completed its new power house at Greenburg, Pa. Several high-speed cars built by the Pullman Company, have been received for the through service from Niles to New Castle.

SPRINGFIELD, OHIO.—The right of way for an electric railway from Springfield to Sidney has all been secured and steps are being taken to finance the project. The road will be known as the Springfield, Piqua & Sidney Traction Company.

DAYTON, OHIO.—A. E. Appleyard, of the Dayton, Lebanon & Cincinnati Railway, has purchased land in Dayton valued at $80,000, to be used as yards, repair shop, round-house and power-house for the road, which is to be operated by both steam and electricity.

COLUMBUS, OHIO.—Representative Bannock has presented a bill in the Legislature giving conductors on interurban lines the powers of police officers whether on their cars or not. At present conductors on passenger trains have police powers while on trains.

ASHTABULA, OHIO.—The Pennsylvania & Ohio Railway recently made a proposition to buy out the Ashtabula Rapid Transit Company, but failing to close the deal, it has announced that it will build a line through East Ashtabula to Woodland Beach and Harmon Park.

BARBERTON, OHIO.—The Northern Ohio Traction Company has made a proposition to furnish lights to the town. If granted a five-year contract it will furnish lights for three cents per light per hour, Philadelphia schedule. Commercial lights will cost ten cents.

TOLEDO, OHIO.—President George B. Kerper, of the Toledo, Bowling Green & Southern Railway has closed a 30-day contract with the Toledo Railways & Light Company whereby his cars will be permitted to use the city company's tracks to the center of the city.

ZANESVILLE, OHIO.—Mayor Holden has announced that in the future he will enforce the "blue laws" and stop Sunday street cars in the city. Manager Gibbs, of the Zanesville Street Railway, has announced he will resist the order and carry the matter into the courts if necessary.

YOUNGSTOWN, OHIO.—Directors of the Youngstown & Sharon Railway met Jan. 7, and voted to issue $1,000,000 in bonds to be used in building the New Castle-Sharon line, in establishing a park near Sharon, to double track a portion of the present line, and to make general improvements.

YOUNGSTOWN, OHIO.—Employes of the Mahoning Valley Railway have received an increase in wages. They will receive 17 cents an hour for six months, 18 cents for the second six months and 19 cents after one year. Heretofore wages have been increased only after two years of service.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway, which is to be changed for electric propulsion, has placed a contract with the St. Louis Car Company, St. Louis, for ten passenger and three combination coaches. Ninety miles of wire and other material have also been contracted for.

COLUMBUS, OHIO.—It appears that the consolidation of the Columbus, Delaware & Marion Railway and the Columbus, Delaware & Northern Traction Company is being held up because of a disagreement over the purchase of the Delaware Street Railway, on which the latter company holds an option.

NEWARK, OHIO.—L. C. Taylor and John S. Black, promoters of the Columbus, Newark, Zanesville & Wheeling Traction Company, state that arrangements have been made with New York banking houses to furnish money to construct the road, and it is claimed that actual work will start in the spring.

COLUMBUS, OHIO.—General Axline, promoter of the Urbana, Mechanicsburg & Columbus Traction Company, announces that the company has been reorganized with new capital, and that all debts of the old company will be settled at once. Work will be resumed by a new contractor in a very short time.

CANTON, OHIO.—The Canton-Akron Railway Company has filed a mortgage for $1,000,000 given to the Knickerbocker Trust Company of New York. The money obtained will be used in completing the road. When fully completed the property will become a part of the system of the Northern Ohio Traction Company.

CINCINNATI, OHIO.—M. J. Mandelbaum, of the Southern Ohio Traction Company, and a prominent backer of the Fordyce scheme of canal-boat propulsion, reports 90 per cent of the grade completed and 50 per cent of the pole line, and says the line between Cincinnati and Dayton will be in operation by April 1.

CLEVELAND, OHIO.—Secretary Lang, of the Southern Ohio Traction Company, has issued a call for a meeting of the stockholders to be held in Hamilton, Feb. 3, to consider and vote on the proposition to buy out the Hamilton & Lindenwald Electric Transit Company and the Miamisburg & Germantown Traction Company.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company is building an extension to Smith's Ferry and will have it in operation about April 1. The company is making extensive improvements to its power-house. A transformer will be installed so that the lighting plant can be used for emergency purposes.

CLEVELAND, OHIO.—The Citizens' Street Railway of Mansfield has filed a mortgage for $400,000 in favor of the Cleveland Trust Company to cover bonds to the same amount issued for the purpose of building the Mansfield-Shelby line (already completed), for making improvements to the present system and for liquidating bonded indebtedness.

SALEM, OHIO.—The Salem Electric Railway and the Salem Electric Light & Power Company have arranged to consolidate and the new company will be known as the Salem Traction Company. The two companies have practically been under the same management for some time. The city franchise has been extended and improvements will be made.

CANTON, OHIO.—Superintendent Douglass, of the Canton-Massillon division of the Northern Ohio Traction Company, has received instructions to continue the work of improving the city and suburban lines under his charge. The Northern Traction Company is in excellent financial condition and will not be affected by the embarrassment of the Everett-Moore syndicate.

CLEVELAND, OHIO.—The three cent fare ordinance proposed by Councilman Howe at the instigation of Mayor Tom L. Johnson was passed by the City Council under suspended rules January 6. It provides for the granting of franchises over numerous city routes on a basis of three cent fares. The routes will be advertised and bids asked for at once. Mayor Johnson claims he is assured of several bids.

MIAMISBURG, OHIO.—The Miamisburg Council has adopted a unique method of determining the speed of traction cars and trains passing through the town. The ordinance calls for a speed of six miles an hour and a man who

[illegible] employes to keep [illegible] cars and trains. He walks along the track, and in event he can not keep up with the object in question, he reports to the Council.

DELAWARE, OHIO.—Farmers of Delaware County have organized the Delaware, Berkshire & Sunbury Electric Railway Company. Officers have been elected as follows: Col. W. H. Knauss, president; E. F. Gwynn, vice-president; J. M. Gamble, secretary-treasurer; J. E. Bierbower, general manager; J. T. Adams, superintendent of construction; J. M. Loren, attorney. Power will be furnished temporarily by the Delaware lighting plant.

RIPLEY, OHIO.—The Ripley, Georgetown, Hillsboro & Columbus Electric Railway Company has organized by electing officers as follows: President, G. Baubach, of Ripley; vice-presidents, J. W. Marshall, of Sardinia, and Albert Krutz, of Georgetown; secretary, John R. Moore, of Georgetown; treasurer, E. E. Galbraith, of Ripley. The syndicate which proposes to finance the road has advised that the right of way be secured at once and the money would be forthcoming.

CLEVELAND, OHIO.—At a meeting held in Toledo Jan. 13, between the Strang Construction Company, contractors for the Detroit & Toledo Shore line, the receivers in charge of the property and representatives of the Cleveland bankers' committee, all differences with the construction company were settled. By the terms of the settlement, the Strang company's claim of $280,000 will be satisfactorily settled at an early date, and the work of completing the road will be pushed. As the matter now stands, Receiver Allen E. Edwards, who was appointed at the instigation of the Cleveland bankers, will have practical control of the road.

CLEVELAND, OHIO.—Stockholders of the Cleveland Electric Railway have received their regular quarterly dividend of 1 per cent. The annual report of the company shows that the road had a very prosperous year. The company has earned all its fixed charges, operating expenses, a four per cent. dividend and over $500,000 that went to pay for improvements and new equipment. In 1900 the company paid 51.38 per cent of its earnings for expenses and taxes, while in 1901 the figures were 55.13. The annual meeting will be held later, when a proposition to increase the capital stock $1,000,000 will be voted on. In view of the embarrassment of the syndicate, it is believed that the proposition will be voted down.

OTTAWA, ONT.—It is reported that the Westinghouse Electric Manufacturing Company is behind the scheme to build an electric railway between the city of Winnipeg, Man., and the town of Headingly.

TORONTO, ONT.—The receipts of the Toronto Electric Street Railway Company, during the year 1901, were largely in excess of those of the previous year, every month showing a substantial increase. The total receipts were $1,636,861, which was $152,263 over 1900.

HAMILTON, ONT.—Mr. Henry T. Therbur, of Detroit, Mich., is head of a syndicate which purposes constructing and operating an electric railway system with the city of Hamilton as its centre, and Galt, Guelph, Berlin and other cities and towns in that section of the province as places to be reached.

PITTSBURG, PA.—On Jan. 17 the details were completed for the consolidation of the Connellsville & Suburban Street Railway and the Youghiogheny Light, Heat & Power Company, of Connellsville, Pa., with the Pittsburg, McKeesport & Connellsville Railway Company. By the merging of these companies parallel railroad lines between McKeesport and Connellsville will be discontinued.

NASHVILLE, TENN.—The Suburban Street Railway has been incorporated to extend an electric railway out Church Street. The authorized capital is $50,000. Incorporators Thos. J. Felder, B. F. Wilson and others. Later the road may be extended to West Nashville.

MILWAUKEE, WIS.—A new electric railway project has taken form and the Common Council will shortly be asked for a franchise.

THE AUTOMOBILE.

THE UNION AUTOMOBILE COMPANY, of Union City, Ind., has completed new buildings and modern machinery is now being placed for the manufacture of automobiles. The company expects to turn out 500 machines this year.

TO TOUR EUROPE.—Dr. Harry Hicks, of Indianapolis, Ind., has arrangements almost completed for a trip through Europe in an automobile—a new Winton gasoline touring car, especially constructed for long-distance journeys. Dr. Hicks will leave Indianapolis soon after the automobile show and will be gone three months.

RIGHTS OF AUTOMOBILES.—The Indiana Supreme Court has decided that the automobile has an equal right with other vehicles on the public highways, and that the horse has no exclusive right to the road, and injuries caused by "spillouts" and "runaways" as the result of frightening horses does not give the injured party a right of action, provided the operators of the automobile take proper precaution to prevent fright.

INDIANAPOLIS AUTOMOBILE SHOW.—Considerable interest is manifested in the automobile show to be held in Indianapolis, Ind., Feb. 17 to 22. All of the large floor space of Tomlinson Hall has been taken and the exhibits will be attractive. Sundries of all kinds will be exhibited. Everything from a 140-lb. motor to the semi-racers, that weigh 2,000 lbs., and big trucks will be exhibited. The show promises to be a great success. All the owners of automobiles in Indiana have been invited to meet in Indianapolis during the show to form a State association. The object set forth is to promote good roads and break down the prejudice which exists in some quarters against motor vehicles. An annual run over Indiana roads and a race meet are suggested.

NEW INDUSTRIAL COMPANIES.

THE ROGERS ELECTRICAL WORKS COMPANY has been incorporated in Jersey City, N. J.; capital, $100,000. Incorporators: John C. Henriques, Nathan Silverman and Walter Blake.

THE CONRAD MUELLER COMPANY, of Indianapolis, with $10,000 capital, has been incorporated to deal in electric vehicles. The incorporators are Conrad Mueller, Peter H. Goodall and Charles F. Reid.

THE COLUMBIA ELECTRIC & MANUFACTURING COMPANY, of Newark, N. J., has been incorporated; capital, $125,000. Incorporators: W. Harvey Jones, Martin K. Robinson and George M. Lane.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has been incorporated under the laws of the State of California, with Trenton, N. J., as the principal place of business. Directors: F. O. Briggs, W. B. Gandy, L. C. Taylor, E. W. Taylor, J. H. Janeway, W. A. Anderson and D. M. Anderson. Capital stock, $2,000,000.

THE WILMINGTON ELECTRIC SUPPLY & CONSTRUCTION COMPANY has been incorporated at Wilmington, N. C., with an authorized capital of $25,000. John Frank, W. H. Howell and others are interested. The company will deal in general electrical supplies, and do a general electric and mechanical construction business.

LOCOMOBILE COMPANY.—A general meeting of the stockholders of the Locomobile Company of America will be held Feb. 11 at the offices of the company, 7 East Forty-second Street, New York City. A resolution will be presented to the stockholders authorizing the issuance of $500,000 of 7 per cent preferred stock to take the place of the same amount of common stock of the company.

LEGAL.

PAN-AMERICAN.—Judgment for $3,130 has been obtained against the Pan-American Exposition Company of Buffalo in favor of the Mayo-Rohrer Company, of New York, for arc lamps, globes and spark arresters.

IN FAVOR OF WESTERN UNION.—The United States Circuit Court of Appeals has made an order directing the Boston Safe Deposit & Trust Company to pay over to the Western Union Telegraph Company $35,786. This money was held in trust by the Boston company as mortgagees of certain minor telegraph lines which the Western Union has purchased and absorbed.

INSTRUMENT LITIGATION.—The Whitney Electrical Instrument Company has answered the bill of complaint of the Weston Electrical Instrument Company in the New York United States Court. It denies the charge of infringement upon the Weston patents and declares them void, because of the prior use of the same ideas in electrical measuring instruments by Elihu Thomson and Charles F. Brush.

BOSTON EDISON LIABILITY.—A concession of liability by the Edison Electric Illuminating Company, in the subway explosion of March 4, 1897, in which a dozen persons were killed and scores were injured, promises to end speedily a mass of litigation for damages involving claims aggregating nearly $1,500,000. Previously the courts had found the Boston Gas Light Company and the Edison Company jointly liable, but the Edison Company had contested the finding. From time to time the case has been postponed in view of the possibility of a settlement, and this week, when the damage cases are called in court, on continuance, the announcement will be made that the Edison Company concedes liability with the Gas company. It is thought that this action will mean the payment of at least $500,000 of the damage claims by the Edison Company. The explosion was said to have been caused by a spark from electric light wires igniting gas which had leaked from the Gas company's pipes into the subway excavation at the corner of Tremont and Boylston Streets. The excavations, it would appear, strained the electric underground mains.

PERSONAL.

PRESIDENT C. A. COFFIN, of the General Electric Company, has sailed [illegible]

DR. LOUIS DUNCAN has, we regret to note, been seriously ill lately, but favorable reports are issued by his physicians.

DR. N. S. KEITH, the well known electrical engineer, mining expert, etc., has established offices at 95 Liberty Street, where he will practice his profession.

MR. C. T. YERKES has sailed again for England, in furtherance of his work in completing the electrification of the London Metropolitan underground system.

MR. J. G. WHITE is a fairly well man again and has been able to visit his offices. He is now enjoying life once more by spending a few weeks among the Lakewood pines.

MR. R. S. MASSON has resigned the position of superintendent of the Independent Electric Light & Power Company, San Francisco, and has opened an office as a consulting electrical engineer.

MR CHARLES S. DRUMMOND, one of the prominent directors of the British Electric Traction Company, who has been on a visit to this side for the past five weeks, has sailed for Europe. Mr. Drummond's sojourn on this occasion was principally made in connection with the British Columbian properties of his company, who control the leading electric traction systems in Vancouver and Nelson, B. C.

MR. G. MARCONI sailed for Southampton on Jan. 22, on the "Philadelphia," [illegible] He was the recipient of many attentions and courtesies while in New York, including lunch with Mr. [illegible] He expects to [illegible] and to continue the important work that has recently attracted so much attention.

MR. J. B. OLSON. It will be of great interest to many of our readers and to the insulated wire industry in general to learn that Mr. James B. Olson has now been appointed manager of sales for the India Rubber & Gutta Percha Insulating Company, of Yonkers and New York City. For many years previous to this Mr. Olson was associated there with the late James W. Godfrey, whose recent tragic death aroused such deep feelings of regret throughout the electrical industry. The faithful portrait which accompanies the present notice is that of a young man who has an unusually wide acquaintance East and West. Mr. Olson was originally associated with Mr. Godfrey in the firearms business as far back as 1879, and afterwards followed him into the insulated wire trade, becoming connected with the New York Insulated Wire Company in 1887, and representing that concern as Western sales agent in Chicago around 1893, the year of the World's Fair, when so many electrical people visited Chicago. Owing to the illness of his wife, Mr. Olson found it necessary to return East and he became associated with the Habirshaw interests in 1894. His succession to the work and duties of the late Mr. Godfrey is regarded not only as a logical occurrence, but as a well-deserved promotion. Mr. Olson, during the many years of his experience in the insulated wire industry, has devoted his time and energies not only to the building up of a successful trade connection, but to the mastery of the many intricate technical details which are of such vital importance in view of the wider ramifications yearly of electric light and power. His name now appears upon the literature of the concern, and his well-known chief, Dr. W. M. Habirshaw, the general manager of the company, is to be congratulated upon the continuance in his service of one who has already become so favorably known, and whose large circle of friendship and acquaintance must inure to the welfare of the interests which he will now represent in the New York City office.



J. B. OLSON

MR. ARTHUR B. PROAL, JR., has resigned his position as chief engineer of the New York & Staten Island Electric Company, Livingston, L. I.

MR. R. B. BRANWELL, who has resigned his position with the De Dion-Bouton Motorette Company, succeeds Mr. W. C. Stuart as manager of the advertising department of the International Motor Car Company.

MR. ST. JOHN MILDMAY, a nephew of Mr. Gisbert Kapp, is visiting this country. He is representing while here the *Corriere della Sera* of Milan, and was one of the participants in the Marconi dinner last week.

DOBBS-DODGE.—The marriage is announced at Ravenna, Ohio, on Jan. 7 of Miss Cora M., daughter of Mr. and Mrs. H. M. Dodge, to Mr. A. E. Dobbs, the well known telephone expert, writer, etc., who is now making his residence in New York City.

MR. FRANK B. RAE, the electrical and mechanical engineer, has removed his office to Exchange Court, 52 Broadway, where he will have increased office facilities for his work in connection with lighting, railway and power transmission enterprises.

MR. CHAS. L. GOODMERE has resigned as superintendent of the Atlantic Coast Telephone Company to accept the position of chief engineer of the United Telephone & Telegraph Company, of Philadelphia. He will, however, continue to reside at Atlantic City, N. J.

MR. A. W. HUTCHINS, for several years connected with the Narragansett Electric Lighting Company at Providence, R. I., has retired from his position with that company to take charge of the sales department of the Acme Switch Company, Hartford, Conn., maker of the Acme time switch.

MR. J. W. MASON, formerly traveling salesman in the States of Illinois, Kansas, and Missouri for the Central Electric Company, of Chicago, has recently been appointed to the position of general salesman for the same company, with headquarters at its Chicago office. Mr. Mason is well known to the electrical trade throughout the West, and his many friends will wish him success.

MR. P. C. BURNS, president of the American Electric Telephone Company, in an interview with a representative of ELECTRICAL WORLD AND ENGINEER, stated in connection with the matters of the Everett-Moore syndicate that all the properties investigated so far have been found to be profit-bearing enterprises, and that the affairs of the company will undoubtedly be straightened out satisfactorily without anything more than temporary embarrassment.

MR. D. THOMSON, a brother of Prof. Elihu Thomson, is now president and manager of the Thomson Electrical Company, Manhattan Building, Chicago. He has had a long experience in the field, being over six years superintendent of the lighting department of the Royal Electric Company of Montreal; two and a half years manager of the Hamilton, Ont., Light & Power Company; two and a half years in management of the Ithaca Street Railway and Lighting Company; two and a half years president and manager of the Hannibal, Mo., Railway Company, and one year manager of the Dubuque street railway system. The new company is making several of his specialties and is also engaged in electrical engineering.

MR. CALVIN W. RICE, of the New York Edison Company, and chairman of the Committee of Papers and Meetings of the American Institute of Electrical Engineers, presented an interesting paper on the Nernst Lamp before the Brooklyn Engineers Club on the evening of Thursday, Jan. 9. Mr. Rice's familiarity with his subject and the numerous examples of American and foreign samples of lamps, which he was enabled to exhibit in operation, resulted in giving to the members of the club one of the pleasantest evenings of the season. He also gave an address on the Utilization of Electricity in Mining before the Boston Society of Arts on Jan. 23.

Trade Notes.

NEW CATALOGUE.—The St. Louis Electrical Supply Company, St. Louis, Mo., is preparing a new catalogue, which will be very complete and up-to-date. The company would like to correspond with all manufacturers interested.

EXHAUST HEADS AND STEAM TRAPS are the subject of Catalogue No. 119 of the B. F. Sturtevant Company, Boston, Mass. Tables give the dimensions, weight and prices of the different sizes of these devices, both of which are illustrated.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that the new type alternating current Gutmann wattmeter brought such an avalanche of orders that it has found it hard to keep up with them. It is now in shape to fill all orders promptly.

OFFICERS ELECTED.—At the annual meeting of stockholders of the Warren Electric & Specialty Company held a few days ago, the directors were all re-elected. Officers were chosen as follows: President, T. H. Gillmer; vice-president, C. H. Angstadt; secretary-treasurer, E. W. Gillmer.

STEEL WHEEL-BARROWS.—In the construction of electric plants the prosaic wheel-barrow is an important implement. Wheel-barrows, carts, wheels, etc., are manufactured by the Archer Iron Works, Chicago, Ill., and a complete line of such implements is described and illustrated in a pamphlet recently issued by the works.

DYNAMOS AND MOTORS.—The protected type direct current dynamos and motors, manufactured by the Robbins & Myers Company, Springfield, Ohio, are illustrated and briefly described in Circular No. 21, issued by that company. This line of machines has been on the market for several years and is well known. The machines possess many points of merit, and are well designed and compact.

THE CENTRAL ELECTRIC COMPANY of Chicago will be pleased to quote on application prices on I. X. L. weatherproof, slow-burning, and slow-burning weather-proof wire, office, annunciator, magnet, and galvanized telephone wire. The Central Electric Company will also gladly furnish prices on Okonite insulated wires and cables for aerial, submarine, and for general use where an insulated wire is required.

T. J. MOSHER ELECTRIC COMPANY.—On Jan. 1 the name of the company established in Grand Rapids, Mich., by T. J. Mosher, under the style Furniture City Electric Company, was changed to the T. J. Mosher Electric Company. The company will conduct a general electrical contracting and repairing business, and will manufacture gas and electric fixtures. The company's headquarters are in the Michigan Trust Building, Grand Rapids.

"TERSE TELEPHONE TALK" is the title of a 24-page pamphlet just issued by the Kellogg Switchboard & Supply Company, Chicago, Ill. The text consists of a review of the independent telephone movement, which is followed by a general description of Kellogg apparatus. The pamphlet is liberally illustrated, ten full page illustrations giving views of the Kellogg Company's exhibit at the Pan-American Exposition. On the front cover is shown a telephone line, the cross arms of three of the poles forming the letter T, which combination constitutes the first letter of the words of the title, "Terse Telephone Talk."

THE HAINES & NOYES COMPANY, 118-132 West Jackson Boulevard, Chicago, which makes a specialty of apparatus for private telephone plant use, has increased its capital to meet growth and made a number of changes in its factory. In consequence it is equipped to turn out the best apparatus at lowest figures. It manufactures telephones for every possible use, and makes up special telephones for mines which are waterproof and damp proof, as well as telephones for electric and steam railways, office buildings, hotels, private residences, etc. Its 1902 catalogue has just been issued, and is most complete one in every detail. It is full of excellent half-tones and very complete descriptions of all the company's apparatus. It may be had for the asking.

THE GAMEWELL FIRE ALARM TELEGRAPH COMPANY last March sent its Pacific Coast representative, Mr. A. J. Coffee, on a business tour of our new possessions in the Pacific Ocean. As a result of this enterprise, a fire alarm and police telegraph system is now being installed in Honolulu, H. I., under Mr. Coffee's supervision, and work will be commenced as soon as plans and materials can be forwarded, on a similar installation in Manila. The Honolulu contracts amount of $40,000, and comprise all the details of thoroughly modern fire and police equipments, including a 300-cell storage battery. Two of the latest type of police patrol wagons are being built, in San Francisco, for the Honolulu police department. The contracts for the fire and police telegraph systems for Manila, P. I., will amount in the aggregate to $74,000.

THE EDUCATION OF MECHANICS.—One of the prime reasons for failure on the part of men who have without assistance endeavored to advance themselves along any particular branch of study is that few are willing to start at the bottom and work along well defined lines. The tendency is to skim over the elementary lessons and jump at once to some point where the student would like to be. The result is that the beginner finds himself in "deep water" and probably gives up too soon, feeling that the subject is too much for his comprehension. As a matter of fact, had he been given only a limited amount of elementary study at one time, and been allowed to thoroughly digest it before proceeding, the road would have been comparatively easy. This is where the American School of Correspondence, Boston, Mass., for example, has proved so beneficial to those who have been deprived of the advantages of an education. Not so many years ago, when books were very expensive and papers few, it was quite a difficult thing for a poor man to advance himself even along the line of his occupation, and to change his business for some other which he felt he was more fitted for was almost impossible. The work in which he accidentally found himself was usually that which he was forced to follow, for no other than the simple, though it might be said tragic, reason that he had not the money to attend some college. To-day, however, a man with a very limited capital, coupled with a desire to be something more than he is, can, without leaving his work, join the ranks of a correspondence school and master almost any branch which is worthy of study.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 14, 1902.

[illegible] Wm. A. Rosenbaum, Patent Attorney, 14 Nassau St., N. Y.]

[illegible] LAMP SOCKET; H. P. Clausen, Chicago, Ill. App. filed April 1, 1901. Means for mounting the supervisory lamps in a telephone switchboard, consisting of spring plates serving as sockets and circuit terminals, are secured to brackets attached to the keyboard. The lamps are easily inserted between the spring plates and removed therefrom.

690,946. PUSH BUTTON SWITCH; M. Guett, Hartford, Conn. App. filed Sept. 23, 1901. Details.

690,952. INCANDESCENT ELECTRODE VAPOR ELECTRIC LAMP; P. C. Hewitt, New York, N. Y. App. filed April 18, 1900. (See page 167.)

690,953. METHOD OF ELECTRIC LIGHTING; P. C. Hewitt, New York, N. Y. App. filed April 18, 1900. (See page 167.)

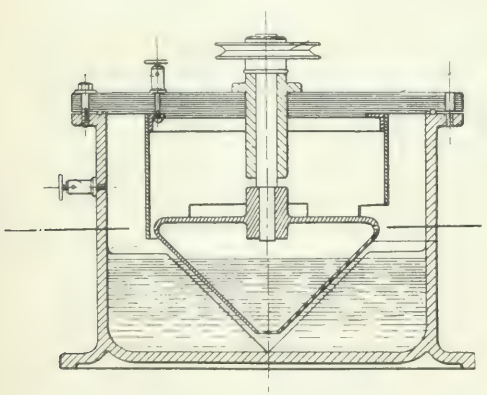
690,958. METHOD OF ELECTRIC WELDING; R. M. Hunter, Philadelphia, Pa. App. filed April 7, 1898. Sheet material is welded together by placing two sheets in contact at a large number of small independent points arranged in the line of the weld, then passing a current through the joint and pressing the parts together.

690,666. CLAMP FOR RAIL JOINTS; W. S. Jones, Chicago, Ill. App. filed June 6, 1901. To avoid passing bolts through the ends of the rails, the fish plates extend beneath the rail and are clamped together at that location. For insulating purposes plates of insulating material are inserted between the fish plates and the rail.

690,973. ROTARY CIRCUIT BREAKER; A. R. Luschka, Chicago, Ill. App. filed Aug. 22, 1901. A hollow vessel shaped like a top and opening at the bottom into a body of mercury, rotates, and by centrifugal force causes the mercury to rise in the vessel and flow outward in a steady stream from an opening at the top against contact plates spaced around the vessel, to thus make and break a circuit through the mercury stream.

690,976. SOCKET FOR INCANDESCENT LAMPS; N. Marshall, Newton, Mass. App. filed Aug. 8, 1900. The contact pieces and parts of the switch are set into cavities formed in a solid block of porcelain.

691,007. MAGNETIC SEPARATOR; F. A. M. Schiechel, Frankfort-on-the-Main, Germany. App. filed Nov. 26, 1898. The magnet poles are arranged so that the magnetic field is created between one north pole and two south poles; the material is supplied to the north pole where the magnetic field is most concentrated, with the result that no material can adhere to the south poles and the stripping belts commonly used can be dispensed with.



690,973.—Rotary Circuit Breaker.

691,024. BATTERY CHUTE OR WELL; E. W. Vogel, Chicago, Ill. App. filed Nov. 5, 1900. A pipe sunk into the ground, closed at its lower end and having a cover at its upper end and a lateral opening below the cover, for the circuit wires which lead from the cells in the pipe. The cells are placed one above the other.

691,060. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed April [illegible]. (See page 167.)

691,101. PROCESS OF REGAINING TIN; P. Bergsoe, Copenhagen, Denmark. App. filed May 10, 1900. (See Current News and Notes.)

691,144. APPARATUS FOR CHARGING BATTERIES; M. R. Hutchison, New York, N. Y. App. filed July 19, 1901. A charging cord having a plug at one end for insertion into a lamp socket, and having two like connecting plugs at the other end; each connecting plug having a male and a female part, the male part of one plug being connected to the positive cord and the male part of the other plug connected to the negative cord, the female parts of both being connected to opposing cords. Having first obtained the polarity of the source of current by using these plugs successively on a polarity indicator, the proper plug is then connected with the battery for charging.

691,[illegible]. ELECTROLYTIC SOLUTION; O. Meyer, Richmond, Va. App. filed Aug. 22, 1901. (See Current News and Notes.)

691,176. ELECTRIC TELEGRAPH APPARATUS; P. Picard, Paris, France. App. filed Feb. 12, 1898. A key connected with two oppositely disposed batteries sends current first from one and then the other of the batteries through two polarized relays and a condenser, in series. The battery circuits are thus closed alternately and the corresponding relay sends a current of corresponding polarity over the line. At the receiving station each alternate impulse energizes the recorder.

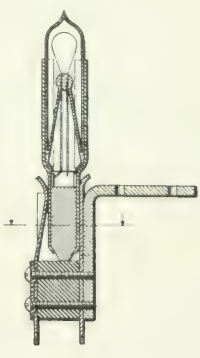
691,187. SWITCH MECHANISM FOR ELECTRIC MOTORS; A. W. Schramm, Philadelphia, Pa. App. filed Oct. 30, 1899. Contacts connected to various sub-divisions of a resistance permanently connected between the field terminals, and a potential-selecting brush and connections whereby the potential at the armature is represented by the potential difference between the ends of one or more of the sub-divisions of the resistance.

691,188. MEANS FOR REGULATING ELECTRIC MOTORS; A. W. Schramm, Philadelphia, Pa. App. filed Oct. 30, 1899. A speed changing mechanism employing in series with the shunt field of the motor, a number of reverse windings or resistances, which may be successively short-circuited or put in circuit.

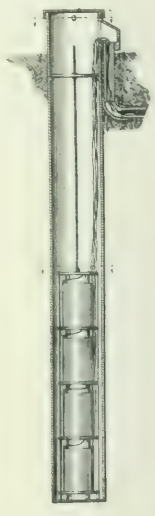
691,197. FIRE ALARM APPLIANCE; D. T. Spring and A. Long, Wheeling, W. Va. App. filed Sept. 24, 1901. Details.

691,229. INDIVIDUAL TELEPHONE SWITCH AND LOCK-OUT MECHANISM FOR INTER-CONNECTING LINES; Albert K. Andriano and Hermann Herbstritt, San Francisco, Calif. App. filed April 19, 1900. (See page 167.)

691,236. TROLLEY POLE BASE; J. D. Buckley and E. H. Phinney, Brunswick, Me. App. filed April 22, 1901. A hood in which the end of the trolley pole and its spring are housed, is mounted to turn on roller bearings on the base piece fixed to the top of the car.



690,928.—Lamp Socket.



691,024.—Battery Chute or Well.

691,245. TELEPHONE CIRCUIT; Walter K. Cook, Mason City, Ia. App. filed Aug. 5, 1901. (See page 167.)

691,262. MAGNETIC SEPARATOR; G. Grondal, Pitkaranta, Russia. App. filed April 14, 1900. Small magnetic blocks are set into a non-magnetic apron over which the material passes; the particles to be separated are caused to turn as they move from one block to the next on account of the difference of polarity between the adjacent edges of the blocks.

691,263. TROLLEY TENDER; A. W. Ham, Lansingburg, N. Y. App. filed April 8, 1901. A spring drum upon which the trolley cord is wound.

691,264. TROLLEY TENDER; A. W. Ham, Lansingburg, N. Y. App. filed June 13, 1901. A modification of the preceding patent.

691,275. TROLLEY POLE CONTROLLING DEVICE FOR CARS OR VEHICLES; W. H. Kilbourd, Greenfield, Mass. App. filed April 10, 1901. The trolley cord passes around a weighted pulley arranged on an inclined track. When the trolley leaves the wire, the pole is retarded by the weight.

691,281. TELEPHONE SYSTEM; Frank E. Mayberry, Medford, Mass. App. filed March 18, 1901. (See page 167.)

691,298. TRANSMITTING ELECTRIC CURRENTS; A. A. E. Sterzing, New York, N. Y. App. filed Aug. 11, 1900. (See Current News and Notes.)

691,113. BONDING PIN AND METHOD OF MAKING SAME; C. A. Holdridge, Chicago, Ill. App. filed Nov. 18, 1901. A conical hollow pin adapted to fit over the end of the bond and be driven into the hole in the rail, is made by placing together two semi-conical parts.


INDEPT.
SHIP
ISHAM AV.
EMERSON
ROAD
BOLTON
NICHOLS PL.
CROSBY PL.
PRESCOTT
SEAMAN
COOPER
ACADEMY
DYCKMAN ST.
DYCKMAN
SHERMAN
VERMILYE
HAWTHORNE
KINGSBRIDGE

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Foldout
Here

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NEW YORK, SATURDAY, FEBRUARY 1, 1902.

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THE EXPORT RECORD OF 1901.

It has already been noted in these pages that the exports from this country for 1901 were not quite so high as those of 1900, apparently, but the decline of $12,000,000 is more than set off by the fact that the amount of $30,000,000 to Porto Rico and Hawaii disappears from export totals. Besides, prices were generally somewhat weaker and lower last year, and the only fair inference is that in quantity American products went abroad as largely as before, possibly in greater bulk than ever. But it would be more satisfactory, so far as manufacturers are concerned, if the falling off in iron and steel had been less than $27,000,000, while the decline in copper of $23,000,000 was due to the unfortunate decline in European requirements. After all, the total falling off in American exports to Europe, where depression was most felt, was only $17,000,000.

Whether the American tide of prosperity is at its full or not, is a moot question, but there are many signs of recovery in Europe, and no reason exists for doubting that a large export trade will be done this year, while importations are also increasing as they must in any normal trade situation. Our iron and steel industries are, in fact, so busy for the year, larger importations in that line may even be expected, but for the miscellaneous goods of American make already becoming known abroad, the market exists that does but need cultivation and attention to become much larger than it is to-day.

LARGER NIAGARA GENERATORS.

The interesting news which we publish this week as to the new generators for the Canadian development of Niagara power is of great importance from whatever point of view it be regarded. These colossi of 10,000 hp are far and away the biggest of their kind, and are virtually about double the size of any machines in New York City, as well as twice as big as the previous units at the Falls. This is a great jump to make, and must, of course, be attended by an equivalent jump in the construction of turbines. Our pleasure at recording the award of this Canadian contract to an American concern is tempered by the belief that the turbines will, as heretofore, be of Swiss design, although the heavier castings may be made on this side. The Swiss engineers and turbine builders are heartily to be congratulated on the skill and boldness that constitutes them leaders in this engineering field, and makes them fitting companions to Mr. C. E. L. Brown.

One naturally wonders what use will be made of this 30,000 hp of current. Of course, some of it can be brought across to the American side, but the plant there is already in process of enlargement and duplication. We shall not be at all surprised to learn that Toronto is the goal. Transmission to that point has already been discussed, and it is an easy 80 miles, with no natural, physical difficulties intervening. The management of the Niagara plant were recently in California, and came back very favorably impressed with the long-distance work done there, 80 miles being an early figure in Pacific Coast power enterprises. Such a Toronto transmission will be but one of many under the British flag, for there is heavy work doing in India, and in our present issue note is made of a serious plan for operating hundreds of miles of South African railway from a distant waterfall.

INTERNATIONAL INDUSTRIAL COURTESY.

In commenting upon the visit last summer to Germany of the British Institution of Electrical Engineers, our English contemporary, the *Electrician*, pays a tribute concerning the cordial spirit

in which the Institution party was everywhere welcomed. To whatever extent, it says, "Made in England" may be better—or worse, we may add—than "Made in Germany," there is no doubt that the English electrical engineers were shown samples of the best of everything, and that they were afforded opportunities of intercourse and exchange of ideas with the most distinguished of their German fellow-workers. We are glad to note that in at least one European country such a spirit of professional and industrial courtesy prevails. It has always been the custom of electrical manufacturers in this country to offer every facility to the properly introduced foreigner to inspect their works, and the grateful surprise in consequence, which we have so frequently heard expressed by such visitors, had led us to believe that the practice was a peculiarly American one, a result of the exuberant national amiability concerning which Herbert Spencer expressed some misgivings. In point of fact, however, little or no danger is incurred—at least in this country—by an indulgence in such courtesy. As a foreign manufacturer sadly remarked when asked if he had derived any benefit from his visit among American electrical works, the success of American manufacturing is so largely due to a combination of restless activity, workshop organization, skilled and ambitious labor and continuous specialization of tools, that while one may learn much by a study of American manufacturing methods, but little or none of the knowledge has yet been applied abroad.

The World's Longest Power Transmissions.

Dr. Perrine's important lecture before the New York Electrical Society on the great power transmission plants of the Pacific Coast came almost like a revelation to many of the engineers who heard him. Plant after plant has been described in the technical press, but somehow isolated descriptions do not sink into the consciousness like a carefully collated discussion of the entire group. We in the East have but an imperfect idea of Californian conditions, and many a striking transmission plant in that region has been quietly slipped into service almost unknown even to the engineering public. Perhaps one reason for this large measure of quiet success is that our coast friends have felt the press of necessity in the matter of cheap power far more than those who dwell a thousand miles nearer the coal fields, and have gone resolutely to work to improve conditions. Consequently, with everybody working for the common good nobody raises an eyebrow at the installation of a 25 or 35-mile transmission of 15,000 or 20,000 volts—it takes two or three times both figures to really awaken interest. Here in the East even a very moderate transmission stirs up opposition with a sharp stick.

California, on the other hand, is the birthplace of real long-distance power transmission on this continent. Pomona saw the first demonstration of high-line voltage, Bodie the first serious power transmission, Redlands the beginning of polyphase transmission and distribution. Niagara, magnificent as it really is, deservedly advertised as no other transmission plant ever has been, has hitherto made less impression upon the art than these, and has not even yet developed what could fairly be called a long or high-voltage line. The vast service of the Western plants has been this, that their promoters and engineers have dared, and, daring, have accomplished, what others have grown faint-hearted at sight of. The result is that today power transmission for more than 200 miles at 40,000 volts is an established commercial fact. It is only 10 years ago this month that the Pomona plant went into service, but 60,000 volts is in immediate sight, its feasibility having already been demonstrated. If to-day one should lay before any engineer personally familiar with the California work, a project for sending power from Niagara to Chicago at 75,000 volts, he would never wince. This great extension of the domain of electrical power transmission has been in two allied but yet distinct branches. First has been the fearless treatment of voltages much higher than custom had hitherto sanctioned. Ferranti, abroad, was seemingly the first man who foresaw the trend of alternating current working, but his experiments, involving the even now desperate resort of high voltage underground, were under such unfavorable conditions that they checked rather than encouraged progress. The Frankfort-Lauffen experiments inspired wonder rather than confidence, and before they had led to any important results, the combination of a persistent California parson and a level-headed American engineer had turned the trick and a 28-mile 10,000-volt line was an accomplished fact.

But high-voltage involves more difficulties than mere insulation strength of materials. It implies as the lines grow longer a serious increase of static effects due to condenser action, and there were plenty of wiseacres, especially of the irreconcilable and fanatical wing of the sect of continuous-currentites, and who solemnly put their noses down to their equations and showed to the satisfaction of any reasonable school-man that long-distance transmission would infallibly prove a disastrous failure. But strange to say there were some practical factors in the matter which they had forgotten, and the lines have kept stretching out to confound them and their fine drawn theories. Every dreaded bugaboo—even resonance—has proved on closer acquaintance to be a fantastic, harmless spook instead of a serious obstacle to further progress.

The two great systems which Dr. Perrine described to the Society with particular care are by all odds the greatest achievements of American engineers in the art of electrical power transmission. Not only are they much longer than anything hitherto attempted, but the Standard Company at least is to operate at a voltage half again as high as any hitherto put in commercial use. Forty thousand volts, the pressure used by the Bay Counties Company at the present time, has already been demonstrated to be entirely feasible. Not only has the problem of line insulation at this pressure been pretty thoroughly worked out, but the voltage in question has been experimentally shown to be below the point at which unusual difficulties are especially to be looked for. But 60,000 volts is nearer a possible danger line, and it is worth noting that it was selected for this work by Dr. Perrine, who was Prince Poniatowski's consulting engineer, some time before even 40,000 volts had been established as a safe working voltage. The later work, and recent experiments at voltages even up to and above 100,000, have in our opinion fully justified Dr. Perrine's courageous choice as well within the limits of a safe practice. We shall be greatly surprised if this tremendous voltage gives any serious trouble in commercial use, and we venture to predict that the transmission into San Francisco will be, upon the whole, as reliable as if it were of a tenth part the length and voltage. With modern methods of construction and insulation the line has ceased to be the weak point in a transmission system. If long it must be kept under thorough inspection, but in a great power transmission system the minor distribution circuits are ten times more likely to cause serious trouble than the main line, because in them there is less obvious need of extreme care. The extreme present range of transmission on these great California systems is 218 miles, over part of the Standard lines from the Colgate power house of the Bay Counties Company, but its success will ensure still further extensions of commercial range. It is worth noting that both these great plants are worked at 60 cycles, showing the entire futility of the extraordinary claims in behalf of very low frequency put forward a few years since. If for any purpose very low frequency is convenient or desirable it is assuredly sound policy to employ it if one wants it, but for all general purposes it is not a matter of necessity or importance even over circuits more than 200 miles long. Dr. Perrine is to be

greatly congratulated not only on the admirable and striking manner in which he has described the splendid work accomplished on the Coast, but for his own personal part in these most distinguished achievements—which has not been small.

Energy, Motor Capacity and Schedule Speed in Electrically Propelled Cars.

The meeting of the American Institute of Electrical Engineers last week was devoted to electric traction in general, and, in particular, to a paper by Dr. Hutchinson. The paper was prefaced by an able introduction from the President. The paper was a theoretical disquisition upon the relations between the power and motor capacity to schedule speed, based on a number of assumptions. It is clear that so many variables enter into the question as to what should be the size of the motors on a car or train, for a given schedule speed over a given profile and distance of track, that unless some definite and simple assumptions are made, there is very little chance of obtaining a formula which will be simple enough for practical use. The same complexity makes the estimation of the watt-hours per car-mile equally hopeless, unless similar assumptions are made. In a problem of this kind, leading to a definite mathematical solution, after the question of accurate algebraic or numerical work has been set aside as settled, the question arises as to how far the simplifying assumptions affect the case, and the amount of deviation in the computed results from those which practice must develop. Thus in the paper under consideration, the train resistance was assumed constant at 18.2 lbs. per ton of moving mass—or not far from 1 per cent. Now, in reality, the train resistance increases in a somewhat complex manner with the speed, owing to air resistance. A formula which employed a simple uniform train resistance would be, therefore, more likely to give reliable results at low speeds than at high speeds.

As the running distances of electric traction increase, the effect of the rate of acceleration becomes of less importance, owing to the relatively small amount of time occupied in accelerating, compared with the total time of each run. But where, as in street car, or city elevated, railroad practice, the runs are short, and a fairly high schedule speed is demanded, the importance of the accelerating conditions is magnified. Having given a length of straight level track between two stopping places, and a uniform braking force or retardation in the brakes, it is clear that the mechanical work performed by the motors on the car will be expended partly on the train resistance, and partly in the brakes. If the train resistance is assumed to be the same at all speeds within the practical range, then the work done against train resistance will be constant, and the only variable quantity will be the work absorbed by the brakes. This would be made to vanish entirely if the train resistance were allowed just to stop the car at the end of the run without having to apply the brakes; so that where the schedule speed was sufficiently low to permit running without brakes, or with no appreciable expenditure of energy in brakes, the least motor output would be attained with any accelerations which just reached the velocity sufficient to bring the car to rest at the distant station. This would entail so slow a retardation, and so moderate a schedule speed, that it would never suit the traveling public, and, in fact, a relatively considerable proportion of the total work done by the motors is usually absorbed and wasted in the brakes in urban street railway service.

The greatest economy of mechanical power, therefore, which a given rapid schedule imposes, is that which makes the velocity near the end of the run least, at the moment when brakes have to be applied, because the loss of energy in brakes is known to be nearly proportional to the square of the speed at which the braking commences. Consequently, the conditions of acceleration for minimum mechanical power are such as give, in the schedule time, the least braking velocity. This condition requires sudden acceleration and prolonged coasting. If, regardless of the feelings of the passengers, the car could be started instantaneously, as though shot out of a gun, and then allowed to coast for the rest of the journey, the speed at the time for applying the brakes would be a minimum. In other words, according to the theory of cars running on a short schedule between frequent stops, the mechanical energy exerted by the motors is a minimum, when the cars are propelled by a momentary impulse which communicates the energy necessary for doing work against the train resistance and against the brakes, during such time as the brakes have to be applied in order to fill the schedule time. As this purely hypothetical and impossible impulsive starting is departed from, and the car accelerates more leisurely by spending more time in getting up to speed, the velocity attained in the middle of the run must be greater to make up for the time lost in starting, and the velocity at the time when the brakes must be applied must be greater, representing a reduced mechanical efficiency. Consequently, on rapid urban service, high mechanical efficiency demands rapid acceleration.

On the other hand, rapid acceleration means either an increased weight of motors, to give the necessary initial torque, or else it means a more wasteful acceleration; since at low speeds powerful torque is only obtained with increased starting current, larger rheostats and reduced electrical efficiency. After a certain acceleration has been attained, the tendency to waste electrical power in the starting rheostats more than offsets the saving in the mechanical power wasted by brakes. To some extent, therefore, the conditions of maximum mechanical efficiency are opposed to the conditions of maximum electrical efficiency, and a compromise has to be effected between them, thus limiting the rapidity of acceleration, even without regarding the comfort of the passengers and the overload current capacity of the system. Moreover, a comparatively small variation in the constants assumed is apt to make a relatively considerable variation in the results deduced under such conflicting tendencies.

The conclusion pointed out in Dr. Hutchinson's paper was that the acceleration giving the least motor weight per ton is the most economical. Also that, in general, the energy per car-mile is least at comparatively low accelerations. This general conclusion was disputed in the discussion, it being held that economy as well as swiftness of service demands a reasonably rapid acceleration. It would seem that the range of variation in the constants assumed by the paper might considerably change the conclusion in different cases. Any such paper must be regarded as a study in pure railway kinematics, as distinguished from a general exposition of railway practice, owing to the great complexity and diversity of the active factors.

Mr. Storer, in discussing the paper, brought out the interesting fact that, on the average, the inertia of the rotating car wheels and rotating motor armatures virtually added 10 per cent to the weight of the car by their gyrostatic momentum, so that a car weighing, say, 20 tons, has its momentum increased by the gyrostatic effect of the rotating parts, to approximately that of a car having no rotating parts, but a mass of 22 tons. Also, that in the day's work, this additional virtual momentum frequently represented a considerable increase in the energy wasted in brakes. During acceleration the retardation due to gyrostatic momentum is overcome and paid for by the current supplied, but during coasting and braking, the momentum plays the same effect as extra mass. We regret that lack of space prevents the presentation in full of Dr. Hutchinson's paper, and of the extended discussion which followed its reading. The whole forms a most valuable and timely contribution to the literature of electric traction, and those interested will do well to obtain a copy, when published, of the *Transactions* containing the same.

Discussing the New York Tunnel Problem.

Following up the interesting discussion started by Mr. Westinghouse as to the dangers arising from the use of combustible cars in electric railway work, further letters have appeared in the daily newspapers, in addition to those we have already quoted, the *New York Times* being the chief medium for their publication. Mr. L. B. Stillwell has an excellent treatment of the subject, and says:

The public demands higher and still higher speeds, and this demand must be met. It should be met, however, conservatively and with due regard to every reasonable precaution that can insure the safety of the traveling public. If speeds are increased, brakes must be made correspondingly more powerful. I have little sympathy with that kind of electrical railway engineering which busies itself exclusively with the construction of theoretical speed curves, ignoring practical questions of railway operation, the importance of which has been established by long years of experience, but I cannot agree with Mr. Westinghouse that in case of a wreck the risk of fire caused by resulting short circuits is at all comparable with the risk of fire when a steam locomotive, carrying in its firebox from 1500 to 2000 lbs. of incandescent coals, plows its way through a car. If the current to each car be supplied through a proper automatic circuit-opening device there is every reason to expect that the current will be cut off before a fire is started. If, in addition to this, as for example in the case of the Manhattan Railway Company, the third rail is divided into sections, each of which is supplied through an automatic circuit breaker located in the sub-station, it would seem that assurance is made doubly sure. Theoretically, of course, it is not impossible that both circuit breakers should fail to operate and that a fire might result, but, in my opinion, the chances of such an occurrence are very remote.

Mr. Ray D. Lillibridge holds that existing electrical apparatus and methods are at least superior to the utmost that steam can do, and remarks:

As to the bogy of short circuits from accidents and resultant conflagration, I have in mind now three accidents of derailment and one of a rear-end collision, all on elevated structures, utilizing the third rail, each of which resulted as such an accident is certain to result, Mr. Westinghouse's assertions to the contrary notwithstanding, in the opening of the circuit breaker at the power house, rendering that section of the road electrically dead. If time allowed, I could point out where one of the companies bearing Mr. Westinghouse's name has advertised to supply precisely such a device, eulogizing its absolute positiveness. Mr. Westinghouse would do well to take a ride through the section of the Fourth Avenue tunnel below Forty-second Street, where electric cars run at high speeds during rush hours on 20 seconds' headway. All the advantages of a properly equipped tunnel are here manifest. I know of no accidents having occurred in this piece of ideal subway. I beg to invite even those who know naught of the technicalities dealt in to contemplate the environment of an electrically driven, lighted and heated train in an electrically lighted tunnel, with atmosphere fresh and breathable, and then compare with this combination a train drawn by a steam locomotive, heated by steam, lighted by gas, in a tunnel filled with noxious lurid fumes.

Electrical Engineers of the Day—XXXI.

A. S. Hibbard.

Mr. Angus S. Hibbard is a native of Wisconsin, having been born in Milwaukee in 1860. He entered Racine College, but ill health forced him to leave college before the completion of his course. Upon returning to Milwaukee he turned his attention to the business of railroads, but gave up that vocation at the end of a year to accept the position of secretary to the general superintendent of the Northwestern Telegraph Company. Here an opportunity presented itself for the study of the telephone, which was then beginning to interest men of affairs. With characteristic enthusiasm Mr. Hibbard took up telephony, and with such signal success that he was made superintendent of the Wisconsin Telephone Company in 1881.

Early in his career with the Wisconsin Telephone Company he earnestly advocated the extension of toll lines, and his work in this direction attracted attention all over the world. He was one of the first to demonstrate the commercial practicability of transmitting speech over long distances. Naturally he was the man to be selected for the first general superintendent of the American Telephone & Telegraph Company. This position brought him to New York City in 1886, where he resided for seven years. These seven years were destined to be prolific in all things pertaining to the telephone. He was one of the first and most earnest advocates of metallic circuits, and expended much energy in securing their introduction.

During his connection with the American Telephone & Telegraph Company, commonly known as the Long-Distance Company, long-distance lines were extended very generally throughout the East and as far west as Chicago. Mr. Hibbard was an active factor in guiding these extensions, inaugurating new operating and maintenance methods, and creating new apparatus to meet the conditions introduced by the construction of long circuits connecting widely separated cities.

In the year 1893 Mr. Hibbard left New York and became the general manager of the Chicago Telephone Company. During his connection with that company the business both, urban and suburban, has been greatly extended, and the system changed from local battery to common battery, with its consequent improvement in service.

Mr. Hibbard has been not only a brilliant executive officer, but he has also been closely affiliated with the engineering side of telephony, and there is hardly a branch of the business upon which he has not left an impression. He has been a member of the various technical committees which have at various times been formed, for the purpose of standardizing methods and equipment. Very many of his improvements have been covered by letters patent, and an idea of their scope may be formed when it is stated that they comprise protective



devices, distributing methods, selective signaling, switchboard designs, operating devices, test circuits, etc. His devices have been used not only in the United States, but also in many foreign countries.

Aside from business, Mr. Hibbard has had many interests, and his friends know him to be a jolly good fellow, and an all-around man. Not endowed by nature with a robust constitution, Mr. Hibbard has sought health as well as recreation in out-doors sports. In the early days of the bicycle he was an enthusiast, and was one of the best amateur riders in Wisconsin. Music is another field in which Mr. Hibbard excels, he having composed several operettas of merit. After the presentation of his most successful operetta, Mr. Hibbard was urged to adopt musical composition and score writing as a profession, and go into the work seriously. Though the inducements offered were of the most congenial nature, his early training in business methods prevailed and music continued as a recreation. For many years he has taken an active part in oratorio work, and is president of one of the largest oratorio societies in the West. With the advent of golf in this country, Mr. Hibbard became a golfer in the most enthusiastic sense, and he has recently built a handsome summer residence within easy reach of the Glenview Golf and Polo Club, Chicago's most popular suburban club. While chasing the elusive golf ball, in an endeavor to outwit Bogy, Mr. Hibbard has been inspired by the muses. His friends were pleasantly surprised to receive recently a copy of "Golfing Songs," which in the spirit of good fellowship, the author dedicated to the members of the Glenview Club.

The Waterside Station of the New York Edison Company—IV. (Concluded.)

Storage Batteries, Boosters and Compensators.

STORAGE BATTERIES are installed at nearly all the stations from which current is distributed, and they perform at least three important functions. First, they insure continuity of the service; second, they smooth out the irregularities of the local demand; third, they assist in the regulation of the system.

The standard battery used contains 150 cells, 75 between the neutral and each outside wire. Each cell has a capacity of 2000 ampere-hours at a one-hour rate, 3000 ampere-hours at a three-hour rate, 4000 ampere-hours at a ten-hour rate.

Fig. 45 is a view of the battery room and a portion of the end cell mechanism in use at the Eighty-fourth Street station, which is characteristic of that at the other stations.

Connections from 20 cells at each end of the battery are brought out to the positive and negative end cell switches, which are operated by a small motor controlled from the main switchboard. Each battery has two end-cell switches on each side of the system, permitting simultaneous connection to two buses. The batteries are charged by means of a booster set, consisting of a 110-hp, 240-volt motor operating at 750 r. p. m., and two 40-kw, 50-volt generators, mounted on the same shaft.

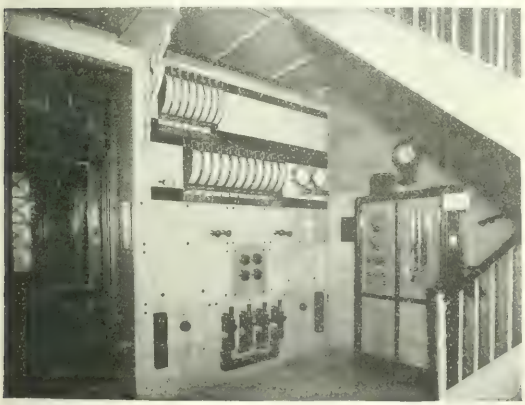


FIG. 45.—LOW-TENSION FEED PANELS AND SWITCHBOARD, EIGHTY-THIRD STREET SUB-STATION.

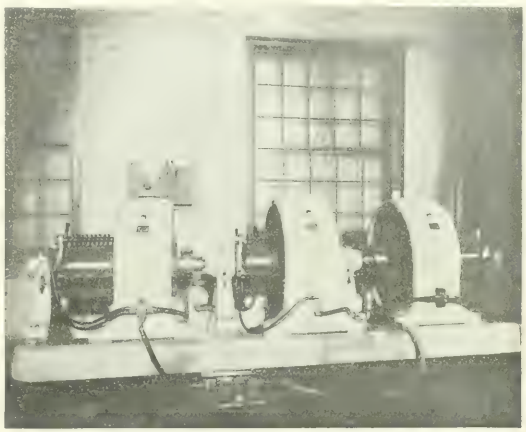


FIG. 46.—BATTERY BOOSTER.

The company's policy of requiring lighting installations of a capacity of more than 5 amperes to be connected on the three-wire system has created an almost perfectly balanced load on both sides of the system. In addition to the battery which assists in maintaining the balance each rotary sub-station is provided with a small compensator set consisting of two 125-volt dynamos, rigidly coupled together and connected in series across the system with the middle point connected to the neutral. When there is a perfect balance both dynamos run as motors, but in case the system is unbalanced one dynamo becomes a generator supplying current to the weaker side.

LOW-TENSION FEEDER SWITCHBOARD.

The low-tension feeder panels are grouped into a positive and negative board, each of which is provided with three sets of bus-bars mounted on the back of the panels, which are built up in sections on the Van Vleck edgewise system. (Fig. 47.) Each panel has two switches, each with a capacity of 1500 amperes connecting with two different busses, and above the switches are mounted a Weston edgewise ammeter and a voltmeter. Pressure wires of each feeder are also connected to a suitable sliding contact switchboard connected to a standard voltmeter.

The feeder neutrals are not brought to the operating switchboard, but are connected with the battery and compensator neutrals to the neutral bus located in the feeder vault of the station. The neutral bus is efficiently grounded at each station and each feeder has its neutral terminal grounded at the feeder end box.

LOW-TENSION FEEDERS AND MAINS.

The feeders and mains are all underground, and are connected in a continuous network in the Edison three-wire system with 2 by 120 volts at the customer's service. In the early underground construction the company used three conductor Edison tubes exclusively, for its feeders and mains, but for some years paper-insulated cables have been used for feeders, and more recently for mains also. For feeders the company has adopted a lead-covered paper-insulated two-conductor concentric cable with a copper section of 1,000,000 cm for each conductor, and provided with six pressure wires (Fig. 48). These cables are designed for a maximum working pressure of 750 volts direct current, and have 5/32-inch paper insulation and a 9/64-inch lead jacket. The common neutral system is used as a general neutral serving for all feeders and connecting with the neutral main at ever block.

The cable mains shown in Fig. 48 are either 350,000 or 200,000 cm. single-conductor, paper-insulated, lead-covered cables. They are designed for a maximum working pressure of 750 volts direct current, with 4/32-inch insulation and 4/32-inch lead jacket.

The accompanying map, printed as a supplement to this issue of ELECTRICAL WORLD AND ENGINEER, shows the extension of the Edison system on Manhattan Island, many of the streets having mains on both sides. The distributing system of feeders and mains represents a total length of nearly 350 miles.

The map shows also the 60-cycle alternating-current circuits in the Bronx district served by the Rider Avenue generating section.

PRESENT STATION EQUIPMENT.

In Fig. 49 is shown the load diagram of the output from the low-tension direct-current service for all stations of the New York Edison Company on Manhattan Island on the day of maximum load, Dec. 23, 1901. The maximum load reached was more than 35,000 kw, exclusive of the alternating-current, 60-cycle service and the direct-

current series arc lamp service of the New York Edison Company. This load was carried by the existing low-tension steam plants, by rotary converters and by the storage batteries distributed among the different stations.

Beginning at the lower end of Manhattan Island in the Bowling Green Building is an annex with two 400-kw rotary converters and a storage battery used for the peak load and local distributing purposes. At Gold Street, near Fulton, is a 1650-hp steam station, equipped also at present with a 500-kw rotary and a storage battery. At Duane Street is the largest station of the company, erected in 1890 and equipped with three 2500-hp, two 1250-hp and three 600-hp engines, all of the multiple expansion type, driving direct-connected dynamos for a 240-volt, three-wire system. The engines are of the Southwark and of the Dickson make, and the boilers Babcock & Wilcox. This station has also a rotary converter equipment consisting of three 1000-kw units. On Elm Street, near Spring, is a rotary substation, with a capacity at present of 2000 kw and a storage battery. At Vandam Street is a 1500-hp steam station, with one 1000-kw rotary converter. At Horatio Street is a sub-station with one 500-kw rotary converter and a storage battery, and at Twelfth Street is a steam

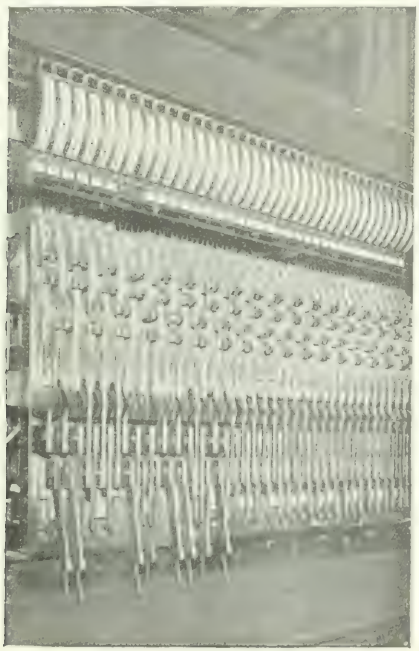


FIG. 47.—LOW-TENSION FEEDER BOARD DUANE STREET.

station containing two 1250-hp compound condensing engines and one 500-hp single-cylinder McIntosh & Seymour engine, two storage batteries and 2500 kw capacity in rotary converters. The Twenty-sixth Street station contains three 1250-hp Southwark, three 600-hp Dickson and two 250-hp Armington & Sims engines, and in the adjoining annex four 1000-kw rotary converters. At Thirty-ninth Street are six 250-hp engines, 3000 kw in rotaries and a storage battery. At Fifty-third Street 1000 hp in engine capacity, 2500 kw of rotaries and two storage batteries. The annex stations in the upper part of the city are as follows: East Eighty-third Street, three 500-kw rotary converters and storage battery; West Eighty-fourth Street, two 500-kw rotary converters and storage battery; East 121st Street, three 500-kw rotary converters and storage battery; West 124th Street, one 500-kw rotary converter and storage battery. A steam station in East Eightieth Street of 3500 hp, with two-phase alternating-current and arc-light machinery, completes the equipment. The storage batteries in all of the plants mentioned, except at Fifty-third Street and Twelfth Street, where the capacity is double the others, are equal to an output of 6000 ampere-hours at 135 volts at a three-hour rate of discharge. They were furnished by the Electric Storage Battery Company.

COMPANY'S INSTALLATION.

The electrical installation supplied from the New York Edison Company system on Manhattan Island, Dec., 31, 1901, is as follows:

Incandescent lamps	970,899
Arc lamps	13,140
Horse-power motors	50,634
Total 16-cp equivalent	1,867,442

Each arc lamp is figured as equivalent to 10 16-cp incandescent

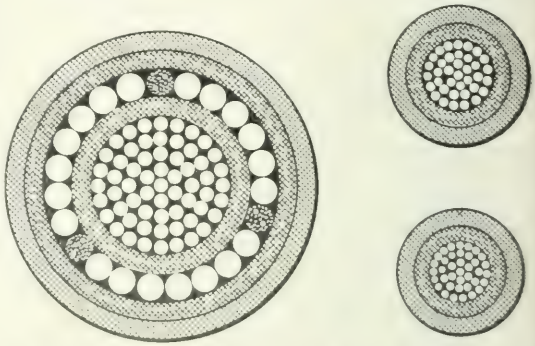


FIG. 48.—CONDUCTOR FOR PAPER INSULATED CABLE FOR FEEDING LOW-TENSION MAINS AND SINGLE-CONDUCTOR PAPER-INSULATED CABLES.

lamps, and each horse-power in motors equivalent to 15 16-cp. The total installation equivalent supplied by central station service on Manhattan Island and the Bronx is 2,282,980 lamps.

The officers of the New York Edison Company are: A. N. Brady, president; N. F. Brady, vice-president and treasurer; T. E. Murray,

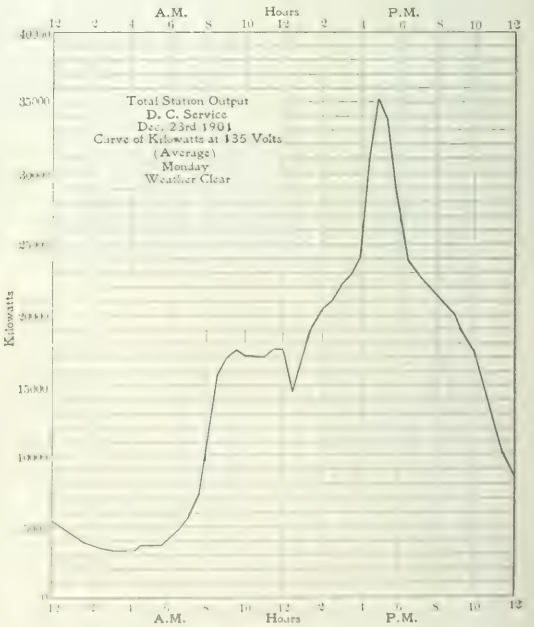


FIG. 49.—LOAD DIAGRAM.

second vice-president and general manager; J. W. Lieb, Jr., third vice-president and associate general manager; L. B. Gawtry, secretary; H. M. Edwards, auditor; Joseph Williams, assistant treasurer; and the following administrative and technical staff: C. S. Shepard, controller; Arthur Williams, general inspector; J. P. Sparrow, superintendent of construction; George Fulton, chief engineer;



FIG. 50.—VAN DAM STREET STATION.

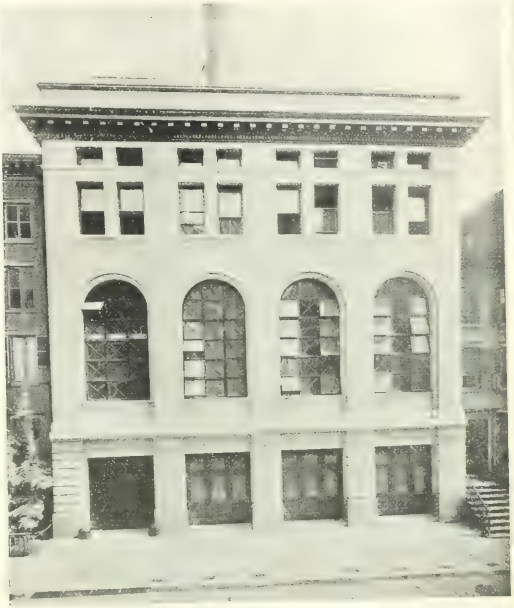


FIG. 52.—TWELFTH STREET STATION.



FIG. 51.—TWENTY SIXTH STREET STATION.



FIG. 53.—DUANE STREET STATION.

STATIONS OF THE NEW YORK EDISON COMPANY.

Henry Stephenson, superintendent of distribution; C. W. Rice, engineer of meter and testing departments; Philip Torchio, engineer of distribution; G. A. Orrok, chief draughtsman; W. I. Donshea, superintendent, first district; H. A. Campbell, superintendent, second district; W. F. Wells, superintendent, third district; W. T. Morrison, acting manager, Bronx district. The plans and specifications of the



FIG. 54.—GOLD STREET STATION.

Waterside station were prepared by the company's engineering staff, of which Mr. John Van Vleck, now of the Rapid Transit Subway Construction Company, of New York, was formerly constructing engineer.

Many of these gentlemen, to whom we are indebted for data, etc., appearing in this article, have been with the company for a great many years, as our readers are well aware. Mr. John W. Lieb, the associate general manager, has in particular been connected with the growth of the Edison lighting system from its pioneer inception, and for well-nigh a decade has contributed by admirable technical and



FIG. 55.—NORTH NEW YORK STATION.

administrative work to the engineering excellence of the plans and performance of the New York Edison Company. It is only necessary to have read this series of articles, to look at the map herewith, and to glance at the stations, great and small, to realize upon such a staff as that given above falls at all times a great burden of responsibility. The manner in which the task is discharged must be judged by the remarkable record, from the economical, engineering and commercial standpoint, which has been made by this, the greatest electric lighting system in the world.

The Growth and Wealth of the United States.

"The Progress of the United States in Its Material Industries," is the title of a monograph issued by the Treasury Bureau of Statistics, which contains a series of statements which show the rapid development during the century of the important factors in the present prosperity of the country. Among the interesting facts presented by these tables are the growth of production, the growth of commerce, the growth of wealth, the growth of money in circulation, the growth of deposits in savings banks and the increased number of depositors in savings and other banks, the decrease in interest on the public debt, and many other facts of this character. On the production side, it may be said that the cotton produced has increased from 155,556 bales in 1800 to 9,436,416 bales in 1900; the wool produce, from 35,802,114 lbs. in 1840 to 302,504,328 lbs. in 1901; wheat, from 151,999,906 bushels in 1866 to 522,229,505 bushels in 1900; corn, from 867,946,296 bushels in 1866 to 2,105,102,516 bushels in 1900; copper, from 650 tons in 1850 to 270,588 tons in 1900; pig iron, from 165,000 tons in 1830 to 15,800,000 tons in 1901; petroleum, from 21,000,000 gallons in 1860 to 2,661,233,568 gallons in 1900; coal, from 3,358,899 tons in 1850 to 267,850,000 tons in 1901; and gold, from $50,000,000 in 1850 to $79,171,000 in 1900.

During the period under consideration exports of merchandise have grown from $70,971,780 in 1800 to $1,487,764,991 in 1901; the per capita in 1800 being $13.37 and in 1901, $18.81. The imports of merchandise have grown from $91,252,768 in 1800 to $823,172,165 in 1901, while the per capita imports have fallen from $17.19 in 1800 to $10.58 in 1901.

Turning to the figures which show the net results of these developments, those relating to wealth, circulation, deposits, etc., the tables show that the wealth has increased from $7,135,780,000 in 1850 to an estimated $94,300,000,000 in 1900; the per capita wealth, from $307.69 in 1850 to $1,235.86 in 1900. The public debt, less cash in the Treasury, was in 1865 $76.98 per capita, and in 1901 was $13.44 per capita; while the interest on the public debt, which in 1867 was $143,781,592, had fallen to $32,342,797 in 1901. The figures of money in circulation show in 1860 a total of $435,407,252, and in 1901, $2,175,387,277. The circulation per capita in 1860 was $13.85; in 1901, $28.02. The deposits in savings banks in 1830 were $6,973,304; in 1883, 53 years later, they were $1,024,856,787, and by 1901, a further period of only 18 years, had reached $2,597,094,580. Meantime, the national banking system had come into operation, and in 1865 the deposits in national banks were $500,910,873; in 1880, $1,006,452,853, and in 1901, $3,044,600,000. The number of depositors in savings banks grew from 38,085 in 1880 to 1,067,061 in 1866, and 6,358,723 in 1901. Railways grew from 9021 miles in 1850 to 199,378 in 1901; and freight carried one mile increased from 39,302,209,249 tons in 1882 to 141,162,109,413 tons in 1900, freight rates falling meantime from 1.24 cents per ton per mile to 75-100th of 1 cent per ton per mile.

Lighting in Rio de Janeiro.

Mr. Eugene Seeger, United States Consul-General, writing from Rio de Janeiro, says: From a prominent representative of Belgian capitalists I have received the following information, which may be of interest to American investors, especially in the gas and electrical industries. The gas company at Rio, which consists exclusively of Belgian capitalists and their representatives and enjoys valuable rights and privileges, is very much in need of funds to make improvements and extensions necessary on account of the largely increased demand and the more modern requirements. In order to develop the earning power the capacity of the plant ought to be greatly enlarged and an electric plant ought to be added. The estimate of expenses for the necessary improvements amounts to about $3,000,000, which sum the company seems to be unable to raise here or in Belgium.

The capital invested in the plant up to date is about $10,000,000, and the company's contract with the city expires in 45 years. The managers would be willing to transfer all their rights and privileges and the controlling interest of the property to an American syndicate which would undertake the necessary improvements, provided they could be accorded a fair share in the net earnings of a new company to be organized on that basis.

Capitalists interested in this enterprise can have the inclosure translated for their benefit. I will, of course, be glad to procure any additional information desired.

The Spectrum of the Enclosed Arc.

By Dr. Louis Bell.

While cleaning a pocket spectroscope the other evening I chanced to turn it, to observe the working of the slit, upon an enclosed alternating series arc easily visible from my study window. The spectrum obtained was so striking and in some respects so instructive that it seemed worth while to put it on record. I doubt not that it has been many times observed, but do not recollect seeing in the technical papers any suitable account of it.

It is well known that the ordinary open arc gives a very brilliant continuous spectrum with light well distributed and possessing no considerable peculiarities of any kind. On separating the poles a bit so that the slit of the spectroscope may receive light from the arc itself instead of from the white-hot carbons one gets a combination of air spectrum and carbon spectrum, the beautiful fluted bands due to the latter showing with exquisite sharpness under high dispersion. But generally speaking the arc as a whole gives merely a strong continuous spectrum closely akin to that of sunlight.

But in enclosed arcs the conditions are very greatly changed, particularly in alternating arcs, which show no crater. The arc is long and formed in a chamber full of heated gases, mainly nitrogen and carbon monoxide. The light comes in part from the hot carbon tips and partly from the arc itself, which is of greatly enhanced brilliancy as compared with an arc in the open air. The striking thing about the spectrum derived from this source is the very great relative brilliancy of the discontinuous arc spectrum. Fig. 1 shows a drawing of the



SPECTRUM OF THE ENCLOSED ARC.

ordinary spectrum of the enclosed arc, made to scale with a direct-vision spectroscope of moderate dispersion. In the lower part of the figure are plotted the Fraunhofer lines of the sun spectrum for reference.

The spectrum of the arc light begins in the crimson near the solar line *C*, everything toward the darker red fading very quickly away. Then comes a fairly bright continuous spectrum through the orange and yellow into the clear green, and then the light fades rapidly up to the bright green of the magnesium group reversed in the sun as *b*. On this continuous spectrum are superposed two brilliant bands of the carbon spectrum, 1 and 2 of the cut. Their edges are indeterminate against the bright background, but they enhance the general light enough to give the appearance of a faint shadow between them, in the yellow of the spectrum.

Then near the solar line *b* begins the carbon band 3 of most vivid and beautiful green, intensely bright and shading off in a way no drawing can well show, into a very faint continuous spectrum reaching through the blue-green and fading into the carbon band 4, a strong, bright, full blue. This band is quite intense and fades away at the edge toward the violet into a narrow region of very dim light, the continuous spectrum here being practically invisible. A little further up the spectrum this is relieved by a moderately bright, deep blue band marked 5 in the drawing. This band falls in the place usually ascribed to a strong band in the cynanogen spectrum, but the dispersion I used was not sufficient to make its identity certain. In fact, the whole matter of the spectra of carbon and its compounds is at present in a rather uncertain state.

At all events beyond this band 5 there is a wide region of darkness, broken finally by the broad and splendid violet band 6. This like the others is due to carbon, and is conspicuously brilliant, shining at times with an intensity that makes it the most striking thing in the spectrum. Compared with the violet in any ordinary continuous spectrum it is enormously bright. Beyond it is complete darkness so far as the eye can see. The spectrum as drawn was from a 7.5 ampere, 60-cycle enclosed alternating series arc on the street. It had a clear outer and light opalescent inner globe. An examination of many similar arcs showed substantially the same results, and rather to my surprise the spectrum of the ordinary 6.8 ampere enclosed series continuous current arc proved to be substantially identical. There was perhaps a trace more of continuous spectrum, but the lower current density seems to have robbed the crater of its efficacy.

With small and larger dispersions, with wide and narrow slits of the spectroscope, the spectra of these arcs preserve the same characteristics. They are notably discontinuous, deriving most of their light from the bands of the carbon spectrum, and are marked especially by the very intense band in the violet. Some of the constant potential enclosed continuous current arcs which I examined showed considerably more continuous spectrum than the series arcs, but the carbon bands were still very noticeable.

All the spectra vary more or less from time to time in the apparent relative brightness of the various regions, as more or less continuous spectrum comes into the background, as the arcs vary slightly in length, or the inner globes in opacity, but the cut is thoroughly typical of average appearances.

The striking violet tinge of many enclosed arcs needs no explanation after a glance at the spectrum. It arises not from any unusual extension of the general spectrum toward the violet end, but from the isolated and extraordinarily brilliant violet carbon band numbered 6 in the cut. The general coloration produced is strong in inverse ratio to the brightness of the continuous spectrum of the carbon tips. With as large a current as 7.5 amperes the general color of the arc is bluish white, while with lower values of the current the hot carbons give comparatively little light, and the violet is more in evidence.

This same violet band accounts for the very remarkable photographic activity of the enclosed arc. It is well known that one can print by such arcs with the greatest facility, and small wonder, for the strong violet band lies squarely in the region of maximum actinic power for ordinary plates, a point where the ordinary continuous arc spectrum is comparatively weak.

If one objects to the violet tinge a shade or outer globe very faintly stained with aurine will bring the light to a quite normal color value or diffusion from a slightly tinted surface will answer the same purpose. But, really, with a proper current density there is no need of this even within doors, although lamps for small currents are in a less desirable case.

One of the most striking things about the matter is that an effect so generally good even in cases of color judging can be produced by a light giving a spectrum so essentially discontinuous. It gives some inkling of what could be done practically by lights like vacuum tubes making no attempt to produce a continuous spectrum, but merely giving lines and bands well distributed in color. In the enclosed arc, as appears from the cut, there is marked general deficiency in the blue, which is compensated by the relatively great intensity of the bands 4, 5 and 6. The net result is a light in which colors appear at very nearly their true values in spite of the discontinuities, provided the current density is reasonably high.

The visible color of a source of light is little index of its composition, as every spectroscopist knows, and in this instance the distribution of the colors through the visible spectrum is rather good. The absence or weakness of a primary color is the thing which makes mischief, and the strength of the red, green and violet carbon bands in the enclosed arc spectrum atones for the gaps in the transition colors to a very considerable extent.

The Canadian Niagara Power Company.

The time for the completion of the Canadian Niagara Power Co.'s work at Niagara Falls has been extended, and the agreement for this extension has been confirmed by the Ontario Legislature. It provides that the period for the completion of the works specified in the agreement of April 7, 1892, be extended to July 1, 1904, under certain conditions. The company must expend, within the Province of Ontario the sum of $500,000 in work, materials, excavations, foundations and erection of buildings, etc., by July 1, 1902, and a further sum of $1,000,000, making $1,500,000 by July 1, 1903. The company will also make default of agreement unless it shall develop at least 50,000 hp by July 1, 1904; and the company must have on that date an outflow tunnel sufficient for not less than 100,000 hp, and have actually ready for use fully 20,000 chp.

The New Power Plant of the Citizens' Company of Rochester, N. Y.

THE new plant being erected by the Citizens' Light & Power Company, in Rochester, N. Y., will be in every respect a first-class modern electrical station, and possesses many features of great interest. The plant is situated in almost the exact geographical center of Rochester, and within less than a half mile of the center of population of the town. It is located on Brown's Race, which takes water from the Genesee River and conveys it to several manufacturing plants for power purposes. The Genesee River divides the city into two portions, from south to north. The new plant will, however, rely entirely upon steam for motive power. The reasons for this decision are, that coal is cheap in Rochester, and the water power furnished by the Genesee River, while practically unlimited during a short season of the year, falls to so low a point during the dry weather, that it is only possible at times, to get enough water from Brown's Race to run the condensers for the engines.

Water storage has been discussed in Rochester for years, but no advance has been made in this direction for so long that people have begun to regard it as something never to be realized. It is, too probable that the expense of storing sufficient water to maintain a steady volume of water in the Genesee River during the dry months would be so great as to be absolutely prohibitive to private capital, and would be an enterprise of such magnitude as could only safely be taken up by the State. Without water storage it is necessary for all users of water to maintain duplicate steam plants of equal capacity to their water plant, and the expense of combined steam and water plants under such conditions, is conceded by all experts to be greater than that of a thoroughly up-to-date steam plant with coal at any reasonable figure.

The plant is built on the side of a cliff, which is excavated to two grades, the upper one being used for the boilers, and the lower one for the engines and dynamos. With this arrangement coal can be carted directly over Brown's Race, dumped into the storing bin and fed thence by gravity through automatic weighing apparatus into automatic stokers, and thence into an ashpit, from which the ashes are removed by a mechanical device. Rochester has become well known as the best lighted city in this country, with about 2800 arcs out of a total of 2930 street lights, and there is practically an unlimited demand for lighting and power from all parts of the territory. We will now proceed to details of the new work.

The Citizens' Light & Power Company, which commenced operation in the fall of 1892, had their plant ready for business Nov. 17, 1893, on Brown's Race, an artificial waterway 36 ft. wide by 7 ft. deep, running from the river at Central Avenue to Brown Street, where the overflow returns to the river. The Citizens' Company built its plant on the river bank below this race, which gave them a head of 93 ft. The original plans were for a building eight stories high, but were finally cut down to three stories and a wheel pit. The company started in with one or two machines, but at the time of the destruction of the plant by fire on Nov. 25, 1900, they had installed and were operating three 500-hp waterwheels, two 600-hp Corliss engines, and one Woodbury tandem compound 600-hp engine, all of which were connected with four jack-shafts on the floor above by rope drives running 7000 per minute. In the boiler room there were eight horizontal tubular boilers of 125 hp each. This steam plant was a very necessary adjunct, as the Genesee water supply is a very precarious and uncertain quantity, the company being obliged to carry a full head of steam always, as they could take no chances of having their business interrupted.

On the floor above the shaft room was the dynamo room. In it there were installed six 150-kw. double-current Westinghouse dynamos, belt-driven from clutch pulleys on the jack-shaft below. They gave 380-volt, two-phase, 50-cycle alternating-current from one end and 500-volt, direct-current from the other end, the idea being to operate all the alternating-current ends in multiple on the alternating-current switchboard and all the direct-current ends on the direct-current switchboard, but were finally operated by running the alternating-current ends together and putting in two Westinghouse 150-kw multipolar machines for the 500-volt work, as there was usually a pyrotechnic wind-up when they attempted to operate both ends at once. They also had two Western Electric 60-light series arc machines.

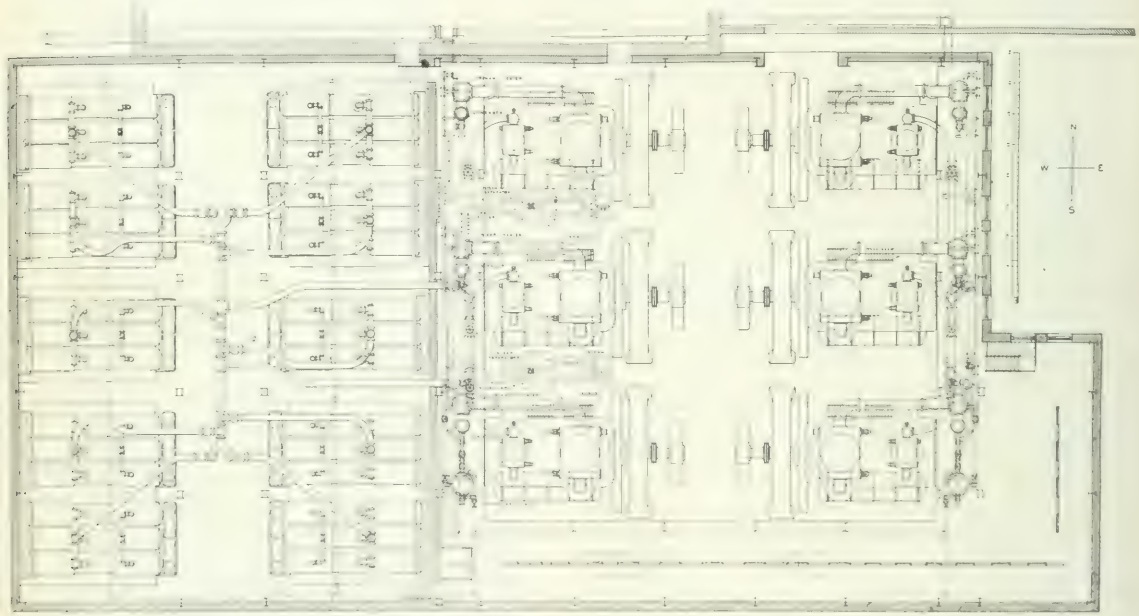


Fig. 1.—Plan of Citizens' Company's Station, Rochester, N. Y.

After this plant burned down it was bought by the present company, and the old station was reconstructed, to be operated until a modern direct connected plant could be built. The reconstructed station consists of the same engines and waterwheels; one jack-shaft was cut out, and two 180-kw Westinghouse two-phase, 2200-volt composite alternators were installed to replace three of the old double-current machines, three of which were installed again, two being used for power along with the two 150-kw multipolar Westinghouse 500-volt machines, and one on lighting circuits separately. The 180-kw machines were run in multiple on the balance of the load.

Business came in so fast that the company decided to erect a tem-

porary engine at once on the site of the new plant; consequently, a direct-connected 500-kw Stanley unit was installed, driven by a horizontal cross-compound Dickson engine and a 650-hp water tube boiler. This machine is also run in multiple with the 180-kw machines, the composite commutators being disconnected and the series and separate winding being connected in series on each machine.

On Christmas Eve all these machines were overloaded, and had an exact balance on every phase, and their proper share of load in proportion to their size, the total being 900 kw. These dynamos were being driven by hand-regulated waterwheels and Corliss engines on the same shafts, and the 500-kw unit by a cross-compound condensing engine, and they worked to perfection. The company also replaced the Western Electric arc machines with three Thomson-Houston light arc machines. The 530-volt direct-current power load goes as high as 800 amperes, and the alternating-current lighting load to 400 amperes at 2260 volts, and two arc machines fully loaded. A load diagram of that date is shown in Fig. 5.

Just south of the old station is a piece of property about 200 ft. long by 96 ft. wide, which was occupied in part by an old factory. This property was acquired, and the old buildings were torn down, revealing the solid rock extending from the race on the west, at an elevation of about 99 ft. above low water to a factory building on the eastern side, about 23 or 24 ft. above low water. On the south side of the new property is located a large factory building, so that in excavating for the new station it was necessary to channel the rock at a distance from the property line of about 2 ft., in order to preserve the adjoining foundations from injury. This left a width of about 93 ft. on which the new station could be built. After a number of studies, it was decided that the engine house should be erected on the end of the lot towards the river, with the boiler house on a step of such height that the coal for use in the station might be driven in the ordinary coal carts from the race street on to the roof and dumped through holes into a coal pocket, which should be situated above the boilers. The race itself runs in a general northwesterly and southwesterly direction, 43 ft. from the building, along the northern side of the lot and 10 ft. from the building at the southerly side. The rock on this line was channeled down to about a grade of 58 ft. for the main floor of the boiler house. The boiler house basement, which is only of sufficient width to take in the two ash-hoppers and the center aisle, was channeled down 10 ft. deeper, while a step of 30 ft. was made to take the west wall of the engine room. The solid rock was leveled up with concrete to about the grade of various floors, as shown on the cross-section, and preparation was made for receiving the steel work, which will shortly be erected.

The design of the building is similar to that of other large electric lighting stations which have been built in the last year, notably that of the Third Avenue station of the Brooklyn Heights Railway Company, Brooklyn, N. Y. The engine room has mezzanine floors on either side, which support steam piping, condensers and other auxiliary apparatus, leaving the engine room a clear space, devoted to engines only. The engine house proper is approximately 76 ft. square inside of the columns, and is spanned by an electric traveling crane of 35 tons capacity, made by Alfred Box & Co., of Philadelphia. The engines themselves are set in two lines, running north and south, with the shafts running east and west, 25 ft. 9 inches from center to center. The generators are outboard of the engine, occupying the center of the engine room, leaving an aisle 10 ft. wide between the two lines of generators.

On the east and west sides of the engine room the four mezzanine floors are placed, the two lowest being continuous with the engine platforms. The third mezzanine is used for the support of the condensers and heaters, and the fourth mezzanine, 46 ft. 8 inches above the engine room floor, has as its outer edge the supports for the crane runway. Eight ft. above this mezzanine floor extends the lower chord of the engine room trusses, which span the engine room from wall to wall 90 ft. in the clear. These trusses are 9 ft. deep at the ends, with the upper chord on a slope ½ inch to the foot, to provide drainage for the roof. A monitor, to give light and afford ventilation for the engine room, extends down the center of the roof, in a north and south direction, above the trusses.

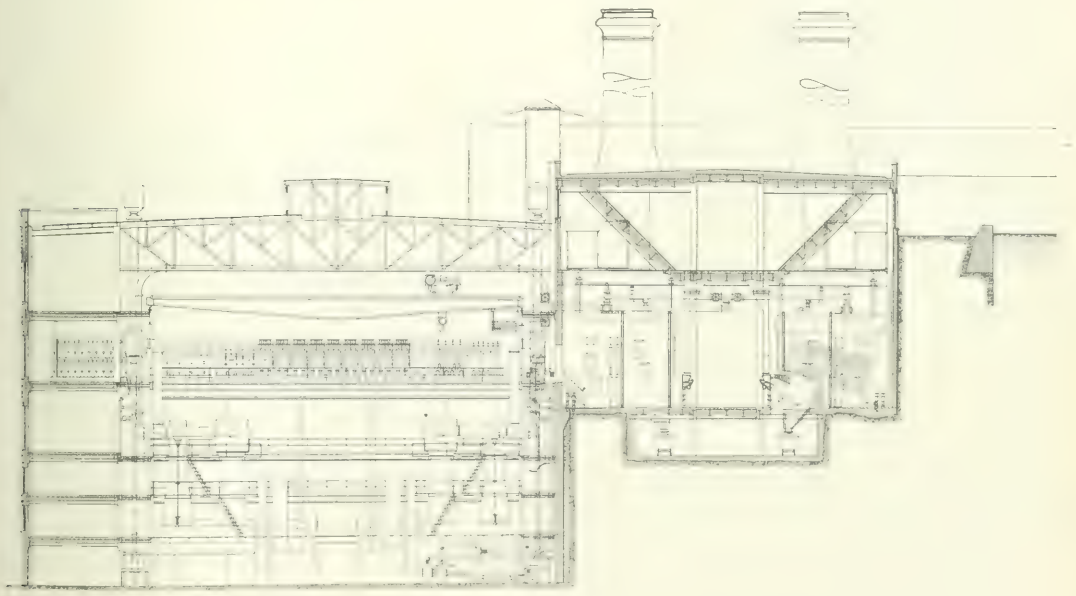


Fig. 2.—Elevation, Citizens' Company's Station, Rochester, N. Y.

At the south side of the engine room are three electrical galleries. The two lower are 12 ft. 6 inches wide, but the upper, on which the switchboard is located, is 16 1-9 inches wide. On the southeast corner of the engine room an addition extending up the full height of the building, 18 ft. 6 inches by 43 ft., serves for additional switchboard space.

The boiler house is 89 ft. 4 inches by 68 ft. 7 inches in the clear, and when complete will contain ten 650-hp B. & W. type boilers, made by the Aultman & Taylor Company, of Mansfield, Ohio, set in four batteries of two boilers each, occupying the four corners of the boiler house, with a single boiler set in the center of either side occupying the space immediately under the stacks. The boilers are set with no space behind them, cleaning doors being provided at the side instead of in the back. The boilers will be fitted with Acme stokers and smokeless furnaces of the latest type.

The up-takes from the boilers will occupy the full width of the

boiler, the back wall being protected by a cast iron plate. These up-takes go directly upwards into the bottom of a flue, which extends the full length of the boiler house on each side, discharging into the bottom of the stacks near the center of the station. The coal pocket having a capacity of 1300 tons, occupies the second story of the boiler house.

The roof over the boiler house is made sufficiently strong to support large coal wagons, which will deliver fuel for use in this station. Numerous hatches are provided, so that the coal may be dumped into the coal pocket and entirely fill it without trimming by hand. The foundations for the stacks are also in this roof, and consist of heavy beams and girders, as will be noted from the description of the structural work. The plate stacks themselves are 10 ft. 3 inches in diameter, 178 ft. above the grates, and 130 ft. above the base or foundation girders. They are lined for 20 ft. above the base with 4½-inch firebrick, and are two in number, standing on the east and west center line of the station, about 41 ft. from center to center. They are surmounted with a lotus, of neat design. A boiler house roof bridge, on a grade of 5 per cent, connects the roof with Brown's Race, forming a runway over which the coal carts can pass, to attain the roof of the station. From a point on the roof of the engine house, near the center of the south wall, a cable runway is built above the roof, following the southerly line of the building and bridging Brown's Race to a cable tower on the west side of the race. Through this cable runway all the electrical cables of the station will be taken to the underground conduits.

The outside building lines in many cases, are only 6 or 8 inches away from the rock, which often extends as much as 40 ft. above the base of the wall, and provision has been made for the water-proofing of the outside of the wall and the proper draining of the space enclosed between the rock and the water-proofing. The walls themselves are to be built of the best hard burned red brick, of selected quality and color. Up to the original rock level the walls are to be laid up in Portland cement, and above this in Rosendale cement. The interior exposed walls of the engine room are to be faced with a hard, light buff face brick, with an enameled brick wainscot running around the engine room about 5 ft. above the floor. This is to be of white enameled brick, with the three lower courses of chocolate color brick.

All floors, with the exception of the main floor of the engine-room, are of expanded metal construction, faced with a 2-inch coat of granolithic finish. The engine room floor itself is to be made of cast iron checker plates, ¾-inch thick, and properly ribbed. The roof of the engine room will consist of terra cotta roofing tile, laid between T-irons, covered with composition roofing and slag. The roof over the boiler house is to consist of expanded metal arches covered with composition roofing and vitrified paving brick, laid on edge, in roofing cement.

As the station has no frontage on the street, the main door of the station will be situated upon the roof, near the partition wall at the south side of the station, and stairs and an elevator will connect this entrance with various floors of engine and boiler rooms.

The engine and generator foundations are of monolithic concrete moulded in wooden forms. Granite capstones are omitted as the quality of the concrete will be excellent, and the heavy cast iron engine and generator bases will be leveled up and grouted with fine gravel concrete. Besides carrying the engine these foundations support the floor beams for the main floor.

Two styles of steel supporting columns are used, one made up of two 12-inch channels, with 16-inch cover plates, and the other of one 16-inch plate and four 6-inch by 4-inch angles, the latter being used in the walls and supporting the crane girders where a greater resistance is required in one direction than in another. As the entire station rests on solid rock, and it being possible to so level the rock off that the base plates on the columns come down to within about 1 to 3 inches of the top of the rock, the column bases were proportioned so as to give under full load a pressure of 36 tons per square foot. This permitted the use of steel bases riveted to the bottom of the columns.

The engine room proper is 76 ft. wide, center to center of columns, supporting the mezzanines and crane girders, and 76 ft. 6 inches long, with mezzanine floors on each side, 6 ft. 10 inches wide. The first two mezzanine floors are on the same level with the engine platforms, the third mezzanine floor is on the same level as the main electrical floor and carries the primary and secondary feed-water heaters and conductors, and the fourth mezzanine floor is 6 inches below the top of the crane girders, and is supported on one side by them as will be seen by referring to the cross section of station. The crane girders supporting the 35-ton crane are 76 ft., center to center; and as it is absolutely necessary that this span be maintained throughout the entire length, a special means of adjustment was designed by which this could be accomplished, by the use of packing plates.

The boiler house is 69 ft. 11 inches wide center to center of columns, and 89 ft. long. The boiler fronts, the automatic stoker, the concrete ash hoppers and part of the side walls of the boilers are supported by the main boiler house floor, but the boiler drums and tube sections are hung from pairs of 15-inch I-beams, which frame into the horizontal coal pocket girders. Above the boilers is the coal pocket, which is 21 ft. wide at the bottom with sides sloping at 45 degs., and 17 ft. 6 inches high to the bottom of the boiler house roof beams.

As the coal is delivered by means of large coal wagons driving over the roof and dumping directly into the coal pocket through any one of the 18 coal holes, it was necessary to make the roof of a substantial and heavy construction. The girders in the boiler house roof are made up of one web plate 36 inches wide and four angles 6 inches by 6 inches, with 14-inch cover plates, where required, and the floor beams are 15-inch by 42-lb. I's, spaced about 3 ft, 6 inches apart. In the center bay of the boiler house are located the two stacks, each stack being 20 ft. 6 inches from the center of the building. The stacks are supported from the boiler house roof by a heavy system of girders and beams. The entire structural work, including the stacks and flues, the stairways, and ornamental facial work is furnished by the American Bridge Company.

The station is designed to accommodate six vertical cross-compound engines, three of which are at present being built in the shops of the Southwark Foundry & Machine Company, Philadelphia. Each engine is arranged to drive one 1360-kw, 2400-volt, 60-cycle alternator placed between the low-pressure side of the engine and an outer pedestal. The diameters of the cylinders are 28 and 68 inches, giving a ratio of 6, and the stroke 48 inches. The engines are designed to run at a normal speed of 90 r. p. m., with an initial steam pressure of 160 lbs. and a vacuum of 26 inches. Under these conditions each engine will develop 1800 hp at 30 per cent cut-off, and a maximum of 3000 hp. They will, however, be built strong enough to work under 200 lbs. steam pressure.

When running with the most economical load they will require less than 13 lbs. of dry steam per ihp per hour, including the steam used in the reheater, while the steam variation from no load to full load will not exceed 3 per cent from the normal. Under any change of load, the internal variation of speed will not exceed ¼ of 1 geometrical degree from the position of uniform rotation. The design of the engines is a most pleasing one, and the massive construction of the parts will at once impress one upon an examination of the outline drawing.

The shaft is of open-hearth forged steel, having a single arm crank on the high-pressure end, and a double-arm crank on the low-pressure side of open-hearth cast steel ,and counterbalanced to offset the weight of the reciprocating parts. The flywheel is 20 ft. diameter, and weighs, with the armature sleeve, close to 125,000 lbs. It is made of cast-iron segments, securely held together at the rim by tee-headed shrunk links, and at the hub by means of fitted bolts through the arwhich lap the joints in the cast-iron rim, and are secured to it by through rivets. The armature sleeve is bolted directly to the spokes of the generator, thus relieving the shaft of any strain between the flywheel and generator.

These engines, as indeed all engines for 60-cycle, three-phase generators recently built by the company, use the King regulating device for readily synchronizing the machines. The operator on the switchboard sends current at will through a small motor, which acts as a governor counterweight, thus enabling him to vary to any extent, the speed of the engine. The governor is of the well-known Porter type, and controls the cut-off on both the high and low-pressure cylinders. It is driven by steel cut spur gears direct from the main shaft of the engine.

The reheating receiver has a reheating surface, which appears tremendous when compared with the short tubes in some of the reheaters recently described, but the builders claim that this is absolutely necessary if the steam economy is to vary but slightly under all conditions of load. The total weight of each engine is about 500,000 lbs., and the dimensions of the principal parts are as follows:

Main bearings—inner (2)	18 in. × 24 in.
Main bearings—outer (1)	22 in. × 40 in.
Outer bearing (1)	20 in. × 30 in.
Crank pin—high-potential	12 in. × 10 in.
Crank pin—low-potential	15 in. × 10 in.
Cross-head pins (2)	9 in. × 10 in.
Piston rods (2)	6½ in. diameter.

A Bulkley condenser is provided with each engine, capable of condensing 24,000 lbs. of steam per hour, and maintaining a vacuum of 26 inches when supplied with cooling water at 75 degs. F. The usual automatic free exhaust valve and connections are placed in the exhaust pipe of each engine, and a Wainwright feed-water heater, suitable for 1800 hp, are fitted with corrugated copper tubes, is connected to each engine exhaust pipe.

The feed water is taken from the hot well or from the city water connections, and is handled by two duplex outside packed plunger pumps, with two 12-inch diameter high-pressure cylinders, two 18-inch diameter low-pressure cylinders, four 9-inch diameter single-acting water plungers, with a common stroke of 18 inches. These pumps are to work against 250 lbs. water pressure, and either is sufficiently large to handle the entire installation. They were furnished by Thomas A. Lewis. From the pumps feed water is taken through the primary heaters, located in the exhaust pipe between the engine and condenser, then to the secondary heater, where it is heated nearly to the boiling point, and from thence into the feed mains, which run along underneath the boilers immediatley in front of the ash hoppers, where connections are made to the vertical lines at the side of the boiler, as mentioned before.

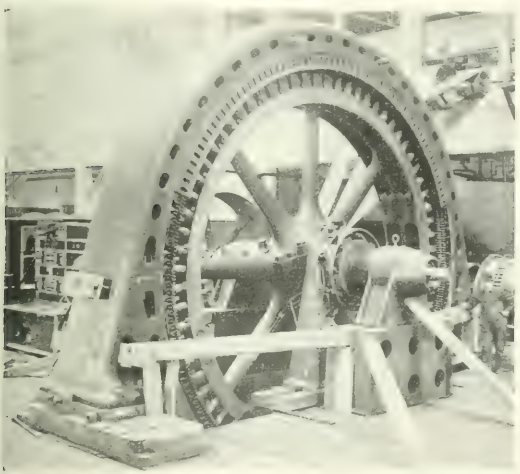


FIG. 3.—1360-KW [illegible]

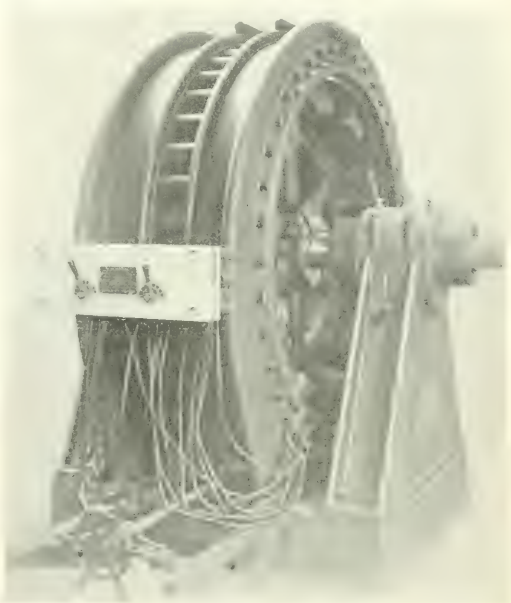
Both the primary and secondary heaters were furnished by the Taunton Locomotive Manufacturing Company, and are of the Wainwright evenflow type with corrugated copper tubes. There are six primary heaters.

GENERATING APPARATUS.

The generating apparatus consists of six 1360-kw, 2500-volt, two-phase, 60-cycle, 90 r. p. m. steam-driven generators, installed in the main station, and three 350-kw, 2500-volt, two-phase, 60-cycle water-wheel generators, direct connected to three turbines, installed in the adjoining station, transformed into an extension of the main operating room. The 1360-kw steam-driven generators, which are of the revolving field type, are designed to carry full rated ampere load and voltage, with a power factor of 80 per cent, and also to carry at rated voltage 25 per cent ampere overload at 90 per cent p. f. for three hours, or 50 per cent ampere overload at 95 per cent p. f. for one hour, after a continuous full-load run, without heating more than 60 C. (by resistance) over the surrounding air. The waterwheel Stanley generators have also a liberal overload capacity and low-heating limit. The excitation of the present generators is provided by two steam driven 75-kw, 125-volt, direct-current exciter sets; but later an induction motor exciter will be added to supplement the steam-driven exciters. These were installed first on account of the greater reliability for continuous service, the excitation of the generators being thereby made independent of any electrical disturbance, which might affect the regular operation of the system, and also on account of the relatively high economy realized by utilizing the exhaust steam to heat the boiler feed water, as this station has no other steam auxiliaries except the boiler feed pumps and stoker engines.

In this station will also be installed three 500-volt motor-generator sets, to replace the old equipment in the old station, and to provide new capacity for this service. These motor-generator sets consist of two sets of 250-kw and one set of 500-kw, 500-volt compound-wound generators, direct driven by 2200-volt synchronous motors. The motor-generators will be started from the direct-current side, and to provide direct current in case of shut-down of the 500-volt direct-current supply a 50-kw, 500-volt direct-current generator has been installed at one end of one of the exciter engine shafts furnished with a coupling. This small generator will also be used to carry light loads as well as for occasionally starting the motor-generator sets.

All electrical connections of generators and exciters, etc., are brought to the operating switchboard in the gallery, running east and west on the south side of the station, and having a lateral extension on the east wing of the station. On this gallery and at the center



[illegible]

facing the center aisle of the operating room are placed the nine generator panels, with instruments and switching gears on the front of the panel and two sets of busses with transformers, etc., on the back. The main switches are single-throw oil switches, with an independent oil tank for each of the four legs of the two-phase circuit. From the oil switch the circuit is brought to a specially designed two-bus knife blade selector switch mounted on top of the panel and operated by a system of gears and levers controlled from the front of the panel. These switches make connections to the two independent sets of bus-bars and enable one to operate different generators on different bus-bars whenever it may be desirable to do so to ensure the continuity of service of the whole system. Each generator panel is equipped with two alternating-current ammeters, one alternating-current voltmeter, one field ammeter, an indicating wattmeter, a ground detector and a synchronizer consisting of two transformers, one on the machine side and one on the bus side of the oil switch, with two synchronizing lamps and a switch in series as well as generator and field switches and an overload relay. The field rheostats are located on the mezzanine floor below the operating switchboard with rheostat dials clamped to iron beams below with pedestal and controlling wheel mounted above in front of each machine panel, and within easy reach of the operator.

On the east side of the machine panels are mounted the exciter panels equipped with ammeters, voltmeters, ground detectors, field rheostat dials, etc., and necessary switches. After the exciter panels come the alternating-current lighting single-phase panels, with two circuits to each panel. Each circuit has a double-throw oil switch, one ammeter and two expulsion fuse blocks. At the extreme end, and on the bend along the eastern ring of the gallery is provided ample space for alternating-current series arc lamp panels.

At the west side of the generator panels are mounted four power panels controlling four two-phase high-tension cable feeders transmitting 2500 volts two-phase current to the direct-current motor generator sub-stations. For safety as well as for economizing space and bring all apparatus within easy supervision of the switchboard attendant, two electrically-operated oil switches, one for each set of busses, have been adopted for these power panels, on which are only mounted two ammeters, one power factor indicator, one polyphase wattmeter, one overload time limit relay and a set of small switches controlling the two electrically-operated oil switches erected on the mezzanine floor below. On the same panels are also mounted synchronizers, which allow to synchronize and close both switches at the same time, thereby tying together the two busses. The load can then be shifted from one bus to the other bus, and the first set of switches opened, thereby disconnecting the sub-stations from the bus without disturbing their operation. Under normal operation, however, the two oil switches on the power panels will be interlocked so as to prevent unintentional closing of both switches at the same time. Following the sub-station power panels there are two power panels

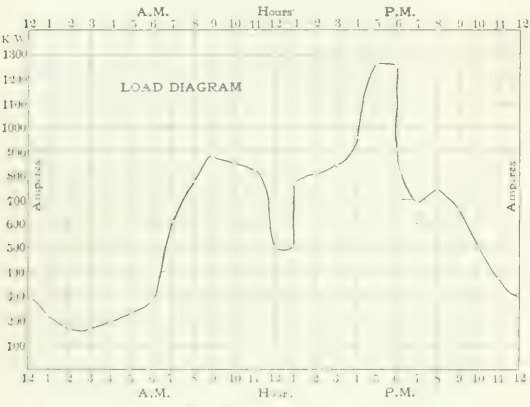


FIG. 5.—LOAD DIAGRAM.

for the 500-volt motor-generator sets installed at the station. Also, for these panels electrically operated oil switches, mounted on the mezzanine floor below, have been adopted, and on the panels are mounted the main 500-volt direct-current switches and field switches, the small starting switch, the switches controlling the E. O. oil switches, the synchronizing lamps and also alternating-current ammeter, p. f. indicator, direct-current ammeter, time limit relay, direct-current circuit breaker. The instruments and switching gears of the two 250-kw units are mounted on one panel and the 500-kw unit, with the 50-kw starter and motor-generator starting switch are controlled from the second panel. Field rheostats and dials are on the floor below, and are operated from stands in front of the panels.

The 500-volt direct-current passes then through a totalizing panel, with ammeter, wattmeter and ground detector, and feeds three direct-current feeder panels, two circuits on each panel, each circuit being equipped with knife switch-current breaker and ammeter.

From the switchboard gallery all wiring is carried in suitable ducts and cable racks to the large manhole in the street outside the station, and from this point the cable circuits are carried underground to the center section of the city, or to the other sections of the city where overhead distribution is used

The sub-station power feeders are made up of paper-insulated, lead-covered duplex cables, drawn into tile ducts, with manholes at every street intersection. There is now only one sub-station located at Minerva Place, near main Street, and at the center of distribution of the business section. The sub-station was a manufacturing building, of which only the basement and first floor have been used for the sub-station, leaving the tenants above undisturbed. In this sub-station are now being installed two motor-generator sets, consisting of one 500-kw synchronizing motor, operated from the 2200-volt, two-phase supply, and driving two direct-connected 250-kw, 135-volt, 360 r. p. m. direct-current generators. In addition a small 75-kw motor-generator set is installed, to be used as a starter as well as to operate at light loads.

All switchboard apparatus is mounted on the same gallery, running lengthwise one side of the building. At one end are the machine panels, with oil switches, bus-selector switches, instruments and synchronizers and overload time limit relays. At present there are no feeder panels, the machine panels being now used also as feeder panels, the feeders being connected to two sets of bus-bars, from either of which any machine can be operated by means of the bus selector switches. Field rheostats of motors are installed underneath the gallery and rheostat dials are controlled from the front of the switchboard.

The low-tension, direct-current switchboard, separated from the high-tension switchboard by heavy soapstone barriers, is divided into three sections, in this order: First, the neutral bus, from which the operation and regulation is accomplished; second, the positive outside pole switchboard for generators and low-tension feeders; third, the negative outside pole switchboard for generators and low-tension feeders. On the neutral switchboard are mounted the main neutral switches, field switches and starting switches, with field rheostat dials, ammeters, station voltmeter and standard feeder voltmeters. The outside pole switchboards have two sets of bus-bars, which can be tied together, and each feeder is equipped with an ammeter. The low-tension feeder cables drop from the feeder switchboards, and, properly racked, are brought to the cable vault, where connections are made to the underground cable feeders. These are drawn into subway ducts and brought to the intersection of Minerva Place and Main Street, where they branch out in different directions, in the existing subways, reaching out into the heavily loaded districts in this section of the city.

The company is now using concentric cables of 1,000,000 cm. sectional area for each conductor, with six pressure wires for feeders and 350,000 cm. and 200,000 cm. single-conductor cables for mains. The neutrals are now of 350,000 cm. section, but 1,000.000 cm. cable will also be used. All low-tension cables are paper-insulated, and are designed for a working pressure of 750 volts direct-current.

It may be wondered at first that a steam-generating plant of this size and importance should have developed in this section where water power is at times so plentiful, but the parties responsible are very confident of the advantages of steam generation over water power, basing their claims first on the fact that water power is uncertain and inadequate at certain periods, which makes it necessary to install an auxiliary steam plant of equal capacity to the water plant, thereby adding expense to the investment account, as well as to the production cost; second, that the water power has to be utilized at several stations, which is detrimental to the economy of operation; third, that the steam plant and the water plants require duplication of station apparatus and transmission lines, and, fourth, that in a highly efficient steam plant, with the price of coal as low as it is in Rochester, the cost of coal is a small factor of the total cost of production and distribution.

The entire plant has been designed under the supervision of Mr. Thomas E. Murray, of New York City, who has conferred as to local exigencies with Mr. M. J. Warner, the general manager of the Citizens' Light & Power Company, and Mr. A. Anderson, the operating superintendent of the Citizens' Light & Power Company. A sufficient guarantee of the efficiency and excellence of the plant is furnished by the fact that Mr. Thomas E. Murray has designed in the past such stations as the Kings County Electric Light & Power Company, of Brooklyn, N. Y., of 10,000 hp capacity; the Waterside station of the New York Edison Company, with a capacity of 150,000 hp; the station of the Equitable Gas & Electric Company, of Utica, N. Y., of 3000 hp capacity, and the Third Avenue station of the Brooklyn Rapid Transit Company, of Brooklyn, N. Y., with a capacity of 50,000 hp.

The fact that the Citizens' Light & Power Company will generate alternating current at 2200 volts will result in giving the citizens of Rochester as satisfactory electric service in the outskirts of the town as in the center, a great desideratum not enjoyed before.



FIG. 1.—PERSPECTIVE VIEW OF THE PHILADELPHIA MINT.

he Electric Light and Power Plant of the New United States Mint, Philadelphia.

BY CLAYTON W. PIKE.

HE new United States Mint, of Philadelphia, is one of which every American may justly be proud. In architectural beauty few of our public buildings are its equals. In size and arrange- nt no other mint, either in this country or abroad, rivals it, while ompleteness of mechanical equipment and in the modernness and elty of apparatus, and particularly in the extensive use of electric er transmission it far surpasses all others.

he foundations and vaults of the building were started in the ng of 1897, while the superstructure was not commenced until 9. The contract for this work was awarded to the late Mr. rles McCaul. Owing to the very great care which had been used he preparation of the plans for this work, it was possible to com- e the building in a period of time which, considering the nature nd materials employed in its construction, was extremely short. that the completed building was turned over to the local Mint au- rities by June 13, of this year, while parts of the building had n in use for several months before that date.

he coining machinery, the power plant, the electric transmission, ther with the extensive subsidiary electric apparatus, was in- led under the plans of Mr. Edwin S. Church, the superintendent machinery of the Philadelphia Mint. The electric generators ch furnish the current for both power and light were furnished the Crocker-Wheeler Company, of Ampere, N. J. Almost all of motors used throughout the entire building in the various pro- es and on the punches, rolls and other machines are of the same ze as the generator.

his building having been started before the Tarnsey law went n effect, the design was made in the office of the supervising itect. To those who are familiar with the government architec- during the past few decades, the result is no less of a surprise n a gratification. The supervising architect has been represented tinuously at the building by the resident superintending architect. Amos J. Boyden, assisted by Mr. R. H. Chappelle, the inspector mechanical and electrical work, and to the continuous presence hese gentlemen is due a great deal of the rapidity with which the ding has been completed.

t is not uncommon at the present time to hear jibes, sometimes d-natured, at the slowness and perhaps inefficiency of govern- ntal departments. The writer, in contrasting his experience in building with that in others, is led to wish that forethought and gment in design, and knowledge and care in execution were to be nd in all buildings to the same extent that they have been evinced his.

STEAM GENERATING PLANT.

he amount of power generated in this plant, the extensive use of chines driven by direct-connected electric motors, together with the use of all the appliances which go to make up a complete and modern plant make this installation one of the most interesting to the electrical engineer.

The boiler plant consists of eight Babcock & Wilcox 150-hp boilers, and equipped with the Hawley down draft, designed for a pressure of 150 lbs., although it is expected that the working pressure will be only 125 lbs. They are arranged in batteries of two in two sets of four boilers each, as will be seen in the accompanying plan, and each set of four boilers is connected with a Green economizer arranged with a by-pass, so that the hot gases can be taken directly to the stack without passing through the economizers. For artistic considerations it was desirable to avoid the use of a high-stack, and since in the refiner nitrous fumes are copiously produced, it was decided to use an artificial draft. This is produced by a 96-inch Sturtevant fan, driven by an engine at each end of the shaft, arranged so that either engine may be used to operate the fan.

The boilers are supplied by two duplex Barr pumps, and the piping

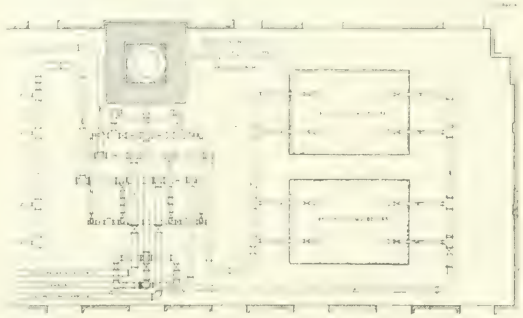


FIG. 2.—PLAN OF BOILER ROOM.

is so arranged that either pump can be used to force water into either end of either boiler. The feed water is heated by a 700-hp vertical exhaust steam-feed water heater arranged with a by-pass and by the economizers.

The steam piping may be considered as made up of three systems—the high pressure, medium pressure and low pressure. The high-pressure system, intended to be operated at 125 lbs., is used to supply the large generator engines. This system is completely in duplicate so as to avoid the chance of a possible breakdown. The medium pressure system, intended to be operated at 70 lbs., is used to supply the small engines and pumps, the reduction in pressure being obtained through a pressure-reducing valve. The low-pressure system is to be used for heating, and is supplied either from the exhaust of the engines or pumps or by means of live steam taken through a reducing valve.

The building is principally heated by the Warren Webster vacuum

system of direct heating. This is supplemented by the ventilating system, which makes use of heated air, which is filtered by being drawn through cloths of close fiber cheviot. The heating apparatus, together with the boiler auxiliaries and the entire plumbing of the building, was installed by S. Faith & Co., of Philadelphia. Among the plumbing features is the arrangement of electrically-driven pumps, by which the various rooms in the building are supplied with both hot and cold water.

POWER PLANT.

The generating plant, the general arrangement of which is shown in the accompanying diagram, consists of four direct-connected slow-speed units. The engines were made by the Edw. P. Allis Company, of Milwaukee, and are one of 100 hp, one of 200 hp and two of 300 hp. They are equipped with new style dashpots, which operate with much less noise than is usual, and permit a higher speed. These engines are erected upon foundations about 9 ft. deep, resting upon a concrete sub-base 12 in. thick. They are guaranteed to give a water consumption not exceeding 23 lbs. per ihp per hour for the smallest size engine and 21.5 lbs. for the largest. The 100-hp engine is intended to cover the night load, and one of the 300-hp engines is expected to serve as a spare unit. Direct connected to these engines are two 200-kw, one 150-kw and one 75-kw Crocker-Wheeler generators designed for 250 volts, and for speeds of 100 r. p. m., 135 r. p. m. and 150 r. p. m., respectively. Their magnet frames are cast iron, and of the internal girder construction, the yokes being divided horizontally. The diameter and face of the commutators are generous in their proportions, and the practice employed by the manufacturers of these generators provides long air-gaps, so that any slight inac-

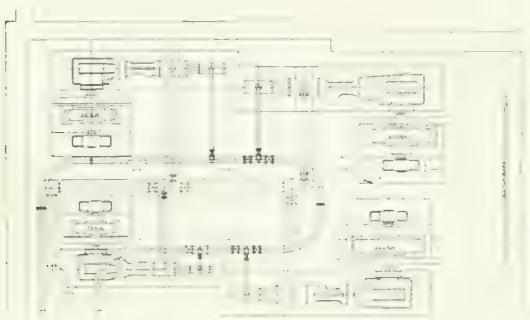


FIG. 3.—PLAN OF ENGINE ROOM, PHILADELPHIA MINT.

curacy in centering the armature or wear in the bearings affects only slightly the total clearance and, therefore, has but a small effect on the magnetic balance of the machines. The brush-holders are of the well-known Crocker-Wheeler parallel movement type, the brush being clamped firmly in a brass box, which moves radially should there be any movement to the commutator. The holder is so constructed that it will permit any individual brush to be lifted off the commutator and retained in that position, or even be removed and replaced again without affecting the character of its seat upon the commutator face. The current is conveyed from this to the rocker arm by heavy sheet copper links. The brush is, therefore, always perpendicular to the surface of the commutator. The general appearance of these generators will be seen in the accompanying illustration.

MOTORS.

For what may be termed the service of the building, 18 motors, varying in size from 2 hp to 25 hp, and aggregating 300 hp, are used These motors are employed for operating the elevators, fans, pumps, blowers, etc. For the coining operations about 120 motors, varying in size from 1-6 hp to 50 hp, and aggregating about 1000 hp, will be used. The motor installation is not yet complete, but already includes 108 motors, aggregating over 750 hp, furnished by the Crocker-Wheeler Company, and a few of the Keystone and Westinghouse makes. In no other mint has the use of electric power for the operation of machinery been carried to such an extent, practically all of the machines employed in the coinage operations being driven by individual motors arranged especially for geared connection, making very compact and workmanlike equipments.

In the process of coining the metal is first passed through an electrolytic refining process, by which the metal is carried through the solution from the anode to the cathode, producing a deposit of a fineness as great as 999.9. The current for this electrolytic refining produced by two direct-connected motor-generators, designed to g 500 amperes at 5 volts. The purified metal is then melted and mi with the proper alloys in order to secure the necessary hardness, a cast into ingots. The ingots are then passed through "topping" n chines (four in number), each operated by a 3-hp motor, in order cut off the rough end of the ingots. They are then rolled out in r ing machines, of which there are six, each operated by a 50-hp mot and are then passed through the finishing rolling machines, opera by 25-hp motors, from which they come out in flat strips of the pro

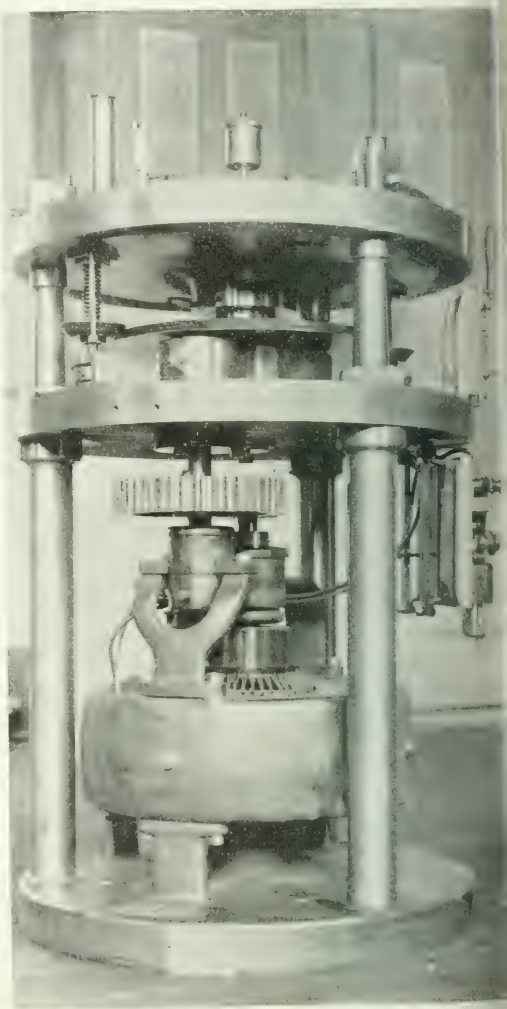


FIG. 4.—UPSETTING MACHINE.

width and thickness. During the rolling process they are annealed intervals by passing them through the long "strip" furnaces (9 number), which are operated by ½-hp motors. These strips are th passed through cutting presses, operated by 3-hp motors, and t circular blanks thus produced are carried to extremely ingenious though quite complicated automatic weighing machines. These machines are driven each by a 1-6-hp motor, and automatically s out hte blanks which are too large or too small. The perfect blan are then carried through several up-setting machines, each operat by a vertical 3-hp motor, and emerge from this with a raised rim edge. They are then carried through the rotary furnaces, driven ¼-hp motors, in order to anneal them, and afterwards passed throu dilute sulphuric acid to remove the coating produced by oxidati

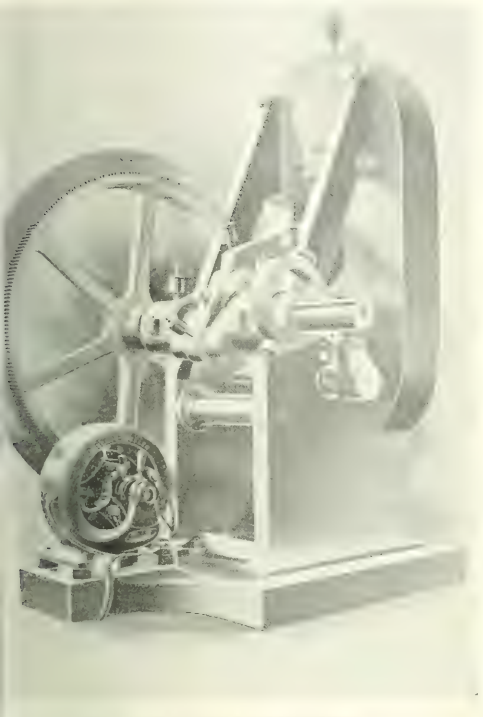


FIG. 5.—ONE OF THE MINTING PRESSES.

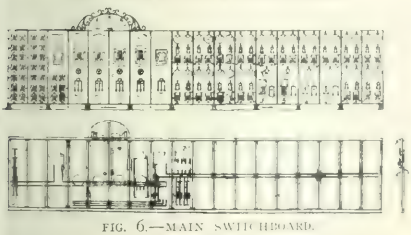


FIG. 6.—MAIN SWITCHBOARD.

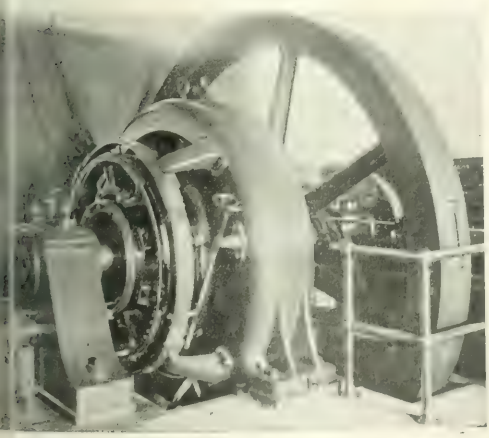


FIG. 7.—ONE OF THE GENERATORS.

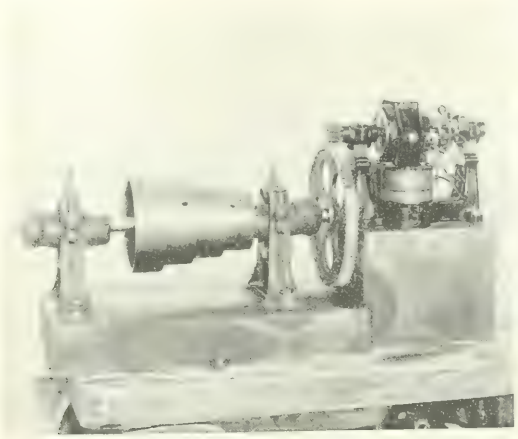


FIG. 8.—GEARED SPEED REDUCER.

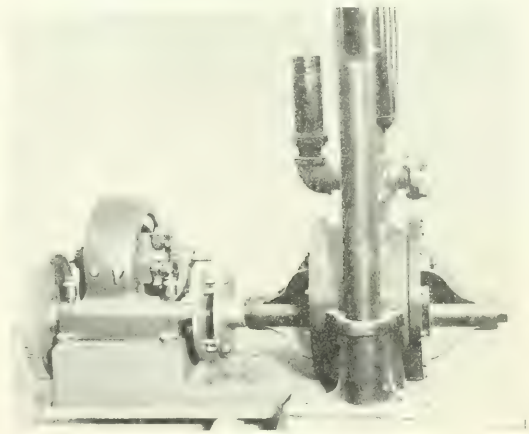


FIG. 9.—HIGH-PRESSURE BLOWER.

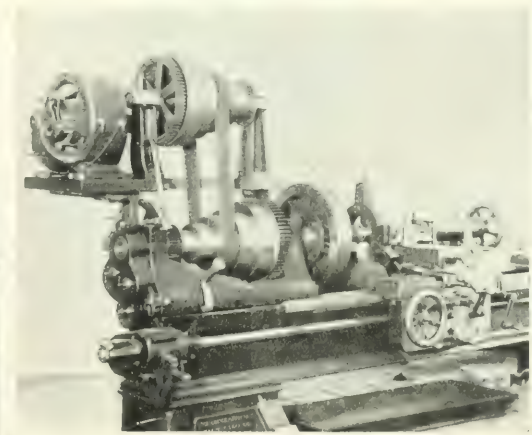


FIG. 10.—MOTOR-DRIVEN LATHE.

THE NEW UNITED STATES MINT, PHILADELPHIA.

All of these small motors as well as the large ones are of the Crocker-Wheeler make. They emerge from this bath clean and bright, and are then ready for the process of coining.

In almost all cases they are of the open type, and in their design and proportions resemble the light and power generators described above.

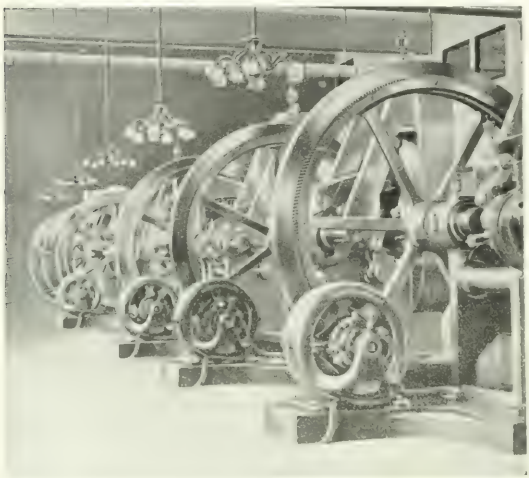


FIG. 1. COINING PRESSES.

The coining presses vary in size according to the denominations of the coins. There are 12 driven by 7½-hp motors and 12 by 3-hp motors. The average speed of coining is at the rate of 85 pieces per minute. The total pressure required for the large coins is about 170 tons.

Various methods are employed for connecting motors to the different pieces of machinery, among them being belt-driving, gearing

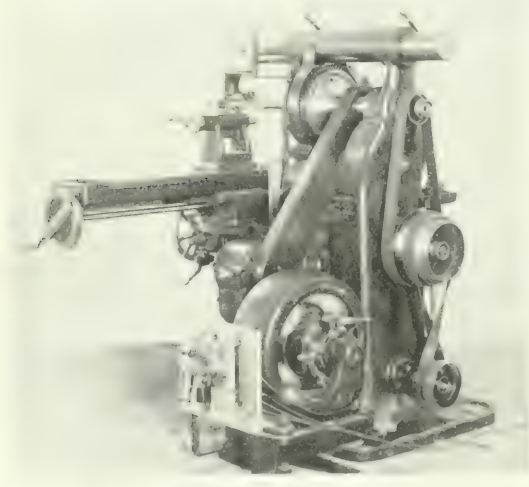


FIG. 2. MILLING MACHINE.

and direct connection. These methods are illustrated in the group of cuts accompanying.

ELEVATORS.

The elevators in this building form no inconsiderable part of the mechanical equipment. One is used for passenger service, and the other seven are for freight. All were supplied by Stokes & Parrish, and all are electrically driven. They are automatically controlle from the car, and are equipped with top and bottom limit switches slack cable switch, safety switch in car and centrifugal governor. Al of these switches are connected in series with the safety cut-out an with the brake magnet. The motors are compound wound, and var in size from 30 hp to 50 hp.

SWITCHBOARD.

The switchboard, which is one of the largest among those installe for isolated plants, is made of pink Tennessee marble 2 inches thick and is divided into 18 panels, four of which are used for the genera tors, two for the lighting circuits and the remainder for the distribu tion to the various motors in the building. The board is arrange with two sets of bus-bars; one for the lighting, the other for th power, arranged with a bus-coupler switch, so that the two set may be connected together or may be run separately, as desired. Th generator panels being equipped with double-throw switches, eithe generator may be thrown at will onto either set of bus-bars. In addi tion, there is a small connection to the service of the local electri lighting company. The general design of the board may be seen fro the accompanying cuts.

The lighting circuits are not provided with switches, for the Cutte circuit breakers on these panels are made with independent arm and are intended to be used as switches as well as circuit breaker On the power panels, single-arm Cutter circuit breakers are employe in conjunction with the switches, and each circuit leaving the boar is supplied with an ammeter.

One of the Thomson-Houston recording wattmeters shown in th diagram is connected so as to measure the total power distribute from the lighting panels, the other to measure the total power di tributed from the power panels. Similarly a Weston ammeter mea ures the total current flowing from the lighting panels and anothe the total current from the power panels. The circuit breaker switches, instruments, and all the metal parts on the front of th board are finished in copper, giving with the marble an exceeding handsome appearance.

The connections between the generators and switchboard consi of Roebling's lead encased, rubber insulated cables, the size bein for the 75 kw, 450,000 cm.; for the 150 kw, 900,000 cm., and for th 200 kw, 1,200,000 cm. These cables are carried in a brick duct co ered with the usual iron plate.

SYSTEM OF WIRING.

As will have been seen from the preceding description and di gram of the switchboard, the wiring of the building is divided in two parts, one for lighting and one for power. The latter include circuits for what may be termed the service motors of the buildin such as fans, elevators and pumps, together with the circuits for th apparatus particularly connected with coining. The service motor have each an independent circuit to the switchboard. The motor for the coining processes are arranged somewhat differently, ther being 26 circuits to supply the 121 motors used for these purpose Each of these circuits leads from the main switchboard to a larg junction box placed in the floor of the room which this circuit su plies. In this box the circuit splits into two or more branche passing through the small power outlet boxes, of which there is on for each motor, which it is expected to install, this power outlet bo being placed in the floor at a point near the location of the moto From the lugs in these power outlet boxes, wires are carried to th motors as they are installed. The large junction boxes thus serv as panel boards, but differ from them in that they have no switche or fuses.

The loss of pressure allowed on the motor circuits between th switchboard and the large junction boxes is 6.5 volts, and the sam loss is allowed on those circuits supplying the service motors.

The current to supply the 4000 incandescent lights and the 16 ar lights in the building is carried from the main switchboard throug beveled glass plate doors complete the artistic appearance of thes boards. As there are no local or room switches, each circuit leavin the panel boards is provided with a knife-blade switch, and the entir board may be disconnected from the feeder by the opening of th main line switch. Owing to the use of 220 volts, the system of dis tances between the metal parts is fixed at 2½ inches and the fus lengths at 3⅛ inches.

The electric fixtures made by Cassidy & Son, of New York, an Horn & Brannen Company, of Philadelphia, are, in the front portio

of the building, quite elaborate, especially the one in the Numismatic Room.

TELEPHONE SYSTEM.

The building is equipped with a complete local telephone system, having an exchange in the guard's room and 51 instruments located in various parts of the building. The system employed is the complete central energy system of the Western Telephone Construction Company, this energy being supplied by a set of storage batteries in duplicate. Any person desiring to call up central has only to lift his receiver off the hook. This causes the shutter of his trap on the switchboard to fall and calls the attention of the operator to him. The switchboard is of the desk pattern, and is equipped with all the latest devices, such as circuit changing switches, relays, power generator, night bell attachment, etc. Its operation is very rapid and the operator is able to handle all of the calls with ease.

FIRE ALARM AND OTHER AUXILIARIES.

While the building is entirely of fireproof construction, yet in order to protect the costly machinery, it was deemed advisable to install a system for indicating the location of any small fire which might occur. The system consists of an ink-writing recorder, similar to the ink-writing telegraph register, connected in series with two mechanical gongs and with 30 alarm boxes, these boxes being distributed in various parts of the building. One of the gongs is placed in the engine room, and the other in the superintendent of machinery's office, while the register is placed in the guard's room. The call boxes are similar to those of the Western Union or American District Telegraph Company, and when the handle of one of them is turned it causes the number of this box to be recorded five times on the tape of the ink-writing register and simultaneously the two gongs strike the number of the station or box. This system is also operated by storage batteries, and the apparatus for it, as well as the telephone, together with some city fire alarm and police signal apparatus, is mounted on the switchboard shown in the accompanying cut. This board is of blue Vermont marble, 5 ft. by 7 ft. in size, and is mounted on an iron framework. It carries the fuse blocks, the telephone wiring, the fire-alarm recorder, the American District and Western Union call boxes, the police telegraph and city fire alarm boxes, and a voltmeter and a voltmeter switch for testing the condition of the

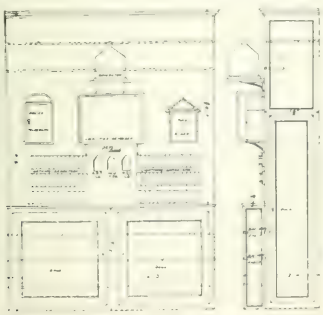


FIG. 13.

various storage batteries, which supply the electrical apparatus in the building.

A system consisting of an Eco Watchman's Time Detector, located in the guard's room, and 30 stations placed in various parts of the building, insures the faithfulness of the watchman. The signals are given on the clock by the watchman turning a handle at each station, which causes a small magneto placed in each station box to send a current through the proper magnet at the clock.

As the Mint is essentially a large factory, it is important that the rooms should be supplied with accurate timepieces, and it was, therefore, decided to install a system of secondary clocks operated by a master clock. The clocks employed are 51 in number, and are made by the Standard Electric Time Company. The current for operating them is supplied by a set of storage batteries in duplicate.

STORAGE BATTERY.

A complete storage battery in duplicate, furnishes energy for the operation of the telephone exchange and fire-alarm systems and the time clocks. This battery consists of 60 Electric Storage Battery Company's cells No. 5-C. These cells are placed in a special room in the attic, and are connected to a circuit-changing switch, so that when the switch handle is thrown in one direction 30 of the cells will be thrown in series and made ready for charging. The other 30 are split up into five groups with a different number of cells in each group, one supplying the telephone exchange, another the fire-alarm system, the third the gas machine, and the fourth and fifth the time clocks. Whenever these cells have been sufficiently discharged, the circuit-changing switch is thrown in the other direction, throwing the duplicate set of batteries in connection with the various pieces of aparatus above-mentioned, and the first set in series ready for charging. The cells are charged from one of the circuits on the power panels through an ammeter, circuit breaker and rheostat, the general arrangement being shown in the diagram.

The electric equipment for lighting and power, from the generators

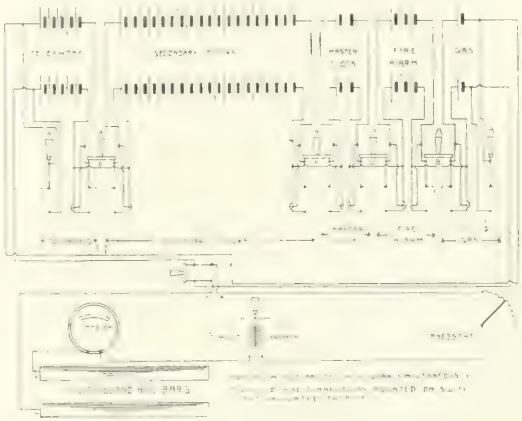


FIG. 14.—DIAGRAM OF STORAGE BATTERY CONNECTIONS.

to the outlets, together with the telephone, time clocks, watchman's detector and fire alarm systems and the storage battery was installed by Messrs. Keller, Pike & Co., of Philadelphia.

Cables at Constantinople.

An item from Constantinople states that outside the terminus of the Oriental Railway at Stamboul stands a bridge, crossing the line. Beyond this the line is single, and to avoid accidents a somewhat complicated system of signals has been established, working by electricity. The wires, over 40 in number, are inclosed in three subterranean cables, and beyond the bridge there are two lightning conductors. On the 15th day of Ramazan the Sultan has to go to Stamboul to kiss the Prophet's Mantle, and the route he takes is always kept a pretended secret, though for several years past he has always gone by sea. There is, in fact, very little probability of his ever going by any other route again; but, were he to choose, he might have to pass over the bridge in question. This year his attention was called to the fact of electric cables running under the bridge, and orders were immediately sent to have them taken up. It was pointed out that the most serious danger might be incurred by disorganizing the signal system, and that the cables could not be disabled without a substitute being furnished, which would take time. All the concession that the Palace would make was that the cables might remain if they were dug up and exposed on either side of the bridge. Consequently, there are now two curious excrescences on the permanent way, where the cables have been disinterred and are exposed to view—an instructive lesson to visitors of the degree of enlightenment to which Turkey has attained in the twentieth century.

Wireless Telegraphy to the Farallon Islands.

Alexander G. McAdie, Forecast Official of the Weather Bureau, San Francisco, is making preparations for the operation of wireless telegraphy between the Farallon Islands and Pt. Reyes, on the California coast, 30 miles north of San Francisco. Permission was recently granted by the Washington authorities for the use of those locations. Plans have been prepared for a mast 150 ft. in height to be erected on South Farallon Island.

Electric Equipment of Railway Docks, Middlesborough, England.

One of the most important fields of modern electrical power work is the equipment of docks. In New York City the idea is not a new one, but was taken up in the earliest days of the electric motor; the fact still remains, however, that very few of the docks around Manhattan Island enjoy the facilities that are furnished by electricity for the quicker handling of freight and cargoes. In Europe meantime, considerable work of this character, as elsewhere in America, is being done, and we are glad to be able to illustrate a fine plant just finished at Middlesborough, England, for the Northeastern Railway Company's docks. This plant comprises no fewer than 17 3-ton jib cranes, 3 10-ton jib cranes and 24 1-ton capstans, and the results already obtained more than justify the equipment.

The 10-ton and 3-ton cranes are virtually the same, except as to size, and the 3-ton description will suffice for all that class of apparatus installed. The 3-ton cranes are 60 ft. in height from quay level to the jib top pin, and have a radius of jib of 44 ft. 9 inches. The



FIG. 1.—ELECTRIC CRANE.

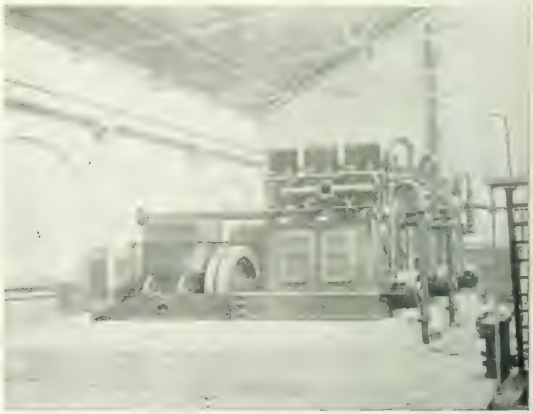


FIG. 2.—GENERATING PLANT.

revolving speed at the hook is 400 ft. per minute, and the travel speed is 30 ft. per minute. The rate of lift with three tons is 150 ft. per minute, or 250 ft. with 1½ tons.

The crane is of the high gantry type, with gantry 30 ft. high, admitting the passage of wagons and engines underneath. The large radius of the crane enables it to cover five lines of rails and minimizes delays caused by shunting. The bottom framing of the gantry is composed of two channels, tied together by plates, and riveted up so as to form an open box-shaped girder. The trod wheels are of cast steel, with double flanges, and keyed on steel spindles running in cast iron plummer blocks bushed with brass. The traveling gear motion is fitted with both hand and electrical gear. The electrical gear consists of an enclosed series-wound multipolar motor, which is coupled to a steel worm working into a delta metal worm wheel. The power is communicated to the trod wheels by means of spur and bevel gearing, the wheels on each side being coupled together by means of a cross shaft, thereby ensuring uniformity of movement and avoiding any twisting strain on the gantry. Hand gear is fitted in addition. Upon actual test it has been found that the time taken to release the rail clips and jacks, travel 30 ft. and refix the clips and jacks is about three minutes. This time includes removing and reinserting the plug connection in the next connection box.

The switch gear for the traveling motor is placed in a water-tight case upon the bottom framing of the gantry, and the switch is provided with a detachable key, which is kept in the crane cabin, and is in charge of the driver. The four uprights are compound steel girders set at an angle which gives the form of a pyramid. Holding-down clips for fixing to the rails, and screw-down jacks for increasing the base when the maximum load is being dealt with, are also provided; but it has been found that the cranes are absolutely stable at all loads up to a considerable overload even without these attachments.

The revolving frame is composed of two H-beams tied together by stretchers and having a cast iron center piece through which the center pillar is taken, and upon which is fitted a grooved steel ring, provided with a series of case hardened balls. The collector is fitted to this pillar, and consists of two copper rings mounted upon ambroin and separated by rings of the same material. The collecting brushes consist of two gauze straps, each encircling one ring, the tension being regulated by springs. These straps are attached to terminals, which in turn are mounted upon porcelain insulators. The crane cabin is of teak, and the front consists of a wrought iron framing glazed to enable the driver to have his work in full view. It contains the lifting and slueing gear and the controlling apparatus.

The lifting gear consists of a barrel, wheel and pinion. The wrought steel pinion is forged solid upon a shaft which is fitted with a half coupling to meet that upon the motor spindle. Upon this shaft there is a band brake actuated by an electromagnet, which will be described later. The pinion gears into a cast iron spur wheel keyed on the barrel shaft. Both pinion and wheel have machine cut teeth, and work in a cast iron gear case, which forms an oil bath. The lifting is done on a single flexible wire rope. The barrel is of cast iron turned and grooved to receive the rope, and is large enough to take the full lift without overlapping. The barrel shaft is carried on cast iron brackets, the bearings being brass bushed, and the whole is mounted upon a cast iron bedplate in conjunction with the motor.

The lifting motor is designed to give 50 hp at 300 r. p. m., and is of series enclosed four-pole type, with slotted armature and carbon brushes. It is completely enclosed and rendered water and dust-proof by means of cast steel end plates. The revolving gear consists of a motor worm, worm wheel and spur gear. The worm is forged solid on the shaft, which in turn is fitted with a coupling to meet the motor. The worm engages with a delta metal worm wheel, and a pinion keyed to the worm wheel shaft engages with a spur wheel which is fitted to a short shaft actuating a pinion. This pinion travels round the rack of the crane and thus slues the cabin and jib. A brake, actuated by a foot treadle, is fitted to the first motion spindle, so that the slueing motion is always fully under control. The slueing motor is of similar type to the lifting.

The electric brake magnet referred to above offers some points of interest. It is placed in series with the armature of the lifting motor, and consists of a horseshoe magnet (with poles arranged as those of a two-pole dynamo) with a solid steel armature of special shape

capable of revolving between them. The passing of the current round the field coils tends to move the armature through a right angle. A lever is fixed to the end of the armature, and the brake, which is normally held on to the brake wheel by a weight, is connected thereto by a rod. The movement of the armature lifts the brake and releases the brake wheel. The great advantage lies in the strong pull and long range. The brake is also connected to a lever which stands at the driver's left, so that the brake can be operated by hand instantly when required.

The controller consists of two separate controllers combined in one case and actuated by one handle. One controller actuates the lifting motion and the other the slueing, and both are connected by pinions and quadrants to the lever. The latter is so arranged that when moved in a vertical plane it actuates the lifting and in a horizontal plane the slueing controller. Thus it will be seen that the hook follows the motion of the driver's hand, lifting when he raises the lever and so on. One particularly conspicuous point about the controller is the ease with which it is manipulated, owing to the absence of click gear upon the intermediate contacts. Notches are provided only at the two extreme and the off positions, and in consequence the controller may be operated by the driver throughout the day without fatigue and its attendant slackness. The resistances are fixed inside the crane cabin. The switchboard consists of polished slate, framed in teak and fitted with automatic cut-out, lifting and slueing isolating switches, fuses and lighting switches. The crane cabin is well lighted by fixed and portable lamps, and a cluster in an enamaled iron reflector is fixed beneath the jib. Terminals are provided upon the switchboard to which may be connected a registering voltmeter and ammeter.

In addition to the cranes 24 capstans have been provided for handling trucks. These are electrically driven, and are capable of exerting a steady pull of one ton at a speed of 200 ft. per minute, or of hauling a load of 100 tons along a level road. The capstan head is driven by a cast iron spur wheel, which is engaged with a steel pinion. The latter is keyed on the same shaft as a brass worm wheel.

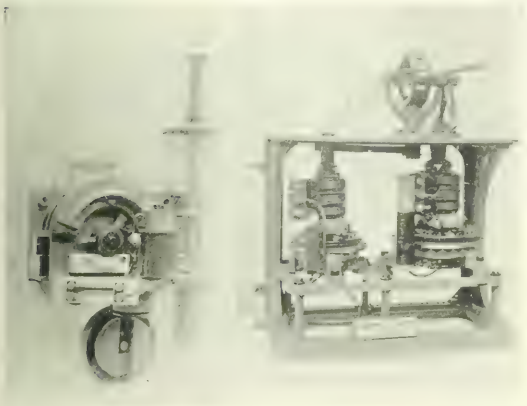
The driving worm is forged solid upon its shaft, and is coupled direct to the motor spindle. The worm and wheel work in an oil bath. The motor runs at 1000 r. p. m., and is completely enclosed. In construction and design it is similar to the crane motors, but it is shunt wound to avoid large variations in the speed of the capstan head. Upon the motor shaft there is fixed an automatic mechanical brake, which, when the capstan head is driven by the motor the brake releases itself automatically, but should the capstan tend to run back through being overhauled by the weight the brake at once locks itself and sustains the load. Such a brake is absolutely necessary upon an electric capstan, as it differs from a hydraulic capstan in one important respect, viz., that in the hydraulic the water in the cylinder holds the load, whereas in an electric capstan there is nothing to sustain the load upon the current being cut off, and if the load is allowed to run back a serious accident may ensue. It is also essential that the brake should be automatic, so as to claim none of the driver's attention from his work.

The electrical switch gear presents many points of interest. It consists of a controller with magnetic blowout and with overload release gear. The controller is worked by a pedal projecting above the capstan case by about 4 inches. This pedal is removed when the capstan is out of use. The pedal is connected to a dashpot, which prevents the controller being operated too rapidly when the driver is starting the capstan, but at the same time by means of valves in the plunger allows the controller to return rapidly to the off position. The return to the off position is effected by means of a weight, which is lifted as the pedal is depressed. In the event of the capstan being pulled up by sudden overload the release gear works instantaneously and breaks the main circuit. Upon the pressure being removed from the pedal the return of the controller to the off position automatically replaces the release switch and the capstan is ready to start again. The whole of the gear is contained in a water-tight cast iron case sunk in the ground, the top of which consists of chequered plates flush with the quayside.

The distribution of current is effected by a network of feeder and distribution cables laid below ground. These cables are fiber insulated and lead sheathed. They are laid in wooden troughs in a mixture of sand and tar, and are at a depth of about 2 ft. from the surface. Water-tight junction boxes are provided at the junctions of the feeders. The crane connection boxes are in two portions, the bottom of which contains the positive and negative distributing cables, and the top the connection apparatus for the cranes. The distributing cables pass through the lower portion, and a connection is taken from each by means of a T-joint to the upper portion. At the same time two cables are taken off to the nearest capstan. The whole of the lower portion is filled in with bituminous compound. The upper portion of the box contains two fuses and the crane connection contacts. Both contacts and fuses are mounted on porcelain insulators, and are completely shielded from damp. The top of the box consists of a chequered plate, with a circular aperture to receive the connection socket. When the box is not in use a water-tight steel cap covers this aperture.

The connection socket consists of a circular gun-metal hood, which accurately fills the aperture in the cover of the box, and is so shaped as to completely shield the joint from wet. The interior of this hood contains two gun-metal tongues, which meet the two clip contacts in the interior of the box. A stud and groove insures that the socket shall enter the aperture only in the correct position. The flexible crane cable enters the hood of the socket through a trumpet mouth, and the whole apparatus is shaped so as to obstruct the quayside as little as possible. There are 52 boxes in all, placed 20 yards apart They have stood the test of the severest weather, and have given no trouble.

The power plant consists of four Siemens-Belliss sets of generating units of which three are together equal to running the complete installation, of which the whole electrical part was furnished and put in by Siemens Brothers & Co., Limited, of Woolwich, England. The dynamos are Siemens' two-pole type, and are designed to give each 240 kw at 400-430 volts. They are coupled direct to compound engines by Messrs. Belliss and Morcom, and designed to run at 380 r. p. m. The switchboard is of marble, and consists of four machine





and one feeder panel. The instruments are of the Siemens' moving coil type. The shunt winding of each dynamo is brought to a switch on the board, and these shunt switches are interlocked with their respective main switches, so that it is impossible to break the exciting circuit of any machine until the armature has been cut out of circuit, nor can the armature be thrown in until the shunt circuit is made.



FIG. 5.—ELECTRIC CAPSTAN.

The four machines are run in parallel upon the bus-bars, and the shunt circuits are excited from the bars. An exhaustive series of tests upon the three-ton cranes shows that the electrical energy consumed in one complete cycle of evolutions at full load is roughly .17 unit or 170 watt-hours. With a fairly skilled operator the cranes make 45 complete "cycles," or operations under load, in an hour.

A Portable Quad for the International Yacht Races.

BY JOHN F. SKIRROW.



FIG. 1.—PORTABLE QUADRUPLEX.

IN making preparations for handling the volume of press matter consequent upon the recent international yacht races, it devolved upon the writer to design and install an outfit of quadruplexes to increase the Postal Telegraph Company's telegraph facilities at the Highland of Navesink, New Jersey, the marine observation tower at that point being the principal station from which the newspaper bulletins describing the races were transmitted. This tower is regularly used in connection with the marine service reports of the arrival of vessels at the port of New York.

It has been common practice where an emergency necessitated the installation of temporary quadruplex equipment to set up gravity battery, or to connect motor transformers with some available power circuit to obtain the required voltage and the grounded battery currents necessary in the operation of quadruplex telegraphy, and to wire up such multiplex apparatus as was required on the spot.

The large number of cells requisite for the desired pressure and the lack of the necessary space for its erection, precluded the use of the former method in this case, while the entire absence of any source of electrical supply or available prime mover, at or conveniently near to the Highlands, prohibited the latter plan. It was decided, therefore, to install an "explosive" engine, dynamo and transformers in the room at the base of the observation tower to operate [illegible] the part of the outfit consisting of a 1-hp Mietz & Weiss kerosene engine, belted to a 1-kw generator, which in turn operated three Perret motor transformers, converting from 110-volt primary to 360-volt secondary, furnished the necessary currents very satisfactorily.

In developing the plans for the operation of the outfit it was deemed advisable to do all possible wiring and construction at headquarters in New York prior to shipment, on account of the somewhat inconvenient location at which the plant was to be operated, the observation tower being located near the crest of the Highlands, close to the famous Twin Lights and some distance from a roadway. The result was the construction of a somewhat unique portable telegraph plant.

Instead of wiring up the instruments at the Highlands, therefore, the quadruplex sets, three in number, were placed in specially designed cases. These cases when closed present an appearance somewhat similar to an ordinary packing case with a handle upon each end. When opened by raising two of the lids and lowering the two others that form the sides of the case, a complete quadruplex operating table and outfit is disclosed. This is placed upon a collapsible framework, which takes the place of table legs.

All of the numerous switches, transmitting and receiving instruments, adjustable rheostats, condensers, resistance coils, etc., etc., that are used in connection with a quadruplex, including those ordinarily placed behind the switchboard in a telegraph office, are secured firmly in the case with permanently wired connections. This arrangement



FIG. 2.—MARINE SIGNAL TOWER.

requires but six terminal binding posts for the connection of extraneous wires to the case, viz., the line wire, ground wire, two local current and two main line current feed wires, the quadruplexes being operated upon the "Field" system, which requires but two main line dynamo pressures.

The local 20 ohm sounder circuits are fed through 500 ohm resistances from the main 110-volt generator, each circuit thus receiving about .2 of an ampere. These sounders are placed in resonators, which are swiveled upon arms so that they may be drawn out close to the operator's ear, or placed in any desired position. Each case is illuminated by six small series incandescent lamps, connected across the local current leads, using a total of .4 of an ampere of curent. A clock for use in recording the time of transmission and receipt of messages is provided, as also are filing hooks for the unsent and sent business, and a closet which holds a supply of message blanks. Upon occasion these units have been changed from their closed "ready to ship" form and placed in active operation as full quadruplexes within five minutes, and have been taken out of service and made ready to ship, within the same brief space of time.

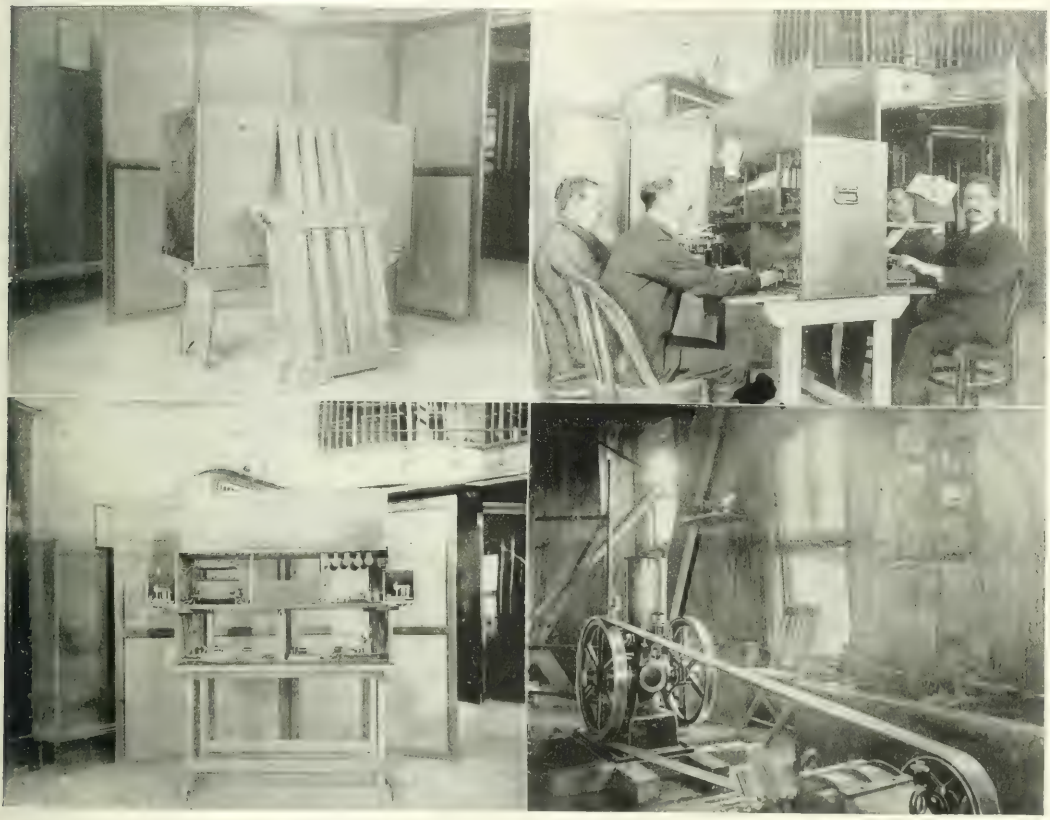
A set of repeaters and half-repeaters, known to telegraphers as "jiggers," is encased in a similar manner, and forms part of the outfit, their purpose being to automatically repeater single "Morse"

circuits into the quadruplexes, where such service is required. The motor transformers are encased in stout pine boxes, each machine being secured to the inside of the lid of its box, in such manner that when this lid is swung open and back against the side of the box, the box forms a supporting bench for the transformer while in service.

The switchboard upon which is mounted an ammeter, a voltmeter with radial switch to all machines, the starting boxes of the transformers, and all the controlling switches, is fitted to slide snugly into an oak case. All connections on this board are brought to binding posts upon the sides and bottom of the board, and are numbered. The transformers are also permanently wired to posts upon their lid bases, which are numbered to correspond with the switchboard posts.

Each transformer case contains a set of wires with connection tips soldered upon each end, so that it is a matter of but a few minutes to connect up the transformer and switchboard outfit, ready for operation. The main dynamo is mounted upon a substantial pine base, and has its field rheostat secured upon one side of the frame. A heavy pine box cover, which may be removed or attached in a minute, encloses the entire machine and is secured to the base. The engine is fitted snugly into a box made of 2-inch pine, the upper part of this box forming a chest in which is carried a complete outfit of such tools and supplies as are required in connecting up and running the engine. This engine case is mounted upon truck casters, and can be readily handled by two men. The exhaust and other pipes are coupled in short lengths and are also boxed. The water cooling tank is crated, and carries a reel of 150 ft. of hose for use in filling the tank, etc. Folding chairs are also provided and shipped with the outfit.

This plant had been shipped to the Highlands and connected ready for operation when the McKinley tragedy at Buffalo occurred. At 4.30 on the following Saturday afternoon it was decided that the Canton (Ohio) office of the Postal Telegraph Company needed the outfit, less the engine. At 6 o'clock the outfit left the Highlands by express, arriving at the Canton office on Monday morning. The outfit was put in operation, giving an equipment of 12 circuits upon three wires in less than an hour's time, and was withdrawn from service at midnight the following Thursday after the late President's interment. Thirty minutes later it was ready for reshipment, and left by express for the Highlands before 10 A. M. on that (Friday) morning The following Tuesday the plant was again in service at the Highlands, and was continued until the conclusion of the series of yacht races, being reshipped to headquarters the day following the final race. One of the quadruplex and repeater units is in an Eastern city in emergency use at the time of this writing, having been placed in service within an hour after its receipt at the office in that city.



Figs. 3, 4, 5 and 6.—Portable Quadruplex in Operation.

The complete plant ready for shipment weighs about 2200 lbs., the engine alone 800 lbs., and the quadruplex units 160 lbs. each. The consumption of fuel used (kerosene) averages 4 gallons per day of 10 hours' service. The load carried at 110 volts on the main dynamo averages 700 watts. Of this the lights take 1¾ amperes and the local circuits 3 amperes, the transformers, of which but two are operated the third being an emergency spare, using up the balance. The outfit is held at headquarters ready to ship immediately to any point. It is particularly adapted to use in quickly establishing emergency offices, such as are required in the event of fire, floods, political conventions, athletic and sporting events, and for military camps. Such an equipment would have been invaluable at the time of the Johnstown and Galveston disasters, or during the Spanish-American war.

Proposed Surface and Underground Electric Road for London.

With reference to the numerous items that have recently appeared in our columns touching the development of electric railway work in and around London, we note that Messrs. Alfred Baker, tramways manager, and John H. Rider, electrical engineer, of the London County Council, have now made a report on tramway subways, etc., for the British metropolis, based in no small measure upon their investigations last year in the United States. They believe that a great advance in the solution of the transportation problem of London will be made if the tramways north and south of the River Thames are linked together, and a plan is presented, showing the proposed extensions under the city and along the river of the subway. Estimating a four-track subway to cost one-third more than a two-track subway,



LONDON COUNTY COUNCIL TRAMWAYS AND PROPOSED SUBWAYS.

the cost of the Boston subway is given in the report at about £425,000 per mile for a two-track subway, and the New York Subway at about £350,000 per mile for a two-track subway. The latter figure, they say, may be considered as a rough guide for a large portion of the proposed subway work in London, given at about £282,000, which, however, does not include the sum for the proposed vault cellars and further vested interests, or the addition of pipe galleries to the subway. The report includes an addendum by J. Allen Baker, chairman of the County Council and vice-president of the highways committee, strongly urging the construction of the subway suggested in the report prepared. A map is given herewith of the plan as noted above.

British Trade in 1901.

Full details of Great Britain's foreign trade in 1901 show decrease in merchandise imports, for the year, of £836,177 from the year preceding, and decrease of £6,028,022 in exports. Reduced to American values, and compared with 1894, the lowest record in recent years,

	Imports.	Exports.	Excess imp.
[illegible]	£[illegible]	£348,345,732	£17,803,254
[illegible]	£[illegible]	£[illegible]	108,701,400
1894	108,344,810	273,785,867	134,558,043
1899	120,001,197	308,252,118	92,430,879
1880	411,229,565	286,414,466	124,815,099

imports in 1901 increased $565,000,000, exports $370,000,000, and excess of imports, therefore, $105,000,000. The above is a comparative table.

Gutta Percha in the Philippines.

By Major J. Orton Kerbey.

THE Spanish war changed the direction of the rubber and gutta percha exploitation. My explorations of alto or hyper Amazonian rubber fields early developed the fact that there were untold millions of acres of virgin rubber forest, and that in the foothills of the Andes gutta percha was to be found. But there may also be rubber and gutta forests in the moon.

The inaccessibility and distance of 3000 to 4000 miles from the Atlantic seaport and the scarcity of labor render these virgin forests practically useless, for to exploit them would add so considerably to the first cost of rubber as to make the effort uncommercial.

To the difficulty of finding laborers in that far-off region and the refusal of outsiders to risk their lives in the malarious rubber swamps may be added the heavy expense of canoeing the cargo long distances on the affluents to few settlements on the Amazon reached by steamboats, which in turn demand freight charges on 2000 to 3000 miles of the river, four-fold greater than the ocean freight rate from the seaport to New York. It should be remembered that the best and most abundant rubber, known in commerce as Para rubber, has to come as far to reach Para as from the latter seaport to New York.

This arises from the fact that the most accessible sources of supply on the lower Amazon, and the principal tributaries have diminished because of the increased demand resulting from the requirements for tires, tubing and belting, and electrical insulation.

It was my official reports published specially by the State Department a year after I had left my consulate to go on my first exploration, which called attention to the question of a future source supply of rubber and gutta percha being necessary. The suggestion of a conservation of present forests and of cultivation were opposed by the rubber combine and the Brazilian Government officials as pessimistic—but all the predictions have since been fully verified.

In a business way the time required for transportation and freight rates from the upper Amazon to New York is perhaps greater than it would be from the Philippines to San Francisco or the Isthmian canals to New York. The advantage of a home product of this valuable tropical export would be to encourage the development of our own possessions, and also to save the payment of the exorbitant export duty of 25 per cent demanded by Brazil on rubber.

The agitation of the investigation of rubber and gutta percha in the Philippines was in a way accidental. I had been engaged in exploiting rubber and gutta percha in Amazonia at the outbreak of the Spanish war, and was in London endeavoring to interest English capital in the Peruvian concession. They were slow to take it up because of the bad reputation of Peruvian bonds. At breaking out of the Spanish war I sacrificed my interests to return on the last voyage of the steamship "Paris" to offer my services to the Government as an expert signal officer and telegrapher familiar with Spanish, and an immune.

Subsequently in riding through the interior of Cuba I discovered rubber of the *costiloa elastica* and other varieties to be indigenous, and so reported to the Agricultural Department. Capitalists not caring to invest in Cuba, I was induced to transfer my attention to Porto Rico. But finding only a limited area of swamp land there adapted to rubber I directed my attention to the Philippines as being located in the rubber belt and possessing the environments and low lands adapted to rubber growing.

My reports and correspondence to the Agricultural and War departments, through Secretary Penrose, of my State, and dating back to the first occupation of the Philippines, were duly referred to the Department officials. Through persistent attention and agitation in Congressional committees asking increased appropriation, the matter was kept before the officials. The War Department, referring all matter to the Philippine Commission, who in turn handed the subject over to the Forestry Bureau, then under control of an army officer detailed to look after the timber interests. The Congressional investigation into the proposed timber land franchises and the Major Hawkin Heinstand hemp inquiries, made officials a bit shy of "rubber investigation." The matter was, however, urged upon the Philippine Commission, and resulted in ordering a foreign scientist to make an examination into the subject of gutta percha. It was at once developed that for some time a large business had been carried on in Mindanao by Chinese merchants, who had shipped or smuggled to Singapore hundreds of thousands of dollars' worth of crude gutta, which had been obtained by a ruthless destruction of 25,000 trees in

a short time. This gutta paid nothing to the island, not even the forestry taxes, but was credited as an English export from Singapore. The business was so profitable to the Chinese that they were able to pay a steamer $100 in gold per day to carry the gutta out of the country. This loss was sustained because steps were not sooner taken to protect the industry. The damage by destruction of the trees is almost irreparable.

The Philippine Commission's report in the advance or proof sheets referring to the existence of gutta in the islands says in effect:

"It appears that while many trees produce gutta mixed with resinous or other substances, the main source of gutta, which is available for commercial purposes, is afforded by trees belonging to two genera *dichopsis* and *paycena*, the former species producing the best gutta known. The destructive method of exhausting by the natives, who cut the trees down and ring them, is unnecessary. It is possible to obtain more satisfactory results by careful tapping without injuring the tree. In 1843 gutta percha trees were abundant on Singapore Island, and on the Malay Peninsula, but they have been so thoroughly cleaned out that the botanical gardens at Singapore cannot obtain plants. The destruction of gutta trees in Sumatra and Borneo have been widespread. The demand for gutta steadily increases like that of rubber, while the supply as steadily decreases. The gutta trade is principally in the hands of the Chinese of Sinpagore, who adulterate in every conceivable way. There is a demand 600 times greater than the supply."

The danger of a famine in gutta, which would prevent cable operations, is as great as that of rubber, and perhaps the discovery of gutta will facilitate the Pacific cable. The officers of the United States Signal Corps, many of whom are expert cable operators and practical electricians, are now giving this subject of gutta, in connection with the manufacture of a Pacific cable, their energetic attention, and beneficial results may be expected in the estimates of the cost due to our own possessions furnishing insulation.

The Signal officers will give the matter of the product of trees, like those of gutta and rubber, especial consideration with a view to advancing the telegraph and cable enterprise of the Government. The trouble heretofore has been that the Forestry Bureau of the Philippines, which is a product of the Spanish occupation, and basing their report on the work of the native forester, only look to the value of a forest by the number of trees that are useful as timber for its various purposes of supplying hard woods for furniture, or trunks of trees adapted for piling or woods for railroad ties, building operations, etc.

A gutta percha or rubber tree standing is worth an average of $20 per tree each season for 40 years, and several hundred trees may be cultivated to the acre at relatively less cost wtih greater returns than from any growing product of the earth.

It is estimated by the Commission that 300,000,000 lbs. of gutta percha have been exported from Singapore during the last 50 years, involving the destruction of at least 150,000,000 trees, and the waste by imperfect collection of some 3,000,000 lbs.

The Philippines were credited with 232½ piculs of gutta percha of 133 lbs. each, and only 5 piculs of inferior gutta during the last six months of the year 1900. This does not represent the total amount exported, as most goes to Singapore and is credited to British North Borneo. Active steps are now being taken by the tropical authorities of the different governments for the propagation of the gutta trees by seed, which is more satisfactory than plants.

Great Britain and Holland are the countries owning all known gutta percha lands outside of the Philippines. They are taking active steps not only to preserve the trees but to establish new plantations. Germany has long had an agent in gutta and rubber producing countries with a view to the introduction of the trees into her African and New Guinea possessions. Some years ago France sent gutta seedlings to all her tropical possessions, a representative of that government visited Borneo. Another representative is now investigating in Java. Yet our Government is slow to take up a matter of such importance and hesitates at appointing a practical expert to assist in developing a great industry.

Holland at present monopolizes all gutta seed, which has become so valuable because of the ruthless destruction of trees that it is found more profitable to keep trees for the seed than to extract gutta from them.

Although the best gutta-producing tree, *dichopsis gutta*, is not yet found in the present open territory, there is no doubt that if it does not already exist the best species can be grown in our own possessions, which is in the same latitude with the habitat in North Borneo. The identification of the genuine rubber and gutta tree must be determined by practical experts. Unquestionably the rubber trees from the Amazon may be transplanted and be grown in the new possessions, several varieties already being found to be indigenous.

A new departure is being made by establishing a Philippines Agricultural Department, which will no doubt relieve the army officers of their detached duty as scientific agriculturists and forests. Professor P. Samson Scribner, a well-known practical and thoroughly scientific gentleman has been placed at the head of the Philippine Agricultural Bureau, who will look after rubber and gutta for the Agricultural Department.

The Telegraph System of Brazil.

"The Telegraph System of Brazil" is the subject of an interesting report to the State Department by Thomas C. Dawson, secretary of the United States legation at Rio de Janeiro. Under date of Nov. 8, 1901, he writes:

The telegraph lines in Brazil are almost entirely owned and operated by the Federal Government. The States of Sao Paulo, Rio Grande do Sul and Ceara have a few comparatively unimportant and unprofitable lines. Certain railroads are permitted to take messages for transmission between points not served by the Federal lines, and are said not to confine themselves to those points. The cable between Para and Manaos is privately owned, though receiving a subsidy from the Government. The coastwise foreign-owned cables do much of the business between the ports from Pernambuco to Santos, as well as practically all the service to points abroad.

The first telegraph line in Brazil was established in 1861, serving Rio and Petropolis. The serious development of a system to serve the whole country began in 1865. The plan adopted is a main line running along the entire sea coast with branches out into the populated regions. In at least three instances, these branches are connected, thus furnishing separate overland communication between Pernambuco and Bahia, Bahia and Rio, and Pernangua and Porto Alegre; in addition to the cost line. * * * When the republic succeeded the empire in 1889, the coast cities and the principal points in the interior on lines of railway had telegraphic service. Under the republic the policy was to extend the branches to reach all populated centers, and the total length of the line was nearly doubled in the following six years.

The main coast line extends from Para to Jaguarao, on the Uruguayan border, is 6849 kilometers (4256 miles) long, and has 23,837 kilometers (14,812 miles) of wire. In the year 1899, 1,348,956 messages, containing 21,284,437 words, were transmitted, for which the average charge was 4613 reis per message and 391 reis per word. Expressed in terms of United States currency at the average rate of 1899, these were equal to 69.2 and 4.4 cents, respectively, and, at the present rate, to $1.09 and 6.9 cents. The milreis tolls have not been decreased to correspond with the rise in exchange. Six hundred reis (8.2 cents) are charged as a fixed tax on each message, no matter what its length, and in addition thereto for each word, including address and signature, from 120 reis to 1070 reis. The minimum rate is confined to messages to stations in the State where the message originates. To the next adjoining State, at least twice as much is charged, and the rate increases by States with their remoteness. The rates on the foreign-owned cable lines, which are much used between the coast cities on account of the superiority and certainty of delivery and intelligibility, are about twice as high.

The officially reported cost of operating the department in 1899 was 7,505,952 milreis, equivalent at the then exchange to $1,126,000, and at the present to $1,771,000. In addition the subsidy to the Para Amazon Cable Company of £17,125 was paid, and 432,000 milreis to other companies to indemnify them for tolls collected by the Brazilian Government for joint traffic. Two thousand nine hundred and twenty-seven persons were employed; 140 in the central administration, 1391 on the line and 1396 in the stations. They were paid 5,891,502 milreis. The revenue from private telegrams within the country was 4,717,445 milreis; from official telegrams sent by and charged against other departments, 1,036,762 milreis; from Brazil's proportion of telegrams from and to foreign countries, 360,894 milreis. The department has never paid for itself.

The Debt of Electrical Engineering to C. E. L. Brown—VIII.

By B. A. Behrend.

OLTEN-AARBURG CENTRAL STATION.

THE station at Aarburg represents surely one of the most interesting plants of Mr. Brown's many-sided work. There were installed in 1895 six 300-hp, two-phase generators, direct connected to turbines running at 28.5 r. p. m. The generators are of the umbrella type, having a diameter of 4500 mm. They operate at 5000 volts and 40 cycles, and hence have 168 poles. Such slow-speed machines have never been built by anybody but Brown. They were originally made as inductor generators, but they failed to give the pressure for which they were designed, and this fact was much talked about among electrical engineers. But it is rarely either wise or instructive to treat even the errors of a really great man with mere ridicule, and in the present case, after seeing the ineffectiveness of his construction, their designer went ahead and altered within an astonishingly short time the inductor generator into a revolving field machine.

Gross exaggerations have been spread about the poor performance of the Aarburg generators, but a glance at the curves of Fig. 44 and the diagram in Fig. 45 shows that these machines really do their duty very well. The voltage rises 13 per cent if a load of 19.6 amperes is thrown off, while they are very well capable of giving 245 kilovolt amperes on a circuit of a power factor of 80 per cent. Their efficiency at load of 200 kw is 88 per cent, which is a good result for so small an output at so slow a speed. The plant is shown in Fig. 46.

RATHAUSEN.

A model slow-speed station is Rathausen, where five 300-hp generators are operating at a speed of 60 revolutions, giving two-phase current of 3300 volts at 40 cycles. Fig. 43 shows the station, Fig. 47 one of the generators, and Fig. 52 its performance curve. In the following we give the data of this machine as published by Mr. Brown sometime ago:

Armature.—Per phase 40 coils of 27 turns. Resistance per phase, 2.25 ohms hot.

Field.—Eighty coils of 43 turns. Resistance, .45 ohm.

The efficiency of this machine for 200 kw is 93 per cent in spite of the small output and low speed.

PADERNO.

The Paderno installation constructed in 1897 and 1898, with its seven 14,500-volt, 1850-kw direct-connected generators transmitting electric power to Milan over a distance of 22 English miles, stands out foremost among the large power transmission plants of the past five years. Fig. 48 shows the plant in course of construction, Fig. 51 shows a drawing of the generator, Fig. 49 shows a view, and finally Fig. 50 represents the performance curve of this machine.

The output of these generators is 73.5 amperes at 14,500 volts and 42 cycles. They are three-phase machines and yield 1850 kilovolt amperes on a circuit of 80 per cent power factor. The speed of the turbines is 180 r. p. m. From Fig. 50 we see that the rise of voltage when full non-inductive load is thrown off, is only 4.2 per cent, while throwing off 1850 k. v. a. on a power factor of 80 per cent produces a rise of only 15 per cent.

Through Mr. Brown's great courtesy we are enabled to give here the winding data of this machine, and a full account of the insulation tests.

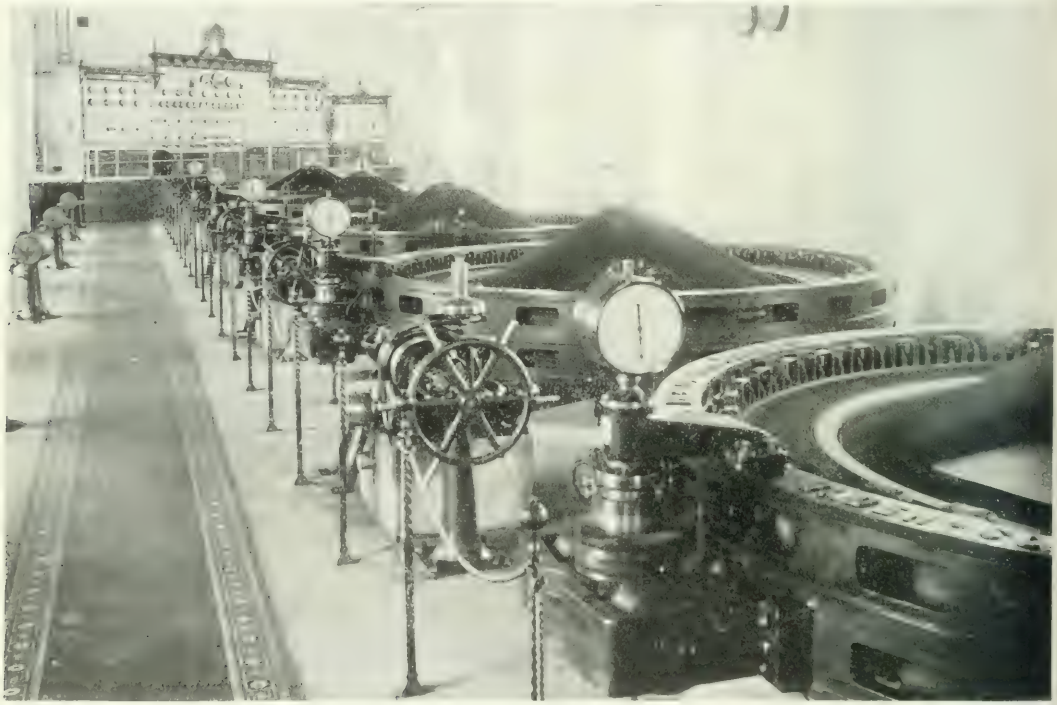


FIG. 43.—RATHAUSEN TWO PHASE GENERATING PLANT.

Armature Winding.—Three-phase winding in Y-connection, 14 coils per phase. Per coil, 30 turns of 6-mm. wire. Resistance of each phase, .76 ohm.

Field Winding.—Twenty-eight coils in series. Per coil, 71 turns of copper strip on edge, 3 by 32 mm. Resistance of field coils, .46 ohm.

Mr. Brown writes about the tests on this machine: "Before being put into the armature the micanite tubes were subjected to a six hours' test with a tension of 30,000 volts alternating applied between an iron tube placed inside the micanite tube and a cover of tinfoil on the outside of the tube—the length of the tinfoil covering being equal to the iron breadth of the armature. Tubes which heated during this test were rejected.

"After the generator had been erected we ran it for about five minutes with a tension of 21,000 volts by increasing the speed and exciting fully. We further carried out the following test with a special

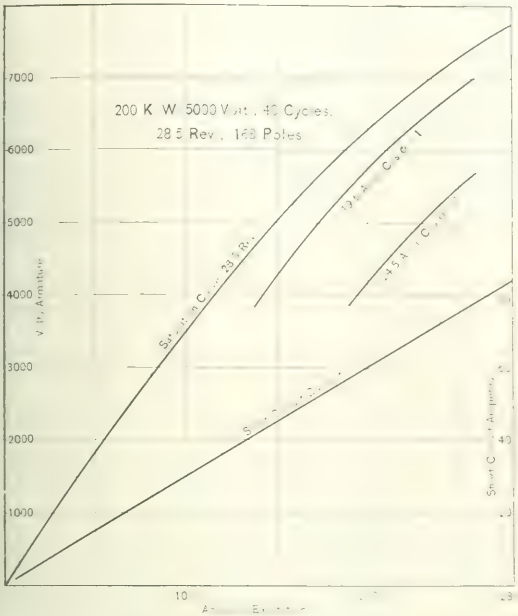


FIG. 44.—PERFORMANCE CURVES OF AARBURG GENERATORS.

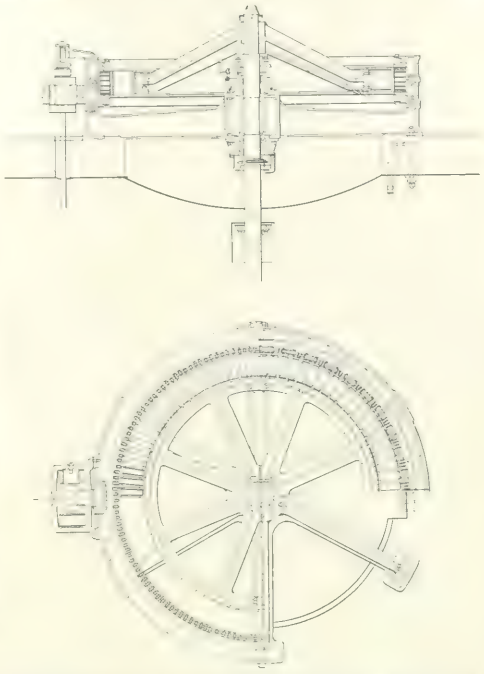


FIG. 47.—300 HP, 60 R. P. M., TWO-PHASE GENERATOR, RATHAUSEN.

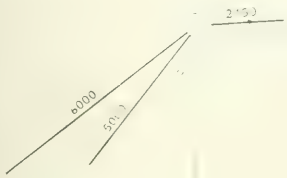


FIG. 45.—DIAGRAM OF POTENTIAL DROP IN AARBURG GENERATORS.

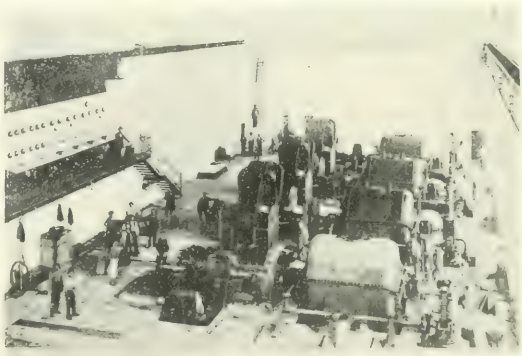


FIG. 48.—PADERNO GENERATING PLANT.



FIG. 46.—AARBURG TWO-PHASE GENERATING PLANT.

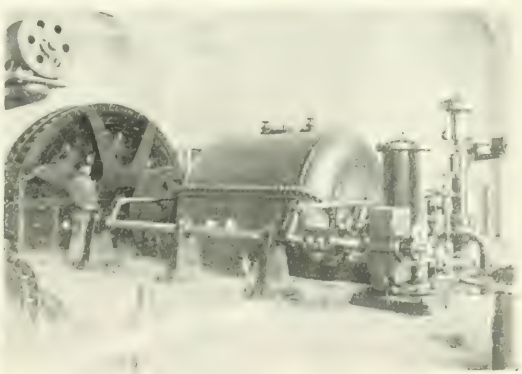


FIG. 49.—VIEW OF PADERNO GENERATOR.

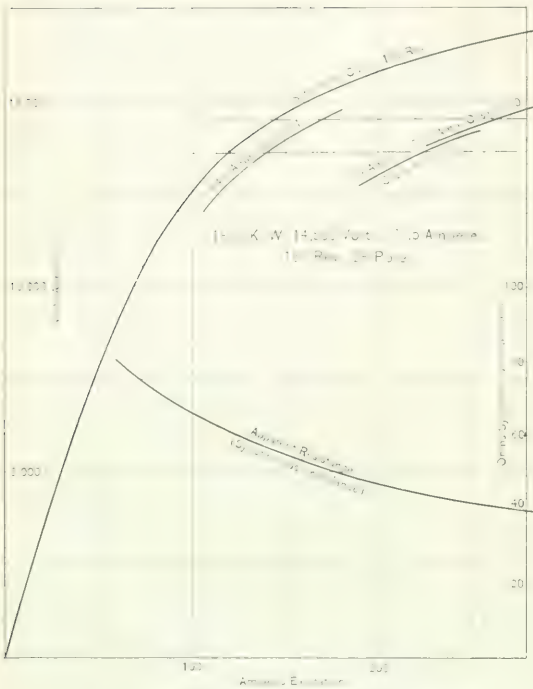


FIG. 50.—PERFORMANCE CURVES OF PADERNO GENERATORS.

transformer: We opened the three-phase winding of a generator at the neutral point of the star connection and, whilst the machine was standing still, applied a tension of 30,000 volts on each pair of the three phases separately. We also applied a tension of 20,000 volts between frame and winding for one hour. All these tests were carried out without the slightest difficulty being experienced.

"In order to give you an idea of the excellence of the insulation, I will relate to you an accident which happened, and which really constitutes the best possible proof. One of the generators with its direct-coupled exciter was running fully loaded when the fuses blew and as the turbine governor failed to act the speed rose to 1.7 to 1.8 times the normal. The excitation was not cut out until after 1½ minutes, and, although the pressure went up to over 30,000 volts, not the slightest accident happened."

The losses of this generator if working on a non-inductive load are as follows:

	Watts.
Core loss	41,000
C^2R armature	9,000
Excitation	11,800
Total losses, excepting windage and friction	62,300
Windage and friction	20,500

The efficiency of direct-connected machines is generally figured according to the Rules of the American Institute, without the loss through windage and friction, and we thus get an efficiency of 96.15 per cent at full non-inductive load.

The Paderno water-power plant operates in parallel with the steam plant at Porta Volta in Milan. This plant, of which Fig. 38 is from a photograph, was in operation before the Paderno installation was built. Both plants have operated for years in parallel without having given the slightest disturbance. The turbine governors in Paderno are equipped with electric motors that can be controlled from the

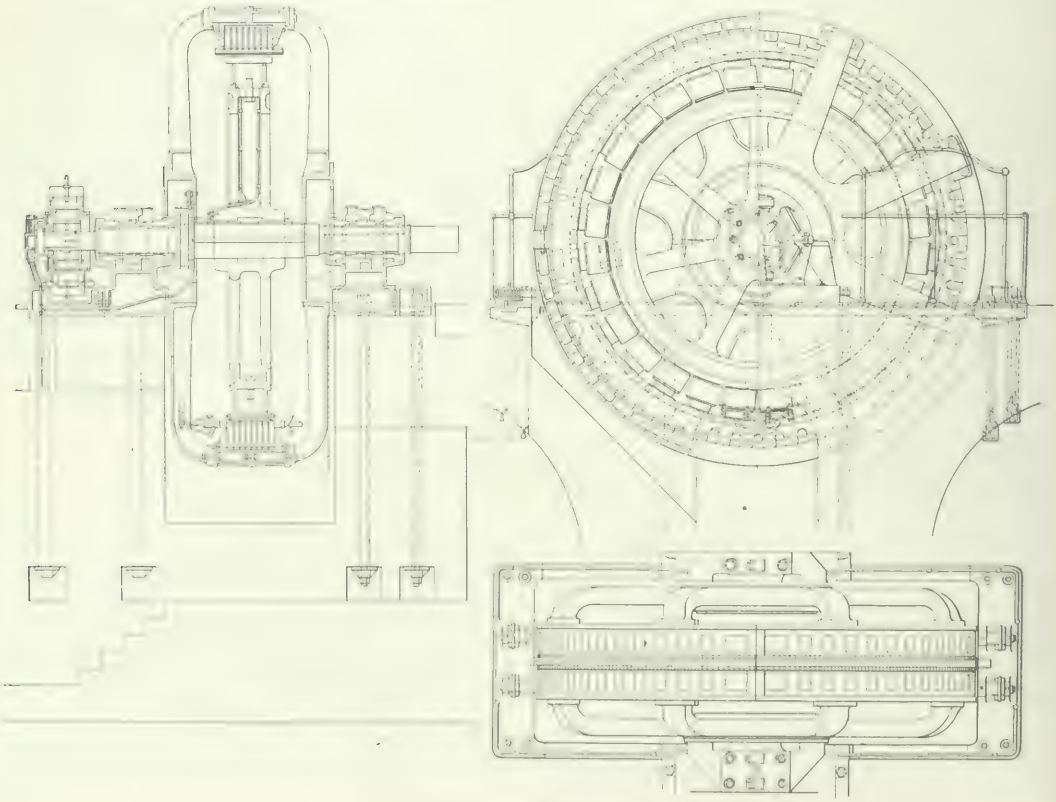


FIG. 51.—PADERNO GENERATOR.

switchboard to distribute the load between the generators and to parallel them with greater facility. Mr. Brown seems never to have had trouble with "hunting" of alternators working in parallel. Steam engines of good design and the use of solid poles doubtless account for his having been spared these troubles. Furthermore, his flywhee' type is particularly well adapted to parallel running. In the case of the Paderno-Milano plant, the poles of the Porta Volta generators alone are solid, while the Paderno generators have laminated pole tips.

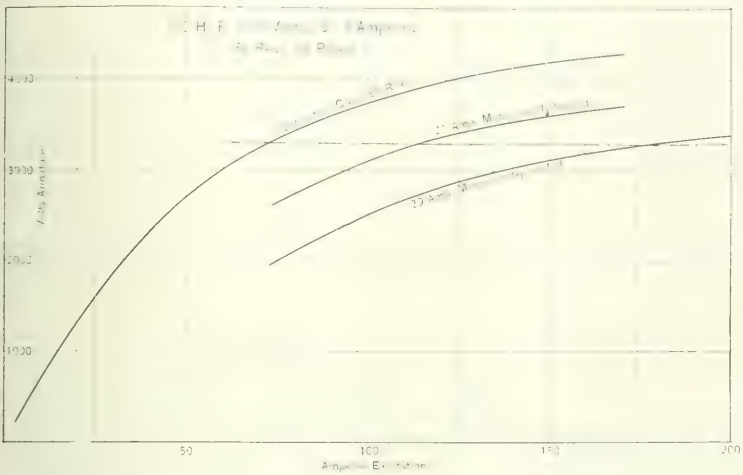


FIG. 52.—PERFORMANCE CURVES OF TWO-PHASE RATHAUSEN GENERATORS.

Notable Development of the Canadian Niagara Power Plant.

No electrical engineering work has equaled in interest and importance the development of the great enterprise for the utilization of Niagara by the Niagara Falls Power Company. There is nothing in the world equal to this splendid example of electric power generation and transmission, and our readers are already familiar with the details of the plant as described in the numerous articles that have appeared in our columns on the subject. The news which we are now able to give, however, will show that so far from finality having been reached in the plans of the company, this work is but in the earlier stages. The latest features of development are such as to arrest more than ever the attention of engineers and capitalists. On the American side, where all the work has been done hitherto, newer machinery of the very latest type of its class has just been ordered, while for the hitherto unattempted utilization of the water power on the Canadian side of the great cataract, the Niagara Falls Power Company has just given a contract to the General Electric Company for three immense units of 10,000 hp each. These machines are not only to be the largest electric generators ever built, but they will embody features of design of the utmost significance, altogether aside from the fact that the new work is to be done under American initiative with American capital and employing American apparatus.

We understand from the Canadian Niagara Power Company, which has just awarded the contract, that these gigantic generators are but the first units in a plant which will probably reach an aggregate of 200,000 hp or more, within a very few years. The power house is to be situated on the flatland adjacent to the Dufferin Islands near the river, less than a quarter of a mile above the Horseshoe Falls. A wheel pit is being excavated in the rock which will be connected by a tunnel tailrace to the gorge below the falls. The dynamos will be placed at the surface level as before, being connected to the turbines by long, vertical shafts, which extend to the bottom of the pit where the turbines will be situated.

The machines contracted for are, as already noted, far larger in capacity than any electric generators previously built. They are also remarkable on account of the high speed at which they will operate, 250 r. p. m, the same as that now used with the smaller 5000-hp generators on the American side. A design has been provided, which affords the best electrical conditions and a very compact form. The external diameter of these machines will be not quite 18 ft., and the total weight of each about 400,000 lbs. They will return 98 per cent of the shaft horse-power in the form of current, and the inherent regulation will be such that the voltage variations will not exceed 8 per cent with maximum possible changes of load. Two very important elements are that the machines will have internal revolving fields, while the older smaller machines have external fields; and that they will not depend on transformers for raising the pressure of the current from 2200 to about five times that figure for the line, but will generate themselves current at the tremendous potential of 12,000 volts, thus dispensing entirely with expensive transforming apparatus.

The adoption of these enormous units in place of the large 5000-hp generators previously the standard at Niagara Falls, is the result of recommendations made by the General Electric Company's engineers and effects an immense saving in the cost of this power development. It reduces the wheel pit excavation and the size of the power house to about one-half, causes a very large reduction in the cost of electrical apparatus per horse-power, and sacrifices absolutely nothing in reliability or efficiency.

This, it may perhaps be worth noting, is the third large contract for generators at Niagara Falls, which has been awarded to the General Electric Company during the past 12 months, including six of the earlier type of 5000-hp machines for the second American power house; five of 5000 hp of a new type for the same plant, and now these huge generators for the Canadian side. No announcement is made yet as to the turbine contract, but it is understood it will go to Switzerland.

Alleged Vast Trolley Network.

It is reported that to exceed the speed made by the fastest trains between New York and St. Louis is the aim of the promoters of an electric system which is to connect the cities by Jan. 1, 1903. This enterprise is backed by New York, Ohio and Michigan capitalists, and it is alleged that much of the money will be supplied by Senator Depew. We doubt it very much. L. P. Myers is securing a 100-foot right of way through all territory intended to be traversed by the new line. Myers says the road will be built of 70-lb. steel rails, double track in many sections, and stone ballast. Orders for rails, sleepers and other equipment of the most modern type are said to have been placed with the manufacturers, but cannot be traced by us. He says the plan is to buy up all the interurban lines in operation in the territory and merge them into one great system.

Profiles now in hand indicate that the line will run from New York to Rochester and Buffalo; that connections will be afforded with Cincinnati, Cleveland, Toledo, Columbus, Fostoria, Tiffin and Springfield, in Ohio; that service is to be given Detroit, Jackson, Battle Creek, Lansing, Ionia, Grand Rapids, Muskegon, and other points in Michigan. The route then passes through cities of Northern Indiana and westward into Chicago. Springfield and numerous smaller places are on the line, St. Louis being the Western terminus.

The cars are to be of the powerful twin motor type, fitted in a luxurious style. All plans for the construction of the road have been completed. Options are being secured in the name of E. Blackman, of New York, who is one of the originators of the scheme.

Automobile Club of America.

The Automobile Club of America has just issued its new year book for 1902, bound in white and dark gray, giving the names of 291 active and 62 associate members, or 353 in all, who own no fewer than 380 automobiles and have 91 new ones under order. The club is growing rapidly, and under President Shattuck is doing excellent work. The book contains considerable information.

Electricity for the New York Central Tunnel.

By Frank J. Sprague.

I NOTE that ELECTRICAL WORLD AND ENGINEER has published in its issue of Jan. 25 the recent letter of Mr. Westinghouse on electric traction and safe care for the New York Central Railroad, my reply thereto, and his second letter, this correspondence having appeared in the *New York Times*. I feel, however, that the second letter from Mr. Westinghouse and the facts in the case require further consideration at my hands, and I take advantage of the hospitality of these columns to defend once more what I deem the best interests of the electric traction art, including those with which I happen to be also more or less identified as their exponent. Mr. Westinghouse, moreover, has no monopoly of public concern. The necessity of doing everything possible to avoid the dangers of fire in a car propelled electrically or otherwise, is apparent to all, and would naturally command support even if recommended by less eminent authority. So, too, will all practical proposals for increasing the structural strength of cars, reducing the liability of crushing and telescoping in a collision, and improving brakes and signals. But the electrical and the transportation world must not be thrown into a panic, and stampeded into paralysis because some particular method of car construction is not found in all existing rolling stock, and because all the possible improvements permitted in new work cannot be universally applied. The simple fact is that Mr. Westinghouse, for reasons of his own, has in the matter of the New York Central tunnel practically asserted that the present problem cannot be solved electrically because the method which he assumes will be recommended is that of motors distributed under the cars, and, the existing cars being combustible, this is dangerous, and hence such a plan must not be considered. All alternative or composite schemes are entirely ignored.

Whatever the detail plans which the New York Central may have under advisement, and as to this my guess is probably as near correct as that of any other outsider, which guess is that Mr. Westinghouse is very much in error, I have not the slightest hesitation in saying that every train movement in the tunnel and at the Grand Central terminus can be efficiently, promptly and safely made under electrical operation. And if it be true, which I do not think it is, that no electrical manufacturer would undertake such a contract, then it is proper to say that there are contracting and constructing engineers who would not hesitate to assume the task, and Mr. Wesinghouse's disinterestedness is not sufficient to make him refuse to supply any needed apparatus of his manufacture which might be found suitable. He should not speak of inventors and manufacturers in terms of suggested disparagement because his particular pride has long been to be a shining light among those classes.

The real problems before the Central management are not alone operative ones, intensified by limited track room, lack of storage space, and consequent congestion of movement, but also those of civil engineering. The proposal to loop the suburban tracks, no matter how the trains are operated, is commendable in the highest degree. But it is certain that such a loop will be operated electrically, and the natural corollary is that the electrical operation will ultimately be carried beyond the limits of the tunnel, at least as to the normal operation of these trains, in which case multiple unit operation, possibly with cars of new construction, will most likely be adopted.

Another problem is the handling of existing trains undisturbed in make-up or equipment, hauled to some point within reasonable radius of the Grand Central station by steam. It is clear that for this terminal work the motors will not be distributed under passenger cars.

It is reported that Mr. Yerkes intends to introduce on the Metropolitan District Railway, of London, an improved type of car. I doubt not that this is so, and that it will be made just as strong and as free from the possibilities of damage by collision and by fire as it is practical to make it, that steel construction for at least the under body of the car will be adopted, but more for structural purposes than because of electrical dangers. In this connection it is proper to point out that most modern cars on the Continent of Europe are so built to-day, and the cars on the Versailles division of the Western Railway of France, operated on the multiple unit plan, are constructed in this fashion. It is also likely that some parts of the upper structure may be made of steel, and other parts of wood or other material treated so as to be non-inflammable, the same as is now required on modern battleships.

The ordinary possibilities of fire on an electric car may briefly be summarized under three heads: Flashing at the contact shoes, which, being carried on an all-steel truck, may be now discounted; breaking of connections or chafing of wires extending from the motors on the truck to the controlling apparatus on a car, caused by frequent and extreme movements of pivoted trucks, which can be avoided largely by good construction, and so far as the car is concerned by proper sheathing, and the making and breaking of current in the main motor controllers. Special insulation is essential in the running of circuits, and it must be provided either naturally in the car construction or by special precautions, whether the car be of wood or steel, more in the latter case. It goes almost without saying that the controlling apparatus itself may, and should be so constructed that no matter what the internal trouble, or what the amount of arcing due to bad or misplaced contacts, the disturbance shall be entirely local, and shall be kept so by being enclosed in an iron-clad structure.

Common sense and prudence then indicate that whatever improvements in car construction may be introduced in the progress of the art, the first essential is to make the apparatus itself which controls motors reliable and fireproof, and then to protect its installation, and the installation of the motor equipment by the best methods known to the art to-day. It is safe to say that when this precaution is taken, the operation of the electrical train is amply safe, Mr. Westinghouse to the contrary notwithstanding. The presence of wood of itself is oftentimes a matter of safety rather than danger in electrical construction, because when properly protected it is not only a good insulator, and, therefore, avoids one of the initial possibilities of electrical trouble, but, properly sheathed with fireproof material the risk from its use is reduced to a minimum. On account of the use of the grounded circuit, the presence of steel renders less possible the absolute isolation of different parts of the electrical equipment and can introduce possibilities of trouble which are foreign to some other construction.

Mr. Westinghouse must find himself in a somewhat embarrassing position, to illustrate which I may refer to a bit of recent history. He states unequivocably that any use of motors under care of present construction on elevated trains or in a tunnel is reprehensible and dangerous. If this be his present contention, in what light does he stand before the management of the Brooklyn Elevated Railway, where, in 1898, he began applying motors under the existing cars. On this road, which, so far as electrically equipped, is operated strictly on the multiple unit plan, there have been three classes of apparatus used, some being of Westinghouse make. Notwithstanding the specific experience of over two years, despite all the changes which had been made and troubles which had been experienced, concerning which he could not be in ignorance, and notwithstanding the fact that the controllers had been taken from under the cars where they were inoperative, and installed inside the cars, the Westinghouse Company, undoubtedly under guarantees of safe and efficient operation, have within the past year made a contract for a number of equipments to be used under the regular cars, in competition with others, at prices and under conditions of payment and guarantees which no competitor would for one moment entertain and which carry their own story, to do the very thing which Mr. Westinghouse himself now condemns. And this contract was supplemented by a proposal to equip the Manhattan Elevated Railway on the multiple unit plan, using the existing cars. Should that collision and accompanying holocaust which he now freely predicts occur on the Brooklyn Elevated with cars equipped with his apparatus, in what contradictory and dangerous position will he and the Brooklyn Elevated Railway find themselves in view of his former protestations and his recent utterances.

Really, if all that is predicted is in any measure true, if it is impossible for all practical purposes to protect existing cars so that they may be safely operated electrically, then the 50,000 railway cars in this country would better be pitched into the scrap heap, the Manhattan, Brooklyn, Boston and Chicago Elevated railways would better replace their wooden ties and do away with guard rails, or go back to steam, electrical science turn backward, and horses and the cable be restored to their former pre-eminence.

American Manufactures.

According to statistics collected by the Census Bureau the gross value of the products of manufacture in the United States in 1900 was $13,003,127,682, as compared with $9,372,437,282 in 1890, an increase of 38.73 per cent.

The Shawinigan Electric Power Plant, Canada.

By Frank C. Perkins.

THERE is a great industrial and commercial future for Shawinigan Falls on account of its recent power development. The accompanying map (Fig. 3) shows its location and the general direction of power transmission lines intended to reach Quebec and Montreal, the former 90 miles distant, and the latter 84 miles away. Three Rivers, which is located 21 miles from Shawinigan Falls, will soon have electric service from this power house, as will many of the towns along the Great Northern Railway between Quebec and Montreal. For a number of years the great power of the St. Maurice River has attracted the attention of promoters; but until recently the title to the property and water has been more or less complicated. The Privy Council of England decided not long ago that the provincial government could dispose of its water powers, and the authorities have been selling these privileges with the understanding that the development be begun immediately.

The Shawinigan Water & Power Company was formed under a charter granted by the provincial government, with the power to develop the water power, manufacture gas and electricity for the purpose of light, heat and motive power, to construct works needed for such purposes, to transmit power generally throughout the Province of Quebec, and to transmit electric power and sell same in the various towns and cities, with the right to expropriate land for its various purposes, including the necessary right of way to any point. The president of the Shawinigan Water & Power Company is J. N. Greenshields, K. C., of Montreal; the vice-president is John Joyce, of Andover, Mass., and the treasurer is Mr. J. E. Alfred, of Boston, Mass.

For the accompanying illustrations and data in reference to this power plant the writer is indebted to the secretary, Mr. Richard W. Douglas, and the chief engineer, Mr. Wallace C. Johnson, who has had much to do with the Niagara power development during recent years. The Shawinigan Falls Power system obtains its water by a canal 1000 ft. long, 100 ft. wide and 20 ft. deep. The water is conducted through this canal to a forebay, formed by building a solid concrete wall or bulkhead from which the water is conducted through pipes to the power house 130 ft. below. This substantial concrete wall is 40 ft. in height and 30 ft. in thickness at the bottom. Each pipe, waterwheel and generator will yield 5000 hp. The water for the operation of the wheel is obtained from the forebay, and is conducted in steel tubes to the power house, each tube having a diameter of 9 ft.

Three of these penstocks are now in place, and three more are still to be installed, and are now under way. The canal has a capacity of 60,000 hp, and the present development is for 30,000 hp. The company purchased about 1000 acres of land, of which 200 acres were reserved for mill sites and about 500 acres for the location of the town, the latter being particularly well adapted for this purpose being high and comparatively level. It is an ideal location for manufacturing plants, using large quantities of power, both electrical energy and water power privileges being available. The St. Maurice has a total length of over 400 miles, and is supplied from a great many lakes and streams, the drainage area being about 18,000 square miles. The water flow is very steady throughout the year on account of the dense forest covering this area, and is in the neighborhood of 26,000 cu. ft. per second. The power which may be developed will not fall short of 100,000 hp ultimately, and the working head is more than 125 ft. Besides the main development, it was decided to take advantage of the fact that at one point the Shawinigan River and the St. Maurice came within 1000 ft. of each other, but with the difference of level of 150 ft., and it was here on a point on the upper bay a second installation was made, this is about half a mile of the main power station of the Shawinigan Water & Power Company. This installation was built by the Belgo-Canadian Pulp Company, whose enormous pulp mill is supplied with water for operating their turbines by the Shawinigan Water & Power Company.



Fig. 1.—General View of Development.

This development consists of a large crib dam through which the water passes at the bottom. The headworks consist of a concrete forebay, which has a height of 40 ft., with the necessary racks and head gates. This solid concrete bulkhead is inside of the crib dam on the bank of the river, and from it the penstocks lead the water through the bank and down to the lower level, discharging through the Shawinigan River as a tailrace after passing through the turbines. The steel penstock between the forebay and the mill is 12 ft. in diameter, and a special tunnel about 200 ft. long had to be excavated through the clay bank for its reception.

This plant will have a capacity of 15,000 hp, which is to be utilized by the Belgo-Canadian Pulp Company, but double this power may be obtained by duplicating the crib and bulkhead next to the present one. The present pulp mill will be able to turn out 10 tons of pulp per day, using for this work about 8000 hp, and an additional 7000 hp,



FIG. 2. SHAWINIGAN FALLS

making the entire 15,000 hp, will soon be used by another additional paper and sulphite mill.

The waterwheels in the main power house were built by the I. P. Morris Company, of Philadelphia, and each has a capacity of 6000 hp under a working head of 125 ft. Two of these turbines are now in course of erection (Fig. 6), and two alternating-current generators of 5000 hp are already installed. The generators were supplied by the Westinghouse Electric & Manufacturing Company. There is provision for another 6000-hp unit in the present power house, and an addition is provided for duplicating the present plant, which will increase the output to about 36,000 hp. The steel tubing from the forebay to the power house increases in diameter from 9 ft. to 11 ft. near the turbines, the thickness of the shell of the flume also increasing from 5-16 inch to 9-16 inch the diagram of the wheels shows them to be of the twin turbine type, having one runner at either end of the casing. The water enters the turbines radially from without, discharging radially toward the center of the shaft into the draft chambers. The draft chambers connect with an 8-ft. draft tube, which passes to the tail water. It increases in diameter to 11 ft. The tail has a low mean level of 25 ft. below the center of the wheel shaft. There are two large air chambers above the casing, which is of cylindrical form. The turbine is 30 ft. long, and is controlled by gates in the draft chambers. The gates consist of butterfly valves closing together at the center between the shafts. In connection with the transmission line between Shawinigan Falls and Montreal it is said negotiations are under way with the Great Northern Railway and other railroads whereby the power transmission line will run over their right of way for the greater part of the distance. This would not only lessen the first cost of the transmission, but would reduce the maintainance expense to a minimum, while the line in passing the 15 towns and cities would find many users of the electric current for incandescent lighting and motor service. It may be noted that the calcium carbide works have been established, and the large Pittsburg Reduction Company's plant is also in operation. The above mentioned concerns alone will use in the near future about 35,000 hp. The example of the Pittsburg Reduction Company and that of the Shawinigan Carbide Company is being followed by other users of electrical energy. An electric railway has recently been installed to take care of the increasing freight traffic. This line has a double overhead trolley line, two trolley poles being used to conduct the current to the motors.



FIG. 3.—MAP OF TRANSMISSION LINES.

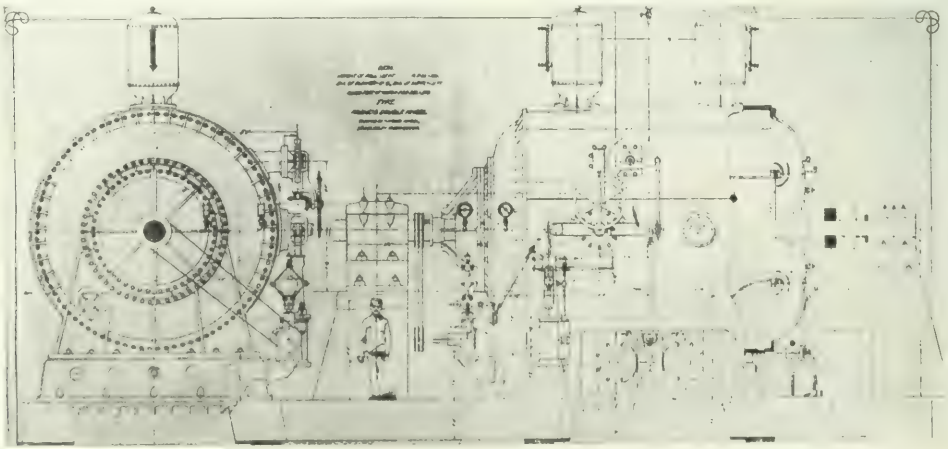


FIG. 4.—6000 HP TURBINES.

The Bremer Arc Lamp.



FIG. 1.—BREMER ARC LAMP.

FOR the past few years a new and interesting type of arc lamp, the invention of Hugo Bremer, of Neiheim, Germany, has received frequent notice in the columns of our foreign contemporaries, and recently practical trials in Germany of the lamp have been reported, at which very favorable results were obtained. Within the last month a number of lamps have been exhibited in operation in New York, and it is understood that the manufacture in this country will soon be undertaken. Two of the lamps are now in regular service outside the Plaza Hotel, West Fifty-ninth Street and Central Park.

The principal features of this lamp are the employment of a compounded carbon, the arrangement of the carbons at an acute angle to each other, the use of a metal chamber above the arc for reflecting the light downward, and the employment of a magnetic field for the automatic regulation of the arc.

The carbons are fed by gravity. When the arc lengthens to or near the breaking point as the carbons consume, an electromagnetically operated lever—the same which strikes the arc when the lamp starts into operation—re-establishes the arc, and by its motion causes the carbons to feed until the arc reaches the normal length.

Both of the carbons in this lamp are of quite small diameter, that of the positive carbon being about 7 mm. and of the negative carbon 6 mm., or about 5-16 inch and ¼ inch, respectively. The negative electrode is an ordinary solid carbon, but the positive electrode

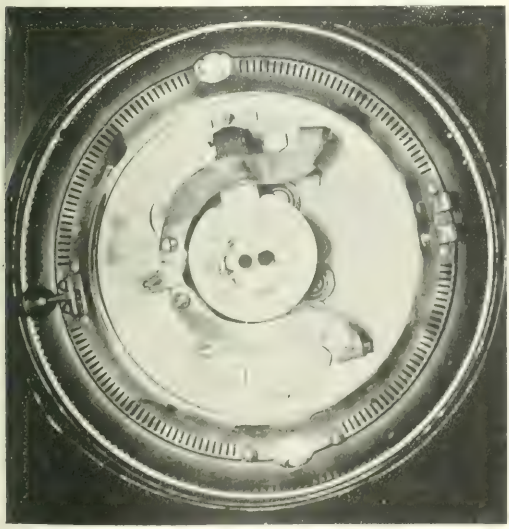


FIG. 2.—CARBON HOLDER AND ELECTRODES.

is a cored carbon of special composition. This carbon contains certain metallic salts in considerable quantity, of which magnesia is one, and also a certain proportion of boron or other material of the same family. In the past difficulty arose in the use of metallic salts in carbons, owing to the fact that they produce scoria, which tend to form an incombustible coating about the points of the electrodes, thereby interfering with or interrupting the arc. A special feature of the Bremer invention consists in the introduction of boron or similar material, as a flux, whereby the otherwise solid scoria is softened or liquified, thus enabling it to drip off and not interfere with the operation of the arc.

The two electrodes are inclined to each other at an acute angle, and the points are surrounded by a metal chamber open below. The magnesium in the positive carbon makes a snowy deposit on the surface of this reflector, thus providing a dull white, highly-reflecting surface. The coating obtained in this way adheres to the metallic surfaces to the thickness of about ⅛ inch. A very simple arrangement is employed to obtain a magnetic field for the control of the arc. The strength of this field is dependent upon the current flowing through the lamp, which gives an automatic character to the magnetic regulation.

The color of the light can be regulated almost at will by the use of proper materials in the arc. The light from the lamps exhibited in New York is particularly agreeable, the character of the illumination furnished being somewhat between that from an incandescent lamp and from an arc, lacking much of the redness of the former and the glare of the latter. Some experiments made last summer at the Laboratoire Central de l'Electricite in Paris showed that for a given total flux of light the efficiency of the lamp is about double that of the ordinary arc lamp, the exact ratio being 200 to 117. In view of the fact that all of the light is distributed in useful directions, the comparison in favor of the Bremer lamp is even more favorable than these figures imply.

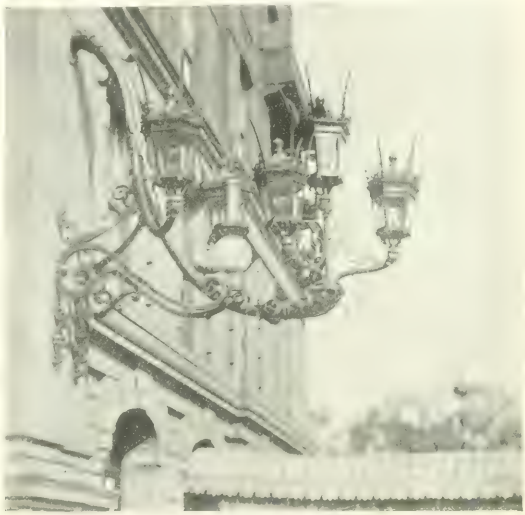


FIG. 3.—BREMER LAMP, PLAZA HOTEL, NEW YORK.

Opposing Federal Telegraphs.

Ex-Postmaster General Wilson S. Bissell, in an address before the Men's Club at Lockport, N. Y., roundly scored the agitation for government ownership of the telegraph. He said there are many reasons why the Government should not own the wires. The expense of management, he said, would be enormously increased because it would hardly be any time before the telegraph service would be extended to every little hamlet in the country. Every Congressman would want every corner of his district connected up by wire with the whole world. It would also throw into the employ of the Government many thousand more skilled workmen, which, he said, the Government should steer clear of. Mr. Bissell said that the Government made a great mistake by beginning rural free delivery, as the expense will far exceed the estimates and the service will isolate the farmers by cutting them off from social intercourse with their fellowmen at the country store and post offices. "What we want is postal savings banks, and not postal telegraph and rural delivery."

Telephony in Belgium.

Mr. G. W. Roosevelt, the active and efficient United States Consul at Brussels, Belgium, furnishes an interesting report on the present status of telephony in Belgium, as noted below: On account of dissatisfaction with the present flat rate system of telephone subscription (by which all subscribers are assessed alike for yearly local privileges), the Minister of Railways, Posts and Telegraphs has decided that it will be abandoned in favor of the more rational measured or message system, which is expected to bring about an enormous increase in telephonic communication.

As introductory, it may be said that, in 1895, at an expense of, roughly, $1,200,000, the Belgian Government obtained a monopoly of telephonic communication, absorbing the interests of the Compagnie Belge du Telephone Bell, the Compagnie Liegois du Telephone Bell, and various other small companies.

For telephonic purposes, Belgium is divided into 17 zones or areas, each with a large central exchange. These zones are not arbitrarily assigned, but allotted, and very successfully, to obtain the most efficient service. Nearly all the local service of Belgium is dependent upon the single-wire, non-metallic circuit system, but the Government is slowly making changes. The two zones of Brussels and Charleroi are now nearly entirely equipped with metallic circuits; the zones of Antwerp and Liege are under study.

A subscriber is entitled to communication with any other subscriber in the same zone, irrespective of distance; also to communicate over long-distance lines, at the regular rate, if he deposits at the beginning of each month an amount covering his estimated monthly expenses. He is entitled to telephonic delivery of telegrams which may come to him. The free delivery by telephone of telegrams is a great advantage and the privilege is almost universally used. Mistakes are very rare, and are guarded against with the utmost care, a key being furnished whereby words not unlike in sound may be clearly defined.

The flat-rate system of subscription varies considerably, in proportion to the magnitude and importance of the locality; thus, the Brussels and Antwerp rate is 250 francs ($48.25); the Charleroi rate, 200 francs ($38.60); and the rate in the five small exchanges built by the Government, 170 francs ($32.81), or for a three years' contract, 150 francs ($28.95); this is for a radius of 1 kilometer (0.62137 mile); longer lines in proportion to the length.

STATISTICS.

Total number of subscribers	13,620	
Increase over previous year	1,277	
Total length of wire (kilometers)	37,602	
Increase over previous year (kilometers)	5,921	
Total number of messages	47,224	
Increase over previous year	5,668	
Telegrams received and sent by telephone	1,443,474	
Increase over previous year	165,648	
Total receipts		$610,300.68
Total expenditures		462,249.58
Net profits		$148,051.10

The rate for interurban service is 1 franc (19.3 cents) per message of five minutes, irrespective of distance. The time may be doubled for 1.50 francs (29 cents), but for longer than ten minutes the rate is 1 franc (19.3 cents) each additional five minutes.

Rates for international service are for five minutes, and are governed by distance and the period of day or night. Thus:

Distance.	Day *Cents.*	Night. *Cents.*
Up to 50 kilometers	29	17
50 to 150 kilometers	38	23
150 to 250 kilometers	46	29
250 to 350 kilometers	58	34
Each 100 or fraction	10	6

Total number of messages	120,075
Increase over previous year	30,560

International trunk lines now connect with France, Germany, Holland and the Grand Duchy of Luxemburg. There are four direct lines between Brussels and Paris. A line with England is under construction. The land lines are now quite finished and the cable is being laid. All the international lines are of the metallic-circuit type.

In public telephones Belgium is woefully deficient, there being only 100 public telephones in the whole country; often in a large town there is but one such convenience. The rate for sending local messages is 5 cents for five minutes.

The 17 zones of telephonic operation cover about one-half of Belgium. It is unlikely that these zones will increase their areas to any great extent. The predominance of single wires will check any great great advance in the number of communications after the message system of subscription is instituted, and any increase in the use of the telephone will make the transformation in the matter of metallic circuits slower than ever.

The central bureaus are, for the most part, well constructed and along the lines of the most recent American practice. The great new exchange in Brusels, in particular, is a model of its kind. The simplicity of telephonic communication within a given zone is marked; each zone has one large central exchange, and, as a rule, nearly all the wires of the zone are directly connected with it. In this the Belgium telephone system has a great advantage over the telephone systems of the United States, where the distances are often so great that direct connection with one great central exchange is impossible. The absence of a large number of intermediate exchanges makes any increase in telephonic communication easy of control.

The Government has stated its intention to place all wires in the large towns in underground conduits, but the advance in this matter has been slight. The conduits adopted for Brussels are of vitrified clay pipes and are of American origin.

As to the out-of-door work in Belgium, as compared with that done in the United States, the only notable difference consists in the use of more iron structures—that is, more iron poles and iron fixtures. In Germany, Switzerland and Belgium expensive and ornamental iron poles are quite general in the cities.

Nearly all the instruments, exchange paraphernalia, etc., of Belgium are manufactured by the Bell Telephone Manufacturing Company, of Antwerp, and although this company is distinctly a Belgian concern, it is pleasing to note that its output is designed, with slight modifications, in accordance with the most recent American improvements. Most of the statistics given are for the year 1899, the most recent data obtainable.

Institute Meeting on Electric Railway Operation.

A very interesting and well attended meeting of the American Institute of Electrical Engineers was held on Jan. 24, devoted to electric railway work. After an admirable review of general traction conditions by President Steinmetz, a paper was read by Dr. Cary T Hutchinson on "The Relation of Energy and Motor Capacity to Schedule Speed in the Moving of Trains by Electricity."

This paper gives a thorough discussion, partly analytical and partly graphical, of the relation of energy and motor capacity to schedule speed. The problem is divided into three stages, viz., the determination of a velocity-time curve; the determination of a general motor curve sheet and the deduction from this sheet of several dependent curves, and the application of the general motor curves to the velocity-time curves. Equations are deduced giving a general solution of the problem involving the motion of a particle from rest to rest with three accelerations. The values of torque and speed in terms of input are plotted for some 20 different tramway motors of different size and make, but it is shown that the agreement is so close that one set of curves can with sufficient exactness be used for almost any railway motor built in this country.

The discussion throughout is based on the assumption that a motor operates at rated capacity on the one-hour basis, and will carry its rated output for 25 per cent of the total time. The average variation of core loss with speed is assumed equal to 41 per cent of the loss with rated speed.

The paper is accompanied by 15 curve sheets and a number of tables. An application of the principles deduced is made to the proposed express service of the New York Rapid Transit line. In this case the schedule speed would be 35 miles per hour, the average distance between stations about 7500 ft. and the time for stop at stations 15 seconds. Dr. Hutchinson states that under the assumptions of the paper it is practically impossible to acomplish such a schedule. The final conclusions of the paper are that the acceleration which gives the lowest motor capacity per ton is in all practical cases the most economical. A very small saving in voltage is not to be com-

pared with the many disadvantages of very rapid initial accelerations. Assuming for instance a gain of 10 watt-hours per mile for an acceleration of three over that required for an acceleration of one, in the case of a 20-ton car and with energy at ½ cent per kw-hour, this represents a saving of .1 cent per car mile, which is too trifling to be considered in comparison with the fixed charges on the greater investment for the motors and distribution system, the load factor at the power station, the increased cost of maintenance, the difficulty of accurate handling of cars, and above all, the much greater discomfort to passengers.

Mr. S. T. Dodd submitted a written discussion of Dr. Hutchinson's paper and contested his conclusion that the lowest acceleration possible under practical conditions is the best. A specific case was taken as an example, and the calculations made in connection therewith indicated that in that case the higher acceleration is the most economical, not only in power house but in equipment.

A written discussion of the paper was also presented by Mr. N. W. Storer, and is printed in full below.

A Consideration of the Inertia of the Rotating Parts of a Train.*

By Norman Wilson Storer.

THE problem of calculating the motor capacity and the amount of power necessary to maintain a certain train service involves a consideration of where all the power which is developed by the motors is expended; of just how much is used in overcoming train resistance; how much in overcoming the force of gravity, and how much in overcoming the inertia. The train resistance is a variable quantity depending on the track, bearings, wind and speed. A considerable number of formulæ have been produced to assist in calculating the train resistance under different speeds, but at the best the amount to allow for train resistance is only approximate. The energy required to overcome the force of gravity and the inertia of the train, however, is susceptible of the most exact calculation, but the latter part is seldom estimated correctly. There is one element in the inertia factor which has been almost entirely neglected, either because it has not been recognized at all or because its importance has not been appreciated. This feature is the inertia of the rotating parts of the train.

It has been generally understood that armatures of small diameter and light weight are desirable because their small flywheel capacity makes easier braking, but it has seldom been considered that this means also less power developed by the motor. A recent investigation of this subject has led to some very interesting results. It is found that the wheels with their low speed and the armatures, which usually revolve at a much higher rate than the wheels, together constitute an important element in the determination of the power required for operating the train. A specific instance will show this most clearly. Take the case of a double truck car weighing 30 tons loaded. It has eight 33-inch wheels weighing about 700 lbs. each, and two motors rated, we will say, at 150 hp each. The radius of gyration of the wheels is about 77 per cent of the radius of the wheel. The center gyration of the wheel, therefore, moves at a rate 77 per cent of that of the train. The flywheel effect of each wheel then is equal to a weight of $\frac{700}{.77^2} = 415$ lbs. when reduced to the speed of the car. Eight wheels will, therefore, add 3320 lbs. to the inertia weight of the car.

The armatures have each a flywheel effect of 1400 lbs. at a radius of 6 inches. With a gear ratio of 18:53 the center of gyration of the armature will move a distance of 9.25 ft. for every revolution of the axle, or for a corresponding movement of the car of 8.6 ft. Its relative speed is, therefore, $\frac{9.25}{8.6} = 1.08$ times the car speed, and the flywheel effect is, therefore, $1400 \times 1.08^2 = 1640$ lbs. reduced to the car speed. The two armatures thus add an equivalent weight of 3280 to the inertia weight of the car.

The wheels and armatures together add an equivalent of $3320 + 3280 = 6600$ lbs., or about 11 per cent to the inertia weight of the car.

The following paragraph will show the effect of a change in the gear ratios:

With a gear ratio of 20:51 the flywheel effect of the armatures would be equivalent to the addition of 2400 lbs. to the inertia weight of the car. This together with that of the wheels adds a total of 5720 lbs., or about 9.5 per cent to the inertia weight of the car.

From a considerable number of instances that have been taken the flywheel effect of the rotating part of an electric car is found to average about 10 per cent of the inertia of the entire weight of the train. This means that 10 per cent more energy is stored in every train than is accounted for by the dead weight; 10 per cent more power is required for accelerating, 10 per cent more energy is lost in braking, and the train resistance measured by the retardation in coasting is 10 per cent below the true resistance.

The actual increase in energy supplied to a train on account of the flywheel effect of the rotating parts is the energy in these parts which is lost in braking. The relation this bears to the total power developed by the motors is dependent on the number of stops, the speed at the time the brakes are applied and on the energy absorbed by the train resistance. Where the stops are frequent, the energy lost in brakes may be from 50 per cent to 75 per cent of the entire power developed by the motors, in which case the energy required by the rotating parts will be from 5 to 7½ per cent of the total.

There are two simple methods for including this item in the calculations. The first is by basing the calculations on a weight of car 10 per cent heavier than the actual in determining the acceleration and drifting. The second is by assuming that the force required to produce a certain rate of acceleration is 10 per cent higher than would be necessary if it were simply a dead weight. This is probably the simpler method, as it gives round numbers for calculations, as 10 per cent added to 91.3 gives practically 100 lbs. per ton as the force required for accelerating at the rate of one mile per hour per second. All that is necessary then in correcting calculations for accelerations is to use this figure of 100 lbs. per ton instead of 91.3. It will give a good average correction, although if great accuracy is desired it will be preferable to calculate the flywheel effect of each of the rotating parts of the train separately. It will usually be found that for slower speed service, where the gear reduction is considerable, that more than 10 per cent will be required while for high-speed interurban work where it would really amount to very little, anyway, on account of the small number of accelerations, the amount to be added for the correction will be less than 10 per cent.

As will be readily recognized this factor will also enter into the determination of the train resistance from the coasting line. Just how much of a correction will have to be made on this account depends somewhat on what is considered to be the train resistance. If this includes the friction in the motor then the train resistance obtained from the coasting line will be 10 per cent lower than the actual train resistance. On this assumption if the retardation in coasting is .2 miles per hour per second, the train resistance will be 20 lbs. per ton instead of .182 as calculated by the ordinary method. If, however, the train resistance does not include the friction of the motor the correction necessary to be made for inertia of rotating parts will be small, because it will be nearly balanced by the motor friction. When the train is coasting, the inertia of the rotating part is added to the inertia of the dead weight of the train in tending to keep up the speed, while the friction of the motor is tending to reduce the speed. When the train is accelerating, or moving with power on the motors, the motor friction is taken into account in the efficiency curve of the motor so that the train resistance to be used in calculating the acceleration should properly not include the motor friction. It will thus be seen that the error due to motor friction and the inertia of the rotating parts will tend to counterbalance each other in the determination of the train resistance from the coasting line. For accurate determinations, however, the train resistance should include a consideration of both the inertia of the rotating parts and the motor friction. The most accurate way to obtain this is to plot the friction curve of the motor and to obtain the inertia of the armature and wheels either from tests or from calculations based on the drawings.

It may be considered that this is an undue refinement, but if the matter is carefully investigated it will be found that the motor friction is quite a considerable portion of the total train resistance, in the same way as the inertia of the rotating parts is a considerable portion of the inertia of the train.

It is understood that general solutions for the railway problem may be offered which will give fair approximations of the motor capacity and the amount of power required. It is understood that any good engineer with a fair amount of experience can give a pretty good estimate of the power requird for a given service even when considering

*A communication presented at the [illegible] meeting of the American Institute of Electrical Engineers.

the capacity of the motor according to the old horse-power rating. But where accuracy is required, every known element should be considered at its proper value, and there will still be at least enough variable quantities in the railway problem. The most reliable estimate for train resistance should be used; the inertia of the rotating parts should be obtained and considered; the weight of the entire train should be known; the acceleration and power curves should be carefully plotted and the average heating effect in the motors should be accurately determined before any large equipment is finally decided upon.

Commercial Measurement of Electrical Energy.

At the recent convention in Milwaukee of the Northwestern Electrical Association, Mr. Elton J. King, of Fort Wayne, Ind., read a paper entitled "Some Important Points in Commercial Measurement of Electrical Energy," of which the following is an abstract:

Mr. King said that the manufacturers, generally speaking, have done much to aid in a satisfactory understanding between customers and central station men by simplifying the readings of dials and reducing the chance of error in computing bills. To the accomplishment of this end some manufacturers are offering counters with larger dial circles and are eliminating constants. In some of the earlier form of meters the use of constants was avoided on many of the sizes by varying the forms of the meter. This method, however, proved unsatisfactory because of the need of a very high speed to avoid constants on large capacity meters. The increased speed attained shortened the life of the meter and introduced large errors because the drag or retarding device failed to correctly drag the meter for required variations in speed. At present there is the almost universally accepted practice of designing the counter so as to retain the same maximum speed for all capacities of instruments and to eliminate the constant by changing the gearing of the counter.

In applying a constant of this character two methods present themselves. The first, by leaving the values of the dials of the counter remain the same as on smaller capacities, and multiplying the reading by the constant 10, 100, etc., depending on the capacity of the meter. For convenience the constant could be placed on the counter. This method, however, presents similar objections to the old method of constants for each different capacity meter, by leaving, to some degree, the same confusion and misunderstanding in the customer's mind, and requiring the repeated application of the constant in the records and in computing bills.

The second, and more advisable, method is to advance the value of each dial of the counter and thus avoid entirely the use of the constant. For example, instead of having the counter read to one-tenth of a kw-hour, as the smallest unit, advance the values of the dials by 10, 100 or 1000, making them read in 1, 10 or 100 kw-hours as the smallest unit, depending on the capacity of the meter. The first consideration of this method might seem unsatisfactory and open to objection as having a tendency to introduce confusion in the reading of meters, and lead to large errors due to the changing of dial values. This objection, however, is reduced to a minimum when we consider that meters that will develop a power of from 30 to 40 milimeter-grammes at full load, will successfully drive direct reading counters reading to one-tenth of a kw-hour as the smallest unit, on meters of 7500 watts (ampere-volt) capacities or less. Meters of these capacities can be made direct reading without changing the values of the dial circles or reducing the maximum time capacity of the counter to an objectionable amount. As it is possible to drive direct-reading counters of so large a capacity without changing the dial values much of the objection that might be presented to this method is eliminated. This is very forcibly illustrated when we consider that in practically all of the meter installations 97 per cent of the meters installed have an ampere-volt capacity of 7500 watts or less. This much has been done on the part of the manufacturer to provide a simple counter to assist in meeting the intelligence of customers and to aid the central station men in establishing a uniform and common unit upon which to compute and render bills.

The losses due to incorrect registration in many of the large stations reaches a percentage of from 12 to 20 per cent after the line corrections have been made and in many of the smaller stations these percentages are much larger. This discrepancy can be directly attributed to the slowness in registration of the meters. The small plant is the one which can least afford to stand a large slow meter discount, as the measured energy is generally distributed over a large territory and measured in small quantities. In a few of the large plants in this country this question is receiving careful attention and a corps of meter attendants is in charge of the meter service.

Broadly speaking, there are two methods of testing meters in general practice. The practice of testing meters in the shop and substituting them in place of meters about which complaints have been received or concerning which a suspicion of inaccuracy exists on the part of the company, is perhaps the most generally used method. There are several companies, however, which have competent meter attendants who check the calibration of the instruments installed in service. Either of these methods is fruitful of good results if carefully and intelligently carried out. By carefully calibrating the light load accuracy of the meters a large percentage of the meter loss can be eliminated, and for this reason it is suggested that a more frequent inspection of the light load accuracy of a meter be made. This inspection could be easily and quickly conducted to a fair degree of accuracy by an inspector provided with a standard lamp, a stop watch and an indicating voltmeter. Provisions could be made for inserting the lamp in circuit where the meter is installed, and it would require but a few minutes to check the calibration of the meter and make any necessary corrections on light loads. This class of inspection could be conducted at much smaller intervals of time than the regular or more thorough examination. In many cases we believe that this class of inspection could be conducted with good profit at intervals of from 4 to 6 months, depending upon the conditions under which the meter is installed, followed with a more thorough examination of the meter at intervals of a year and a half or two years. With means at hand for renewing wornout parts, such as the jewel and shaft, the meter attendants should be able to keep the meters in reasonably accurate calibration.

Mr. Gille mentioned the practice of his company of calibrating meters while on the line, using indicating wattmeters, and considered this one of the most convenient ways to check up a meter on the system that he knew of. Mr. King said that calibrating meters with indicating standard wattmeters is really the best and most accurate method of accomplishing results. The use of a standard lamp for checking a light load is convenient for the small central station people, as it can be done very quickly, but it is certainly advisable to install meters so that they can be checked with the standard wattmeter, and if meters can be installed under such conditions, the use of a standard wattmeter would be much preferable to the use of a standard lamp.

Professor Jackson was sorry to see the use of a standard lamp and indicating wattmeter recommended for testing meters on light loads, because it was a slovenly method. When the meter expert of a manufacturing company advises the central station man to use that method, he will use it, and he was sorry to see such advice given. The indicating wattmeter costs no more than the indicating voltmeter, and every central station should have indicating wattmeters for checking its recording meters. If a station does not feel that it can afford to have a sufficient number to test all sizes of meters under varying loads, it certainly ought to have one that would cover the light loads on all meters, a medium load on the average meter, with perhaps whole load on the average meter. In reply to a question as to the practice of checking total output with the amount of current sold as shown by the meter at the consumer's and the proportion those amounts are and how they vary with respect to direct and alternating currents, Mr. H. C. Wirt gave some data. In a particular case the kw-hours produced at the switchboard for commercial lighting only were 729,923 by meter, and the kw-hours registered by meter at consumer's lamp installations were 309,001 kw-hours, showing a loss in transmission of 58 per cent, leaving available for sale 42 per cent. Part of this, of course, is line loss, part accounted for by slow meters, and a large part core loss. In another case the figures were 671,006 kw-hours and 393,222.6 kw-hours, respectively, showing a loss in transmission of 41½ per cent, and leaving available for sale 58½ per cent. This latter refers to an Eastern station, and is not any worse than probably some of the Western plants. Mr. Williams said that at the Madison station there are both alternating and direct-current meters on the switchboard, and all consumers have meters. The losses are separated out of our losses, including the core losses, transformer, meter and shunt losses, etc., both for the direct and alternating currents. The consumers' meters, as compared with the registration of the station meters, register from 75 to 80 per cent, and on the direct-current and power system is from 85 to 90 per cent; the transformer core losses are from 5 to 7 per cent of the output, and the meter shunt losses run from 3 to 5 per cent on the alternating. That brings the loss unaccounted for down to about 10 per cent.

Professor Jackson, referring to a remark by Mr. Bowen, said it is not wholly a question of sales per pound of coal that interests

the station, but it is the sales per pound of coal plus the cost of labor and interest. Now, when you come to take that extra item into account it makes station wattmeters of more value, because they decidedly influence the management of the station. Moreover, the station wattmeter when used properly in conjunction with the readings monthly of the consumer's wattmeter, enables the station manager to arrive at a point at which he should attack his losses, and can attack his losses with the greatest success. But the fact is more work is done toward improving the steam engine in the station to the last economy, than in all the rest of the plant put together, yet the steam engine is the place where the least can be gained ordinarily for a given amount of expenditure of labor and money. The station wattmeters will go further than anything else towards enforcing the lesson upon the manager's attention that it is not the engine that is at fault, but it is the fireman that is at fault, that his transformers are at fault, that his meters are at fault.

Mr. Doherty called attention to the fact that we must know where our losses come in to correct them. You can calculate the core loss of your transformer to reasonable accuracy; you can also calculate the shunt loss of your meters and the resistance loss of your lines, and the difference will represent your theft of current and the faulty registration. If you do not separate out the core losses which are a constant, regardless of the amount of current you sell, your real, unaccounted-for current will vary considerably in different months in the year, on a percentage basis, because in the winter time your lights will average more than an hour's use in Western central stations, and in the summer time they will average less than an hour; the maximum may be as much as four times greater than the minimum. With a transformer capacity equal to the connected load, a core loss of two per cent alone amounts to 10 kw-hours per lamp per year. The average use of lamps in these Western central stations is about 18 kw per year. Among those lamps there will be many that do not use 1 kw-hour per lamp per year, but you must send from the station 11 kw-hours to supply that, so you are getting from the consumer a return of not 20 cents, but less than 2 cents per kw-hour. If a man uses 18 kw you are sending from your station 28 to supply him, and if you are getting 20 cents a kw-hour for current sold, you are getting 16 or 17 cents per kw-hour for current generated.

The measure of a good meter are cost, ease of repair, ease of installation, etc., and in addition to that other factors must be considered. In a general way, the meter should be as light as possible; second, the moving parts should be as light as possible, because the weight of the moving parts has most to do with the wear of the jewel; the meter should have a low-shunt loss, for the sake of economy. All of the alternating-current wattmeters have so low a shunt loss that it is not important. Figuring labor and fuel at one cent per kw-hour, you have a cost for one wattmeter of 8 cents per lamp per year for the item of shunt loss, and for the two wattmeter installation it amounts to about 16 or 17 cents. The greatest objection to shunt loss is the fact that much heat is dissipated in the meter and must be gotten rid of, and the maximum capacity of the meter is dependent more largely on the amount of heat which must be dissipated than on any other one factor. The average induction meter is good for 300 per cent overload, and some of them for 700 per cent overload. There are two sources of heat generation in the meter; one is from the shunt loss, and the other from the drop in the series coils. There is also a reactance drop that does not cause heating, but does affect your regulation. The drop in the series coils is the most important point in selecting a meter. Its regulation affects the capacity of the meter, and there is no advantage in a meter having a large drop in the series coils.

As to the desirability of a high torque meter, as the net torque must be the same in all cases, and as the meter with high torque must be compensated for by the extra drag in the magnets, there is no advantage in it. Concerning the question of reducing the loss between current generated and current sold, this is a problem in transformation, transmission and metering. As a rule, the resistance loss of an alternating-current system is not heavy; the core loss, while but a small percentage of the total capacity of the station, yet amounts to considerable if the quantity of current used is large, because this loss goes on practically the same for 24 hours per day. This is also true of the shunt loss in meters. With modern induction meters it is possible to register the current to a point of accuracy which leaves very little to be desired. The present induction meter with dust-proof case and with light moving parts, well built to start with, with permanent magnets that are permanent, should run three to five years without any attention whatever. As to transformer core loss, Mr. Doherty said he has succeeded in getting good results in central stations by systematically overloading the transformers.

In Madison the core loss is .54 of 1 per cent on connected load, and that is why Mr. Williams is getting the high efficiency he has just mentioned, which apparently are from a December report. In December the lights are used for long hours, and, therefore, the percentage goes down, and it increases in the summer time. An average of the year for that station is about 73 per cent for alternating current.

Where individual transformers are used practically 100 light transformers should be employed. Where transformers are connected up together, the transformer capacity can be gotten down in some districts to 25 per cent of the connected load, and in the city often as low as 33⅓ per cent. It makes a great difference whether you have got 33⅓ per cent capacity in transformers wasting current or whether you have got 100 per cent, and it is largely a problem in capacity of transformers which must be considered together with other possible core loss. Core loss is, as a rule, the big source of loss in an altternating-current station. Mr. Doherty expressed himself a firm believer in more exact regulation than any direct-current station that was ever buil in transmitting current over any considerable area.

The Storage Battery Automobile.

Mr. H. P. Maxim recently delivered an interesting lecture before the Automobile Club of America, in which the present status of the gasoline and storage battery automobile was discussed in detail. Two inherent disadvantages of the former are noted—it cannot start under load, and it cannot be overloaded. In detail, the gasoline automobile engine of to-day stands wanting in ignition apparatus generally, in the proper proportioning of number of engine cylinders, engine horse-power and gear change, in friction clutch constructions, and in not providing in ordinary machines intended for the public the automatic governor.

Taking up the electric automobile, Mr. Maxim considers that there is generally more prejudice and less knowledge concerning the electric storage battery, and what it will honestly do and what it really requires, than any other piece of automobile apparatus that is one-half as much used. We continually hear broad and sweeping condemnation in one breath, and amazing claims of mileages and capacities per unit of weight in the next. As a matter of fact, the general lack of knowledge concerning the storage battery has caused and is causing it to suffer just the same as has been the case with the gasoline engine.

In the beginning the lack of knowledge of its necessities and care, even on the part of the manufacturer, caused it to turn out in practice just about as far from what we originally had the right to expect as anything could. But again, notwithstanding all this an addition of the public prejudice added, the many extraordinarily advantageous features of the system of which it was a part, prevented its being kept down. To-day we have in it a piece of apparatus which, while far from perfect, yet possesses possibilities which compel its consideration.

As an example, the best automobile storage battery we could buy three years ago and be sure of getting had a maximum capacity, at a certain discharge rate, of 2½ ampere-hours per pound of complete cell. This meant that with a vehicle of the style and general characteristics then demanded, the maximum weight of battery that it was practical to put into it could not in every-day service be counted upon to average more than 20 miles on one charge. It had, where it could be treated individually, and with skill and understanding, relatively few ailments, and could be counted upon to have a life of about 100 vehicles discharges before losing 50 per cent of its original capacity.

To-day, barring patents, we can buy batteries, which have a capacity at the same discharge rate per pound as before, of 4½ to 5 ampere-hours per pound of complete cell. This means that twice the mileage is to-day obtainable in the same vehicle and with the same weight of battery. But what is more important, the positive plates of these batteries (which are the minimum life factor) will give, where certain well understood and easily avoided abuses are not practiced, a life of at least 125 complete vehicle discharges, without losing any of their original capacity. Taken as 40 miles per discharge, this is 5000 service-miles that the storage battery of the best type of to-day can be absolutely counted upon to give.

When we look for the causes of this improvement we find satisfactory and reasonable ones. The battery plates are made with many times more active material upon them. They are provided with sepa-

rators which not only give plate separation, but form a veritable lock for the active material, absolutely preventing its escape from its plate. The plates and these separators and many details about the jar, are carefully proportioned so as to ensure that the combined element, when it is in place, forms a solid, self-supporting structure. Except by the most violent formation of gas is it conceivable that any of the active material can get away from the plates.

As an instance of the effectiveness of this construction, which is becoming common in all the best types of pasted batteries, I have seen several of them after the completion of the 100th discharge. The separators were actually an integral part of the plates. They could not be removed without taking the active material off in large sections. This certainly made it seem evident that one of the most serious difficulties in past batteries has, in these latest types of storage batteries, been permanently overcome.

The constructional features of the grids do not seem to affect, to any material extent, the capacity per pound, provided they do not present an unnecessary amount of dead rot. They do affect the life, however, since if the positive grid is so arranged as to leave important parts too much exposed to oxidizing action, it is soon weakened enough to break, lose conductivity and suffer permanent and serious reduction in capacity.

The separators, which seem to be chiefly responsible for the increased practicability of the recent storage battery, are usually in all of the different types, made of thin wood. They are cheap, porous, very slowly affected by acid, and when made with small vertical ribs, furnish the necessary separation for acid space between the plates, and furnish an admirable surface for holding the active material closely against the grids.

This, of course, as far as it goes, promises us practicaly results. But, nevertheless, even with all these, and the many small detail improvements, which we have not time to consider, our automobile storage battery is still wanting, if it is open to injury by ignorance or carelessness in charging—the cause of most of the injury of the past. Violent overcharging would burst off anything.

This point has been met by an automatic charging outfit, which has appeared recently on the market. It is provided with a resistance, marked to suit the different standard makes of electric automobiles, and when used in conjunction with suitable current, automatically sets a rate which is safe. Then, when the voltage across the battery terminals indicates that the maximum safe amount of charge has been given, it automatically cuts out.

Our batteries thus, either in the owner's stable or in a garage, need no longer be dependent upon the watchfulness and knowledge of an attendant for their correct charging. Our past experiences have proven that this cannot but have a most advantageous effect, and still further add to the practicability of our automobile storage battery.

There seems to be every reason, therefore, for believing that our present automobile storage battery, as our manufacturers know how to produce it, and to protect it, is to-day, even in untrained hands, as practical a piece of automobile apparatus as we have before us.

The tremendous importance of anything that will tend to increase the practicability in general, of the automobile storage battery, is realized when we consider the motor system it makes available to us.

Nothing that has ever been devised comes anywhere nearly being as suitable for traction purposes as the electric motor. It is able to start under any load, able to accept any over-load up to the point of actually burning up, is of ideal mechanical simplicity and suitability for connection to the driving wheels of a vehicle, absolutely automatic in its running, and independent of any consideration, preparation, mechanical knowledge, or skill on the part of the driver of the vehicle it propels other than that necessary to guide it.

Mr. Maxim spoke of the great assistance the Automobile Club of America could give the American public, as a whole, by undertaking a competitive trial of automobile storage batteries, and to make the results public in an unprejudiced way. It is now an entirely practicable thing to get plenty of good batteries, and, of course, we know how to make a practical test of them. The storage battery is not an expensive piece of apparatus to make in quantities of two or three, and besides the manufacturers there are many electrical engineers and electro-chemists who would welcome an opportunity to publicly demonstrate their ideas on storage batteries, if they could feel sure that their efforts would receive whatever credit were due them.

In conclusion, Mr. Maxim dwelt on the bearing of the two powers, electricity and gasoline, upon each other. He considered that the utilitarian conditions which each power's characteristics enables it to best meet, will determine absolutely its respective field, the word "utilitarian" being employed both in a pleasure, as well as a business sense. In Europe, and in France especially, the utilitarian is not recognized, and in this respect we have gained in the past and will gain in the future. The generally more effete and less practical instincts of the European have caused the sporting element—in the aristocratic European understanding of the term, a thing which we in this country scarcely grasp—to be the dominant factor.

In no European country has the success followed attempts to produce and encourage the utilitarian automobile that has followed in this country. Witness the number of automobile business wagons taking a legitimate part in our daily city service, as compared with the case in Europe, and our automobile cab service right here in the city of New York, as compared with similar attempts in London and Paris.

The European may invent, but it is the American who reduces to practice. It is the indomitable national instinct of utilitarianism, even in our pleasures, that Americans possess, which is going to successfully develop our gasoline, electric and steam automobile, lead them into the fields best adapted to their several characteristics, and ensure their superiority.

The electric will absolutely, certainly dominate wherever comfort and convenience in transportation is demanded, and where absolutely no consideration of the vehicle is possible other than that necessary to guide it. Gasoline will absolutely dominate wherever a ton-mile must be accomplished at the minimum of expense, and wherever distances exceed the practical limitations of the storage battery. Mr. Maxim believes that the final automobile will be the product of the American engineer and mechanic, just exactly as have been the best steam locomotives and the best street cars.

Behr Electric Monorail in Germany.

Before the Association of German Engineers, Mr. F. B. Behr has recently delivered a lecture on the high-speed monorail road authorized between Manchester and Liverpool, and on high-speed electric roads in general. The German Imperial Railway Department and technical personages of note manifested great interest in this subject, and many eminent men were among the audience. The president of the Railway Department, Dr. Schulz, with Herr Streckert and Herr Schroder, two other of the highest railway officials of the empire, were present. Among others were Professor Slaby, Professor Riedler, Herr Kemman (technical adviser of the Deutsche Bank), Herr Wittig (director general of the Elevated Railway), and a representative from the British Embassy. In the course of his remarks Mr. Bahr alluded to the experiments now being carried out between Berlin and Zossen, and said:

"The feature of high speed, and especially the creation of a type for the introduction of high-speed railways, seems not to have been to my mind the principal object in the minds of those who have investigated these experiments. If I may be allowed to say it, with all diffidence, however successful from an electrical point of view these experiments may be, and no doubt will be, from a high-speed railway point of view—quite distinct from the electrical working—it seems to me that they cannot lead to any final result. Working on a practically straight line they can never produce a type to be adopted generally for high-speed traveling. This I have fully explained in beginning my lecture, and in this I am fully confirmed by the experiments themselves. If a two-rail line cannot be absolutely safe in theory, no experiments can prove it to be so; and, further, when you compare the weights and results, as far as I know them, we find that the carriage used of a weight of 94 tons, and carrying 45 passengers, used 3000 hp during the acceleration and 1000 hp on the rest of the journey. These figures are more than double those which will be used on the Manchester-Liverpool line. The carriage sanctioned for the Manchester and Liverpool line weighs 39 tons for 38 passengers, and uses 515 hp, against 94 tons weight of carriage at Zossen for 45 passengers, with an average horse-power of 1100, and an accelerating horse-power of 3000. This means at least double the consumption of electricity per passenger and double the amount generated at the generating station. The height of the carriage without the trolleys is 14 ft., as far as I can judge from the drawings against mine, which is 11 ft. With the trolleys it is practically double that of mine. The same thing applies to the weight of the structures over which the train runs, as, per foot of bogie, the weight of the Zossen carriage is nearly double that of the Manchester and Liverpool line. This also applies to the pressure per sleeper, which is also 17 tons at Zossen, against 9½ at Liverpool."

Electric Canal Towage in Europe.

With regard to the familiar efforts that have been making to apply electricity to the European canals, a cable dispatch from London, of Jan. 11, says: Frank W. Hawley, vice-president of the Erie Canal Traction Company, has been on this side several months quietly securing concessions for the operation of European canals by electricity. The Erie concern to-day secured control of about 5000 miles of canals in England, and on the continent. As a result cargoes will shortly be shipped on the same bill of lading from Duluth, Minn., to Brussels, Bruges, Ghent and Cologne, and later to many points in the United Kingdom, France, Germany and Italy.

At the forthcoming session of Parliament the British legislators will be asked to grant permission for the erection of central power stations for the propulsion of traffic on at least two British canals. These will be operated with American capital, though their control will nominally remain in British hands.

Mr. Hawley gave an interview to a representative of the Associated Press as follows:

"It is true that the traction company is making considerable progress in securing all-water routes by electrically operated canals throughout Europe. I cannot tell you yet the names of the English canals which will figure in Parliament. There are in the United Kingdom 1138 miles of canals owned by railroads which do not make a very good financial showing, but 2768 miles of English canals, independent of railroads, show earnings of £729 a mile, which is greater than that shown by many American railroads. However, we have been able to get control of a portion of these, because their operation and maintenance expenses are over 70 per cent of their gross receipts. The largest canals in England—namely, the Birmingham, Grand Junction, Leeds and Liverpool and Oxford and Bridgewater—are not far removed from sources of electric power supply, at least, nothing like so far removed as is the canal at Oakland, Calif., where the power is transmitted from the Yuba River, a distance of 140 miles. Therefore, it is merely a question of getting the necessary consent of Parliament for the conveyance of this electric energy before the English canals will be equal to the canals of America and Belgium, where electrical energy has resulted in increased facilities with a corresponding reduction in the cost of operation."

The officers and directors of the Erie Canal Electric Traction Company, according to a recent list, are Louis A. von Hoffmann, of L. von Hoffmann & Co., president; Frank W. Hawley, vice-president; A. B. Donaldson, secretary; Charlton T. Lawis, John G. Carlisle, Thomas C. Platt, Frank W. Hawley, Alfred S. Heidelbach, of Heidelbach, Ickelheimer & Co.; William H. Baker and James Virdin. The Alden motor towage system of Mr. H. N. Alden, controlled by them, has been described fully in these pages.

French Criticism of the Weaknesses of Wireless Telegraphy.

In the discussion of the relative merits of wireless and submarine telegraphy, Messrs. Boulanger and Ferrier, two French army engineers, offer the following considerations:

1. Insecurity of communications.

2. Necessity of constructing very high supports for the antennæ, from the moment that the distance to be covered is at all great.

3. Cumbersomeness and sensitiveness of the apparatus.

The first of these objections is the most serious, and, unfortunately, so far, it does not appear to be possible to remove it entirely. If the fact that messages can be intercepted is not a very important objection, owing to the possibility of using cipher codes, the same cannot be said about the fact that the reception of a mesage can be interfered with by a transmitter even placed at a considerable distance off. Moreover, in warm climates (and why not in warm weather anywhere?) the reception of telegrams can be very much disturbed by atmospheric perturbations.'

The necessity of employing very high supports for the antennæ is no great objection on shipboard, where, moreover, there is no occasion generally of corresponding at great distances. But such is not the case when working from land.

As a rule, communications are more difficult over land than where the stations are separated by water. It was thus that the trials made in the Transvaal gave no practical results. Good communications can, however, be had on land with sufficiently elevated antennæ. But, beyond 50 to 60 meters in height, the construction of supports presents great difficulties. Recourse must, then, be had to captive balloons; but these are at the mercy of the winds.

It follows, therefore, that the progress obtained by Mr. Marconi, though important, does not yet allow wireless telegraphy to supersede the processes hitherto in use. Whenever possible, it will always be preferable to employ existing methods, which possess the great advantage of simplicity. Nevertheless, in many cases, wireless telegraphy will be a precious complement to the other, and ought not, therefore, to be neglected. At sea, for instance, it would often be the only means of communication, and it is easy to imagine circumstances when even on land no other means of telegraphing would be available, especially in military operations.

It is in this field that the practical use of wireless telegraphy must be sought, and the progress accompanied since its inception warrants the hope that the aim of its adepts may soon be attained.

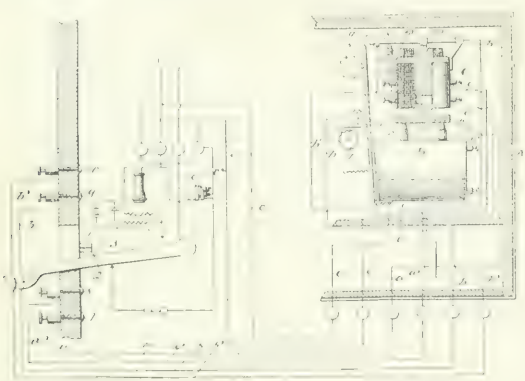
Electrifying the Water Powers and Railroads of South Africa.

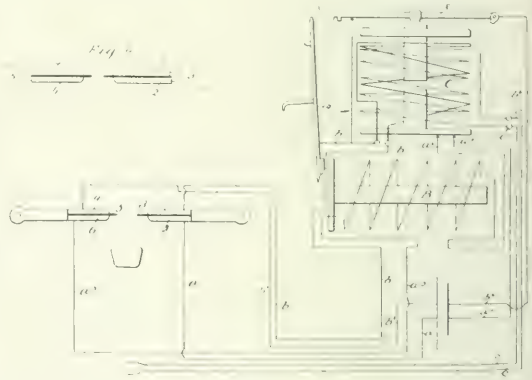
War is not the only thought in men's minds in South Africa. Professor J. T. Morrison (Professor of Physics at the Victoria College, Stellenbosch) has just delivered an interesting lecture in Cape Town upon "The Development of Water Power, with Some Reference to South Africa." In his opinion, South Africa possesses, in the Orange River Falls, the source of far more than sufficient convertible energy for working the Cape Government railways. They are not the only falls capable of being so converted, but he selects them as being the most suitable for this purpose, in spite of their rather inconvenient situation. Cape Town is distant from them 400 miles, Port Elizabeth and East London between 400 and 500 miles. The question, he said, was whether or not it was practicable from a financial point of view to transmit power 400 or 500 miles, and make it pay, and was it a question which the Government could take up and deal with as a matter of policy? He ventured to think it was, notwithstanding the circumstance that were the scheme entered upon it would entail the longest transmission of power yet attempted. He proceeded to quote facts in support of his contention that such a scheme would be financially profitable. Taking the returns of the year 1897 as a basis, he found that the Cape Government Railways used something like 10,000 hp. That would mean 50 engines in constant use, but the probability was that 100 were used. These would be of 200 hp each. The cost of fuel in 1897, without wages or anything else, was £299,000, representing a cost of £30 per horse-power. In transmitting power 400 miles, the capital cost would be distributed as follows: Works at the falls (which are 200 ft. high and capable of producing 30 times the power required) would cost, at an outside estimate, £180,000; 400 miles of copper wire to carry 40,000 volts would represent 5000 tons of copper and would cost £400,000; the erection of the transmission line would cost another £180,000. But the power could not be used at the high pressure of transmission, and it would also have to be used in motors of 200 hp each. The cost of this would be £600,000, making the total cost £1,360,000 ($6,800,000). Nothing depreciated so little as hydraulic machinery, and only 4 per cent per annum need be written off for this (a very high rate), equalizing £54,400, which with 5 per cent interest on £68,000, made a total annual expenditure of £122,400 ($612,000). Comment on the comparison between this and the present cost was needless. The change from steam to electrical power could be effected with ease Steam and electric engines could run on the same line, and as the former fell out of use they could be replaced by the latter. There were, he continued, certain parts of the line on which the power from the Orange River Falls would never be used. For example, it would not be necessary to transmit that power to Cape Town, as there were sources of power in the neighborhood. The Wynberg line could be worked from these sources. It required a little less than 1000 hp. There were sufficient available running streams close at hand from which the power could be derived. It would not be difficult to get 400 or 500 hp from the Stellenbosch district, while there were many other sources, like the Witte River, for example. Moreover, the Wynberg line, being a busy line, would be an excellent one on which to try the experiment.

New Telephone Patents.

There are three telephone patents in the issue of Jan. 21, two hailing from Germany and the third curiously enough from Germany's nearest neighbor in this country—Hoboken. Another coincidence is that two of the patents relate to service meters. The trend of telephone practice, in the aim to make low rates and extend the development of the telephone by party-line and message rate service, is strikingly represented by the numerous patents that issue on party-line systems and service meters. The evolution of working systems, however, seems to require the production of many that will not work—outside a laboratory—and of many that are devised wholly without regard to the practical conditions that govern the commercial supply of telephone service. A similar waste of effort occurs in every phase of life, from the works of nature to the products of the mind of man, so there is little profit in protesting.

The American patentees, Messrs. Robert and William Hammatt Davis, of Washington, D. C., and Mr. Daniel C. Woodbury, of Hoboken, patent a recording system for use in connection with any sort of apparatus where it is desired to record either the total time or the number of times that the apparatus has been in use, or both. The invention is specifically described as furnishing a telephone meter to be used at sub-stations, though its use is not so limited, and certain features of it are considered capable of much wider application. The inventors consider that a telephone service meter should be entirely automatic, not requiring any special act on the part of the subscriber to operate it, that the placing of meters at the exchange is objectionable because of the complication of wiring, the demand on space, and because the subscribers prefer to have the meters under their own inspection "to do away with any possibility of fraudulent overcharge by the telephone companies."





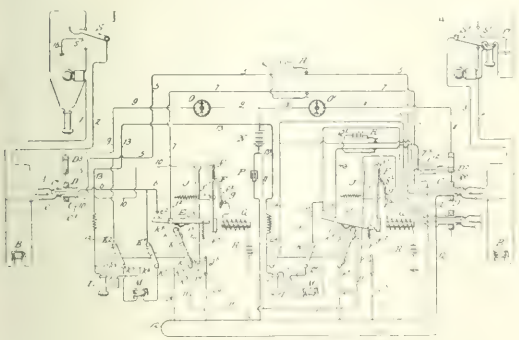
FIGS. 1, 2, 3 AND 4.—DAVIS AND WOODBURY'S TELEPHONE RECORDER.

Referring to the diagrams, Fig. 1 shows the system applied to a magneto telephone system, Fig. 3 is a diagrammatic view of the recording system and Fig. 4 is a detail view of a contact device by which the switch-hook automatically closes the circuits of the meter in its rise and fall, shown in Fig. 1 as projecting into the opening in the side of the telephone box. One of these contact pieces is placed on each side of the opening and projecting into the path of the switch-hook. They are composed of two strips of conducting material, as 1 and 2, separated by a flexible strip of insulating material, as 3. Strip 1 is connected to binding-post 9, strip 4 to binding-post 10, strip 2 to binding-post 7 and strip 6 to binding-post 8. When the switch-hook rises it makes contact between 2 and 6, but in passing bends back the insulating strips and so does not make contact between strips 1 and 4. When the hook descends contact is in like manner made between strips 1 and 4 and not between 2 and 6. When a subscriber uses his telephone, the hook in rising closes 2 and 6, making the following circuit: Strip 2, post 7, wire a, battery, wire a^1, contacts 11, closed by a plate on armature 12, wire a^2, magnet B, wire a^3, post 8, strip 6, back to 2. Magnet B attracts armature 13 attached to lever 14, which releases wheel 15, allowing a time-recording device to start; at the same time arm 16 moves wheel 17 one point, recording the call. Lever 14 is held in position by a notch in lever 18, in which it engages when attracted by B. When the conversation is finished the downward movement of the switch-hook closes contact between 1 and 4, making this circuit, strip 1, post 9, wire b, one coil of C, wire b^1 (b^4 being broken as 18 is held away from contact 19 by lever 14) lever 14, 18, wire b^2, battery wire b^3, post 10 and by 4 and hook back to 1. This energizes magnet C, repels armature 20, raises 18 and releases 14, which stops the time-recording device. Armatures 12 and 20 are polarized, so that current that repels 12 will also repel 20. When a sub-station is called by the exchange, the calling current energizes circuit cc^1, which is in shunt to the armature of the magnets, and contains the second winding of C; C then draws up 12, thus opening the circuit aa^1 at contacts 11, so that when the switch-hook rises in response to the call B will not be energized and no call will be registered. When the hook is depressed C is energized through circuit b^4 and repels 12, thus re-establishing the connection between contacts 11, and leaving the recording device in condition to register another call.

Further modifications of the system are shown illustrating the application of the system to common battery work, and describing a time-lag controlling device to enable the subscriber to call a second time for the same connection without repeating the record on the meter. The device, however, stands little chance of adoption in practice, as apart from its complication and expense and the doubtful feature of the whole working depending on the integrity of the flexible insulating strips to be bent to and fro every time the hooks moved, a meter such as this meets the fundamental difficulty that it would register every call while telephone rates are based on completed connections.

Herr Georg Ritter, of Stuttgart, Germany, patents a telephone system relating in particular to a register and testing system for telephone exchanges. The principal feature of the invention is of course the service meter, which Mr. Ritter places at the central office and so arranges that it will operate only when the called subscriber has taken down his telephone, thus registering completed connections and not merely calls. To accomplish this object, however, Mr. Ritter indulges in a combination of listening-key relay and interconnected levers of somewhat ferocious complexity, and which would require to be of very solid and accurate workmanship to perform effectively all that is required of them. This arrangement is shown in the diagram, where KK^1 K^2 make up the combination listening key and circuit changer, connected by an insulating connecting rod K^2 and G is a relay controlling the lever F connect to lever J by an insulating link and controlling contact lever J by means of the latch f. Each sub-station has a ground connection 16, 17, with contacts ss^1, over which the switch-hook passes to operate relay G which is connected in a grounded circuit made up of line wire 3, plug-tip, wire 7 levers E and F, spring f^3 and through coil, battery H to ground. The meter circuit is the principal point of interest. O represents the meter of calling sub-station I. The circuit, starting from the jack-ring D is made up of wire 9, meter magnet, battery N wire 11, lever J and wire 10 to socket C^2 of the calling plug. Normally the circuit is open of course between the plug and the jack, and when the plug is inserted and contact between C^2 and D closed it is still open at K^1 on lever K and j^4 on lever J, which have to be brought together to complete circuit between wires 10 and 11. When the operator

answers a call she moves the [illegible] and K^2 on K^8; this throws her telephone in circuit and also, by the action of roller K^9 at the end of K on bent spring e^3, throws lever E up into engagement with latch f on lever F, held forward from G by the spring f^7. Having obtained the number she throws the triple lever key to the position shown in the diagram and so brings the contact K^1 on lever K opposite contact j^4 on lever J. When the called subscriber takes down his telephone he momentarily grounds line 3 and so energizes G, which attracts f^2 and consequently F, releasing the detent lever E; the rise of the left end of E closes contacts e^1 e^2, thus completing 6 7, previously interrupted at that point. The relay G being energized momentarily only the linked levers J and F are drawn away by the spring j^7 immediately after F has been attracted for the release of E, and j^4 then makes contact with k^1, thus connecting wires 10 and 11, which completes the local meter circuit through battery N and causes the meter to register. No call can be registered until the called subscriber has taken down the telephone. The device has been well worked out, but it is open to the objection that its operation would require the use of a rather complicated mechanical outfit which, since it is controlled by the listening key, must necessarily be placed in the switchboard. The system stands little chance of adoption in American practice. Mr. Ritter is also responsible for a patent covering a telephone exchange system which has for its object the automatic ringing of the called sub-station and the



RITTER'S TELEPHONE SYSTEM.

automatic interchange of the circuits of the operator's telephone and the disconnection signal in the proper sequence. The system has been worked out with extreme ingenuity, but it is excessively complicated. The general principle is the employment of a relay to operate the circuit-changing device, the relay being included in a local circuit completed when the plugs are inserted in the jacks, a third conductor in the cords being used for this purpose according to ordinary practice, so that the relay is energized when the two plugs are in. The automatic ringing device consists of a pair of mercury tube contacts, mechanically connected to the circuit changing levers controlled by the relay; the tubes are tilted by the action of the relay and the flow of the mercury subsequently maintains contact with the ringing-machine during the period of its flow back to its normal position in the tubes. The action of the relay is also automatically controlled by a mercury contact device. If all went well with Mr. Ritter's glass tubes and mercury contacts, all the operator would have to do would be to insert the two plugs, as this, besides connecting the two subscribers, starts the cycle of operations which automatically rings the called station and subsequently switches in the disconnection signal. Mercury contacts of such character, however, are not held in much repute by telephone engineers.

Yerkes in London.

A cable dispatch from London of Jan. 23 says: The *Times*, in one of its financial articles this morning, states that influential stockholders in the Metropolitan Railway have issued a circular favoring a union in the electrification scheme with the District Railway and the leasing of their line to the Yerkes company, with a guarantee of 3½ per cent on the ordinary stock. This seems to be Yerkes' final triumph.

A Decision On Appeal Against the Carty Bridging Bell Patent.

Judge Buffington, of the United States Circuit Court of the Western District of Pennsylvania, handed down a decision on Jan. 27 which was concurred in by Judge Acheson, finding that the John J. Carty patent of the American Bell Telephone Company is invalid. The Western Electric Company first commenced the litigation of this patent in 1897, bringing suit for infringement against the Millheim Electric Company. The Carty patent was then sustained in decisions by the local circuit court, and later by the United States Court of Appeals. A few months ago the Western Electric Company, backed up by this former decision, entered suit against the Anthracite Telephone Company, of Williamsport, Pa., asking for a preliminary injunction which was refused by Judge Acheson on the ground that the court had not heard all the facts in the Millheim case. In his opinion Judge Buffington first reviews the suit brought by the Western Electric Company against the Milheim Company, in which the Carty patent was sustained, then he explains the Carty patent in substance as follows:

The Carty device is of the multiple circuit construction, and at each station is a permanent bridge, in which is seated a bell magnet with a high co-efficient of self-induction, and of marked impedance. There are also two other bridges, normally open and closed only when the station is in use. The telephone bridge circuit normally open is closed in multiple arc with its own bell magnet, and, of course, with all others in the line when in use. The generator call circuit normally open when used forms a second bridge or cross-connection between the wires in parallel circuit with the bridge circuit of its own bell and those of all others in the line. In operation the tendency of the call current to short circuit is counteracted by using a bell magnet of high self-induction and impedance.

This not only prevents short circuiting, but effects a more even current distribution through the bell magnets of the entire system. By means of the numerous windings of the bell magnets the small portion of the call current passing, exerts a marked magnifying effect on the cores and a spirited working of the call signal.

The opinion then continues: Does such a combination involve a patentable novelty? The solution of this question turns on whether the placing in combination of these elements, all of which individually were old in the art involved, represents inventive genius, or was the natural advance incident to the application of electrical engineering skill to the solution of recognized difficulties. The general principles applicable to series and multiple are distribution of currents were known and utilized prior to Carty's alleged invention, and in a multiple arc system the current divides itself among parallel bridges in proportion to their several resistances.

It was known also that by the use of magnets of high impedance certain currents would and certain currents would not be allowed to pass. So also the difference between voice currents and generator call currents in telephoning was appreciated, and the fact that high impedance magnets were opaque to the former, but not to the latter.

In view of prior development of this art evidenced by the devices to which detailed reference has been made, and the definite prior knowldge of the electrical profession of the principles of bridging, multiple construction and the use of magnets of high impedance and self-induction for signaling purposes, and to prevent the shunt and loss of voice currents, we are of the opinion that the combination shown in Carty's patent contains no patentable novelty. Such conclusion is not at variance with the opinion in the Milheim case or of the Circuit Court of Appeals. Those cases were rightfully decided on the facts before the courts, but the actual state of the art was not then called to the court's attention; it was then found that every element of Carty's device was in itself considered old. The novelty lay in their combination, for it was not shown any such combination had been made before.

We now find that there were in existence in the clearing-out drops and the signaling apparatus of the long-distance lines, such application of the principles on which Carty's combination rests; that their application to party lines was but the natural, and to be expected advance in the progressive art to which they appertained.

Each forward step prepares the way for another, and to burden a great industry with a monopoly to each improver for every step thus

made, except where marked by an advance greater than mere engineering skill, is unjust in principle and hostile to progress.

Judge Acheson, in a brief opinion, says: "The final hearing of this case took place in Pittsburg, and at my request Judge Buffington sat with me and has prepared the opinion of the court, which I file herewith. I fully concur in the views Judge Buffington has expressed, and, accordingly, a decree will be entered dismissing the complaint."

Independent Telephony in Wisconsin.

Probably very few persons, not only throughout the country generally, but in Wisconsin, outside of those directly interested have any adequate realization of the independent telephone movement in Wisconsin. This movement started six or seven years ago in the smaller towns and among the farmers, with a demand for cheap telephones and plenty of them, and now the records show that there are about 200 independent companies operating exchanges and toll lines in the State. To give an illustration of the way in which these companies have grown, take the counties of Rock, Green, Walworth and Jefferson. Two and a half years ago there was not a single independent telephone in use within their borders. In those counties there are now 4000 of them. With this in mind, it is not so surprising to learn that there are over 20,000 independent telephone subscribers in the State, and 500 miles of farmers' lines and toll lines connecting various cities, villages and towns. A map of these lines shows a veritable network over most of the State.

The counties of Sheboygan, Manitowoc, Rock, Green, Dane, Walworth, Columbia, Marquette, Iowa, Sauk, Richland, Grant, Crawford, Vernon, La Crosse, Monroe, Juneau, Pierce, Wood and Waupaca are especially spider-webbed with lines, while Waukesha, Racine and Kenosha counties show as yet an almost unoccupied field.

Leaving out scores of small exchanges with less than a hundred subscribers, there are about 50 cities in the State which have exchanges of over 100 telephones, and the following is nearly a complete list, with the number of telephones in use: Madison, 1350; Appleton, 1200; Superior, 812; La Crosse, 860; Racine, 800; Janesville, 785; Sheboygan, 700; Richland Center, 650; Fond du Lac, 500; Wausau, 480; Beloit, 475; Baraboo, 400; Portage, 355; Viroqua, 320; Monroe, 340; Grand Rapids, 305; Rhinelander, 300; Elkhorn-Delevan, 300; Merrill, 295; Hancock, 210; Broadhead, 200; Manston, 200; Evansville, 200; Reedsburg, 200; Clinton, 197; St. Croix Falls, 195; Sparta, 190; Edgerton, 180; Pardeeville, 175; Fort Atkinson, 174; Marshfield, 170; Neillsville, 165; Tomah, 140; Platteville, 136; Prairie du Chien, 130; Lancaster, 125; Barron, 125; East Troy, 120; New Richmond, 120; Ripon, 120; Sauk City, 102; Plymouth, 100; Millin, 100.

The Badger State Long Distance Company, operating toll lines south, each and west from Madison, now connects 40 or more cities and villages, besides many farmers' lines, and furnishes connections with 5000 urban and rural telephones, and by this spring when its lines are completed to Racine and to Rockford, Ill., it will have 7000 telephones at its service. New exchanges are already projected at Ashland, Oshkosh, Green Bay and several other places.

Power Plant for the St. Louis Exposition.

Advices from St. Louis, Mo., state that contracts for the construction of the power plant of the Exposition of 1903 have been made to the Westinghouse Electric & Manufacturing Company. Guido Pantaleoni, resident representative of the company, who negotiated the contract, says that the plant will cost $1,000,000. It will consist of 10,667 hp. The Citizens' Electric Light & Power Company, of St. Louis, has contracted with the Exposition management to furnish one-half of the total horse-power for the fair at a cost of between $400,000 and $500,000. The Westinghouse Company will supply the other half of the required power from the World's Fair plant on the site.

Machinery Hall will contain the plant, which will supply the incandescent lamps and 2000 arc lamps on the grounds. The amount in cash paid by the Exposition Company to the Westinghouse Company on the contract will be $390,000. The machinery to be installed will be redeemed by the Westinghouse people after the fair in partial payment of the expenditure of $1,000,000.

Mr. Pantaleoni states that the total horse-power which the World's Fair will use is 25,000. The first of the machinery will arrive on the site Dec. 1, 1902. Between that date and March 1, 1903, when the equipment will be installed, the plant will be thoroughly tested and turned over to the Exposition Company.

The award is for the plant complete and installed, including boilers, engines, generators, foundations, piping, cooling towers, smoke-consuming devices, short stacks for mechanical draft and other equipment. The plant is to be an exhibit, and will be situated in Machinery Hall, the most southwesterly of the group of big exhibit buildings. The boilers are to be located in a separate building 100 ft north of Machinery Hall. This building will come close under the fence at the western limits of the site near Skinker Road, and will thus be out of observation.

A tunnel is to lead the steam pipes from the boiler house to the engines. The main smoke flue of the boiler house is to be in the shape of a tunnel passing under the floor of the house and leading to the stacks. The engines to be used are vertical compound condensing.

Electric Traction in England.

Addressing the annual convention of the Tramways & Light Railways Association the chairman, Sir C. Rivers Wilson, stated that at present it was impossible to get many electric traction projects considered on their merits. If they were promoted in Parliament by private bill, or under the tramways act, they were liable to be blocked by the veto of the local authorities. If they were promoted under the light railways act the opposition of any railway company was practically fatal, and the opposition of the local authorities made the project hopeless. They had hopes from the establishment of the Light Railways Commission that greater facilities would be given in promoting this form of enterprise.

Electrical traction had made considerable progress in spite of all the obstacles it had had to encounter in 1901. When Mr. Atherly-Jones addressed them last year he mentioned that there was at that time 1200 miles of tramway in operation, but that comprised horse and steam as well as electrical traction. The latest figures given for electrical traction alone were 777 miles actually constructed, 533 under construction, and 927 authorized and about to be constructed, making a total of 2237 miles. They were a long way from the figures of their American and Continental friends, but they would observe that progress had been made, and he thought public opinion was gradually awakening to the beneficial results to be obtained from this species of enterprise. The cars running at the end of 1901 were 5844, and he understood that there were on order at the present time 777. During the present year an event of considerable interest was to take place. A meeting of the Union International de Tramways was, at the invitation of the association, to be held in London between July 1 and 4, and in connection with the meeting there would be an international tramways and light railways exhibition.

In this connection it may be noted that the construction of 133 miles of electrical tramways in South Lancashire, connecting Manchester, Liverpool, Wigan, Warrington, Leigh, St. Helens, Bolton and surrounding districts, is being rapidly pushed forward, considerable progress having been made in several lengths. Contracts have been entered into for lines from Haydock, Brough, Ashton and Hindley, from Hindley to Hindley Green, Atherton to Bolton, Atherton to Tyldesley, and Atherton to Leigh and the boundary of Lowton. The contracts for the whole of the permanent way of these tramways, necessary buildings, plant, rolling stock and complete equipment of generating station have been let for $1,750,000 (£350,414).

Brooklyn Wires.

Commissioner Dougherty, of Water Supply, Gas and Electricity, of New York City, has decided to urge before the Board of Estimate an appropriation for putting the Fire and Police departments' wires in Brooklyn under ground. The cost will be $10,000 for each department. He will also urge that the poles in use at present for carrying these wires be painted and kept in as sightly a condition as possible hereafter. The cost of this is estimated at $2,000 for the Fire Department and $500 for the Police Department. The name of Louis F. Burchard has been recommended by several persons for deputy commissioner in the Borough of Brooklyn.

CURRENT NEWS AND NOTES.

ADOPTING MARCONI SYSTEM.—The International Navigation Company will, it is understood, establish the Marconi system of wireless telegraphy on its steamers.

PERSIAN GULF TELEGRAPHS.—It is stated that England proposes to obtain permission from Turkey to erect a telegraph line from Koweit to Fao, on the Persian Gulf. Koweit is the proposed terminus of the Bagdad Railway opening up that section of Persia and the Gulf.

THE TELEGRAPH IN COREA.—The news has reached Tacoma by steamer that the Russian Minister at Seoul, Corea, has been granted the concession to construct a telegraph line from Seoul to Kyong, whence it will be extended to Vladiostock. This will give direct telegraphic communication between Corea, Russia and Nagasaki, Japan.

TRANSFORMER PATENT DECISION.—The United States Circuit Court of Appeals of New York, in an opinion written by Judge Lacombe, has confirmed the decision of the District Court, which declared valid certain claims of the Stanley transformer patent of March 1, 1892. The claims at issue were 1 and 3, which are fundamental in their scope. The parties to the litigation were the Westinghouse Electric & Manufacturing Company and the Saranac Lake Electric Light Company.

TELEPHONY IN PARIS.—A well informed Paris correspondent writes: "You published an item recently about the reduction of the telephone rate in Paris to 300 francs per annum ($60). But the reduction has not yet materialized, and there is no sign of its coming to pass. Paris is probably the cheapest big city in the world to telephone, but the management is not very vigorous. There are too many people with a finger in the pie. Of course, what they ought to do is to introduce message rates and put up the price for the big users, bringing it down for the small ones."

CURE FOR CONSUMPTION.—A cable dispatch from London of January 22 says: Dr. Symes-Thomson, consulting physician at the Hospital for Consumption, Brompton, in a lecture delivered here, spoke hopefully of the experiments which are being carried on at the hospital in the treatment of phthisis by means of Tesla's high-frequency currents and the injection into the veins of a chemical substance that is fatal to the bacilli. He quoted statistics showing that the deaths from tubercular maladies in London had decreased 55 per cent in 40 years, and predicted that such diseases would be extinct within a century.

RUSSIAN INDUSTRIES.—The disastrous effects upon Russian industries of the existing financial and commercial crisis in that country are shown in the depreciation of the share values of the French and Belgian companies, concerning which some official data have been published. On Oct. 15, 1899, the Stock Exchange value of the shares of 98 Franco-Belgian companies was 1,316,332,000 francs; on Oct. 15, this year, it had fallen to 536,292,000 francs, a depreciation of 59 per cent. The glass manufacturers suffered very heavily; the value of the total foundation capital of six such concerns falling from 17,987,000 to 3,632,000 francs. The gas and electrical companies' shares have fallen in value from 36,820,000 to 13,140,000 francs, a depreciation of 61 per cent.

FIRE IN PARIS UNDERGROUND.—As bearing upon Mr. G. Westinghouse's recent advocacy of incombustible electric cars, the following cable dispatch from Paris of Jan. 25 says: Many Parisians were seized with fright when they saw on Wednesday last thick smoke pouring from the Metropolitan Underground road at the stations of Marbœuf and the Alma. A motor of one of the trains had taken fire, and the flames were spreading with great rapidity. The train proceeded to the Champs Elysees, where the conductor requested everybody to get out as rapidly as possible. No one was hurt, but the cars were all completely burned up. All who assisted in the extinction of the fire were nearly asphyxiated, and long after the running of trains was resumed a thick smoke pervaded the tunnel and inconvenienced the passengers.

"EDISON COLLEGE GRADUATES" is the rather striking title of an article in the *New York Sun*, based on the idea that association with Edison is a training of the best kind in itself, regardless of other education. It describes in a personal way the following men who have "graduated" from the Edison Laboratory, as from a college: Nikola Tesla, Charles Batchelor, F. J. Sprague, Samuel Insull, S. Bergmann, A. E. Kennelly, E. H. Johnson, John Kruesi, T. C. Martin, S. S Wheeler, H. W. Leonard, P. Seubel, R. N. Dyer, F. McGowan, L. Stieringer, W. K. L. Dickson, A. Weber, E. G. Acheson. The list is, however, very far from complete, and should include also such well-known men as F. R. Upton, W. J. Hammer, R. Fessenden, C. J. Reed, R. T. Lozier, J. W. Lieb, W. S. Barstow, and many others, who were either actually employed by Mr. Edison or have carried out under his personal guidance and instructions some of his earliest ideas. The "Edison men" ought to get together some day and celebrate the "old man," as they all call him with affectionate irreverence.

PARIS FRANCHISES.—It is stated in a London newspaper that the Paris municipality is not getting on very smoothly with the monopoly companies who pay it for their privileges. The omnibus company is about to apply for the canceling of its agreement, on the ground that the Metropolitan Railway is a breach of contract and seriously reduces its traffic. The gas company has also for some time had friction with the municipality, the latter demanding a reduced tariff both for the public lamps and for private consumers. The Socialist Councilors advocate the "municipalization" of gas, but a committee of engineers consulted by the Prefect has reported against this idea, on the grounds that a new set of gasometers and pipes would cost 250,000,000 francs, that the experiment of municipal electric lighting in the Halles quarter has not been a success, and that Parliamentary sanction would not easily be obtained. Another project is to farm out the gas supply to a new company for a share in the profits. This is about to be discussed by the municipality.

IMPROVEMENT IN THE METALLURGY OF ALUMINUM.—The hydrate of aluminum, like most colloidal precipitates, retains with great tenacity considerable quantities of the precipitant and also of the radical with which it was before combined—a most unfortunate circumstance from a metallurgical point of view, for as the hydrate is separated by the reaction of carbonic acid gas on sodium aluminate, very appreciable percentages of sodium carbonate, amounting in some cases to 7 per cent, are held by the precipitate, and passing into the electrolytic cell, are decomposed, resulting in the contamination of the aluminum with more than mere traces of the alkali metal. Mr. H. W. Jordan, of Syracuse, observes that the amount of salt so retained, is governed largely by the temperature of the reacting gas, and that by superheating the carbonic acid to a temperature above the normal boiling point of the aluminate solution, and preferably to 400 degs. F., the quantity of carbonate held by the hydrate can be reduced below one-half of one per cent. Mr. Jordan's patent, issued Jan. 21, has passed by assignment to the Pittsburg Reduction Company, the sole American producers of the metal.

A MEDIEVAL BISHOP.—At the annual dinner of the Manufacturers' Association of New York Bishop Frederick Burgess, the newly chosen Episcopal head of the diocese of Long Island, said in part: "It is the duty of the preacher to sometimes look on the dark side of an industrial age with its multiplicity of inventions. These inventions are threatening our domestic life, and are endangering the sancity of the home. They are threatening the welfare of our women. There are 6,000,000 women wage-earners in America, and 60 per cent of our workingmen could not support their families unless their women also went out to work. To find their places as breadwinners the women have to go out of their own homes, out of the protection of their brothers and fathers. We meet them in the trolleys and in the street, and they push and jostle as hard as the men. Their modesty is being rubbed off and there is a lessening of the chivalry of men. Industry, inventions and billion-dollar companies are not all. If this world is not to become a pitiless struggle, crushing out the family life, men must take on some of the tenderness of women and the chivalry of man must be preserved."

SPANISH SYSTEM OF WIRELESS TELEGRAPHY.—Colonel Cervera, of the Spanish Army, has, according to a Madrid dispatch, invented and developed a system of wireless telegraphy, which is now working successfully between Tarifa and Ceuta.

NEW YORK CENTRAL TUNNEL.—In his evidence before the coroner as to the recent accident in the terminal tunnel, Chief Engineer Wilgus, of the New York Centrals, says that the underground terminal will be about 18 ft. below the surface and connections will be made with the Rapid Transit tunnel. It is expected that the work will be done inside of two years. Mr. Wilgus considers that it is impossible to improve upon the present signal system in the tunnel.

TRANSMISSION AND THE GREAT LAKES.—A Cleveland correspondent states that the vessel owners on the Great Lakes are viewing with suspicion the rapid extension of water power utilization for electric transmission purposes. At the recent annual meeting of the Lake Carriers' Association the report of the secretary pointed out the tendency to utilize for this purpose all waterfalls in the connecting waterways of the Great Lakes, and unless the Government authorities and vessel interests are on the alert they will find that the interests of navigation will be injuriously affected thereby. Considering all the water has got to flow ultimately into the lakes, "we don't see why."

COPPER OXIDE DRY CELL.—A patent granted Jan. 21 to Albert De Dion and Georges Bouton, of Puteaux, France, describes a dry cell, the two elements of which are oxide of copper and zinc. Oxide of copper is compressed in the form of a cylinder, and has embedded in the middle a cylindrical strip of copper which forms the positive electrode. The containing vessel is of zinc and the exciting fluid is caustic potash or soda. The battery may be hermetically sealed and presents, it is claimed, the important advantage that it can be regenerated by the electric current when the battery is exhausted —that is, when the oxid of copper is reduced and potassium zincate is formed, the passage of an electric current causing the oxygen released by it to combine with the copper, the potash being set free.

TROLLEYS FOR CHINA.—It is announced that steps are being taken in this city for the organization of a corporation, constituted of some of the most influential street railroad interests of New York, to make a bid for the contract to build, equip and operate a system of electric street railroads in the city of Shanghai, China. Tenders for this purpose must be made to the Shanghai Municipal Council by March 7, unless a postponement is granted. An effort to give such bids was made two years ago, but was subsequently frustrated. The present plan is stated to be upon a more stable basis. J. R. Patterson, of Fearon, Daniel & Co., is engineering the plan to make an American bid for the road. The new road is to be 23 miles in length, and of standard gauge. It is intended that the operation shall be done by natives. An English company has already been organized to bid for the plan. The amount involved will be about $5,000,000.

GOVERNMENT PACIFIC CABLE.—At Washington on Jan. 28, by a vote of 8 to 7, the House Committee on Commerce decided in favor of Government construction, operation and maintenance of a Pacific cable, and ordered a favorable report on Representative Corliss' (Rep., Mich.) bill, providing the details of the undertaking. As finally determined upon, the measure provides for a Government cable from the coast of California to Hawaii and the Philippine Islands, via Midway and the Island of Guam, or by whatever route the President may consider most practicable. The maximum cost is fixed at $10,000,000, of which $500,000 is made immediately available. The work of construction is intrusted to the War and Navy departments, and after the cable is laid its operation is to be under the control of the Postmaster General, Secretary of War and Secretary of the Navy.

INDEPENDENT TELEPHONY WEST.—Telephone manufacturers, supply men and other kindred interests announce that a banquet will be tendered in Chicago to exchange representatives from Illinois and adjoining States on April 9 or 10. At that time the Illinois Independent Telephone Association will also convene in Chicago, and as the officers of that association are on the committee for entertainment of visitors, all interests will be amply cared for. For some time the necessity of an interstate or Central States telephone association has been apparent, and a large number of exchange owners are strongly in favor of such an organization. This matter having come to the attention of the manufacturers and dealers in telephone apparatus and auxiliary supplies, they decided at a joint meeting, held at the Palmer House, Chicago, Jan. 16, that on the occasion of this gathering they would provide entertainment for the visitors during their stay in Chicago. For full information, date of banquet and other particulars, an invitation which will be mailed direct to delegates and representatives, will give the points, and due announcement will be made in the electrical press.

THE WATER POWERS OF IRELAND.—The measure introduced in Parliament a couple of seasons ago by T. M. Healy to make possible the utilization of the vast and wasted water power of Ireland will be brought up again at this session. The measure, though a most admirable one in every respect, was for some reason opposed by the landlord interest, and it accordingly received its quietus in the House of Lords. Interest in it is revived by a plan now being discussed in France for the exploitation of the resources of the Pyrenees. The mineral wealth of these mountains, particularly in zinc, aluminum and iron, has been esteemed highly since 1874. The problem has been to work them at a profit, owing to the difficulties of transport, on the one hand, and the absence, on the other, of coal to smelt the ores on the spot. The idea now is to use for this latter purpose the water power of the mountain torrents. It is claimed that in the adoption of a plan of this sort lies the industrial regeneration of France and Ireland. It is computed that the wasted water power of the Pyrenees is equal to the whole of the steam power employed in all the factories of Europe. In Ireland the conditions are similar. That large tracts of territory in Ireland contain mineral wealth of various kinds is undeniable, and if some such measure as the Healy bill became law a long stride would have been taken toward the industrial regeneration of the country.

MANUFACTURE OF ELECTRICAL CONDENSERS.—Two patents were issued Jan. 21 on the manufacture of electrical condensers, one to Professor Elihu Thomson and the other to Jesse Coates. The Thomson patent relates to a method of impregnation or insulation. A number of condensers are arranged in a bunch lightly pressed together, and then thoroughly baked for a number of hours in a hot oven. They are then placed in the bottom of a treating tank having an air-tight cover, which is connected to an air pump and exhausted, the interior of the tank being heated by steam coils. After the pumping has continued about ten hours, insulating material is caused to flow in the bottom of the treating tank, its level being allowed to rise so as to cover an inch or more of the bottom portion of the condensers. Steam is circulated through the heating coils, and the insulating fluid being thus in a highly fluid condition and in a fairly complete vacuum, is readily absorbed by the porous substance of the condensers into which it is drawn by the action of capillary attraction. As the fluid gradually creeps up through the condensers it pushes before it whatever bubbles of air or collections of gas may remain until, when the entire insulating substance of the condensers has become saturated, the last trace of the gas and vapor has been removed. After the condensers have thus become saturated, the level of the insulating fluid in the treating tank is allowed to rise until the condensers become wholly submerged, after which the pumping may be discontinued. The condensers are now allowed to cool, a cooling liquid being admitted to the pipes for this purpose. To prevent the occurrence of cracks as the insulating material solidifies, mechanical pressure is applied by screws through the sides of the treating tanks. The insulating fluid near the top of the tank may be maintained fluid, while that below is cooling, this being done by passing steam through only one or two of the steam pipes at the top of the tank. The Coates patent employes an apparatus very similar to that of the Thomson patent, but provision is made whereby the condenser elements are cooled from the interior of the mass instead of from the exterior. In arranging the condensers for treatment, each condenser is placed between two thin sheets of metal and then a number of condensers are arranged side by side in a frame in such a manner that they may be acted upon by cooling devices so arranged as to abstract heat from the interior of the mass of condensers as assembled. Cooling boxes are located for this purpose between the pairs of condensers, into which cooling water is admitted after the insulating material has been thoroughly saturated in the manner described in the Thomson patent.

LIGHTING ST. PAUL'S CATHEDRAL.—A cable message from London of Jan. 18 says: In addition to providing electric lights for St. Paul's Cathedral, J. Pierpont Morgan has added to his original gift, making the total over £10,000. It is expected that the new lights will be very soon in use in the choir.

SYSTEM POWER IN TUNNELS.—Assemblyman Wainwright has introduced a bill prohibiting any railroad corporation operating any road by steam power in any tunnel in the Borough of Manhattan. Violation is made a misdemeanor, and upon conviction, the corporation is punishable by $500 fine for each offence.

RAILROAD TELEPHONY.—The Illinois Central Railroad will have all its principal stations equipped with telephone. The installation will cost about $100 per mile or approximately $540,000 for the entire road. Chicago will probably be the starting place. Almost simultaneously work will be commenced at New Orleans and St. Louis. From these centers a two-wire line will be extended to the principal points until every station in the entire system is included.

TELEGRAPH CODE FOR AFRICA.—The United States State Department has received a telegram from the manager of the Western Union Telegraph Company, at Washington, to the effect that the "unicode" has been deposited by the British Government at Aden and Cape Town, and may be used in addition to the codes already notified for messages to and from Cape Colony, Natal, Rhodesia, Seychelles, Mauritius, Madagascar, British and German East Africa, Mozambique and Lourenco Marquez.

BRANLY AND LODGE.—According to a cablegram to the *New York Herald*, M. Henri Poincare, the eminent mathematician, has called upon Professor Oliver Lodge to confirm publicly his private acknowledgment of Professor Branly's priority in the discovery of the filings coherer. Professor Branly has received a prize from the French Academy of Sciences for the discovery, which he announced to the world in 1891. The claims made for Dr. Lodge appear to date no earlier than 1893.

WIRELESS TELEGRAPHY BETWEEN TRAINS.—A Jamestown, N. Y., dispatch states that Captain F. P. Cobham, of that place, has invented a system of wireless signaling between railway trains which, it is stated, has worked satisfactorily in tests. The instruments, which are placed on the locomotive, give notice when the engine is within 2000 ft. of another engine on the same track, and at the same time indicate in which direction each locomotive is moving. If one of the locomotives is stationary the fact is also indicated.

THE CAPE-AUSTRALIA CABLE.—United States Consul General Bray reports from Melbourne, Nov. 10, 1901, that the Eastern Extension Australasia & China Telegraph Company, Limited, has notified the government of the State of Victoria that the Cape cable from Durban (Natal) to Freemantle, Western Australia, is now ready for use, and congratulatory messages have been exchanged with the governments of Cape Colony, Natal and Mauritius. The section of the cable between Freemantle and Adelaide, South Australia, is now in course of construction.

COLOGNE STREET RAILWAYS.—United States Consul Barnes reports that the Cologne Street Railway Company has been acquired by the city for $3,451,000, payable in annual installments up to June, 1913. The city has appropriated $4,204,000 to convert existing lines into electric traction and for the building of some new lines. The ordinary fares charged on the line are the equivalent of 3½ cents per passenger for the maximum distance and 2 4-10 cents for the minimum distance. Persons attending educational institutions get commutation tickets costing 1½ cents. Motormen receive as wages 83 cents, and conductors 71.4 cents per day of 10 hours, with one day every two weeks off.

AUTOMATIC FROST ALARM.—An automatic frost alarm is now in successful operation in a vineyard in the frost belt of California. The first instrument was invented and installed by Mr. L. L. Lewis, a vineyardist located near Sacramento. The apparatus consists of a mercurial thermometer in the shape of a horseshoe with a bulb at each extremity. A platinum wire connects with the mercury in the thermometer, and when the temperature falls a circuit is closed, causing an electric bell to ring an alarm until the atmosphere becomes warmer. The instrument is placed in a vertical position with the two bulbs uppermost. On a recent occasion the automatic apparatus sounded a timely alarm during the night, and the vineyardists turned out and began "smudging" or lighting fires between the rows of vines. By two hours of this smoking process the frosting of the vines was entirely prevented, while other vineyards in the vicinity will lose their entire first crop.

EFFECTS OF TELEPHONY.—Professor Zimmer, of Germany, has made a careful analysis of the mental conditions of women school-teachers. He has drawn his information from all the asylums in Germany, Austria, Switzerland and Russia, and found that in every 85 female patients there is one school-teacher. In Prussia there is one teacher to every 350 women of the population. It seems to follow, therefore, that mental disorders among teachers are four times as numerous there as they ought to be. He says: "If telephone girls or salesgirls show signs of mental disturbance it is not to be wondered at, for their occupations are hardly those a woman can call suitable to her sex, but in teaching, which is usually considered a suitable employment for women, when the results are so disastrous there is every reason for serious consideration." Professor Zimmer is sure that in other countries, notably England and the United States, where women are more widely occupied in business and in professions than in Germany, scientifically collected statistics will show the same melancholy results.

BROOKLYN TROLLEY TUNNEL.—The report of the commissioners appointed in Brooklyn to pass on the route and style of construction of the proposed Manhattan-Brooklyn Rapid Transit tunnel has been approved by the Appellate Division of the Supreme Court, Brooklyn. The commissioners, in their report, recommended the Flatbush Avenue route and the carrying out of the plans laid down by the Board of Rapid Transit Commissioners without change. The commission has secured the requisite consent of property owners along the proposed route without necessity of recourse to condemnation proceedings, so that nothing now stands in the way of advertising for bids under which the contract is to be eventually let but the completion of the work of formulating the contract itself. Letters and appeals have reached the members of the commission demanding that whatever contract be entered into there should be as a result only a 5-cent fare chargeable within all the limits of the five boroughs at any points where the routes for tunnels as laid down shall reach.

AUTOMOBILES IN BELGIUM.—Mr. George W. Roosevelt, United States Consul at Brussels, Belgium, writes: In view of the growing interest in mechanical traction, our manufacturers of automobiles, cycles, etc., may care to learn that, in the early spring two international exhibitions of automobiles, cycles, etc., are to be held in Brussels. From the 8th to the 17th of March, 1902, an International Exposition of Mechanical Locomotion will be held in the grand hall of the palace in the Park Cinquantenaire; from the 15th to the 23d of the same month, the tenth International Exhibition of New Locomotion (automobiles, cycles, sports and industries connected therewith) will be held at the Pole Nord, Brussels. In the international exposition at the Park Cinquantenaire, there is to be a section devoted to aerostatics, organized by the Aero Club of Belgium, and under the direction of the aeronaut, Mr. Capazza, who will exhibit two of his balloons, one torn and worn, accompanied by his parachute, and the other inflated. The exhibition will include every kind of known mechanical locomotion, automobile, velocipede, aerial, electric, maritime and nautical. Trials of aerial locomotion will take place in the Park Cinquantenaire during the exposition. As regards the disposition of eventual profits, the Belgian Syndical Chamber of Automobiles has decided to make the following division: Twenty per cent will be set aside as the nucleus of a fund; 30 per cent will be used in experiments, such as races, competitions, trials, etc.; and 50 per cent will be returned to exhibitors, who will thus share directly in the profits of the exposition and have the chance of regaining a part of the amount expended by them for space. In this way, constructors and agents may participate without incurring very great expense.

MONEY FOR COOPER UNION.—Announcement is made that Andrew Carnegie has given a second gift of $300,000 to Cooper Union, New York City, and that the heirs of the Peter Cooper estate —ex-Mayor Abram S. Hewitt and others. have given another $300,000. The income which will be derived, will enable Cooper Union to expand and improve itself both regarding instructors and its accommodations for students. It will enable the institution to occupy its entire building, making use of the added space for educational purposes and doing away with numbers of the stores on the ground floor, the rental of which formerly was necessary to help defray the expenses of the institution. Likewise, this additional revenue will enable suitable compensations to be paid to the teachers and instructors. Among other improvements contemplated is the enlarging of the physical laboratory so that with the incoming year there will be increased facilities for instruction in electricity.

LONG-DISTANCE TELEPHONE WORKING.—With regard to a recent discussion in our columns of long-distance telephone working, the London *Electrical Engineer* makes the following comments: In the issue of Electrical World and Engineer for the 7th inst., the editor puts forward an interesting scheme for relieving the long-distance telephone lines in the States of a large part of the heavy traffic with which they are burdened in the busy hours of the day. Putting it shortly, his plan seems to be to use the lines for about four hours each night for telegraphing messages, which would be delivered at their various destinations by telephone on the opening of the offices in the morning. Assuming the use of an automatic printing instrument at a working speed of 100 words a minute or thereabouts, he points out that in the case of a single line between Chicago and New York, about 500 ten-word messages per hour in each direction would be within the range of capacity of the system if such messages were directed to the respective telephone numbers of the recipients. The message slips could be filed away and telephoned to the proper addresses on the opening of business hours, the slips being sent on by post as an additional check as fast as telephoned. The whole operation would only take a few hours, and the result would be a very convenient and cheap method of sending night messages quickly, and a considerable increase in the earning capacity of every long telephone line. As opening up a new source of revenue, the editor regards the scheme as offering a capital opportunity, besides doing the public a favor which would still further increase the popularity of the telephone. Such an arrangement in this country would, of course, not be practicable, as we have no long-distance telephone lines the limits of which could not be reached almost as quickly by post, but in the States, where the conditions are vastly different, we see no reason why the scheme should not work well.

Letters to the Editors.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest the article by Dr. Roeber in your issue for Jan. 18, 1902, in which he criticises my views about the Edison nickel accumulator.

In regard to the word "aqueous tension," which I have heard in common use as an abbreviated form for "aqueous vapor tension," it is merely a matter of terms. The word "tension" alone is used in exactly this sense on page 134, Volume I., of the English translation of "Mendeleff's Principles of Chemistry." I have consulted several chemists in regard to the term, and they say without hesitation that "aqueous tension" could mean only "aqueous vapor tension." The original article was written after a hard day's work, and I suppose I used the shorter term, following the path of least resistance. Whatever ambiquity of the term "aqueous tension" there be, it certainly cannot mean "osmotic pressure." A glance at my original equation would have shown that it did not hold for "osmotic pressure," but did hold for "aqueous (vapor) tension." Had the formula been developed on the lines of the osmotic theory it would have been expressed in terms of the ionic concentrations.

With regard to the hydrogen electrode, I thought it well known that its potential changes but little with the concentration changes of the alkaline solution. For this reason it can be used in practical work where its results are properly interpreted, as a means of diagnosing the electro-chemical changes at anode or cathode. As its potential depends on the concentration of the hydrogen ions and this concentration in an alkaline solution varies but little, I thought it unnecessary to reply to this point of Dr. Roeber's.

Dr. Roeber's elaborate theories of concentration changes have been, it would seem, the result of theoretical, academic discussions. Any theoretical superstructure should be built on a firm, experimental foundation. I have made a good many measurements of the polarization of cells of the oxygen-lift type, and have found that "concentration polarization" is but slight, provided no lower stage of oxidation has been reached. The steady drop in voltage on closed circuit is due in great part to entirely different causes, i. e., changes in the electrical properties of the plates themselves.

Dr. Roeber's well-worded and well wrought out theories of concentration changes which do exist, but have but little effect on the polarization changes in alkaline solutions, are like vernal flowers, very pretty, but "have nothing to do with the case." On one point I am in perfect accord with Dr. Roeber; that is, that any matter under discussion should be decided in the light of experimental evidence, and that my views also should be placed before that court of appeal.

Hartford, Conn. Woolsey McA. Johnson.

Engine Specifications.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the letter of Mr. Bertram in your issue of Jan. 11, asking for an expression of opinion as to the guarantee to be given by an engine builder covering the regulations of engines for driving alternators in parallel operation, I can say that the engines built by us for this purpose are guaranteed not to exceed a certain per cent variation in speed from no load to full load, and are also guaranteed not to exceed a certain maximum angular variation or displacement of a point on the flywheel of the engine with reference to a point on a flywheel revolving uniformly at the normal generator speed, the latter guarantee being usually stated at such a fractional or decimal part of one degree as would correspond to a displacement of 2½ degs. of phase.

As you will see, the above guarantee completely protects the buyer as far as the satisfactory operation of the engine on the score of speed and angular variation is concerned.

Milwaukee, Wis. Edwin Reynolds,
Chief Engineer Allis-Chalmers Company.

To the Editors of Electrical World and Engineer:

Sirs.—The letter of Mr. Bertram in your issue of Jan. 11 brings to mind a case of ancient history in which the generator manufacturer desired to limit the phase displacement to 675-1000 of a degree (.675 deg.), for a unit having 106 poles at 68 r. p. m. This means for the engine 125-10,000 of a degree (.0125 deg.) variation from the mean position, which is practically impossible.

In the light of further experience all manufacturers of generators are now willing to allow 2½ degs. phase displacement, which may easily be translated to terms of angular variation by dividing by one-half the number of poles.

The most difficult possible case for engine manufacturers, under present conditions, would be the one stated above, which covers a 60-cycle generator at 68 r. p. m., the permissible angular variation from mean position of engine during a revolution being 47-1000 of a degree (.047 deg.). The engine manufacturers are willing to meet this extreme condition, and, therefore, the engine specification may be simply "The departure from uniform motion during a revolution shall not cause a phase displacement to exceed 2½ degs. either way from position of uniform motion, which, in terms of degrees of angular variation per revolution, equals $\frac{5}{\text{poles.}}$"

Chicago, Ill. A. D. Lundy.

To the Editors of Electrical World and Engineer:

Sirs.—In your last issue Mr. Bertram inquires if there is a clause which can be stated in plain English and which will cover the successful parallel operation of engine-driven alternators. I believe there is no clause which covers broadly and without qualification the successful parallel operation of engine-driven alternators under any and all conditions, but clauses can be inserted in the contract which will so far protect the operating company that it can proceed with a reasonable anticipation that such difficulties as are met with can be

surmounted, provided, of course, the operating company will confine its dealings to manufacturers whose purpose it is to provide a successful installation, as distinguished from those manufacturers who consider their duties and responsibilities fully discharged when they have delivered the apparatus the contract calls for, irrespective of its strict adaptability to the purposes for which it was purchased.

There are certain difficulties connected with the disposition of circuits, and the control of auxiliary apparatus which cause more or less trouble, but which so indirectly concern the engine and dynamo units that I do not think such difficulties are properly within the scope of the engine or dynamo contract. Eliminating these external troubles, and assuming that the dynamos are properly designed, I believe that engines meeting the following requirements will give satisfactory results:

1. The engine speed from no load to full load, or within any other specified limits, should not fall off more than a specified percentage. It is possible to get close regulation with some engines and still run in parallel. Apparently this is not true of all engines.

2. The speed characteristics of engines designed to drive dynamos operating in parallel should be practically the same. In other words, the speed of all the engines should be practically the same for the same load, irrespective of what the load is. For the proper division of the load between the several dynamos, this is absolutely necessary if there is no speed changing device for changing the speed of the engines while in operation. With a speed changing device, differences in the speed characteristics can be compensated for if the load is not too variable, but even then reasonable accordance in the speed characteristics is desirable.

3. The angular deviation, by which we mean the amount a point on the flywheel varies in position during the revolution when compared with a point on a wheel running at an absolutely even speed at the average speed of the engine, should not exceed the amount specified by the dynamo manufacturer.

4. The governor should be so constructed or so controlled that, without impairing the regulation, it will not vary the admission of steam synchronously with variations in load (and, therefore, variations in speed) due to the interchange of cross-currents between two or more dynamos operating in parallel, while at the same time it is left free to vary the admission of steam to suit changes of load in the working circuits.

New York. E. A. Merrill.

To the Editors of Electrical World and Engineer:

Sirs.—In the matter of engines for alternators the buyer does not by any means have a monopoly of the trouble. It appears to us that the engine builder has much the largest share. His bid is based upon the supposition that average conditions will be met. When the contract is awarded he often finds that he must adopt a much more expensive construction than contemplated in order to make a satisfactory engine to direct connect with the dynamo selected.

There is much variation in the requirements as to angular variation, which means large differences in flywheel weights, perhaps so great that altogether different shafts are required in two units of the same capacity and speed, simply on account of one having so much more flywheel weight than the other.

Another difference in practice is in the weight of armature and the magnetic pull due to displacement of the field. It is apparently assumed by the dynamo builders that the magnetic pull due to a displacement of the revolving element of the generator of 1-32 inch from its true position, must be provided for by the engine builder, and by inference that a greater displacement than this is at the risk of some one else.

A recent case is of an alternator of 125 kw at 240 r. p. m., in which the weight of the revolving element is 3800 lbs., and the magnetic pull due this displacement is given at 3000 lbs., making in case the displacement should be downward a total of 7400 lbs., which in a 125-kw unit is readily provided for with standard construction.

But the next job is a 90-kw alternator by the same makers, in which the revolving field weighs 5000 lbs., and the pull due to 1-32-inch displacement is 15,000 lbs., or a total of 20,000 lbs., a weight out of all proportion to the capacity of the generator, and so great that to design a shaft and bearings to carry it at the speed (270 r. p. m.) is not by any means a simple problem.

The consequence is that the engine for the 90-kw unit is a heavier and more expensive machine than the one for the 125-kw machine. As the only way we can see out of these difficulties we have adopted the practice of submitting prices for engines for direct connection to alternators only upon receipt of full data regarding these points. We enclose you copy of the questions to which we request replies in such cases.

Erie, Pa. L. J. Armstrong,
Superintendent Ball Engine Company.

[Following is a copy of the enclosure referred to: In the case of engines direct connected to alternators, intended for parallel operation, it is necessary to have the following data: 1. The number of poles or the frequency. 2. The maximum angular variation. This should be stated clearly and should specify whether the total variation or the variation either side of the mean is meant. 3. Magnetic pull by displacement of shaft. 4. Weight of revolving field. 5. Radius of gyration of revolving field. The last two items are necessary in order to correctly figure the flywheel weight needed. The third and fourth affect the shaft diameter. And all are essential to figure cost of engine intelligently. Engines operating in parallel should not have a speed regulation closer than 4 per cent. Synchronizing devices will be furnished, if desired, at an extra price.]

Properties of Collector Rings.

To the Editors of Electrical World and Engineer:

Sirs.—I wish to thank you for having kept your readers informed of the various discussions which have been going on lately in the European electrical papers relating to the new properties of ring collectors or commutators, and which were pointed out by me in patent specification relating to self-excited, series, shunt and compound-wound alternators, now filed in the United States Patent Office. This new property consists in the absence of the ordinary effects of self-induction in the windings of, for example, the armature of a bipolar dynamo, when the latter is connected to a polyphase circuit of, say, p phases, by p brushes resting on the commutator, the angular distance between the brushes being $\frac{360}{p}$ and driven at the speed of synchronism, the direction of rotation being that of the revolving field produced by the polyphase currents sent into the windings through the p brushes.

This property, which had never before been pointed out, was not *a priori* evident. It is true that the coils of an armature, at whatever speed the latter be driven, give passage to currents which are essentially variable, and as a consequence it was thought that we would find between any two brushes the counter-electromotive force of self-induction developed in the group of sections in series between these two brushes and induced by the instantaneous variation $\frac{di}{dt}$ of the current i which traverses these sections. This was the opinion put forward by M. Leblanc.

I have shown if there be always a tendency to produce a counter electromotive force of self-induction, it may, however, be counterbalanced at or in the neighborhood of synchronism by the electromotive force due to mutual induction between, on the one hand, the sections in short circuit under the brushes in which the rapid variation of current were taking place during commutation; and, on the other hand, the sections in circuit. I have furthermore shown that, leaving aside the question of harmonics, the commutation at synchronysm is perfectly satisfactory.

Up to the present time the published discussions have only related to polyphase currents. I take this occasion to call to the attention of those of your readers who have followed this discussion that it is possible to impress the effects of self-induction even in those cases where single-phase current only is introduced into the armarture by two brushes set at an angle of 180 degs. To do this, it is only necessary to add to the armature a polyphase short circuit winding—a squirrel cage winding, for example. The alternating flux produced along the line of the brushes ($\phi\, max.\, sin\, wt$) can be considered at any instant as the resultant of two revolving fluxes, $\frac{\varphi\, max.}{2}$ turning, in the opposite sense one with respect to the other. If the armature is driven at synchronous speed in one direction or the other, one of the fluxes, $\frac{\varphi\, max}{2}$ which turns in the same sense as the armature will continue to exist, while the other turning in the opposite sense with a speed $2w$ with respect to the armature, is neutralized by the

polyphase short circuits, and we have the same effect as if we were dealing with a polyphase instead of a single phase circuit. This is the well known property of magnetic screens.

The commutation is evidently made better in the same measure as the effects of self-induction have been neutralized by the polyphase short circuits. If in a case where we are dealing with polyphase currents, we introduce this second short circuited polyphase winding on the armature, these latter can only be of secondary importance, and do not change in any way the nature of the phenomena; but in case we make use of single phase currents, their presence is necessary for the production of the same effects.

I trust that this explanation will suffice in the minds of your readers to terminate discussion on a question which has given rise to much confusion, and to which I would not now allude if publications in your pages had not opened this question.

Sevres, France. Marius Latour.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers

Single Phase Synchronous Motor Without Excitation.—Boucherot.—Hospitalier's ondograph, in its most recent form, contains a small synchronous single-phase alternating current without any winding which is supplied with direct current. This is the simplest type of motor, as it consists only of a movable aggregate of iron sheets, which turns between the projecting parts of another fixed aggregate of iron sheets, which is provided with the winding in which the alternating current flows. He illustrates the motor and gives some calculations regarding it; he believes such motors are very suitable for laboratories whenever one wants to produce synchronous movements without complications.—***L'Ind. Elec.*, Dec. 10.**

REFERENCES.

Synchronous Converters.—Blondel.—A second mathematical paper on the graphical theory of the regulation of synchronous converters. This paper deals with the determination of the excitation of the converter, but is too mathematical to be abstracted. The synchronous motor diagrams may easily be applied to the study of the converter and enable the analysis of the conditions of its operation to be made in the most varied cases. This method enables one not only to prophecy qualitatively the phenomena, but also to calculate them numerically by combining the characteristic curves with the experimental data.—*L'Eclairage Elec.*, Nov. 23.

Uniformity of Speed of Steam Engines and Operation of Alternators in Parallel.—As has been noticed before in the Digest, a section of the Internat. Soc. of Elec. in Paris has been discussing this problem at length. This issue gives a complete account of the following papers, abstracts of which have been noticed before in the Digest: An exposition by Leblanc of the program of the committee; a paper by David on a method of measuring by experiment the degree of uniformity of speed during one revolution of a steam engine; a paper by Cornu on an optical method for determining the law of the periodic variation in the speed of a revolving engine; a paper by Boucherot, on definitions, analysis of diagrams, oscillations and mechanical resonance. Several tables and 30 plates of diagrams which belong to these papers are given in a separate number.—*Bull. de la Soc. Int. des Elec.*, Nov.—An illustrated account of the discussion of these papers, by Rateau, Cornu, Boucherot, Dubois, David, Perrin, Hospitalier, Arnoux, and Saletter, Harle & Co., in *Bull. de la Soc. Int. des Elec.*, Dec.

Alternating Current Motor.—Fischer-Hinnen.—A brief illustrated description of tests made with a self-starting single-phase motor without brushes, of the type recently described by him.—*L'Eclairage Elec.*, Dec. 21.

Core Transformers with Maximum Efficiency.—Punga.—A long article, illustrated by diagrams, giving the mathematical theory of the design of core transformers so that the efficiency becomes a maximum.—*Zeit. f. Elk.*, Dec. 15, 22.

Large Alternators.—Rothert.—A very long article on the design of large alternators. Tables are given, showing in detail the data of the design of 23 different alternators of different makes which had been exhibited at Paris. These data are then carefully analyzed.—*L'Eclairage Elec.*, Nov. 30, Dec. 7.

Alternators at the Paris Exposition.—Guilbert.—A long article in which he gives a critical summary of the principal and general features of the alternators exhibited at the Paris exposition.—*L'Eclairage Elec.*, Nov. 23, Dec. 7.

Switches for Shunt Motors.—Krause.—An illustrated description of a device for sparkless disconnection of shunt motors. He shows how the same device may also be used for reversing switches.—*Elek. Zeit.*, Dec. 26.

Lights and Lighting.

Arc Lamps.—Blondel.—A brief note criticizing some special points in a paper of Laporte and Leonard on arc lamps, recently abstracted in the Digest; he discusses especially the cause of discrepancies between this and his own measurements. He adds a brief remark about Laporte's paper on the Bremer arc lamp. He calls attention to the fact that the relative efficiency of the Bremer arc lamp compared with the Brille lamp, differs greatly, whether it is used with or without a globe, while the addition of the globe should cause the same reduction in both lamps. Without globe the consumption of energy per spherical candle in the Bremer lamp is half that in the Brille lamp; with globe, it is more than 60 per cent. He explains this by saying that while the addition of a globe apparently modifies the economy of the Bremer lamp, it is simply because the presence of the globe makes the distribution of its light more uniform; the measurements having been made in a plane perpendicular to the plane of the carbons, i. e., in the most favorable plane. The addition of the globe simply corrects and exaggerates the cause of the superiority of the Bremer lamp. A fault of this lamp is the instability of the light. The rapidity of the consumption of the carbons in this lamp is interesting because it confirms the general rule that in arc lamps, any gain of illumination is accompanied by a reduction of life.—*Bull. de la Soc. Int. des Elec.*, Nov.

Alternating Current Incandescent Lamps.—Leonard and Janet.—A paper, giving an account of an investigation of the variations of the luminous intensity in one period, of the incandescent lamps supplied with alternating currents. The method used is described and results are given of tests regarding the variations of the luminous intensity during one period (which for a 110-volt lamp with 42 periods, was 16 per cent total variation in parts of average luminous intensity); influence of the frequency upon the variations; influence of the mass of the filament upon the variations; influence of the waveform of the e. m. f. of supply upon the absolute variation of the luminous intensity; variation of the power and of the calorific capacity during one period. The results are given in diagrams and tables.—*Bull. de la Soc. Int. des Elec.*, Dec.

Power.

Power Transmission Plant in New Zealand.—Hays.—An abstract of a paper read before the Elec. Assoc. of New South Wales. The town of Rotorua in New Zealand is a favorite resort of tourists and sick people. When the institution of a modern system of drainage and sewerage was undertaken an electric power transmission was adopted. The single-phase alternating current system is used in conjunction with water-power. There are two turbine-driven, 50-kw alternators of the inductor type, the voltage being between 3200 and 4200. The line is 13 miles long. The sewerage pumps are driven by induction motors. Current is also supplied for lighting.—*Lond. Elec.*, Dec. 27.

Electricity in a Mine.—Bruhm.—An illustrated article on the electric installation of mines, near Halle, Germany. For the generation of the electrical energy, gas engines are used, gas being utilized which otherwise would be wasted. The gases come from a distilla-

tion of coal-tar for the production of paraffin. There are two gas engines, each driving an 80-kw, 3000-volt alternator. The transmission line is 2.2 kilometers long. At the receiving station the voltage is reduced to 120 for lighting and 500 for power purposes. Descriptions are given of an electric winch and a centrifugal ventilator.—*L'Eclairage Elec.*, Dec. 21.

Traction.

Hamburg.—Vellguth.—An extended and fully illustrated article on the street railway system of Hamburg and Altona, Germany. In 1886 at the request of the municipality, some extensive experiments with storage battery cars were made which proved complete failures, fortunately for the railway interests of Germany, as if these experiments had proved successful the different cities might have required the introduction of storage battery cars on other roads. In 1894, the first trolley line was put in operation by the company, and in 1897 the electrification of the entire system was practically completed. The company owns 138.83 kilometers of track, most of which is double track, and adding switching, depot and other tracks, the total would be 260 kilometers. Under the franchises all of the tracks and buildings within the city limits of Hamburg lapse to the city in 1922. The company also pays the city 0.25 cent for every passenger carried, which amounts to about 9 per cent of the gross receipts. It also pays to the city 5 per cent of all the money received for season tickets, and a certain percentage of its surplus after the payment to the stockholders of a 6 per cent dividend. The track construction is very heavy, and rails weighing 53 kg. per meter are used throughout. The trolley system is used throughout. The trolley wire used in the suburbs is 8.3 mm. in diameter, while that within the city limits is a wire with a cross section of 80 square mm. Recently a wire having a rectangular shape but rounded at the four corners has been introduced. The area of this wire is 90 square mm. Experience has shown that it is a simple matter to stretch this wire. Current is purchased from the local electric light and power station. At the several feeding points where the current passes into the trolley wires, the tramway company and the electrical company both have wattmeters, by which the power taken is measured. There are 33 of these points and 800 amperes is the maximum current fed at any of these points. No feeding point is selected where there is less than 500 amperes to be fed into the circuit. The company uses controllers with six operating and six braking steps. The short circuit and magnetic brake operated by the controller, are employed simultaneously with the hand brake for operating purposes, but the motorman has instructions to use the last braking point which furnishes the current direct from the trolley wire only in cases of emergency, and the controller is fitted with a register which shows how many times this emergency stop is used. The motor pinion is of cast steel and the gear of gray iron. These materials have been selected, as it is found that the life of each is about the same, and the company believes in installing a new gear and a new pinion whenever one has worn out.—*St. R'y Jour.*, Jan. 4, and Internat. Ed., Jan.

Rail Feeder Construction in San Francisco.—Foster.—An illustrated description of the methods used for improving the rail return on his system. As originally built, the rails were connected by fish-plates and bonded by three bonds of 85 square mm. As the load of the system increased, the return became inadequate and the company decided to increase the capacity of the return circuit. For this purpose a number of old horse-car rails bonded by iron rivets were buried in the ground to connect the negative bus-bar with the track and the joint was made by surrounding it by a copper tube. It was immersed in water for four months, at the end of which time the joints showed 17 per cent more conductivity than an equal length of rail, or a loss of only 5 per cent over its original conductivity. The soil in which the rails were laid was clay, which was practically neutral chemically. At the ends of this auxiliary negative return of old rails, copper waterproof cables were connected to join the ends of the track rails. The connection made here and the connection between this auxiliary rail return and the negative bus-bar are shown by diagrams. A reduction in kilowatt hours output of 2¼ per cent has been obtained.—*St. R'y Jour.*, Jan. 4, and Internat. Ed., Jan.

Electric Locomotives.—An illustrated description of two electric locomotives built by Thomas Parker, one of standard gauge for use in hauling cars about an industrial establishment, and the other a very small narrow-gauge mining locomotive. The larger locomotive is provided with center and side hooks for attaching it to its load and is intended to operate on 200 volts. There is only one motor placed in the center and geared to both axles. Above this motor is a pulley block so that it may be removed from its position below the foot board without resorting to the use of a crane. This renders any repairs necessary very easy. The locomotive is provided with sand boxes and powerful brakes and is operated by an ordinary tram-car trolley.—*St. R'y Jour.*, Int. Ed., Jan.

Storage Battery Electric Locomotive.—An illustrated description of a locomotive of British make, equipped with sixty accumulators having a capacity of 525 amp. hours. The cells are claimed to be unaffected by vibrations and free from buckling or breaking of the plates. The positive block is formed by a variation of the Plante process; and the negative consists of a series of cylinders which are inserted in holes punched in the positive plates. The locomotive has four wheels and two motors which are geared to the axle by a double reduction having a total ratio of 20 to 1. It has been found that in use around a factory there is much less risk of fire than with a steam locomotive as well as a considerable saving in labor.—*St. R'y Jour.*, Int. Ed., Jan.

References.

Determining the Resistance to Traction.—An article illustrated by diagrams. The best method of measuring with an automobile is to run it at a known speed on a level road, to suppress quickly the driving force and measure the time until the automobile is at rest. These measurements are repeated for various values of the initial speed. The tests can be shortened by measuring the time required to pass from one speed to another speed. He shows how to calculate the resistance to traction from these measurements.—*L'Eclairage Elec.*, Nov. 30.

Energy Consumption of Cars.—Gueroult.—The first part of a mathematical article in which he determines the average consumption of energy of a car per hour or day, as a function of weight, average normal speed, number and duration of stops, coefficient of friction, and the size of the wheels.—*L'Eclairage Elec.*, Dec. 7.

Installations. Systems and Appliances.

Charging for Electrical Energy.—Esson.—An article on "principles and profits in electric supply." He severely criticizes the Wright maximum demand system. He says it is absolutely impossible to devise a practical system by which every consumer would be charged with strict regard to equity. The aim of the business is to sell the greatest possible number of units per year without increasing the total capacity of the plant, i. e., to improve the load factor. Wright claims that the maximum demand system has this effect, but others say that a flat rate gradually reduced as the business of the station increases, is equally effective. It is admitted on all hands that the maximum demand system of charging is most unpopular, that it leads to endless disputes, and that the ordinary consumer is quite incapable of understanding it. The great objection to the system lies in the fact that the number of units which the consumer has to pay for at the high rate is never twice the same, is always changing and is a function of nothing connected with his installation of which he has knowledge. In this regard Andrews' system is simpler; he charges a flat rate for the current with a fixed charge per lamp per year in addition. But as the varying charge basis is in Wright's system an objection, so is the heavy deposit per lamp in Andrews'. The present author suggests adopting a basis of units per lamp per year. So many units per lamp per year would be charged at a comparatively high rate, while units consumed over and above these would be charged at a comparatively low rate. Or a system of rebates or discounts on a flat rate may be used. The foregoing remarks apply to stations owned by private companies. For municipal stations he suggests that every ratepayer should pay "for the inestimable boon of having the means to a healthy and pure artificial light brought to his doors." The standing charges should be met by a general rate levied on all ratepayers in the compulsory area, while the production charges should be met by a flat rate for current supplied.—Lond. *Elec.*, Jan. 3.

Economy of Isolated Electric Plants.—Parsons.—An account of what appears to have been a careful examination of the relative advantages of isolated plants and electricity supply from central stations, from actual records of cost. Over 250 buildings with isolated plants in New York were visited, but only 17 were found where reliable information in every particular was available. Only

these were considered in the analysis of the cost records. Those of five office buildings are analyzed in detail; and as they include one of the largest office buildings in New York, one of the smallest, and three buildings of average size, they cover the field fairly well; they indicate as a rule the marked superiority in economy of the isolated plant, but in one case it is shown that a slight error of installation combined with unfavorable load conditions may, even in the very largest buildings, render the isolated plant of doubtful economy. The next class of buildings considered is the loft buildings; from the figures given for three loft buildings it appears that the installation of a plant in a building of this class and the sale of current to the tenants at central station rates, or in very large loft buildings, at 10 per cent to 25 per cent reduction from those rates, would in most cases prove very profitable. Figures are then given regarding a department store, showing a very great advantage in the installation of the isolated plant, and with the two important points in its favor, that the average load factor is quite high and that a steam plant is a necessity whether the electric plant is installed or not, there seems little doubt of the advisability of its installation in the department stores.—*Eng. Mag.*, Jan.

Electric Distribution from Central Stations.—Snell.—An abstract of his presidential address to the Newcastle Section of the (Brit.) Inst. Elec. Eng. He criticises the schemes of supplying power in bulk. "Where there are a number of small towns, each of which with, say, 10,000 or less inhabitants, and possibly the demand for a network of interconnecting light railways, it would undoubtedly be a waste of public money to put down separate sets of plant for each little place. In such a case it is probably the most rational method to adopt a station common to them all. But where a town has a population of, say, 20,000 or more inhabitants, it deserves consideration whether it may not be cheaper and better to install a local station, rather than take energy in bulk from a distant one, and then after transformation to distribute it locally. The all important advantage claimed for these county stations is an improved power factor, but the writer fails to see how in the same latitude the summation of a number of small peaks is going to result in an improved load curve; and yet upon this factor all depends." He strongly advocates the larger use of storage batteries. The guiding principle in designing stations ought to be simplicity. He believes that "ultimately a plain two-wire system of distribution will be preferable to a three-wire distribution now so universally employed. The effect of the cost of insulation and the comparatively large balancing wire required in practice—much larger than is demanded in theory—levels the economy down that is said to be gained in a three-wire system enormously, and the effect on insulation of the negative cable, by putting a permanent stress upon it, and the effect of osmosis, caused by earthing the middle wire, does, the writer knows from experience, cause a much heavier rate of depreciation on that cable and the negative service leads, which more than counterbalances the economy thought to be gained."—Lond. *Elec. Rev.*, Dec. 27.

San Francisco.—A very long and well illustrated description of the power plant of the Independent Electric Light & Power Company in San Francisco. The electric system is characterized by two-phase generation, three-phase transmission and a distribution enabling one to obtain two-phase current at either 115, 230, 440, or 2300 volts, and direct current on the three-wire system at either 110, 220, or 440 volts, and alternating current arc lighting on either the constant current or constant potential circuits. The electric equipment of the power-house consists of three 1500-kw and one 500-kw two-phase generators; two 100-kw direct-current dynamos as exciters and seven 750-kw raising transformers. An additional 1500-kw generators has been ordered. The frequency is 500 volts two-phase.—*Jour. of Elec.*, Dec.

REFERENCES.

An article, giving brief ilustrated descriptions, taken from patent specifications, of systems of C. F. Scott, Lamme, Steinmetz, E. Thomson, Potter, Davis, Sunt, Reed and Farrar.—*L'Eclairage Elec.*, Dec. 14.

Transformer Sub-Stations.—Winawer.—An illustrated description of the transformer stations in Karlsruhe. Thirty-six are above the ground in boxes and contain two 30-kw transformers each, 5 are underground and 10 are placed in houses.—*Zeit. f. Elek.*, Dec. 22.

Lightning Arresters.—Klein.—An illustrated description of horn lightning arresters, partially surrounded with iron to give the lines of force a desired direction.—*Elek. Zeit.*, Dec. 19.

Wires, Wiring and Conduits.

Overhead Transmission Lines.—Loppe.—A long mathematical paper on the design of overhead high-tension transmission lines. Each insulation represents a weak point for the insulation of the line, so that the greater the distance between two consecutive poles, the better; on the other hand, the mechanical strength of the line and the first cost must be taken into consideration. The influence of the variations of the temperature and the stress is discussed at some length, and the general considerations are given for determining the lengths of spans which may be allowed. The paper is too mathematical to be abstracted. Numerical examples are given.—*Bull. de la Soc. Int. des Elec.*, Aug., Sept., Oct.—An account of the discussion which followed and in which Roux, Arnoux, Boucherot and Loppe participated, in *Bull. de la Soc. Int. des Elec.*, Dec.

Electro-Physics and Magnetism.

Barlow's Wheel.—Carvallo.—To determine the motion of a system of movable circuits and the currents which traverse them, Maxwell uses the equations of Lagrange. The expressions adopted for the kinetic energy is composed of two parts, these being the force of inertia of ponderable matter, and the function of electrodynamic forces, called the electrokinetic energy. This would mean that the electrodynamic forces and the induced e. m. f.'s, are not applied forces, but forces of inertia. The present author, however, shows that the equations of Lagrange break down in a case such as that of Barlow's wheel, for if correct the wheel should stop rotating. He finds in the behavior of Barlow's wheel a confirmation of Maxwell's contention that the energy of a system of currents is a kinetic energy, whereas the electrodynamic forces and the induced e. m. f.'s are forces of inertia.—*Comptes Rendus*, Dec. 2; abstracted in Lond. *Elec.*, Dec. 27.

Induced Radio-Activity.—Curie and Debienne.—All bodies become radio-active when they are placed in a closed vessel with the solid salts of radio-active barium. They have found that the effect produced can be increased 40 times, and also rendered more regular, by replacing the solid salt by its aqueous solution. They have made a number of striking experiments with substances placed in what they call an "activating enclosure," i. e., a vessel containing a radium compound.—*Comptes Rendus*, Dec. 2; abstracted in Lond. *Elec.*, Dec. 27.

Radio-Activity and Luminescence.—De Heptinne.—Results of experiments showing that a gas which becomes luminous at a certain low pressure under the influence of electrical vibrations, becomes luminous at a higher pressure when exposed at the same time to the action of X-rays. Radium rays have a similar effect.—*Comptes Rendus*, Dec. 2; abstracted in Lond. *Elec.*, Dec. 27.

Permanent Magnetism.—Abt.—An account of a determination of the permanent magnetic moments of a number of specimens of steel manufactured at the Resitza iron works of the Austro-Hungarian Railway. The collection of steels comprises 10 carbon steels, two manganese steels, six steels with a specially high percentage of manganese, six chromium steels, and two nickel chromium steels. The tables of figures show that the mangetic moment reaches a maximum with a magnetizing current of 20 amp. But the maximum in the case of the strong manganese steels is already attained with 10 amp The latter also has the smallest permanent magnetic moment. The highest permanent magnetism is shown by the nickel chromium steel, the ratio of the two permanent magnetisms being 22.5 in the case of long bars and 17.6 in the case of short bars. One particular brand of manganese steel containing much manganese shows no permanent magnetism at all, however great the magnetizing current. —*Ann der Physik*, No. 12; abstracted in Lond. *Elec.*, Dec. 27.

REFERENCES.

Skin Effect of Electrical Oscillators.—Chant.—An illustrated account of an experimental investigation of the skin affect in electrical oscillators; both cylindrical and spherical oscillators were tested. The results are given in a table. It appears that both in the case of the cylindrical and of the spherical doublets, the excessively thin gold leaf shells were quite as efficient as the solid metal bodies.—*Am. Jour. Sc.*, Jan.

Hertzian Exciters and Resonators.—Poincare.—A brief article criticising a recent article by Johnson on this subject.—*L'Eclairage Elec.*, Nov. 30.

Terrestrial Magnetism.—The December issue contains a paper by

Gilbert on some experiments upon the relations between ether, matter, and electricity; reports by Boergen, Eschenhagen, Hepites, Haga, Fraser, de Moidrey, Farr, Hosmer, Claxton, on the magnetic observations made during the total solar eclipse of May 17, 1901; an obituary notice, with portrait, of Prof. Eschenhagen; a communication, by de Moidrey, on magnetic observations in Southeast China; an illustrated description, by Watson, of a set of magnetographs designed by him; and an article, by Hazard, on the central physical observatory of Russia.—*Terr. Magn. and Atm. Elec.* Dec.

ELECTRO-CHEMISTRY AND BATTERIES.

Mineral Production and Chemical Industries in 1899.—Statistical articles and summaries, comprising nearly the entire issue; many refer to the production of the world, but most of them to the United States; they deal with gold and silver in 1901; mines in California, Leadville, San Mignel Co., Utah. A review, by Wells, of the progress in the cyanide process. Iron and steel in 1901; the different markets in the United States. In 1900, the United States produced a total of 600,832,000 lbs. of copper, including copper in its sulphate; in 1901 the production was 595,000,000 lbs.; this is a moderate decrease, for the first time in a number of years. The production of aluminum in 1901 is assumed to have been larger than in 1900, although the Pittsburg Reduction Company does not give out figures. Other articles deal with lead, zinc, tin, mercury, nickel and cobalt, platinum, coal, bauxcite, the chemical market in 1901, the mining industries of British Columbia, Western Australia.—*Eng. and Min. Journ.*, Jan. 4.

Tests of Aluminum Bronzes.—TETMAYER.—An account of tests made in the Zurich Polytechnic School at the request of the Neuhausen Aluminum Company, who provided the samples. The specific gravity first rises and then falls, as the percentage of aluminum increases. The maximum strength for soft alloys was obtained with 3.4 per cent Al, and for hard alloys with 1.4 per cent Al. For brass, the electricity decreases with the increase of Al, and is extremely low with 2 per cent of the latter. Silicon increases the specific gravity and reduces the elasticity. Iron, in the proportion in which it was present in the alloys, was not observed to sensibly influence the physical characteristics. Aluminum bronze, containing 10 per cent Al with 1.5 per cent Si and Fe, is too brittle to be of any practical value. As regards the abrasion by friction, the hard alloys, with less than 89.6 per cent Cu, lose little in weight, while the soft alloys, with less than 6 per cent Al, heat and wear away rapidly.—*Rev. de l'Elec.*, Aug. 31; abstracted in *Science Abstr.*, Dec.

Electrical Recovery of Pure Tin from Waste Tin Cuttings.—GELSTHARP.—An illustrated description in detail of a process which is said to have been successful in a practical trial. The tin is recovered by electrolysis, and the clean iron is either sold as best scrap or converted into green copperas, which may be further converted into red oxide and Nordhausen sulphuric acid, the profits derived therefrom being exceptionally large. The electrolyte in the stripping tanks is a 1¼ per cent solution of commercial de-arsenicated spirit of salt, to which is added a small quantity of oil of vitriol.—*The Elec. Chem. and Met.*, Dec.

REFERENCES.

Potentials of Electrodes.—HABER.—A long article giving highly theoretical notes on the notation of the potentials of electrodes and on the calculation of the potential difference at a reversible electrode, several types of reversible electrodes being discussed in detail. He discusses especially the process in so-called oxidation and reduction cells.—*Zeit. f. Electrochemie*, Dec. 5.

Preparation of Semi-Permeable Membranes.—MORSE and HORN.—A description of a method of making strong semi-permeable membranes of copper ferro-cyanide in the walls of porous cells, by means of electrolytic deposition.—*Chem. News*, Aug. 30; abstracted in *Science Abstr.*, Dec.

Aluminum.—WILSON and MORRISON.—Longer abstracts of the two papers of these authors, recently noticed in the Digest.—Lond. *Elec.*, Dec. 27.

Non-Aqueous Solutions.—CIOMMO, WALDEN and CENTNERSZWER, FRANKLAND and FARMER, FRANKLIN and KRAUS.—A review of several investigations by various authors, of the electrolysis of non-aqueous solutions.—*Zeit. f. Elektrochemie*, Dec. 12.

Conductivity of Solutions in Glycerine.—DE CIOMMO.—An account of measurements of the conductivity of strong solutions of caustic soda and potash in glycerine of fixed strength, namely, 96 per cent glycerine, and 4 per cent water.—*Nuo. Cim.*, Aug.; abstracted in *Science Abstr.*, Dec.

Pan-American Exposition.—NORDEN.—A review of the electrochemical exhibits at the Pan-American Exposition in Buffalo.—*Zeit. f. Elektrochemie*, Dec. 12.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Alternating Current Terminology.—Some further contributions to the discussion on alternating current terminology which has begun in that journal by Hospitalier, as noticed recently in the Digest. The Academy of Science of Toulouse suggests the following terms, instead of those put in parenthesis which had been proposed by Hospitalier: if U and I are what is called in this country effective e. m. f. and effective current, and "*a*" the phase difference between e. m. f. and current, the propositions are as follows: U I, "effective power" (Hospitalier: apparent power); I cos a, "intensity in phase" or "useful intensity" (current in phase); I cos a, "intensity out of phase or "useless intensity" (current in quadrature); U I cos, a "power in phase" or "useful power" (real power); U I sin a, "power out of phase" or "useless power" (frictive power); sin a, "coefficient of uselessness" (factor of impotence); "*a*," angle of phase difference" or "angle of uselessness"; $U \div I$, "effective resistance."—Some critical remarks by Raverot on the method of resolving a vector into its components, as current into the current in phase and the wattless current; he says that from the point of view of the physicist, there is nothing more artificial than this method of representation. He urges looking after the exact physical meaning of power in alternating current phenomena and to suppress a certain number of "fictive and even parasitic" definitions.—*L'Ind. Elec.*, Dec. 25.

REFERENCES.

Measuring Instruments.—ARMAGNAT.—An article, giving brief illustrated descriptions, taken from patent specifications, of electrometers, devised by Townsend, Wilson and McClelland, E. Thomson; galvanometers by Steele; Rimington; Davis and Conrad; Atkinson, Waddell; a compensation voltmeter of Th. Duncan for measuring the loss of voltage in the main feeders of a distribution network.—*L'Eclairage Elec.*, Dec. 7.

A continuation of his article giving brief illustrated descriptions, taken from patent specifications, of the following new instruments and methods of measuring; a device, by Mershon, for measuring at any part of an alternating current network, the potential difference at another point; a resistance box of Fleming for industrial measurements; a Wheatstone bridge with automatic regulation by Darwin, Griffiths, and Whetham; a device by Goddin for registering the indications of instruments with a feeble directive force.—*L'Eclairage Elec.*, Dec. 21.

Terrestrial Magnetism and Instruments of Precision.—WINDMUELLER.—An illustrated account of experiments in which he investigated the influence of the field of terrestrial magnetism upon instruments of precision. For very accurate instruments this influence must be taken into account. The instruments tested by the Reichsanstalt have a mark showing in which direction to the field of terrestrial magnetism the instrument has been tested.—*Elek. Zeit.*, Dec. 26.

Uniformity of Speed During One Revolution.—BLONDIN.—A paper on the methods of measuring the degree of uniformity of speed during one revolution and the maximum angular displacement. He recommends the use of the stroboscopic method, in combination with the photography of the curves.—*L'Eclairage Elec.*, Nov. 16.

Application of Oscillographs to the Study of Alternators.—BLONDEL, DOBKEVITCH, DURIS, FARMER, and TCHERUOSVITOFF.—A full reprint, with many illustrations of their paper presented to the Internat. Elec. Congress in Paris, noticed in ELECTRICAL WORLD AND ENGINEER, Sept. 15, 1900; *L'Eclairage Elec.*, Dec. 14.

Analyzing Alternating Current Waves.—JANET.—A brief illustrated mathematical paper on an apparatus of Coradi for determining the constants in Fourier's series into which a given alternating wave can be resolved.—*Bull. de la Soc. Int. des Elec.*, Nov.

TELEGRAPHY TELEPHONY AND SIGNALS.

Telegraphy.—An editorial discussion of the possible development of commercial telegraphy in the near future. Statistical data from Germany are given which shows that there is no general need for

high-speed telegraph systems. But it would be good to provide a few very important lines—especially those for international service—with a high-speed service. Of the countries from which statistical data are published, it is only England and Turkey in which the income from the telegraphs is greater than the costs, while in Belgium, Norway, Switzerland and Spain the costs exceed the revenues. To cheapen telegraph service, it would be necessary first to diminish the number of attendants. It has been found possible with the Rowland system for one attendant to care for four receiving instruments. Attention is called to the suggestion of Koller that telegrams should be delivered to the telegraph station in the form of perforated tapes; the number of attendants could then be reduced to one-fourth and the fees could be reduced to one-half. What is wanted now is a simple and cheap instrument for this purpose.—*Elek. Zeit.*, Dec. 19.

REFERENCES.

Baudot Multiple Telegraph System.—ROBICHON.—An illustrated description of portable Baudot instruments. They were made use of during the recent visit of the Russian Emperor to France, in order to fulfill the enormous telegraph service in lines which were otherwise not much used.—*Jour. Teleg.*, Dec. 25.

Statistical.—Statistical articles on the telegraph and telephone cables in Germany; and on telegraphy and telephony in Russia in 1899.—*Jour. of Teleg.*, Dec. 25.

MISCELLANEOUS.

Electricity and the Growth of Plants.—HEBER.—An illustrated account of some experiments showing the beneficial influence of electric currents upon the growth of plants. Electrodes were put in the soil at different sides of the plant and a direct or intermittent current sent through the soil from an external source, or a zinc and a carbon electrode were placed at opposite sides of the plant and connected by a wire so that a short-circuited cell was formed.—*Elek. Anz.*, Dec. 15.

REFERENCES.

Electrochemist and Metallurgist.—This British Journal is in future to be published bi-monthly instead of monthly.

Lightning, Electrical Times.—The London weekly journal, which up to 1900 appeared as *Lightning*, and last year as *Lightning, the Electrical Times*, will hereafter appear as *The Electrical Times.*

New Books.

LES APPLICATIONS PRATIQUES DES ONDES ELECTRIQUES. By Albert Turpain. Paris: C. Naud. 412 pages, 271 illustrations. Price, 12 francs.

This most recent work on wireless telegraphy is a thoroughly up-to-date, comprehensive and, what is more to the point, a practical work on the subject, dealing as it does not so much with the historical progress made in etheric wave telegraphy since 1897 as with the practical methods involved in sending and receiving wireless messages. Any attempt, however, to adequately describe the phenomena attendant on the wireless transmission of energy must necessarily begin with the experiments in electric undulatory motion discovered by Hertz and the effects of electric waves upon segregated metals as embodied in the investigations by Branly. For this reason the author has devoted the first chapter to the production and observation of these waves. To those who are familiar with Hertz's work on "Electric Waves," describing his own experiments with the Reiss micrometer spark-gap detector the first part of Turpain's Telegraphy Without Wires, will be especially appreciated, for the descriptions he gives of the detectors are very exact and with the detailed drawings accompanying the text they are much more lucid than in the memoirs of Hertz. After Hertz published the results of his researches his work was rapidly reproduced and advanced by MM. Sarasin and de la Rive, Blondolot, Righi, Lodge, Branly and other noted physicists; the work of all these scientists Turpain reviews briefly and as thoroughly as the practical nature of the book requires.

In the second chapter of the author rehearses at length the available modes and sources of e. m. f. suitable for the production of the disruptive discharge. These include the static machines of Holtz and Wimshurst, following which is a very complete list of the various induction coils constructed according to the plans and specifications of Apps, Elihu Thomson, de Rochefort and others. The superiority of the induction coil over the static machine, Turpain points out, arises from the necessity of employing a motor and battery in conjunction with the latter to operate the revolving discs, whilst he maintains that the steadiness of the current discharge of the electric machine is advantageous. An induction coil is so much more portable, convenient and compact that it is doubtful if it will ever be replaced by the more cumbersome glass plate machines.

To the subject of interrupters Turpain devotes much space and gives many drawings. There are over a dozen different forms described, commencing with the simple mechanical vibrator and running the whole gamut of ingenious contrivances devised for "making" and "breaking" the primary circuit of a coil, with the greatest efficiency. In systems of wireless telegraphy the value of means for suddenly breaking the primary is often overlooked or under rated; nearly all coils are equipped with interrupters of very ordinary construction and usually are far from the high standards necessary for producing the maximum effect with the minimum amount of energy. The interrupter and condenser of a coil should be in proper adjustment relatively, as well as with the coil with which they are used, or the spark emitting the waves will be enfeebled. The interrupter then is as essentially vital to the good working of the system as the coil itself or the coherer, and even more so, since the maximum efficiency of the spark depends largely upon the interrupter, and the more sudden the break the steeper will be the wave front of the oscillatory discharge and, therefore, the greater the energy with which the waves are emitted, and, finally, the distance covered. Turpain classifies interrupters as follows: (1) Tremblers or mechanical vibrating; (2) rotators or mechanical contact revolving; (3) turbines or mercurial jet; (4) electrolytic. The various forms of mercurial turbine interrupters based on centrifugal force so much in vogue in Europe are considered in the text, as well as the complete specifications and drawings of the Wehnelt electrolytic interrupter; a multiplicity of improvements upon the original form—either real or fancied—are described with much attention to detail. It will thus be seen that, owing to its importance in connection with wireless telegraphy, there is method in the amount of space allotted to interrupters by the author.

Another feature that gives the reader a clear conception of what has been done in the way of spanning distances by the various systems is a compliment of authentic tests giving the height of the vertical wires or antennæ, the distance between the stations, and where and when the tests are made among the more important, are those made by Marconi, Slaby, Ducretet and others. The results show that the Italian inventor succeeded far ahead of his contemporaries in his efforts to establish a "long-distance" record. The experiments of Tesla and Thomson with high-potential, high-frequency currents are treated quite fully considering the limited part they have played in wireless transmission, but according to M. Turpain their application to wireless telegraphy is practical if their apparatus is constructed for this specific purpose. Those who have witnessed Tesla's experiments with 20-meter spark lengths will find this section very interesting if not indeed instructive, especially in view of the fact that great things have been claimed for and are seriously expected of the Tesla system in this country. From the many reports concerning the adaptation of his apparatus for long-distance transmission of intelligence without connecting wires, as well as the very recent Tesla patents issued, it would seem that Turpain has some justification for his favorable views.

Nearly one-half of the book is taken up by an appendix describing apparatus relating to coherers, occasionally to divers topics appertaining to the art, but more chiefly to the analysis of recent patents granted to inventors in the United States, France, England and Germany. Turpain does not critically consider to any extent the various appliances and apparatus, but describes them with characteristic French clearness and conciseness, which, together with the accompanying drawings—the greater number are in outline or diagrammatic—practically eliminates all chance of misunderstanding the author or shrouding in obscurity the topic. Mathematics are almost entirely avoided as well as the underlying theories involved. In the chapter on Hertzian waves appear some formula, and the only part which may be designated as theoretical is that relating to the several solutions offered by different physicists to account for the propagation of electric waves, wherein they seemingly defy the laws of light in following the curvature of the earth—if they really do—and what the constants of the earth may be.

M. Turpain has given us a work that is what he himself claims for it—a work based not on theory but on the practical results obtained by the many workers in every land on this fascinating subject. To those who are working along this line a study of Turpain's

book offers much useful information not readily available otherwise. To others who have only a passing interest in wireless telegraphy it will serve to broaden their views of what the European workers, especially, have done to advance this new art.

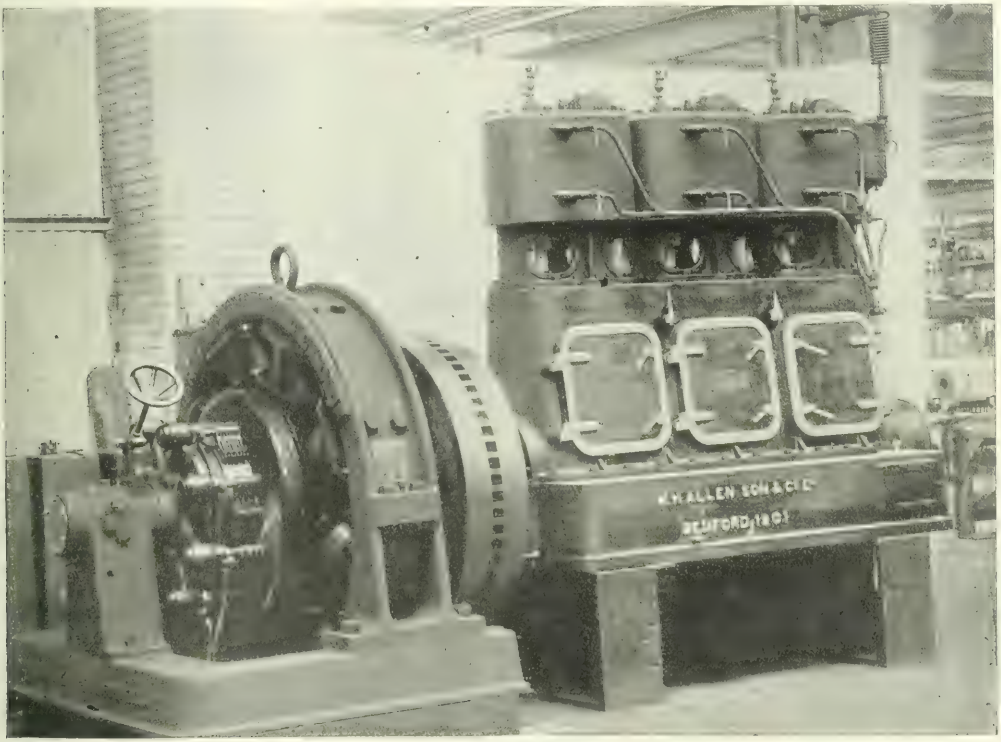
With Fahie's "History of Wireless Telegraphy," Lodge's "Modern Views of Electricity" and Turpain's "Les Applications Practiques des Ondes Electriques Telegraphie Sans Fils," the nucleus of a library of a new art may be had covering virtually everything known in the state of the art of wireless telegraphy up to the present time.

BOOKS RECEIVED.

MUNICIPAL ENGINEERING AND SANITATION. By M. N. Baker. New York: The Macmillan Company. 317 pages. Price, $1.25.

English High Speed Engines for Electrical Generation.

The accompanying illustration shows a type of engine designed for electrical generation by W. H. Allen, Son & Co., of Queen's Engineering Works, Bedford, England. It is of the three-cylinder compound type, and especially designed to maintain a high efficiency under varying loads. As illustrated, the engine is direct connected to a Crompton direct-current generator, having a normal output of 435 amperes at 460 volts and 450 r. p. m.



ENGLISH ENGINE FOR ELECTRICAL GENERATORS

The shaft is forged from a solid bloom of Siemens-Martin steel, the eccentrics being also solid with the shaft. A considerable advantage is claimed in having the crank-shaft and eccentrics solid at high speeds, as the number of independent moving parts is thus reduced to a minimum. In order that the high speed may be maintained for a considerable time, the engine is fitted with a system of forced lubrication, a small pump of simple and efficient design and driven direct from the engine being placed inside the bed plate for this purpose.

The valves are of the solid piston type, and take steam on the inside edges, thereby diminishing the pressure on the glands as compared with valves taking steam on the outer edges.

The governor is of the centrifugal kind, with controlling springs fixed direct on the end of the crank-shaft, and revolving with it. It is connected by means of an arrangement of levers to the throttle valve, which is immediately above it, and is so arranged that the speed of the engine can be varied by the attendant within 5 per cent above and below normal speed while the engine is running, if it be desired.

The length of the engine bed is 94 inches, width 54 inches, and height from the lower edge of the base-plate to the top of cylinder covers 86 inches. The small space occupied by this class of engine for the power given out is thus very noticeable, and, as will be seen from the tests, particulars of which are given below, there is no sacrifice of the efficiency of the engine, while the steam consumption compares favorably with, and is, in fact, better than many first-class two-cylinder compound engines of the same power. The engine is fitted with a governor acting direct on the throttle valve, with the view to reducing the variation in speed to a minimum in the event of the whole or any portion of the load being suddenly thrown on or off, the stop valve remaining full open under all conditions.

Following are the data of a trial run of six hours: Steam pressure, 150 lbs. at stop valve; mean ihp., 308.8; revolutions, 451.3; water per ihp., 16.4.

On the governor trials, with stop-valve full open, the mean speed at the moment before breaking the circuit was 448 r. p. m.; on throwing off the whole load, amounting to 261.5 ehp., the speed rose steadily to 475 r. p. m., and then settled at 453 r. p. m., the duration of time from throwing off the load to settling being about 5 seconds. It will thus be seen that the maximum variation was 5½ per cent, while the settling speed only showed a rise of 1 per cent above the mean speed. For the half-load test the mean speed of the engine was 448 r. p. m. prior to the removal of the load, which rose to 470 on breaking the circuit, and settled at 464, the time being about 4 seconds.

Messrs. Allen & Co. have designed for the larger sizes of their engines a by-pass valve, operated by the governor spindle, which, when the engine is operating an overload, allows high-pressure steam to pass into the receiver and so help the low-pressure cylinder.

Electric Features of a Modern Hospital.

Mr. John Pierpont Morgan has presented to the Society of the Lying-In Hospital of New York City a magnificent new hospital and equipment just opened for public use. The building is on Second Avenue and Eighteenth Street, is eight stories high and rises 150 ft. from the sidewalk. It embodies a great many features of novelty, including electrical, and is perhaps the furthest reach in modern medical and surgical skill, so far as equipment is concerned. The well-known

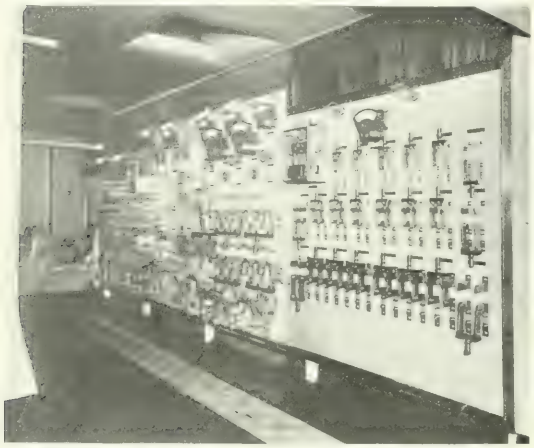


FIG. 1.—THE SWITCHBOARD.

physician, Dr. J. W. Markoe, who is responsible, we believe, for much or all that has been done, is to be congratulated on the admirable results.

While the electrical features are not in many respects new, it may be noted that at every turn one finds some electrical system or device in operation to enhance the welfare of the patients and staff. The building has a complete electric light and power plant of its own, with Babcock & Wilcox boilers, Phœnix engines and three Westinghouse direct-current, direct-connected generators of 200 kw, 150 kw and 100 kw, respectively, supplemented by a "Chloride" equipment from the Storage Battery Company of 2500 ampere-hour capacity, fed through



FIG. 2.—GENERATING PLANT.

a 10-kw motor-driven booster. The smokestack runs up through the center of the building with a huge spiral stairway, and constitutes also a ventilating and sanitary flue. There are four Sprague electric elevators, three dumb waiters and one ash lift. No fewer than 27 electric motors for various purposes are in use, chiefly, if not all, of C & C make, and aggregating about 270 hp, ranging from 1 up to 35 hp. The very handsome switchboard was built by the General In-



FIG. 3.—AUXILIARY BOARD.

candescent Arc Light Company and the wiring in iron duct, etc., was done by the Western Electric Company. There is a small auxiliary

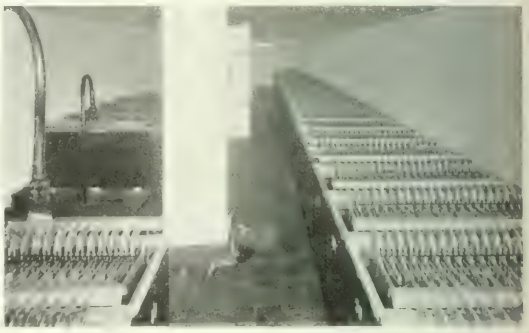


FIG. 4.—STORAGE BATTERY.

board and system by which the bells and annunciator system are rung by a Crocker-Wheeler ringing motor-generator, which, when



FIG. 5.—INVERTED ELECTRIC LIGHTS IN ONE OF THE WARDS.

current happens to be off from the generating plant automatically cuts out itself and cuts in a primary battery outfit to do the work. All told, the plant affords service for about 3200 lamps of 16 cp.

One of the most noteworthy features of novelty is the introduction

by the Electric Regulator Company of the Sayles regulator for dimming the lights in all the wards and a number of the private rooms. There are, we believe, no fewer than 32 of these equipments, and the hospital is the first installation of this ingenious device, which has already been described and illustrated in our pages. In the rooms the lights are in the ceiling, masked by ground glass bulls-eyes; in the wards the lights are carried on long, plain stems, with an inverted hood or septum, not transparent, and throwing all the light up to the ceiling. The fixtures are usually of 2, 4 or 6 cluster lights, governed by metallic push panels, and the Sayles regulator box of metal adjoins, all setting flush with the wall. The regulator gives three steps, the first "making darkness visible," then up to the full candle-power, and the convenience of the device is so apparent upon the first glance that its general adoption in all such institutions seems inevitable. It is difficult to imagine wards better lighted, without glare, or more softly dark when the dimmers are in use.

Another feature is the electric ambulances, for which there is a separate charging board. In this form of vehicle the side opens up and is raised while the mattress runs out on the supporting lower



FIG. 6.—ELECTRICAL INCUBATOR.

half. The convenience in handling patients is remarkable. We may add that Mr. C. O. Mailloux is the consulting engineer of the plant, which was installed under his direction, assisted by Mr. Charles E. Knox. The chief engineer operating the plant, to whom we are indebted for information, is Mr. J. George Hermes.

The Development of "Oscillating" Electric Fans.

In itself the electric fan motor has been one of the most notable successes among inventions and industries, selling by the hundreds of thousands, making a new market for current, and mitigating in a manner that every American appreciates the fierce heat of the summer. It is only natural that several and various changes from the original and standard form should be made, and concurrently with marked and rapid improvements in design and construction there have been seen many novelties and some curiosities. One of the most praiseworthy lines of improvement has been that which proposes the better distribution of the breeze from the fan. A great many people object to the steady uni-directed blast from the fan, aimed steadily at one part of the room, one human being, and but one portion of his upper anatomy; and a well-known electrical engineer has gone so far as to characterize stationary fan motors as "pneumonia screws." It was to meet objections of this nature that Mr. T. Romer Weyant, a well-known inventor of this city, brought out last year a device that attracted considerable attention, in which with vertical feathering fan blades and checked in its swing by a chain, the fan was able to deliver its breeze, as it oscillated, to every occupant of a large room. He has now made another considerable stride in a fan motor that is being introduced for 1902 by the Shedd Electric & Manufacturing Company, of 136 Liberty Street, New York City. Last year the company bought fans in the open market and equipped them with its oscillating devices, but for the season now opening they have produced a complete equipment of their own that is more than usually deserving of notice.

The new motor is remarkably compact and efficient, and its neatness of design can be seen from the accompanying cuts. It is enclosed but not exactly "iron clad," the openings between the bi-polar field and the armature being so contrived as to keep a constant stream of air in large volume passing through the machine, with consequent minimization of heating. The armature has a rose, or end-on commutator, and by this means the carbon brush tubes are placed parallel with the fan shaft. The pull of the fan driving the air from the

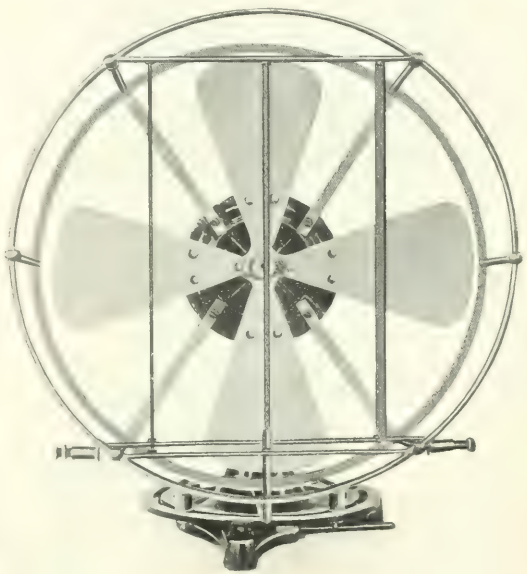


FIG. 1.—OSCILLATING FAN.

motor causes the armature to press the commutator against the brush-springs, and it would appear that a more perfect contact and flotation of the armature in the field is thus obtained. The leading-out wires from the armature are carefully protected against moisture, and against any injury, by means of a boxwood cup. The upper part of the motor field frame is removable by loosening one screw, and the entire mechanism can be examined, etc., while the fan is in full operation. This tends to the frequent inspection that adds so much to the durability of machinery, while the openness of the construction is against the accumulation of dust and dirt. Wick-feed oil cups are used.

The resistance is another interesting feature, consisting not as usual in wire, but in a composition in bar form, over which the contact moves, so that the variation of speed is not by a few jumps, but by a delicate variation of degrees up to the full amount, the maximum in this fan being, moreover, unusually high, so that users can adjust the amount of breeze most closely through all the range of summer temperatures.

Coming now to the special oscillating features of the fan motor under consideration, it will be noted at once by those who recall the earlier form that the oscillator blades have been greatly reduced in number, and that the chain has been entirely suppressed, so that even its faint rattle is no longer heard. The motor itself is buoyed up on ball bearings in the stand, and the motor as it oscillates hits softly limiting thumb-screws in the quadrant at the base, so that its range of swing can be varied from a short arc up to an almost complete circle; while its rate of oscillation or periodicity is also equally under con-

trol. The reversible fan guards have limiting stops, and these can be screwed in or out so as to give any desired angle to their inclination, and thus the fan motor turns from side to side, distributing its grateful breeze into every corner. In one instance in New York City, a restaurant that was using six ordinary fan motors, has two of these "oscillators" now doing the same work. A plan that seems quite

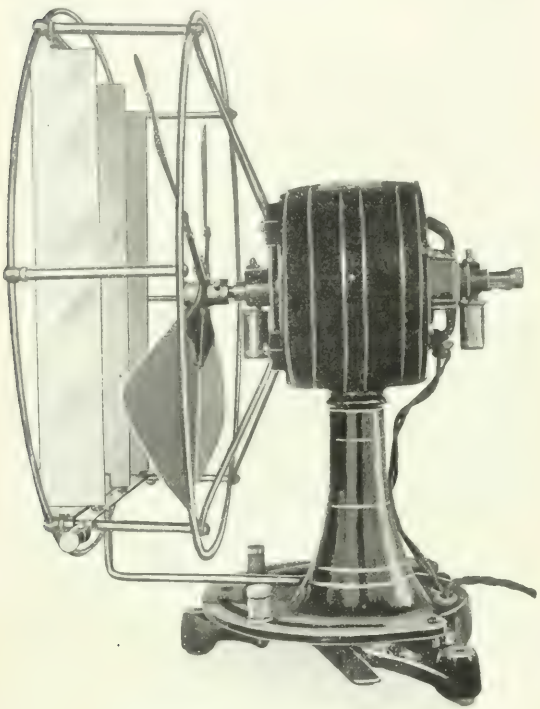


FIG. 2.—OSCILLATING FAN.

popular is to mount the device on a stout pedestal "and let it swing."

The officers of the Shedd Company are Harry M. Shedd, president; R. J. Peterson, treasurer; Theo. A. Moolten, secretary, and T. R. Weyant, genera manager.

Central Energy Intercommunicating Telephone.

The latest type of a central energy intercommunicating telephone recently put on the market by the Haines & Noyes Company, 118-132 West Jackson Boulevard, Chicago, is made up in any kind of wood desired, and is of high piano finish. The transmitters are of its non-

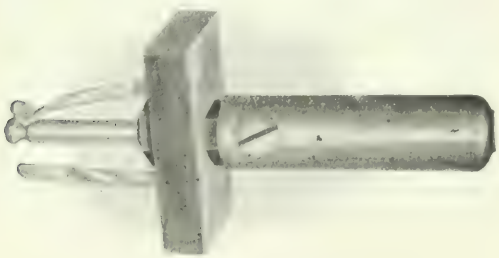


FIG. 1.—TELEPHONE JACK AND PLUG.

packing type for long-distance use. They are of heavy cast brass. The receivers are of the bi-polar pony Bell type, with water-shrunk

In designing this apparatus the idea was to overcome the usual hard-rubber shell. The cords are of green linen and have sealed connections inside the receiver. The hooks have platinum points and German silver springs, absolutely sure and positive. The jacks are heavy and of German silver. The plugs are all brass with ball tip and hard-rubber handle. The silk cord has underneath it a spiral brass piano spring which covers the copper strands and prevents breaking



FIG. 2.—INTERCOMMUNICATING TELEPHONE.

It is not necessary to return the plug to the home station after being used to permit the home station to be rung up by any other station. These telephones are in use throughout America and Canada.

The installation of this system is very simple. There are three more wires used than the number of stations desired, while the batteries are placed in one central place.

Flash-Light Electric Signal Telephone Switchboard.

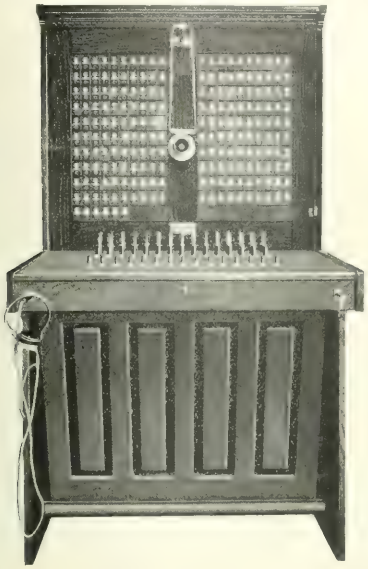
The illustration (page 243) shows a new type of electric light signal switchboard made by the Eureka Electric Co., of Chicago, which contains a number of improvements over the ordinary type of switchboards and central office equipment. The cut shows a regular 200-capacity cabinet with 200-line signals installed and 6 electric light transfer signals. Additional cabinets can be mounted by the side of this board, giving a capacity up to 1000 lines, without making any change in the original installation. The board is made for both magneto and central energy work.

The cams employed in the operator's circuit are of the lever Bell type key, and are mounted on a shelf holding the electric light clearing signals as well as the plugs and cords. A special feature is that by an ingenious arrangement a self-contained automatically cut-out relay is employed, which is also removable, for the line signal. The transfer employed is also of the self-contained automatically cut-off relay type, and operates as follows:

An operator desiring connection with another board in the system by the insertion of a plug into the jack of the transfer relay lights the light on both her board and the board with which she desires connection, the instant that the called operator answers, both lights are automatically extinguished. This simple flash light relay transfer system makes it impossible to hang up the subscriber or a pair of cords, without the signals remaining lit.

The rapidity of operation is such that one operator can easily and with comfort accommodate and handle 200 subscribers. The advantage of one operator handling this number of subscribers is quite apparent in the earning capacity of the exchange. The apparatus may be operated either from primary batteries or from regular equipped exchange having generators, dynamos and storage cells. The cabinets are all furnished in quarter-sawed oak, finished in golden oak finish. The construction of the key shelf is three-ply and hinged; the plug shelf is covered with heavy belt leather and bushed to prevent wear on the table as well as the plugs and cords.

In designing this apparatus the idea was to overcome the usual objectionable features found in boards of the flash light pattern. As all the relays are self-contained and in units, as many can be installed up to the capacity of the cabinet as may be desired by the purchaser, either at the time of purchase or at a later date. The boards are furnished for straight full metallic systems, but are readily adapted to either common return or grounded systems as well. The



TELEPHONE SWITCHBOARD.

operator's circuits are of the Eureka transmitter type, and the usual other attachments like those generally placed on its express typeboard. The cabling throughout this switchboard is done with silk and cotton-insulated wire, all joints being soldered to their respective terminals without the use of acids.

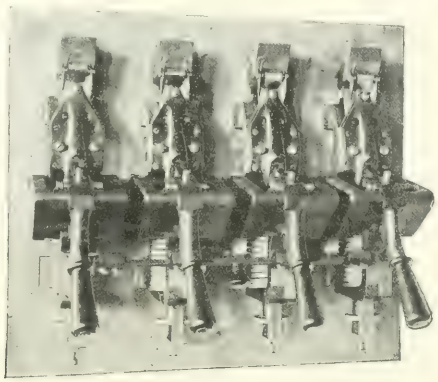
"Multiple Voltage" Circuit Breakers.

The modern practice of driving shop machines by electric motors connected directly thereto has resulted in the development of various schemes for providing these motors with a wide range of speed. One of the best known is that called the "multi-voltage system," for the protection of which the Cutter Company has brought out a circuit breaker, an illustration of which is shown in the accompanying cut. The instrument consists of four single-pole automatic circuit breakers, with the latches so connected that an excess of current passing through the operating coil of any one breaker will open the four poles at the same instant. Having independent arms, it is a combination of a switch and a circuit breaker, and renders the use of the usual hand-switch unnecessary. The tripping mechanism is provided with a small handle, so that the four poles can be released manually.

The movable switch member consists of copper laminations, and is brought by toggle mechanism into contact with flat copper terminals, which are parts of the studs. The automatic overload release is obtained by means of a plunger, which, upon the passage of excessive current, is drawn into the solenoid and strikes the latch a "hammer blow," releasing it and allowing the breaker to open. Such a circuit breaker set is placed between the "compensating transformers" and the load. The "compensating transformer" consists of either three direct-current motors, of different voltages, mounted on the same shaft, or a double commutatored motor and a single commutatored motor, mounted on the same shaft; the combined voltage of the set, in series, being equal to the voltage of the generator.

The individual machines run either as motors or generators, depending upon the manner in which the load is divided between the various circuits. The variable speed motors which such a system is designed to drive have their fields connected across the outside wires, thus receiving the maximum voltage, while the pressure at the armature terminals may be varied by shifting it from one circuit to another of the four-wire system; the constant speed motors being run the highest voltage, therefore, on the outside wires.

With such a system it is absolutely essential that in case of an overload on any one wire, the entire four wires be open at the same instant; for, assuming that a heavy load is on one circuit and a single motor on an adjacent circuit, if the wire common to the two circuits



"MULTIPLE VOLTAGE" CIRCUIT BREAKERS.

should be opened in any way, the current due to the heavy load would be sent directly through the small motor, most likely burning it out and short circuiting that circuit, which would make the remaining motors speed up, due to the increased voltage obtained from the other circuit and causing general damage.

Cable Head and Protector Terminal.

The cut herewith shows a new cable head terminal made by the Eureka Electric Company, of Chicago. This head can be used at the junction pole terminal, or as an office terminal, and is so constructed that fuse protection can be employed. The base of the head is tin, and to this the cable solders. The joint is wiped and the cable head becomes the junction terminal and part of the cable. The bridle wires are then attached and connected to the line circuit, making a compact and complete junction pole terminal head, or office terminal head.



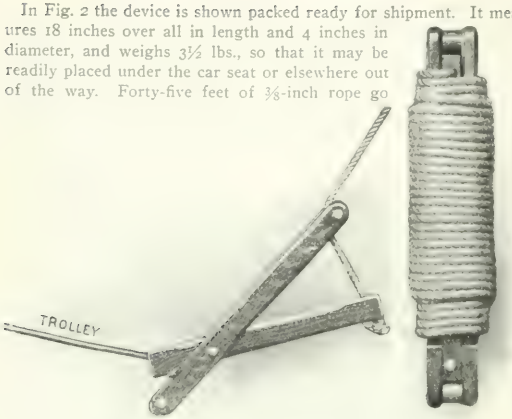
CABLE HEAD.

The general construction of the head is of steel, pressed and formed into shape, and after the cable has been attached to the head and the joints soldered and wiped, the inside of the head is filled with oxite or paraffine, thereby giving protection from moisture to the cable and protecting it against any damages. These heads are built in 26, 52 and 104-pair sizes, and will also be furnished readily in special sizes where requirements demand. In addition to giving protection to the exchange by either fuse or heat coil, as may be preferred, on the side of the heads is mounted a ground bar lightning arrester device, thus giving all the protection that can possibly be had in a cable head terminal.

Trolley "Pick-Up."

The device illustrated on next page is designed as a means of picking up a broken trolley wire and suspending it in the air temporarily, thus permitting of the operation of cars until permanent repairs are effected. The tongs are made of oak, and the rope which is attached thereto is intended to be thrown over the limb of a tree or over a guard wire or feeder, so that the broken end of the wire may be lifted above the track. With this device suspension of traffic may be avoided in the case of a break.

In Fig. 2 the device is shown packed ready for shipment. It measures 18 inches over all in length and 4 inches in diameter, and weighs 3½ lbs., so that it may be readily placed under the car seat or elsewhere out of the way. Forty-five feet of ⅜-inch rope go



FIGS. 1 AND 2.—TROLLEY "PICK-UP."

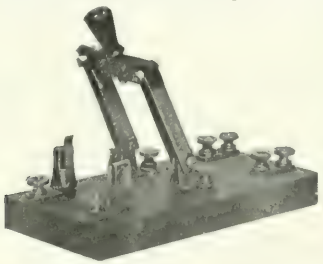
with each pick-up. This device was invented by Mr. Andrew Ambuhl, general manager of the Decatur Traction & Electric Company, Decatur, Ill., and is being manufactured by the Garton-Daniels Company, Keokuk, Iowa.

Improved Heavy Current Switches.

It has long been the practice in building circuit breakers of the automatic type to use special means for preventing the destruction of the working contacts by an auxiliary break. Such an arrangement, it is said, is really less needed on a switch which always opens quickly than on one operated by hand and liable to be opened or closed slowly.

In the new switch made by Johnson & Morton to meet these conditions the blade is made double of single pieces of pure copper, and the current-carrying contact is between the inside surfaces of the blade and a spring contact post fitting between them. The contact post also has an auxiliary contact touching on the outside of the blade, and forming the first and last point of contact when the switch is operated. By this means the arcing is all confined to a point used only for that purpose, and can in no way affect the working contacts of the switch, which by constant use are worn to a more perfect fit instead of being rapidly destroyed by the arc.

The construction of the switch is very simple. The electrical parts



HEAVY CURRENT SWITCH.

consist of three pieces in each pole, namely, a contact post, a hinged post and a blade, each one a single piece of pure hard-drawn copper. The blade is doubled on itself, and the yoke or handle bar is inlet into the front end, with a bolt attaching the two parts in the most secure manner possible. The blade straddles the contact and hinge posts, and the hinge bolt is threaded into one side of it with a jam nut to prevent any loosening or tightening from use. Both the hinge and contact posts are folded from sheet metal, and the form gives resilience at the contact surfaces with all the rigidity of a solid block. Both parts are fatsened with two screws.

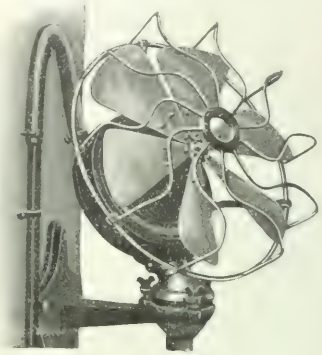
The firm anticipating the great demand for such a switch, have equipped their factory with full automatic machinery for the production of the switches and are putting them out at the price of the ordinary type.

Bracket Style of Water Fan Motor.

A ball-and-socket bracket type of water fan motor is shown herewith, the manufacture of A. Rosenberg Company, of Baltimore, Md.

This water fan is intended to be regarded as on a par with the very best makes of electric fans, and like the adjustable electric fans, can be turned and tilted in any direction while running. They are made in two sizes, 7-inch diameter and 9-inch diameter. The 7-inch type is made in two styles for fan service, as well as for driving light machinery, such as a sewing machine, ceiling fan, churn, scroll saw, etc.

The bracket style shown in the cut is supplied with 12-inch 6-blade



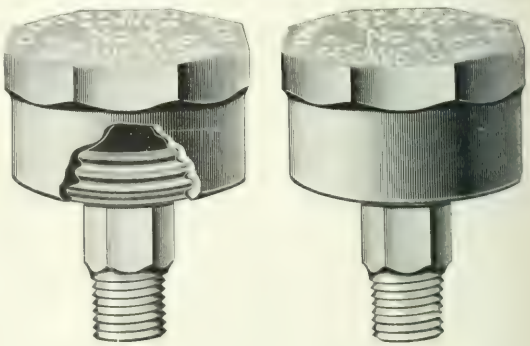
WATER FAN MOTOR.

brass fan and brass guard, and both styles will drive the fan 700 r. p. m. with a pressure at 15 lbs. in the pipes, up to 1700 r. p. m., where there is pressure of 60 lbs., the speeds varying with the pressures. No limit is placed upon the pressures which can be applied, and a great range of speeds can be had by simply turning the water cock.

These fan motors are handsomely enameled and decorated, consume very little water and are of the same power as the general type of electric 12-inch fan motors. Some of these 7-inch water motors have been in constant use for several years, running telephone exchange generators day and night.

Improved Oil Cup.

The oil cup shown herewith is being introduced by Messrs. Charles H. Besly & Co., No. 10 North Canal Street, Chicago, Ill., under the name of the Badger oil cup. The cup is to be used with Helmet oil, and is designed for general machinery having hard usage. It has an octagonal cap, which can be operated by hand or wrench. The base of the cup has a round thread with hexagon steel stem threaded, screwed into base and expanded. This steel stem



FIGS. 1 AND 2.—OIL CUP.

will not break off. The cup has a round thread both in the cap and on the base, as shown in sectional view. The thread will not strip, cross or clog.

This cup is made in six sizes, ranging from 1¼ inches, outside diameter, to 3⅝ inches, outside diameter, with pipe thread from ¼ inch to ½ inch.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on time loans was easier and offered in liberal amounts, the closing rates being 4@4½ per cent for all periods from 30 to 60 days. The stock market, though dull, showed a better tone, due partly to easier money and an expected good bank statement. There was little of importance done in connection with the industrials. Amalgamated Copper was steady, although a slight further reduction was announced in copper prices, and there was talk of the accumulation of the stock by inside interests. The United States Steel stocks were quiet and steady, and developed no new features. In the traction list Metropolitan advanced on the report of a new stock issue with "rights" by that company. There was considerable activity, the sales aggregating 219,075 shares, and the quotations ranging between 164 and 173. The closing price was 169⅝, a net gain of 5⅛ points. Brooklyn Rapid Transit was weak and inactive, closing at 65, a net loss of ¼ point. Manhattan Elevated closed at 135, a net loss of 1⅜ points on the week's trading. In the electric list General Electric was the only stock that showed a gain, the others being weak with downward tendencies. General Electric closed at 280, which was a net advance of 1 point, the sales being 1100 shares. Westinghouse Electric closed at 174, a net loss of 3 points; Western Union remains unchanged at 91 and Commercial Cable closed at 166, a gain of 6 points. Following are the closing quotations of Tuesday, Jan. 28:

NEW YORK.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
American Tel. & Cable..	90	—	General Electric	279½	279½
American Dist. Tel.....	38	—	General Carriage	1¾	1
Brooklyn Rapid Transit.	65½	66	Hudson River Tel	100	100
Ches. & Pot. Telephone.	-	-	Metropolitan Street Ry.	167⅝	171¼
Commercial Cable.....	161	—	N. E. Elec. Veh. Tran...	1⅝	1⅝
Electric Boat.....	26	25	N. Y. Elec. Veh. Tran...	11½	12⅛
Electric Boat pfd.....	48	47	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1⅛	2¼	Tel. & Tel. Co. America	—	—
Electric Vehicle.....	2	1¾	Western Union Tel.....	90¾	91¼
Electric Vehicle pfd....	4	4	West. E. & M. Co.....	174½	175½
			West. E. & M. Co., pfd...	172	—

BOSTON.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
Am. Tel. & Tel.....	158	158	Mexican Telephone	2	2
Cumberland Telephone..	-	-	New England Telephone.	130	—
Edison Elec. Illum.....	280		Westinghouse Elec.		87½
Erie Telephone.....	19½	20½	Westinghouse Elec. pfd..	—	—
General Electric pfd....	—	280			

PHILADELPHIA.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
American Railways.....	—	44½	Phila. Traction.....	97⅞	98¾
Electric Storage Battery.	60	56	Philadelphia Electric....	3⅜	3⅜
Elec. Storage Batt'y pfd.	60	56	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	5⅛	5⅞	Pa. Elec. Veh. pfd.....	—	2¼

CHICAGO.

	Jan. 21.	Jan. 28.		Jan. 21.	Jan. 28.
Central Union Telephone.	—	—	National Carbon pfd.....	83½	83
Chicago Edison.....	163	164	Northwest Elev. com....	38	35
Chicago City Ry.....	190	190	Union Traction.....	10	11¼
Chicago Telep. Co.....	—	185	Union Traction pfd....	47¼	47
National Carbon.....	18¼	18½			

DIVIDENDS.—The Boston Edison Electric Illuminating Co. has declared a regular quarterly dividend of 2½ per cent, payable Feb. 1. The Grand Rapids Railway directors have declared a regular quarterly dividend of 1¼ per cent on the preferred stock, payable Feb. 1. The directors of the Twin City Rapid Transit Company have declared the regular semi-annual dividend of 2 per cent on the common stock, payable Feb. 15. The directors of the Minneapolis General Electric Company have declared a dividend of $3 per share on the preferred stock, payable Feb. 1. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent on the assenting stock. The Allis-Chalmers directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock. The directors of the New England Telephone Company have declared the regular quarterly dividend of $1.50 per share, payable Feb. 15. The Bell Telephone Company, of Philadelphia, has declared a dividend of 2 per cent, payable Jan. 25. The directors of the American Light & Traction Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 15. The directors of the Minneapolis General Electric Company have declared a dividend of $3 per share on the preferred stock, payable Feb. 1.

A. D. T. ANNUAL MEETING.—At the annual meeting of the American District Telegraph Company last week the old officers of the company, Thomas T. Eckert, president; C. A. Tinker, vice-president, and C. S. Shivler, secretary and treasurer, were re-elected. There was no contest, differences between opposing interests in the company having been compromised before the meeting was held. C. A. Missing was elected a director, in the place of the late Marcellus Hartley, and W. H. Taylor, instead of E. Bartow Hepburn. This leaves the Western Union interests still in control. General Eckert's annual report to the company shows that the total income for the year was $630,701.68; the total expenses, $527,282.02, leaving a total net revenue of $103,419.66, which, with a cash surplus on Dec. 31, 1900, of $80,503.65, leaves a total surplus of $183,923.31. The company paid dividends during the year 1901 of $96,107.50, leaving a net surplus on Dec. 31, 1901, of $87,815.81. It is understood the proposition to reduce capitalization from $4,000,000 to $2,000,000 will not be carried. The Western Union Messenger Company, incorporated at Trenton, N. J., with a capital of $500,000, is not likely now to do business.

WESTERN TELEPHONE COMPANIES.—The Western Telephone & Telegraph Company, with an allowed capital of $32,000,000, and the Occidental Telephone & Telegraph Company, with a capital of $5,000,000, have been incorporated at Trenton, N. J. The first was incorporated by Chandler Hovey, George E. Perrin and Albert T. Walker, of Guttenberg, N. J., and Elmer H. Geran, of Matawan, N. J., and the Occidental Company by the same persons, together with Russell Robb, Horace Rogers and Henry R. Hazen, all of Boston. The capital of the Western company is to be divided into $16,000,000 of preferred stock, calling for 6 per cent non-cumulative dividend until February, 1904, and then become cumulative, and $16,000,000 of common stock. Both companies are chartered under the act of 1896, thus authorizing their operation outside of New Jersey.

BELL TELEPHONE BONDS.—Kidder, Peabody & Co., of Boston, and Vermilye & Co., of New York, are offering at 99 and accrued interest $10,000,000 of 4 per cent bonds of the American Telephone & Telegraph Company, part of an issue of $13,000,000, the other $3,000,000 having been sold already. The money is to pay for the Western Telephone & Telegraph Company—or Erie system—just acquired, and whose treasury has had $6,000,000 just paid into it for needed extensions and improvements. President Fish shows the net Bell telephone revenue for 1901 to have been about $8,000,000. The present $38,000,000 of bonds take $1,520,000, leaving $6,800,000 at present applicable on stock.

THE STAR TELEPHONE COMPANY has been incorporated at Albany, N. Y., with a capital stock of $1,000,000. The incorporators were Axel W. Hallenborg, Alfred B. Cruikshank, Erskine B. Essig, Sheron S. Atwater and Frederick Koch, of New York; Frank W. Goreth, of East Orange, N. J., and C. Edward Blackman, of Brooklyn. Mr. Hallenborg said that the company would not disclose its plans for some time yet. Its charter permits it to maintain telephone and telegraph lines from New York to Albany, Boston and intermediate cities; also upon Long Island and from Jersey City to Philadelphia.

NEW ENGLAND ELECTRIC VEHICLE.—The New England Electric Vehicle Transportation Company has disposed of all of its vehicles, and now has $145,000 cash on hand besides its real estate. It is anticipated that when the company disposes of its real estate assets (assessed for $204,000) it will be able to divide between $1 and $1.50 per share in liquidation among its stockholders. The first dividend in liquidation amounted to $2.50 per share on 225,000 shares. The company has succeeded in settling practically all the lawsuits against it, the remaining unsettled suits being fully covered by insurance.

FRENCH SECURITIES.—Some of the year's declines in French securities are thus summarized by the *London Economist's* Paris correspondent: Paris Omnibus shares fell from 1,402 francs per share to 703; Metropolitan Underground, from 600 to 567; East Parisian Tramways, from 410 to 115; Thomson-Houston, 1,265 to 703; Paris Gas Company, 1,350 to 825; Rio Tinto mining shares, 1,440 to 1,015; Cape Copper from 140 to 116.

THE SEATTLE ELECTRIC COMPANY will hold a special meeting at Seattle, Wash., Feb. 21, to increase the capital stock from $6,750,000 to $8,000,000, such increase to consist of $1,250,000 of preferred stock. The stock transfer books will be closed from Feb. 7 to Feb. 21, inclusive.

UTICA TROLLEYS.—At a meeting of the stockholders of the Utica & Mohawk Valley Electric Railroad, New York State, it was voted to increase the capital stock from $461,237 to $3,100,000, of which $600,000 is preferred stock.

PHILADELPHIA BELL TELEPHONE.—There has been listed on the Stock Exchange $999,350 additional stock of the Bell Telephone Company, of Philadelphia.

MONTREAL ELECTRICAL FINANCES.—At a meeting of the shareholders of the Montreal Light, Heat & Power Company on Jan. 14 the directors were authorized to issue bonds of the company to the extent of $7,500,000 for the purpose of reorganizing the bonded indebtedness of the various companies that have been amalgamated into the big electric concern. The issue will be distributed as follows: Bonds of the Chambly Company, $2,000,000; general purposes, $500,000; bonds of the Gas Company, $880,000; bonds of the Royal Electric Company, $525,000; to be borrowed from time to time as may be necessary for purposes of construction, etc., $3,595,000. The new sub-station of the company will be ready for operation in May next, and it is stated will be the finest and best equipped building of its kind on the continent. When all the alterations are completed, the company will have a total steam horse-power of about 6000, in addition to the 20,000 hp from Chambly. The Montreal Company has just sold $2,500,000 4½ per cent bonds to N. W. Harris & Co. This company has $17,000,000 capital stock outstanding. It controls the public lighting of the city of Montreal, both by gas and electricity, and furnishes gas and electricity for domestic and commercial use, for illuminating, heating and power. It also supplies the Montreal Street Railway with power. The Heat & Power Company owns a large water-power plant for the development of electricity at Chambly, on the Richelieu River, the outlet of Lake Champlain. The power generated at this plant is transmitted 18 miles to the city of Montreal. In the past Canadian financiers have placed their large loans in London, but under present financial conditions they are coming to the leading banking houses of the United States.

ALLIS-CHALMERS.—Judge Elbert H. Gary, chairman of the board of directors of the United States Steel Corporation, has been elected chairman of the board of directors of the Allis-Chalmers Company, capitalized at $25,000,000. Wm. Allis retires with Edwin Reynolds. William J. Chalmers, of Chicago, is chairman of the executive committee of the company. It is not known whether ex-Judge Gary's accession to the corporation will relieve Mr. Chalmers of some of his duties, but it is supposed the new chairman's work will be largely on the financial side, leaving the operating of the factories in the hands of Mr. Chalmers. Mr. Gary has been a leading official of the gradually expanding Steel Corporation since it began to take form. He was one of the organizers of the American Steel & Wire Company. Later he became president of the $200,000,000 Federal Steel Company, and last year he was chosen chairman of the board of the United States Steel Corporation.

ANGLO-AMERICAN CABLE.—A holder of Anglo-Cable stock says: "If Marconi's wireless telegraphy were to render the Anglo-American cables absolutely valueless, thus making it necessary to wind up the company, according to the last balance sheet, there would be nearly £1,000,000 surplus (mainly derived from the splendid reserve fund, which is invested in gilt-edged securities outside the business) in which the deferred shareholders would participate equally with the preferred. This would make the value of the deferred nearly 14, which are now quoted at little more than 8. If such would be the position in the event of winding up, how much should the stock be worth in a going concern?"

SECURITY CONDUIT.—The New York Sheriff has received an attachment and two executions, aggregating $1,491, against the Security Conduit Company, of 585 Washington Street. The attachment is in favor of Francis B. Boynton, for $700, for money loaned to the company, and the executions are in favor of John Hankin, $435 on a note, and Woodbury G. Langdon, $356 for money loaned. The company was incorporated March 4, 1901, under New Jersey laws, with a capital stock of $250,000. Charles A. Boynton was president and Robert H. McCutcheon treasurer.

TERMINUS FOR TROLLEY TUNNEL.—It is the general impression among New York real estate men that the block bounded by Fourteenth, Provost, Thirteenth and Henderson streets, Jersey City, which has been sold to Rollin C. Newton, will be used as a terminal station for the proposed trolley tunnel under the Hudson River to Morton Street, New York. Surveys of the block have recently been made by civil engineers said to have been employed by the Metropolitan Street Railway Company, of New York. The price paid for the property was $60,000.

NEW YORK TRANSPORTATION.—It is stated that the Electric Vehicle Company last week paid an assessment of over $500,000 on its holdings of New York Transportation stock. This was the only outstanding block of New York Transportation on which the recent assessment of $10 a share remained unpaid.

SYRACUSE, N. Y., BONDS.—Redmond, Kerr & Co., of New York are offering $2,000,000 first mortgage 5 per cent gold bonds of the Syracuse Lighting Company at 102½ and accrued interest. The company has $1,000,000 of 5 per cent preferred stock, and $3,000,000 of common stock.

DEVELOPMENT IN PORTO RICO.—Stone & Webster, Lee, Higginson & Co. and De Ford & Co., of Boston, have organized the Ponce Electric Company to do a street railway, lighting and power business in Porto Rico, with a capital of $415,000.

AMERICAN CRANE & CONVEYING COMPANY is the name of a new proposed consolidation which will, if it goes through, include concerns now building electric cranes.

Commercial Intelligence.

THE WEEK IN TRADE.—The general trade conditions remained favorable, the most notable of these being the steadiness of general prices. Iron and steel continue strong, though on the surface there is apparently a quieter demand, and the improvement in the car shortage situation makes a larger production. There is more doing than usual at this time, and the mills have never had so many advance orders booked. The demand for structural material all over the country continues exceedingly heavy. The bids on the New York Rapid Transit power house were opened on Jan. 23, and will receive immediate consideration. In other metals irregularity is still a feature, weakness being manifested in copper, which failed to develop consumptive demand, although quotations for it have again declined and sheet copper has likewise been reduced. The price quoted on the New York Metal Exchange at the close of the week is 11 cents flat. Electrolytic is quoted at 10⅞ cents, and casting stock at 10¾. Railway earnings continue in a very satisfactory condition. For the first half of January, 51 roads reported an increase of 10.8 per cent in gross earnings over the figures for the same period last year. Eight of the 51 roads show losses from last year. The business failures for the week, as reported by *Bradstreet's*, numbered 292 against 291 the week previous, and 281 the same week last year.

REPRESENTATION OF FOREIGN INTERESTS.—The Goudey-McLean Company, of 88 Maiden Lane, New York City, recently established with a view to acting as managers for foreign sales of a syndicate of manufacturers of electrical apparatus and fittings, in addition to the agreement with various electrical concerns to whom reference was lately made in these columns, has entered into arrangements with the New York Safety Insulated Wire Company for the purpose of the exclusive handling of that company's export business in all foreign countries other than Mexico. A contract has also been made with the Garton-Daniels Company, of Koekuk, Iowa, for the representation of that concern's interests abroad. Mr. Edward E. Goudey, who was formerly manager of the foreign department of the Wagner Electric Manufacturing Company, of St. Louis, Mo., is secretary of the Goudey-McLean Company. He is now in Europe for the purpose of appointing agents in the principal electrical centers in Great Britain and on the Continent, and will remain on the other side, according to present arrangements, until May. Offices have already been opened in London and Glasgow, and negotiations are about completed for the establishment of a Paris agency. The London business of the company will be under the management of Mr. A. Woodley, lately connected in an executive capacity with the Edison-Swan Company. Offices have been taken at 90 Cannon Street, E. C. The Glasgow office is under the supervision of Mr. James Barclay. The company proposes to make a specialty of furnishing complete plants. An 18-hp lighting outfit has recently been ordered for shipment to a coffee plantation located in the vicinity of Port Limon, Costa Rica. The dynamo was manufactured by the Milwaukee Electric Company. Several direct-current Milwaukee motors have also been ordered for Cuba. A complete telephone exchange has just been shiped to Berlin, and several lightning arresters, made by the Garton-Daniels Company, have gone forward for Belgian parties. Inquiries now on hand include a complete telephone equipment for 600 subscribers, for Japan, and a 4000-hp vertical triple-expansion condensing engine intended for lighting purposes in Glasgow

INDUCTION MOTORS FOR COMSTOCK MINES.—A contract has been closed by Leon M. Hall, consulting electrical engineer for the Comstock Pumping Association, for three 225-hp Westinghouse three-phase induction motors, which will be used to operate the new pumps for draining the C & C shaft. These pumps will be operated by current from the Truckee River General Electric Company's transmission plant at 2300 volts. The motors will make 495 r. p. m. The drainage water will be pumped from the 2100-ft. level to the Sutro Tunnel, 450 ft. above. The estimated capacity is 6,500,000 gallons per day. The hydraulic elevator now in use requires 850 hp to keep the water down to its present level. One hundred thousand dollars' worth of Westinghouse and General Electric motors are operated in the Comstock Mines.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Jan. 22: Amsterdam—3 pkgs. machinery, $60. Argentine Republic—82 pkgs. material, $5,336. Auxerre—6 pkgs. machinery, $165. Brazil—162 pkgs. material, $5,473; 4 pkgs. machinery, $332. Berlin—4 pkgs. material, $175. Balboa—2 pkgs. material, $175. British Possessions in Africa—382 pkgs. material, $31,637; 47 pkgs. machinery, $2,645. British West Indies—47 pkgs. material, $1,087; 3 pkgs. machinery, $101. British Guiana—25 pkgs. material, $2,350. British East Indies—19 pkgs. machinery, $442; 18 pkgs. wire rope, $1,350; 1 pkg. material, $81. Bordeaux—1 pkg. material, $29. Bristol—19 pkgs. machinery, $2,905. British Australia—84 pkgs. machinery, $7,779. Cuba—95 pkgs. material, $5,097; 105 pkgs. material, $2,917; 3 pkgs. manufactures of copper, $97; 9 pkgs. machinery, $1,600. Central America—47 pkgs. machinery, $584. Dutch East Indies—1 pkg. material, $16. Dublin—6 pkgs. material, $400. Ecuador—8 pkgs. material, $153. Fieume—67,500 lbs. copper, $8,184. French West Indies—1 pkg. material, $45. Genoa—675 pkgs. manufactures of copper, $200. Glasgow—7 pkgs. material, $701; 9 pkgs. machinery, $697; 37 pkgs. electric cables, $14,027. Havre—10 pkgs. material, $538. Hamburg—4 pkgs. machinery, $85; 61 pkgs. material, $2,664. Huddersfield—9 pkgs. material, $250. Hayti—7 pkgs. material, $117. Leeds—6 pkgs. machinery, $500; 8 pkgs. material, $446. Liverpool—473 pkgs. copper material, $26,000; 116 pkgs. wire, $1,844. London—242 pkgs. machinery, $16,132; 120 pkgs. material, $6,394; 92,500 lbs. copper, $14,288; 11 pkgs. electric cables, $2,469; 4 pkgs. manufactures of copper, $280; 24 pkgs. wire, $288. Mexico—4 pkgs. machinery, $154. Manchester—155 pkgs. machinery, $45,124; 10 pkgs. material, $250; 3 pkgs. material, $65. Marseilles—3 pkgs. material, $182. New Foundland—1 pkg. material, $30. Newcastle—12 pkgs. machinery, $1,364. Portugal Possessions in Africa—2 pkgs. material, $21. Peru—116 pkgs. copper wire, $2,050; 11 pkgs. material, $341. Reval—10 pkgs. machinery, $1,628; 336,557 lbs. copper, $42,699. Rotterdam—1,188,985 lbs. copper, $141,640; 3 pkgs. material, $60. Southampton—9 pkgs. material, $269; 15 pkgs. machinery, $723; 3 pkgs. wire, $266. Stockholm—67,234 lbs. copper, $8,746. San Domingo—13 pkgs. machinery, $217; 2 pkgs. manufactures of copper, $63; 5 pkgs. copper wire, $140. U. S. Colombia—2 pkgs. manufactures of copper, $30. Venezuela—166 pkgs. material, $579; 428 lbs. copper, $17. Walsall—4 pkgs. material, $180.

LARGE POWER PLANT FOR ST. LOUIS.—The contract for the foundation of the largest electric plant west of New York was let Jan. 25 by the Citizens' Electric Light & Power Company, of St. Louis, to the Hill-O'Meara Construction Company, of that city, for $300,000 for the foundation alone. The entire plant will cost $2,000,000. The plant will be erected at the foot of Biddle Street. It will extend well into the river in order that the company may get its water supply without using the city mains. The building will have a water front of 500 ft., and will extend back 200 ft. from the river. The contracts call for the completion of the foundations within 120 days. The main river wall of the foundation is to be 11 ft. thick and 60 ft. high, constructed of steel buttresses 6 ft. apart, and incased in concrete, the base having buffers of oak to protect the coal boats which will be moored alongside. Above this foundation the building will rise 60 ft. Charles H. Ledlie, the engineer who has drawn the plans for the plant, has already contracted for the 26 boilers, which will be used, and the four engines, three of 700 hp each and two of 2500 hp each. According to his plans all the transportation of materials for the building and for its future maintenance will be by water to save expense. The coal will be dumped in gravity bins and fed automatically. The average production of the plant will be 20,000 hp.

ROWLAND TELEGRAPH FOR ITALY.—The multiplex printing telegraph system invented by the late Professor Rowland, of Johns Hopkins University, will be installed in Italy. The Rowland Telegraphic Company, of Baltimore, has been awarded a contract by the Italian Government to equip a line between Rome and Naples, and if it is satisfactory other Italian lines of telegraph are to be supplied with this system. Considerable interest has been manifested by European governments in this system. The company is manufacturing machines for the use of the German Government between Berlin and Hamburg and Berlin and Frankfort. Louis De Goll, president of the company, has been in Europe for some time in connection with the installation of the system. It will be recalled that eight messages can be sent at one time over one wire, four going in one direction and four in the other. Typewritten copies of these messages are made at both the points of sending and receiving by the action of the machine. One operator can also send the same message over four different wires to four different cities. This arrangement can be quadruplexed, so that 16 cities or points of delivery can be reached. The system was shown in operation at the Paris Exposition of 1900.

WESTINGHOUSE CHANGES.—The retirement of B. H. Warren from the second vice-presidency of the Westinghouse Electric & Mfg. Co. has brought about the following changes in the organization of that concern: Mr. Frank H. Taylor, until recently fourth vice-president, has been advanced to the position of second vice-president, and as such will be in charge of the sales of the company and have a general supervision over its affairs. Mr. L. A. Osborne, manager of works, has been made fourth vice-president, in which capacity he will have charge of the engineering and producing operations of the company. Mr. Arthur Hartwell has been advanced to the position of sales manager in charge of the sales organization. Mr. Hartwell has until recently occupied the position of manager of the Chicago office of the company. Mr. Philip A. Lange, until recently general superintendent, has been made manager of works, in which position he will have charge of the manufacturing department of the company. The organization in other respects remains as heretofore. Mr. George Westinghouse, president; Mr. Ph. Ferd. Kobbe, third vice-president and treasurer, in charge of financial department; Messrs. G. W. Hebard and W. M. McFarland, acting vice-presidents; Mr. T. W. Siemon, assistant treasurer; Mr. A. M. Mattice, chief engineer; Mr. Charles F. Scott, chief electrician; Mr. B. G. Lamme, assistant chief engineer; Mr. James C. Bennett, auditor.

THE STEAM LOOP ABROAD.—The Steam Loop and Holly gravity return system are receiving flattering recognition, particularly at the hands of English engineers, and as a result Westinghouse, Church, Kerr & Co. have received several excellent contracts lately for equipments of this kind. One of the latest is from a large manufacturing concern which is one of the most important establishments in the British Isles. It is claimed that this plant will have the finest equipment for manufacturing in Great Britain, and that every department will represent the highest development of modern engineering. Consequentiy, the decision to introduce the steam loop and Holly gravity return system is very gratifying to Westinghouse, Church, Kerr & Co. Another contract reported by the export department of the company is for an equipment for La Gran Fundicion Central Mexicana, Aguas Calientes, Mex., placed by the American Smelting & Refining Company. The system has also been adopted for the Albany (N. Y.) Felt Company, the Waterloo (Iowa) Gas & Electric Company, and Everett (Wash.) Railway & Electric Company.

GERMAN EQUIPMENT FOR JAPANESE COLLIERIES.—The contract for the electrical equipment, which is intended to be installed in the collieries operated by the Hokkardo-Tanko Railway, Japan, has been awarded to the Siemens-Halske Company, of Berlin, the German firm's prices being 13 per cent lower than the best bids secured from American sources. The principal items in the contract, which is valued at nearly $70,000, are two 300-kw generators and the same number of direct-connected engines of 350 hp capacity each. The contract for the boilers has been placed with an American firm—the Heine Safety Boiler Company, of St. Louis, Mo., whose New York offices are in the Bowling Green Building. There will be four boilers, capable of developing 200 hp each.

FOREIGN CONTRACTS.—The municipality of Ghent, Belgium, is inviting tenders for a concession of 31 years with a monopoly during the first 15 years, for the erection and maintenance of an electricity supply station and service. Further particulars may be obtained by addressing L'Ingenieur de la Ville, 3 rue Royale, Ghent, Belgium. The Town Council of Johannesberg, South Africa, is inviting tenders for the supply of a three-phase alternator of 250-kw capacity. The contract closes Feb. 28, and tenders should be addressed to Lionel Curtis, acting town clerk. The municipality of Rockhampton, Queensland, is inviting bids for the construction of a complete electric railway system. The contract closes March 31. Particulars may be obtained of H. E. Bellamy, city engineer.

RATING OF RUSSIAN FIRMS.—Under date of Dec. 20, 1901, Consul-General Holloway, of St. Petersburg, says: One of the greatest hindrances to American business in Russia has been the difficulty in ascertaining the financial standing of firms soliciting credit, as commercial or inquiry agencies are unknown in this country. The usual way of prosecuting such inquiries is through special attorneys, who investigate and report on each case separately, charging according to the time occupied, viz., from 10 to 100 rubles ($5.15 to $51.50). I am now advised that The Bradstreet Company, through its New York or Berlin agencies, is prepared to report on the financial standing of Russian business men, corporations and firms.

SYDNEY POWER HOUSE CONTRACT.—The American Bridge Company, of New York, has been awarded the contract for the furnishing of the structural steel to be utilized in the extension which is about to be made to the central generating station of the Sydney City & Suburban Tramways, New South Wales, the same company having secured the contract for the original station, which is built with some 1200 tons of steel ,and is the first metal construction building in Australia. The present contract calls for 700 tons of material. Delivery is to be made inside of four months.

WESTERN ELECTRIC-BALL PLANT.—The M. A. Meyer estate, Chicago, are installing an electric plant in their building at southwest corner of Van Bureau and Franklin streets. The Ball Engine Company, Erie, Pa., furnish the engine, which is direct connected to a 100-kw Western Electric generator.

WESTINGHOUSE ENGINES FOR SWEDEN.—Graham Brothers, of Stockholm, which concern represents the Swedish interests of a number of American manufacturers, and is the largest handler of American electrical equipment in that part of the world, has placed a contract with Westinghouse, Church, Kerr & Co., calling for the supply of two vertical cross-compound engines of 250 hp capacity each. These machines will be direct connected to generators of German manufacture. The equipment will be installed in a new electric light and power plant, now under construction in the Swedish capital. Some of the other recent contracts secured by Westinghouse, Church, Kerr & Co. comprise two 330-hp vertical cross-compound engines, also one 150-hp engine for installation in the new Omaha shops of the Union Pacific Railway Company. These engines will be direct connected to Westinghouse generators. Several motors have also been ordered from the Westinghouse people for the same shops. The equipment is intended to be used for both light and power purposes. The Boston & Albany Railroad is to be furnished with a 330-hp vertical cross compound engine to be direct connected to a Westinghouse generator. This outfit will be for lighting use. Two vertical cross-compound engines of 200-hp capacity and also a 150-hp engine, both to be direct connected to Westinghouse generators, are to be furnished for light and power purposes to the Pittsburg Bank of Savings Building. The Minneapolis Chamber of Commerce Building is to be installed with two 150-hp vertical cross-compound engines, also a 100-hp machine direct connected to Westinghouse generators for both light and power, and the Orr Cotton Mills, of Anderson, N. C., have ordered a 21½ by 37 by 22 steeple compound engine. This machine will be capable of developing over 1200 hp.

ELECTRICAL EQUIPMENT FOR BOMBAY HOTEL.—The big hotel which is now under construction at Bombay, India, by Mr. J. N. Tata, a wealthy Parsee merchant and principal partner of Tata & Co., of 27 William Street, New York, is to be equipped with electrical machinery, etc., which it is estimated will entail an expenditure of nearly $100,000. The hotel, it is said, will cost $600,000 without furnishings, and will be the largest and most modern establishment of its description in the Far East. It will be five stories in height. There will be 400 rooms. An interesting feature will be that 20 suites of rooms fronting the sea are to be cooled by artificial refrigeration, the machinery for the supply of which will be operated by electricity. It is said that this will be the first instance of an hotel adopting this plan to make its rooms comfortable in hot weather. The specifications call for four engines, to run at 460 r. p. m., of 75 hp each, at 140 lbs. pressure, and four dynamos, to be wound for 110 volts and 365 amperes, at 460 revolutions. There will be three electric elevators. The refrigerator motors are to be shunt wound, two in number. They are required to work at a potential of 100 volts, and to develop each 40 hp. There are to be about 1200 lights of various sizes. American concerns are expected to furnish the electric light plant, the refrigerating machinery, the insulated wires, etc., elevators and telephones.

TELEPHONE CONTRACTS.—During the past two months the Haines & Noyes Company, Chicago, U. S. A., have closed the following large contracts for telephone apparatus: The Manistee Iron Works, Manistee, Mich.; Story & Clark Piano Company, Grand Haven, Mich.; David C. Cook Publishing Company, Elgin, Ill.; Rush Medical College, Chicago; Evanston Hospital, Evanston, Ill.; St Anne's Hospital, Chicago; Chas. F. Elmes Engineering Works, Chicago; Armour & Co., Chicago; Chicago & Eastern Illinois Railroad, Chicago; Ingersoll-Sargeant Drill Company, Chicago; Otis Apartment Building, Chicago; Hamilton Apartment Building, Chicago. They have also equipped the following electric railways with telephone apparatus: Tampa Electric Street Railway Company, Tampa, Fla.; Houghton County Street Railway Company, Hancock, Mich.; Blue Hill Street Railway Company, Milton, Mass.; Ponce Railway & Light Company, Porto Rico.

AN EXPORT CLUB FOR NEW YORK.—A movement is at present on foot for the purpose of establishing an export club in New York, and negotiations are being conducted with a view to the acquiring of spacious premises downtown, which will serve as a central point of reunion, where the individual buyers of the New York export and commission houses can meet socially the representatives of manufacturing concerns. It is proposed to adopt the most complete up-to-date system of cabinet filing of catalogues, price lists and discounts which it is suggested will make it preferable for the buyers to come to the rooms of the club for information and reference. The temporary offices of the club are located in the Coffee Exchange Building, 66 Beaver Street.

LARGE WATER POWER PROJECT FOR BOMBAY.—Mr. J. N. Tata, of Bombay, the head of the Indian house of Tata & Co., whose New York offices are located in the Lord's Court Building, 27 William Street, is reported to be primarily interested in a project for the erection of an extensive water power plant to be situated at Neral, about 40 miles distant from Bombay. It is proposed to generate electricity for the purpose of supplying general power to various manufacturing establishments in Bombay, and to furnish current for the operation of the electric traction system, which is about to supplant the existing horse tramways in that Indian city.

TELEPHONES FOR HONOLULU.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., report that they have recently shipped to their agent, Mr. Guy Owens, of Honolulu, Sandwich Islands, a 24-point switchboard complete for the new Hackfield & Co. office building there; two 6-point plants complete for the office and shops of the Honolulu Iron Works; one 4-point board complete for the Oahu Railway & Land Company, and one 24-point board for plantation work. Among domestic orders they note shipment of a 12-point system to the Newcastle (Pa.) Steel Works.

LORAIN RAILS FOR NEW ZEALAND.—The Lorain Steel Company, of Lorain, Ohio, will make shipment, per Norton & Son's steamship "Oakley," of 1200 tons of steel rails, together with 50 tons of special work, intended to be used in the construction of the Auckland Electric Tramways Company, Limited, of Auckland, New Zealand. This system is controlled by the British Electric Traction Company, Limited, of London. The contract for the building of the road has been undertaken by the electrical engineering and contracting firm of J. G. White & Co.

VAN RENSSELAER LANSINGH & CO., of Chicago, agents for holophane glass and pagoda reflectors, have recently moved from a suite of offices in the Fisher Building to a store at 18 East Adams Street, where there is a better opportunity to make a public display of these goods. A contract has been closed for putting holophane globes on the lamps in the corridors of the Old Colony Building, securing better illumination while reducing the number of 16-cp lamps in each corridor from 10 to 5, thereby effecting a calculated saving of $300 per year.

NEW YORK CITY.—The New York Telephone Company has established a central office at Briarcliff Manor, the country place of Mr. W. W. Law, of New York City. One hundred and twenty long-distance telephones have been installed, connecting the barns, dairy houses, residences and a summer hotel. This is probably the only community in the world where the number of telephones is greater than the population.

W. H. SCHOTT, formerly manager of various electric lighting interests in Chicago, is now conducting a prosperous engineering and contracting business with office at 1220 Marquette Building, Chicago. Mr. Schott has recently put in steam heating plants at Bedford, Ind.; Bloomington, Ind., and Coshocton, Ohio; gas plants at Franklin, Ind., and Bedford, Ind., and the mechanical and heating equipments of the Century Building, Indianapolis, and the Illinois Asylum for the Insane at Peoria, Ill.

EQUIPMENT FOR ENGLISH LIGHT RAILWAY.—To the Cheltenham & District Light Railway Company, England, the contract for the construction of whose road Thos. Nevins & Son, of East Orange, N. J., are primarily interested in, is being shipped considerable Westinghouse equipment. The order for the cars was secured by the John Stephenson Car Company, of Elizabeth, N. J.

VICTOR TURBINES FOR BRAZIL.—W. H. Crossman & Co., of 77 Broad Street, New York City, have placed an order with the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, through the New York office, for two Victor turbine waterwheels capable of developing 500 hp. The outfit is intended to be installed in Santos, Brazil.

STANDARD TRACTION BRAKE COMPANY report an order from the Amsterdam (N. Y.) Street Railway Co. for the equipment of all their cars with magnetic brakes. The city is very hilly, accidents have happened with runaway cars, and tests have shown that the magnetic brake is just what is required to ensure safety.

DRY BATTERIES FOR LONDON.—The Chloride of Silver Dry Cell Battery Company, of Brooklyn, is shipping its specialties to John L. Sardy, of Saracen Chambers, Snow Hill, London, E. C., who is one of the half-dozen more prominent handlers of American apparatus and machinery, etc., in Great Britain.

THE GENERAL ELECTRIC COMPANY has just received the award of a large power plant contract for the fine new Readville, Mass., shops of the New York, New Haven & Hartford Railroad, not far from Boston. This plant will include a lot of motors and be one of the very best of its kind.

WESTINGHOUSE-PARSONS TURBO-GENERATORS.—The B. F. Goodrich Company, of Akron, Ohio, has requisitioned for the supply of two Westinghouse-Parsons turbo-generators of 750 and 400 kw, respectively. These machines are intended to be utilized for general power purposes.

BRILL CARS FOR WESTERN AUSTRALIA.—The J. G. Brill Company, of Philadelphia, Pa., will next week forward 25 trolley cars they have built to Freemantle, Western Australia, for use on the Kalgoorlie Electric Tramways Company, Limited—an English concern.

Special Correspondence.

ENGLISH NOTES.

London Office, Electrical World and Engineer, Jan. 25, 1902.

MERSEY RAILWAY COMPANY.—The Mersey Railway Company, whose system is being converted from steam to electricity by the British Westinghouse Company, has ordered from George F. Milner & Company, of Hadley, fifty-seven cars of a new and interesting type suitable for its underground work. The same firm are making 125 cars for the Hampton Court section of the London United Tramways Company, and a large number of cars for various corporations. The British Westinghouse Company has been awarded the contract for electric cars required by the Lancaster Town Council in connection with the local tramways. The value of the contracts is £30,000.

INCANDESCENT LAMPS.—The Edison & Swan United Electric Light Company, Limited, have received the honor of appointment by royal warrant as purveyors of electric lamps to his Majesty the King.

PARIS UNDERGROUND.—The new proposed underground line in Paris has now been settled upon, and the Paris Municipal Council has formally adopted in its main lines the committee's recommendation to grant a concession for a new "tube" railway running between Montmartre at the north end of the city, and Montparnasse at the south end. The company offers to pay to the municipality a tax or due of 1 centime per passenger carried over its line up to 30,000,000 passengers, and 2 centimes per passenger for any number over 30,000,000. This is for second-class passengers; for first-class passengers the due will be 2½ centimes. The concesssionaire company is also to provide not less than $100,000, nor more than $400,000, toward the completion of the new Boulevard Raspail. The new line is to be sunk at a much greater depth than the Metropolitan electric lines now in course of construction or already running; the tunneling will be at a depth from 24 feet to 115 feet beneath the street surface. Contrary to what has happened in the case of the Metropolitan line, the new company is to carry out the entire work at its own expense, and is to undertake to link up with existing lines at certain points. The work is to be carried out without any necessity arising to take up the roadway. The concessionaires are Messrs. Berlier and Janicot, engineers and contractors. The Omnium Lyonnais, one of the most important electric traction concerns in France, is financing the scheme.

LARGE ENGINES.—The engines which the Wallsend Slipway & Engineering Company, of Wallsend-on-Tyne, is to construct for the Manchester corporation promise to be the largest yet made for the purpose in Great Britain, the total power for each of the two being over 6000 horse-power. It is interesting to note that this is the fourth large electric engine contract which Mr. Andrew Laing has carried out at the Wallsend works. The Manchester engines are to be of the triple-expansion type, but with four cylinders and four cranks.

PROMOTING ELECTRICAL INDUSTRY.—Lord Avebury presided over a special meeting of the London Chamber of Commerce, when an address was delivered by Mr. R. P. Sellon, chairman of the electrical trade section of the chamber. Mr. Sellon urged that the backwardness of England in the practical application of electrical science was due to restrictive legislation, which had no counterpart in those countries, such as the United States, Germany, and Switzerland, which had taken full advantage of the possibilities of electrical science. The Electric Lighting Act of 1882 proved practically fatal to the introduction of electricity supply. Nothing was done by municipal authorities, and it was found impossible to raise private capital in the face of a purchase clause which empowered the surrender of the undertaking in 21 years for a sum representing only the value of the plant and buildings. The amending Act of 1888 extended the tenure to 42 years, but the power of veto possessed by the local authorities still interposed an obstacle to the free expansion of electricity supply. Why were there 15,000 miles of electric tramways in the United States against less than 500 in Great Britain? This anomaly was traceable to the Tramways Act, 1870, which contemplated horse tramways exclusively, but by it electric traction found itself governed for nearly two decades. Less than 50 miles of electric traction were constructed in Great Britain until the Light Railways Act, 1896. The effect of the Tramways and Electric Lighting Acts upon the manufacturing industry might be judged from the fact that the capital employed in electrical plant production in Great Britain was less than one-fifth of that in Germany and one-tenth of that in the United States, while the system of heterogeneous specifications under which local authorities had purchased their installations had made standardization and specialization practically impossible. Amendment of existing legislation was indispensable. If afforded a fair field, the development of electricity supply and traction within the next ten years might be expected to engage, at a modest computation, £250,000,000 of capital. He urged that a standing committee, or some other body representative of the electrical industry, should be created, with which Government and State departments should confer when framing or amending legislation or regulations affecting the industry.

General News.

THE TELEPHONE.

ABBEVILLE, LA.—The long-distance telephone lines have been completed to this city, and connections made by the Cumberland Telephone & Telegraph Company. Alexandria is in telephonic communication with New Orleans and all places south of here.

DETROIT, MICH.—The Co-operative Telephone Company has been organized here with a capital of $200,000, and it has asked the People's Telephone Company for a price on its plant. The company will equip a plant in opposition to the Bell company and intends eventually to dispose of its plant to the city. The officers are F. F. Ingram, president; Hamilton Carhart, vice-president; Wilbur Brotherton, secretary; C. M. Burton, treasurer.

PORT HURON, MICH.—The outfit of the Harrison Telephone Company, which had been taken down by the city after being condemned as being in an unsafe condition, was sold at auction and all but the junk was purchased by the Citizens' Electric Light Company, the projected rival concern to the old light company.

RED WING, MINN.—E. E. Peck is figuring on establishing an independent telephone plant here and says that if a subscription of $5,000 is made to a capital of $18,000 he will install a modern system with conduits in the business section.

MOUNTAIN LAKE, MINN.—The Mountain Lake Telephone Company has recently built a 17-mile toll line to Comfrey and Darfur and contemplates building one or two small town plants in the spring. The present switchboard has a 50-drop capacity, the apparatus being that of the Stromberg-Carlson and Standard companies. The company now has 66 subscribers.

ST. LOUIS, MO.—Manager Henry Weaver, of the Planter's Hotel, has let a contract for a complete telephone system in that hostelry. Each of the 360 rooms will be supplied with the latest style instruments, and a switchboard will be placed in the office and two operators will be stationed there throughout the day. Besides securing connection all over the hotel, any telephone in and out of the city may be reached.

RALEIGH, N. C.—The Bell Telephone Company has completed long-distance connections between Raleigh and all outside points.

REIDSVILLE, N. C.—The Reidsville Telephone Company has been incorporated with $6,500 capital. The incorporators are R. J. Oliver, C. N. Evans and others.

TARBORO, N. C.—Mr. Geo. Hoderness, of Tarboro, president of the Carolina Telephone & Telegraph Company, states that his company has bought the exchanges at Smithfield, N. C., together with the toll lines. He also states that a copper wire will be built from Raleigh to Selma.

WILLIAMSTON, N. C.—The Williamston Telephone Company contemplates extending its lines to Jamesville and Hamilton, N. C. Its present switchboard capacity is 100 drops, the apparatus used being that of the Phœnix Electric Telephone Company. The Williamston company now has 70 subscribers.

CALLAWAY, NEB.—A plan for the construction of a telephone line from this place to various points in the country and to Oconto Lodi, Triumph and Arnold is now under consideration.

BENEDICT, NEB.—A telephone company has been organized in Benedict with a capital stock of $10,000. Mr. E. E. Watts is president. It is the intention to run a line to York, Stromsburg, Thayer and Gresham, besides connecting all the farmers on the way.

PHILLIPSBURG, N. J.—The Warren Telephone Company, of Phillipsburg, N. J., has been incorporated, with a capital of $100,000. The incorporators are M. T. Lynch, John H. McGrath and Howard Mutchler.

GREENVILLE, OHIO.—The Greenville Home Telephone Company, has increased its capital stock from $50,000 to $100,000.

CANTON, OHIO.—The Canton exchange of the Stark County Telephone Company is now in operation, with 600 telephones.

MARION, OHIO.—The Marion County Telephone Company has secured quarters for its exchange, and apparatus will be installed as soon as possible.

SHELBYVILLE, OHIO.—Farmers in this community are organizing a company to build a farmers' line in connection with the Mutual Telephone Company of this place.

NEW BALTIMORE, OHIO.—The New Baltimore & Venice Telephone Company has been incorporated with $50,000 capital stock to build exchanges in the towns mentioned.

BOWLING GREEN, OHIO.—The Central Union Telephone Company is making extensive improvements to its service. A new switchboard, cables and instruments will be installed.

MIFFLIN, OHIO.—The M. & W. Telephone Company has elected the following-named officers: Dr. J. H. Hutchinson, president; J. H. Stillwagon, secretary, and B. J. Aby, treasurer.

FINDLAY, OHIO.—On complaint of a citizen an injunction has been allowed restraining the Home Telephone Company from charging in excess of $12 per annum for its residence service.

POMEROY, OHIO.—The Pomeroy Home Telephone Company is extending its lines to Coolville, Olive, Chester and Orange townships. Direct connection will be made to Athens and Parkersburg.

NAPOLEON, OHIO.—The Citizens' Mutual Telephone Company is preparing to build an independent system in this place. The Bell company has also applied for a franchise in the town.

BROADWAY, OHIO.—Fire a few evenings ago destroyed the telephone exchange and its equipment, entailing a loss of about $5,000, the insurance being half that amount. The town is cut off from telephonic communication.

MECHANICSBURG, OHIO.—The suit brought by C. H. Marvin to secure a receivership for the Mechanicsburg Telephone Company has been settled out of court. C. H. Marvin retires from the company and affairs will be conducted as heretofore.

COLLEGE CORNER, OHIO.—Messrs. T. B. Barkley, C. E. Ardery, James Ardery, J. C. Barkley, James James, Dr. B. F. Forry, John Brier, Chas. Stout, Jacob O. Urban and W. E. Blake will incorporate the College Corner & Southern Telephone Company.

BEAVER, OHIO.—W. H. Ruhlman, of North Lima, Ohio, has succeeded in organizing a local telephone company in Beaver. Two hundred subscribers have been obtained. The new company will be given long-distance service over the independent lines.

PAINESVILLE, OHIO.—The Painesville Telephone Company held its sixth annual meeting a few days ago, re-electing the old officers. The company is erecting a new exchange building and is planning some extensive improvements to switchboards and lines.

HAMILTON, OHIO.—The City & Suburban Telegraph Association has been operating in this city for over twenty years on a franchise granted to an individual. Such franchises have recently been held invalid and the company has just secured a substitute franchise from the city.

LIMA, OHIO.—The Lima Telephone & Telegraph Company held its annual meeting recently, electing the following directors: D. J. Cable, C. H. Cory, W. H. Duffield, J. R. Sinclair, C. F. Stolzenbach, George W. Beers, Maxime Reber, H. D. Critchfield and J. B. Hoge. The company's new equipment has been practically all installed and service will open about Feb. 1.

JACKSON, OHIO.—The Jackson Home Telephone Company held its annual meeting recently. E. L. Sternberger was elected president; T. J. Morgan, vice-president; C. W. Haslett, second vice-president; M. D. Jones, secretary-treasurer. The three exchanges operated by the company are making rapid progress. Over 700 lines are now in use and 1000 will be put in by July 1.

ST. PARIS, OHIO.—The St. Paris Telephone Company has elected the following officers: C. E. Buroker, president; J. D. Poorman, vice-president; Frank A. Zimmer, treasurer; H. M. Black, secretary. The usual dividend was declared. Affairs of the company were reported to be in an excellent condition and prospects for the year very bright. Improvements will be made.

AKRON, OHIO.—The Akron People's Telephone Company held its annual meeting a few days ago. Officers were elected as follows: Will Cristly, president; C. W. DeVoe, vice-president; J. R. Nutt, treasurer; J. S. Benner, secretary, and W. F. Laubach, general manager. The report shows that the company is in an excellent condition, with total net earnings after paying interest on bonds of $18,499.79. Contrary to general report this company is not controlled by the Federal Telephone Company.

DOYLESTOWN, PA.—The United Telephone Company has been granted a local franchise for Chalfant.

BRADFORD, PA.—One hundred of the 500 local subscribers to the Bell Telephone service have ordered their service discontinued, because the company declined to meet the rates made by a rival concern.

NORRISTOWN, PA.—An ordinance has been presented to the Town Council by the Montgomery Subway Company for a franchise to construct a subway through the borough, in which wires of all kinds shall be placed.

ABERDEEN, S. D.—The Dakota Central Telephone Company has purchased the Aberdeen telephone exchange and will remove the central office to its new headquarters.

BRAINARD, S. D.—A rural telephone system embracing about forty telephones is being agitated in Brainard township by the farmers. The project will doubtless materialize.

SIOUX FALLS, S. D.—The Citizens' Telephone Company, of Sioux Falls, has been incorporated; capital, $200,000. Incorporators: E. W. Coughran, W. T. Doolittle, H. H. Natwick, G. W. Burnside and J. R. Conway.

CHATTANOOGA, TENN.—The Alabama & Georgia Telephone Company was granted a twenty-year franchise in the city. An exchange will be established at once.

NASHVILLE, TENN.—The Memphis Telephone Company has increased its capital stock from $400,000 to $600,000. This is the company which is putting in the independent telephone system in Memphis and its promoters are behind the Nashville Telephone Company which is seeking a franchise from this city.

SALT LAKE CITY, UTAH.—P. W. Madsen and S. F. Fenton will apply to the City Council for a franchise to establish an independent telephone system.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has given an order for the purchase of 100,000 pounds of copper wire, making 400,000 in all purchased this year.

KEYSER, W. VA.—The telephone line between Romney, W. Va., and Gore, Va., has been purchased by Mr. Hoover, proprietor of the Winchester Telephone Company and the Gore line. He will make many improvements in the service.

DAVENPORT, WASH., is now connected with the mining camps in the Cedar Canyon district by a telephone line constructed by C. A. Galloway.

BARABOO, WIS.—A factory for the manufacture of telephones is to be established at Baraboo.

SAUK CITY, WIS.—The Big Hollow Telephone Company, capital stock $15,000, has been incorporated by M. Sanson, H. J. Ellepson and A. Friederichson.

CAMBRIDGE, WIS.—The Prairie Queen Telephone Company connects Cambridge, Utica and Stoughton. It contemplates extending its line to reach all farmers in the vicinity of the towns named.

LAKE MILLS, WIS.—The officers of the Interurban Telephone Company, of Madison, have closed the deal for the purchase of the Lake Mills Telephone Company. The new company expects to improve the line.

MENOMINEE, WIS.—The M. A. Schmoyer Company has been granted a franchise by the village authorities to construct and operate a system of telephone lines and exchanges for local and long distance service.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company is seeking to consolidate all the independent telephone companies in Wisconsin into one organization to establish a long-distance system in the State. A. W. Hutchinson, of Weyauwega, Wis., is president of this company.

MILWAUKEE, WIS.—The Interurban Telephone Company, of Madison, was recently incorporated by A. L. Hutchinson, H. E. Kipler and Charles Schennecker. The capital stock is $200,000. The company will construct, operate and maintain a system of telephone lines and exchanges in this State, and which may be extended outside this State.

MILWAUKEE, WIS.—The Great Western Telephone & Telegraph Company recently formed and incorporated, has been seeking a franchise from this city. At the same time two other newly organized independent companies asked for franchises, but were turned down. The Great Western company is still in the field with the Wisconsin Bell Telephone Company, fighting every movement. The majority of the Common Council seems in favor of a new telephone company.

ELECTRIC LIGHT AND POWER.

HUNTSVILLE, ALA.—It is stated that at the next meeting of the City Council a special committee will report in favor of establishing a municipal electric light plant. S. M. Blalock, representing the Westinghouse Company, has been in Huntsville to make estimates.

HARTFORD, CONN.—Mr. Charles R. Reynolds, electrical inspector for the Hartford Board of Fire Underwriters, reports that there are used in Hartford 77,000 incandescent lamps, 1934 arc lights and 3650 horse-power in motors.

SAN FRANCISCO, CALIF.—The Copperopolis company recently placed orders in San Francisco for an electric light and power plant for the use of its mines in the Baker City region in Eastern Oregon.

SAN FRANCISCO, CALIF.—The Butters Company, which is working the tailings in Six-Mile Canyon, Nev., by the cyanide process, has three years' work in prospect at one point. Electricity will be used in the process and 200 tons per day will be handled. Electric current has been contracted for.

SAN FRANCISCO, CALIF.—A 6000 candle-power electric searchlight has been installed in the high tower of the ferry depot building, in San Francisco, by order of the State Harbor Commissioners. During the prevalence of fogs, the rays will be directed in such a way as to guide the captains of ferryboats in finding and entering the slips.

SAN FRANCISCO, CALIF.—The San Joaquin Electric Company's property in Fresno and other places in California will be sold under an order of the court as a result of litigation in which the Mercantile Trust Company, trustee, is the plaintiff. The total amount due the creditors is $683,494.49. No bid of less than $350,000 will be received by Attorney Lynn Helm, appointed special master. The company is given eight months in which to pay the debt.

SAN FRANCISCO, CALIF.—The Standard Electric Company recently completed its dam, located twelve miles from Jackson, Amador County. The distance from the electric power station is three-quarters of a mile. The dam is built of earth, and its upstream side is faced with rock. It is 700 feet in length on the top and 127 feet in height. A tunnel 3000 feet in length connects the retaining dam with the electric power house. The plant could be operated for eight days by the water retained by this dam alone.

MONTREAL, CAN.—Fire a few days ago damaged the works of the Royal Electric Light Company to the extent of $50,000.

VENICE, ILL.—The Venice Electric Light & Power Company, which holds the contract for lighting the Tri-cities, is preparing to increase its power by the addition of several new generators. This action is taken in view of the rapid increasing demand for lights.

INDIANAPOLIS, IND.—The Board of Public Safety having awarded the contract to the New Telephone Company for transmitters and receivers in the Gamewell police boxes, now discovers that it cannot operate the boxes without a switchboard and the Central Union Company, which had the contract last year, will remove its switchboard. A new one is needed, and there is a dispute between the Board and the New Company as to whether a switchboard was included. The company wants $250 extra for putting in the necessary switchboard.

BOISE, IDAHO.—The sum of $150,000 has been paid to the First National Bank of Boise for the entire capital stock of the Capital Electric Light, Motor & Gas Company. The purchaser is the Boise-Payette Electric Power Company.

ALBERT LEA, MINN.—The Albert Lea Light & Power Company, with a capital stock of $400,000 authorized, $125,000 of which is to be paid in cash, has been organized here, with George C. Edwards, of Bridgeport, Conn.; Frank N. Jewett, of Chicago; Mark M. Jones, B. J. Shockley, and Samuel S. Edwards, of this city, as incorporators. The new company will take over the plant and business of the Albert Lea Electric Company, and will furnish electricity and hot water heat.

ST. LOUIS, MO.—The Magnatite Foundry Company is increasing its electrical equipment.

ST. LOUIS, MO.—The Missouri-Edison Electric Company on Jan. 14 re-elected officers as follows: S. M. Dodd, president; James Campbell, vice-president; S. B. Pike, secretary; John G. Kelly, treasurer. These, with the following, constitute the board of directors: Thomas H. West, James W. Bell, R. C. Kerens, Edwards Whittaker and J. C. Van Blarcom.

ST. LOUIS, MO.—The Imperial Electric Light, Heat & Power Company, which has caused many complaints and a great deal of trouble regarding the installation of a smoke consumer at its plant, has notified the city authorities that it is now negotiating for a smoke consuming device, and that it will be put up as quickly as possible. The city has given the company until Jan. 30 to close the contract.

REIDSVILLE, N. C.—The town has ordered one 60-kw alternator from the Westinghouse Electric & Manufacturing Company, to be added to the electric light plant.

ALBANY, N. Y.—The Electric Light Company, of New Paltz, has been incorporated with a capital of $20,000. The directors are J. L. Cunningham, of Paterson, N. J., and F. K. Gillespie and E. C. George, of New York City.

ALBANY, N. Y.—The Binghamton Light, Heat & Power Company, of Binghamton, has been incorporated, with a capital of $500,000, to furnish electricity in Binghamton, Lestershire, Port Dickinson, Union, and other places in Broome County. The directors are Frank Cunningham, T. M. R. Meikleham and Thos. J. Waters, of New York City; William B. Dinsmore, of Tuxedo Park; George W. Dunn, Clarence F. Hotchkiss, F. W. Jenkins and George F. Johnson, of Binghamton, and Chauncey Eldredge, of Boston, Mass.

CALDWELL, OHIO.—The Caldwell Electric Light Company will increase the capacity of its plant.

GALION, OHIO.—A company composed of Galion people has secured a franchise for an electric lighting and steam heating plant.

CUYAHOGA FALLS, OHIO, has raised $5,000 on bonds for a dynamo and engine for lighting to be operated in the city water works.

LA RUE, OHIO.—J. W. Barber, of Columbus, and H. E. Hill, of Marion, are endeavoring to secure franchises for electric lighting systems in La Rue and Prospect.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company has been incorporated with $15,000 to build a lighting and power plant and to furnish steam heat.

BUTLER, OHIO.—A telegram from Butler, Ohio, says municipal ownership of the electric light plant there is a failure. Notwithstanding the receipts are large, there is a deficit of $500 per month.

BELLVILLE, OHIO.—The municipal lighting plant which was installed some months ago, threatens to bankrupt the village. The plant has run behind about $1,000 in two months and the leakage can not be discovered.

COLUMBUS, OHIO.—At the recent annual meeting of the Columbus Edison Electric Light Company officers were elected as follows: President, Adolph Theobald; vice-president, John Siebert; secretary and business manager, A. W. Field; treasurer, Emil Kiessewetter.

BUTLER, OHIO.—The municipal lighting plant which was installed some months ago is proving a great disappointment to citizens. The monthly income of the plant is $125 and the expenses over $200. There is now a deficit of over $1,000 and three of the six Councilmen have resigned as a result of the general complaint.

CINCINNATI, OHIO.—A company calling itself the Universal Electric Light Company has obtained an option on the property of the Wyoming Electric Light, Heating & Power Company. The latter company furnishes light in the villages of Wyoming and Lockland, and is incorporated for $50,000. It is supposed that the Cincinnati Gas & Electric Company is back of the deal.

BENNETTSVILLE, S. C., is issuing bonds for an electric light plant. Mr. J. M. Jackson is of the committee having the matter in hand.

NASHVILLE, TENN.—Bids have been opened in Nashville for wiring the city in connection with the new electric light plant. The work will probably cost $10,000.

DUBLIN, TEX.—The Dublin Light & Power Company, of Dublin, Tex., capital stock $20,000, has been incorporated by R. W. Higginbotton, J. N. Higginbotton and T. L. Higginbotton.

DALLAS, TEX.—Gravi'le P. Mead, of Fort Worth, Tex., has been appointed by the Federal Court receiver of the Standard Light & Power Company, of Dallas, upon application of the General Electric Company of New York. The amount involved exceeds $50,000.

DALLAS, TEX.—The Standard Electric Light & Power Company, of Dallas, which the city authorities have accused of being a trust, with other local companies, was placed in the hands of a federal receiver Jan. 11 on application of the General Electric Company, of New York, which claims to hold $55,000 worth of the Standard company's bonds.

SALT LAKE CITY, UTAH.—H. C. Edwards is seeking an electric light franchise in this city.

SALT LAKE CITY, UTAH.—Electric energy generated at Snoqualmie Falls by the Snoqualmie Light & Power Company may be carried to Portland, Ore., over 180 miles of wire.

SALT LAKE CITY, UTAH.—A new company has been formed at Weises, Idaho, to build a dam to cost $280,000 to reclaim 40,000 acres of land. It is said the company will also erect a power plant at the dam site.

SALT LAKE CITY, UTAH.—The White Beaver Mining Company, of Rossland, B. C., has placed an order for a new powerful electric hoist to be installed necting Nyack, Sparkill and other villages of Rockland County.
rapidly as possible.

SALT LAKE CITY, UTAH.—Plans are under consideration by the Utah Light & Power Company to carry into effect the construction of a large dam in Ogden Canyon to impound sixteen billion cubic feet of water. The cost of the dam will be about $350,000.

NEWPORT NEWS, VA.—The Consumers' Heat, Light & Ice Company has offered for sale to the city its electric light plant. The company is now being sued by a New Jersey corporation, but fifteen days were granted during which the City Council was to consider the offer.

SALT LAKE CITY, UTAH.—Captain Tice, of Baker City, Ore., will organize a company backed by Eastern capital for the generation of electric power for operating the mining and manufacturing machinery of Baker City. The company will use the water of Eagle Creek.

SALT LAKE CITY, UTAH.—The E. W. Clark Light & Power Company, of Tooele, is about ready to commence work. The plant will be located in Tooele Canyon, of 300 horse-power, and capable of furnishing light and power to Stockton, Tooele and very likely to Grantsville.

SALT LAKE CITY, UTAH.—A company will be formed of Eastern capital to build a large power plant on the Santiam River, Ore. A dam 60 feet high and 230 feet long has been built by private parties, and it is at this point the plant will be installed. It is understood that the lumber mills in the vicinity will contract for power as well as a number of small towns in the county. The proposed plant will be of 500 horse-power, driven by means of a new turbine patented by a Portland man.

SALT LAKE CITY, UTAH.—Regarding the big power scheme by which the mines of the Idaho district along the Wood River are to be supplied with electricity, a representative of the company says: "The syndicate that is to put into execution the Hollister scheme for an electric power plant at the Shoshone Falls began active operations last week, when miners were put to work at the Falls. Work will be pushed as rapidly as possible, and one of the finest plants in the western country will be installed."

MADISON, WIS.—Madison is to have a new gas and electric light company. The articles of incorporation have been filed. The incorporators are Henry H. Morgan, Henry T. Sheldon and M. H. Oakley, and the capital stock has been placed at $200,000.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has been granted the privilege of making certain connections between car lines on Twenty-first Street and Third Avenue.

NEW HAVEN, CONN.—Application has been made to the Superior Court to change the name of the Thompson Tramway Company to the Worcester and Connecticut Eastern Railway Company. This probably is the first legal step toward the formal consolidation of the electric roads in the northeastern part of the State, and reaching to Worcester, Mass., in one organization.

VALLEJO, CALIF.—A franchise for an electric street railway in this city has been granted to J. W. and H. F. Hartzell, of San Francisco.

SAN FRANCISCO, CALIF.—The North Shore Railway Company was recently incorporated, with San Francisco as the principal place of business. Directors: R. R. Colgate, John Martin, E. J. de Sabla, Jr., R. M. Hotaling, A. Borel, J. C. Coleman, C. de Guigne, A. H. Small and E. Coleman. Capital stock, $6,000,000; subscribed, $90,000. An electric railway will be constructed from San Rafael to Sausalito, Calif., and swift ferryboats will make close connections with San Francisco. Various extensions will be made in time.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company has executed a mortgage for $750,000 for the purpose of issuing bonds to that amount. The Union Trust Company and the Security Trust Company, of this city, are named as trustees. The mortgage will be filed in Marion, Hendricks and Morgan counties, through which the road will pass. The bonds are to be of thirty years' duration and will bear interest at 5 per cent.

NOBLESVILLE, IND.—The Central Traction Company has awarded the contract for 150,000 ties for the Indianapolis division of its road. It also awarded the contract to the Carnegie Steel Company for the rails. Both contracts call for immediate delivery. Several large firms are figuring on the contract for the power-house to be erected in this city at once.

DES MOINES, IA.—The Toledo Electric Railway has filed articles of incorporation with the Secretary of State, showing a capital of $200,000. This is the line which is being promoted by P. E. Hall, of Cedar Rapids, and is projected to run from Traer, Ia., in a southerly direction through Toledo and Tama and on south into the coal regions of Mahaska County, terminating at the town of Buxton. W. C. Walters has been elected president of the company; J. R. Caldwell, vice-president; C. E. Walters, secretary, and H. A. Shanklin, treasurer.

NEW ORLEANS, LA.—The deal whereby the syndicate, represented by H. H. Pearson, Jr., will assume control of the New Orleans City Railway Company, is announced as completed, the new owners to take charge March 1.

BALTIMORE, MD.—Final arrangements have been made to charter the Baltimore & Frederick Electric Railway Company. This corporation is formed to build the trolley line from Baltimore to Frederick. Messrs. Frank H. Callaway, John W. Ellard and James E. Ingram, Jr., of Baltimore, with Messrs. J. Roger McSherry and Johnzie Beasman, of Frederick, will be the incorporators. The new company will be chartered under the general laws of Maryland and will have a capital of $1,500,000. The line will be 45 miles long between Baltimore and Frederick.

ALBERT LEA, MINN.—The Albert Lea Light & Power Company, that expects to secure the building of an electric line of railway from this city to Mankato, and which has a capital stock of $400,000, has perfected its organization, as follows: President, George C. Edwards, of Bridgeport, Conn.; vice-president, Frank N. Jewett, Chicago; secretary, Norman Peterson, Albert Lea; treasurer, Benjamin J. Shockley, Albert Lea. The new corporation stepped into the business of the Albert Lea Electric Company, and will expand that plant as well as promoting the railroad enterprise.

TRENTON, N. J.—The Delaware Valley Traction Company has been incorporated; capital, $100,000. Incorporators: Wm. A. Buckman, Geo. Buckman and Wm. F. Sadler, Jr.

ASBURY PARK, N. J.—A committee representing the holders of $507,000 worth of the $800,000 5 per cent first mortgage bonds of the Atlantic Coast Electric Railway Company, has applied to the Chancery Court for a receiver for that company.

HOLLY BEACH, N. J.—The Five-Mile Beach resorts of Anglesea, Wildwood and Holly Beach will be connected by a trolley road before the opening of the season. An ordinance granting a franchise to the Cape May and Anglesea Traction Company to construct a trolley road through Wildwood will be granted.

ALBANY, N. Y.—A hearing has been given before the State Board of Railroad Commissioners on an application of the Rockland County Traction Company to construct and operate an electric railway line thirty miles long, connecting Nyack, Sparkill and other villages of Rockland County.

AKRON, OHIO.—The Northern Ohio Traction Company will institute an all night service on its city line.

MT. VERNON, OHIO.—The Mt. Vernon Electric Railway has obtained a franchise for an extension of its lines.

TOLEDO, OHIO.—The annual meeting of the Toledo Railways & Light Company was held Jan. 16. The old officers were re-elected.

COLUMBUS, OHIO.—Officials of the Appleyard syndicate announce that through service will be opened between Columbus and Cincinnati by July 1.

BUCYRUS, OHIO.—The promoters of the proposed Bucyrus, Upper Sandusky & Lima Railway claim they have secured the necessary backing for their road from New York people.

DAYTON, OHIO.—General Manager Rannells, of the proposed Dayton & Kenton Traction Company, announces that a contract for constructing the road has been placed with Falk Brothers, of Milwaukee.

WELLSVILLE, OHIO.—The East Liverpool Street Railway has been notified that it must operate 12-minute cars instead of a 24-minute schedule, as at present. The Council will take action if the order is not complied with.

GREENVILLE, OHIO.—The Greenville Council has granted a 25-year franchise to the Richmond & Greenville Traction Company. The road will be an extension of the Dayton & Northern Traction Company's road now in operation to Greenville.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway held its annual meeting Jan. 15. The following officers were elected: L. Black, president; W. M. Tuller, vice-president; E. M. Friess, secretary, and A. Forney, treasurer.

STEUBENVILLE, OHIO.—It is stated that a syndicate headed by J. J. Hensel and Thomas M. Goodman, of New York, and Theodore Ward, of Philadelphia, is planning to build an electric line from Steubenville to Youngstown by way of Lisbon, Salem, Leetonia and Canfield.

COLUMBUS, OHIO.—A certificate has been filed with the Secretary of State consolidating the South Canton Belt Line Railway Company and the Middle Branch & Canton Belt Line Railway Company under the name of the Canton Belt Line Railway Company. The capital stock is $25,000.

SPRINGFIELD, OHIO.—At the annual meeting of the Dayton, Springfield & Urbana Railway, held Jan. 16, the stockholders decided to double track the line from Dayton to Springfield. Officers were elected as follows: John S. Harshman, president; John G. Webb, vice-president and secretary, and A. E. Appleyard, treasurer.

CLEVELAND, OHIO.—The annual meeting of the Cleveland, Elyria & Western Railway was held Jan. 16. A quarterly dividend of ¾ per cent. was declared. Officers elected: A. H. Pomeroy, president; A. E. Aikens, vice-president; F. T. Pomeroy, treasurer and general manager; E. F. Schneider, secretary; J. O. Wilson, general passenger agent.

STEVENS POINT, WIS.—The Wisconsin Valley Power & Light Company has had in view for some time the construction of an interurban electric railway connecting Stevens Point with Grand Rapids. D. O. Fisher is one of the promoters of this enterprise.

THE AUTOMOBILE.

AUTOMOBILE LINE ON EADS BRIDGE.—The capital stock of the Interstate Traction Company at Belleville, Ill., has been increased to $250,000. This company will operate an automobile line across the Eads Bridge at St. Louis.

THE GOODRICH MOTOR VEHICLE COMPANY, of Omaha, has incorporated to manufacture motors and vehicles of various kinds. It is capitalized for $200,000 and the principal incorporators are: O. A. Goodrich, M. T. Munsinger, John N. Westberry, R. A. Talbot and James Barrett.

TO BUILD AUTOMOBILE STABLES.—Edmund C. Stout, of the firm of Hill & Stout, architects, will undertake a new form of speculative building in the erection of five automobile stables on East Seventy-fifth Street, New York. Mr. Stout has acquired the property from Daniel E. Seybel. Each one of the new buildings will have a frontage of eighteen feet and will be three stories in height. The first floor will be used for the storage of automobiles and will be provided with all facilities for charging those of the electric type. On the second floor will be a room for the owners' use, while the top floor will be fitted up as a living apartment for chauffeurs. It is said that the total amount involved in the undertaking is not far from $300,000.

LEGAL.

SUBMARINE BOAT SUIT.—Suit has been brought in the United States Circuit Court for the Southern District of New York, by the Electric Boat Company, the builders of the Holland sub-marine boat, against the Lake Torpedo Boat Company for infringement of the patents owned by the former company. A submarine torpedo boat now being built by the Lake Torpedo Boat Company at Bridgeport, Conn., is the bone of contention which has roused the struggle in the courts. This boat was designed by Simon Lake, who several years ago built the Argonaut, a boat which dived beneath the water and crawled on the bed of the river, bay, and ocean. In the complaint of the Electric Boat Company a general infringement of its patents is claimed, and it is specifically alleged that its patents are infringed in general safety devices, in arrangement of the storage battery, arrangements for drainage and ventilation, arrangement of ballast tanks, and arrangement for automatic compensation for loss of weight after the shooting off of torpedoes. In the infringement suit, $100,000 damages and an injunction preventing further work on the boat now being constructed at Bridgeport are asked.

TELEPHONE LITIGATION.—In the appeal of the American Bell Telephone Company from the Bethlehem decision in favor of the National and Century Telephone Manufacturing companies, the United States Circuit Court of Appeals in Boston has granted the continuance asked for by the Bell company until the April term. The continuance was opposed quite strenuously.

PERSONAL.

MR. ROBERT H. GOLD [illegible] is no longer connected with the Gold Car Heating Company.

MR. C. L. DUPUY, [illegible] representative of the Northwest Fixture Company, Seattle, Wash., has gone on a trip to the Pacific Coast.

MR. HENRY A. TRUITT has bought from Mr. Thomas Gibb the entire right, title and interest in the Imperial Electric Company, of Philadelphia.

JUDGE E. H. GARY, of United States Steel, has been elected chairman of the Allis-Chalmers Company. Mr. William Allis retires on account of ill-health.

MR. NEWCOMB CARLTON, lately so prominent in the management of the Pan-American Exposition, has been elected vice-president of the Bell Telephone Company of Buffalo.

MR. G. MARCONI, who already has the Order of the Crown of Italy, has now been decorated by the King with the Order of St. Maurice and St. Lazarus.

MR. S. L. COLES has had a couple of good articles recently in *Collier's Weekly* on the old, new and coming rapid transit facilities in New York City. He sees great opportunities for improvement in the present situation.

MR. ROBERT E. HAMBLIN, manager of the Toledo, Bowling Green & Southern Traction Company, has accepted the position of general manager of the Toledo Home Telephone Company. He will assume charge Feb. 1.

PRESIDENT A. B. CHANDLER, of the Postal Telegraph & Cable Company, has been writing very interestingly in the *Saturday Evening Post* about the openings, or lack of them, for young men in the modern telegraph field.

MR. G. R. NEWCOMER, formerly United States representative for the United States Carbon Company, has opened an office at 39 Equitable Building, Memphis, Tenn., as Southern representative of the Commercial Supply Company of St. Louis.

PROF. W. E. GOLDSBOROUGH has now been confirmed as chief of the department of electricity for the St. Louis Exposition of 1903, and will have under his charge all matters relating to the electrical exhibits. He is taking up his duties at once.

MR. LEWIS NIXON, naval engineer, proprietor of the Crescent City Ship Works at Elizabethport, N. J., and the new leader of Tammany, has an interesting and suggestive article in the February *Success* on the work that may be expected from submarine boats. He has lately been engaged in building several Holland boats for the Electric Boat Company.

MR. H. H. SYKES.—The appointment is announced of Henry H. Sykes, of St. Louis, Mo., to be general superintendent of the Southern New England Telephone Company. Mr. Sykes is now connected with the Missouri Bell Telephone Company. He will succeed E. B. Baker, whose resignation will take effect May 1, as already announced in this column.

MR. THOMAS P. THOMPSON, master electrician in the department of yards and docks in the navy yard at Norfolk, Va., has tendered his resignation to the Government and will engage in architectural and electrical engineering with the firm of Webb & Thompson, of Norfolk. The Government has ordered an examination to select a master electrician for this position.

MR. A. E. WINCHESTER, general superintendent and commissioner of the municipal lighting plant at South Norwalk, Conn., was in New York this week and reported a very successful year. He denied, however, the rumors attributing to the commission an intention to take over the local street railway. This story arose from some old arrangement as to supply of current.

MR. THOMAS A. EDISON is now a fireman. He has been made an honorary member of the Edison Hook and Ladder Company at Menlo Park, N. J., whose truck house was formerly the laboratory of the famous inventor. In this house the Edison work on the telephone, electric light and phonograph was done. It was there that the first installation of incandescent light was put in operation.

DR. S. SHELDON, of the Brooklyn Polytechnic Institute, delivered a very interesting lecture on Jan. 28 at its club rooms before the Automobile Club of America on "The Electric Motor." It was beautifully and profusely interspersed with experiments and was heard with much attention. Dr. Sheldon is to favor the club with a second lecture on "The Storage Battery" a fortnight hence.

MR. W. R. BRIXEY, manufacturer of insulated wires and cables, has had a very serious experience in connection with the explosion this week in the unfinished rapid transit subway opposite the Murray Hill Hotel, when half a dozen persons were killed and over 150 injured. Mr. Brixey has for some years occupied a suite of rooms on the Park Avenue side of the hotel and he and Mrs. Brixey were there at the time of the explosion. Mrs. Brixey was in an inner room and fortunately escaped any injury, but Mr. Brixey received the full blast and shock of the concussion and was terribly cut about the head by huge flying pieces of glass. When he and his wife got out of the hotel he very bravely refused assistance, telling the doctors to attend to other people, and, bleeding from his wounds, staggered to a doctor's office near by, where he swooned away. He was carried to the German Hospital and treated at once for fractured skull; and at last reports was doing as well as could be expected. The doctors hope that his sturdy English constitution will pull him through in good shape. That he emerged from the accident with his life is a miracle.

Trade Notes.

MR. HUGO REISINGER, 11 Broadway, New York, is sending out a very handsome calendar desk pad for 1902 as a reminder of "Electra" carbons.

DELTA METAL.—The Phosphor-Bronze Smelting Company, Limited, 2200 Washington Avenue, Philadelphia, has issued its January price list of its Delta metal.

KNAPP ELECTRIC & NOVELTY COMPANY, of New York City, finding it necessary to enlarge its plant, is removing to 511-513 West Fifty-first Street, and will be installed there this week.

CHANGE OF NAME.—The Interstate Insulating Company, of Sandwich, Ill., has changed its name to Illinois Electric Specialty Company and the company's capital has been increased from $2,500 to $7,000.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has just issued Circular No. [illegible] describing its line of dynamos and motors. Copies of this circular will be sent to the trade on application.

THE MILWAUKEE COMMUTATOR COMPANY, Milwaukee, Wis., is sending out some very fine bars made true to angle and gauge from pure lake copper. It is also doing a large business in copper and brass castings for the electrical trade.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY announces that it is fully prepared to furnish its new patented switchboard ringing and listening keys in any quantity, and is mailing a neat card with a cut of the key and full description.

NEW CENTURY PRIMER.—The New York & New Jersey Telephone Company is giving some education on the uses of the telephone in a booklet entitled "The New Century Primer." Twenty-six facts concerning telephone service are conveyed in nursery rhyme style.

THE SCHAEFFER & BUDENBERG MANUFACTURING COMPANY is the new style of the old firm which has long been making steam and boiler gauges, etc., under the name of Shaeffer & Budenberg. The New York address will be 66 John Street as before.

"FALCON" FLUSH RECEPTACLES.—In a leaflet of recent issue by the Falcon Electric Manufacturing Company, of New York, the Falcon extension plug and flush receptacle, and flush plug and flush receptacle are illustrated, in connection with information and prices of these devices.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising a new addition to the family of Adams-Bagnall arc lights. It is a series alternating in both shunt and differential types. The shunt type is the one used with the so-called regulator system, and the differential is for use with "tub" or transformer system.

THE ILLINOIS ELECTRIC SPECIALTY COMPANY has removed from its old office, 1203 Marquette Building, to 510-512 Tacoma Building, Chicago, where it will be pleased to meet its friends. It is receiving a large number of orders for its direct reading ohmmeter and it keeps its factory working overtime to supply the demand.

THE BRECHT AUTOMOBILE COMPANY, 1207 Cass Avenue, St. Louis, Mo., has issued a pamphlet of its automobiles, automobile gearing and parts. The Brecht gear is adapted for use with either electric, steam or gasoline vehicles, and the illustrations show it to be of neat appearance with a general look of solidity and gracefulness.

AUTOMOBILE SUPPLIES.—Mr. A. L. Dyke, St. Louis, Mo., recently issued some circulars giving illustrations and pointing out the chief advantages of several devices used in connection with automobiles. Mr. Dyke carries a large stock of Dyke engines, running gears, carburetters, tool sets and a general line of supplies for automobiles.

CHASE-SHAWMUT COMPANY, of 390 Atlantic Avenue, Boston, Mass., has just issued a very neat and handy little red book of electrical data and diagrams that should prove quite useful to a great many people. We understand it can be obtained by all interested in the company's fuse wire, switches, switchboards and other apparatus.

THE LINCOLN ELECTRIC COMPANY, 71 Ontario Street, Cleveland, Ohio, is making a line of dynamos and motors, which machines are illustrated and described in a catalogue and price list just issued by the company. The company manufactures bipolar and multipolar machines, elevator motors, plating dynamos and alternating-current dynamos. The pamphlet gives directions for setting up these machines.

THE CONTINENTAL TELEPHONE CONSTRUCTION COMPANY, Chicago, has closed the contract for the installation of a 600, fully equipped central energy switchboard and some outside construction, with 1500 capacity, at Freeport, Ill. On account of the increase in business this company has been compelled to seek larger offices and will now be located and doing business at Rooms 510-512 Tacoma Building, Chicago.

ELECTRICALLY-DRIVEN TOOLS.—Jas. Clark, Jr., & Company, Louisville, Ky., have issued a pamphlet on the "Willey" electrically-driven tools manufactured by them. Both the tools and motors are built in the same shop and adapted to each other. The firm is offering a line of enclosed type motors designed especially for driving individual machines. The motor is simple in construction and well designed to meet the requirements of such service.

THE REYNOLDS ELECTRIC COMPANY, of 221-225 Fifth Avenue, Chicago, is contemplating arrangements for enlarging its plant. This firm has in process of completion several new patented devices which will be of interest to electricians everywhere, and of which a more detailed story will be told in these columns as soon as it is deemed advisable. The rapidly increasing orders for the "Original Reynolds Flasher" makes the enlarging of its present plant an imperative necessity.

ELECTRICAL SUPPLIES.—The Central Electric Company, Chicago, Ill., has issued a complete price list of general electrical supplies. The pamphlet contains 174 pages with a very complete index. A noticeable feature of the work is the almost entire absence of illustrations, only a few of the newer and more important devices being thus shown. The space ordinarily occupied by illustrations is, however, entirely taken up by important information and figures regarding the articles listed.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, reports more orders for its Cross oil filters from the big steel corporations and other large concerns throughout the country. Excellence cannot be better attested than by "repeat" orders, which in its case means supplying a concern with anywhere from three to twenty-five filters. The Burt Manufacturing Company will be pleased to send its catalogues to any one interested.

DROP HAMMERS are indispensable machines in all forging shops. The Billings & Spencer Company, of Hartford, Conn., has given a good deal of information regarding its drop hammers, of which it makes a very full line, in a recent pamphlet. These machines are illustrated, both complete and in parts, the parts being numbered to facilitate ordering. Besides manufacturing drop hammers the company produces trimming presses, heating furnaces, machine tools, etc., and drop forgings of every description, in copper, bronze, iron and steel.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it has already closed a large number of fan contracts for the coming season. It is expecting an unprecedented demand. It is handling the Peerless for direct current, and the well known Emerson for alternating current. These fans are made up in an unusually large number of styles and types, and the company is prepared to furnish any voltage or alternation. It is issuing two very attractive catalogues, one covering the direct current fans and the other alternating, which will be mailed on application.

SLOT MACHINES FOR TELEPHONES.—The rapidly extending use of automatic telephone pay stations is evidence that they are satisfactory instruments. The American Toll Telephone Company, 43 Sheriff Street, Cleveland, Ohio, is one of the leading manufacturers of these devices, and has just issued a neat booklet describing and illustrating six different styles manufactured by it. These instruments are proof against tampering, and the company has such confidence in its machines that it offers to send them out on 30 day's trial, to be returned if not satisfactory.

BATES ELECTRIC FANS.—The ceiling and desk fans manufactured by D. L. Bates & Bro., Dayton, Ohio, are well known throughout the world. The firm has lately added a trunnion fan to their line. They make a specialty of fans for direct current only and as their product has been on the market for the past eleven years, it is a difficult matter to improve them, as changes have been made from year to year until perfection has been attained. The firm has about all they can do to supply the trade, even at this early date. They have issued a very pretty calendar, which will be gladly furnished to any one interested in fans.

GRAPHITE ELECTRODES.—The subject of graphite electrodes for use in electrolytic and electro-metallurgical processes is discussed at considerable length in a very attractive booklet of recent issue by the International Acheson Graphite Company, of Niagara Falls, N. Y. The manufacture of these electrodes and their properties are described, and the advantages to be derived from their use are pointed out. The general subject is well treated and the information contained in the pamphlet will no doubt be of much value to all interested in this line of work. Marginal references are printed in red to readily catch the eye, and the cover is of artistic design.

WESTERN ELECTRIC CATALOGUE.—We have received from the Western Electric Company a copy of its new general supply catalogue. It is a volume about 7½x5½ inches, handsomely bound in dark green cloth, and containing nearly eleven hundred pages and three thousand illustrations. It appears to contain everything which could possibly be wanted in any line of electrical industry, house goods, electric lighting and power supplies, street railway material, etc. The catalogue will be sent to any address, charges paid, on receipt of $1. It is virtually an illustrated dictionary of practical electricity and reflects great credit on the manufacturer it represents and the indefatigable compilers.

NEW FAN MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., is sending to the trade a circular letter calling attention to its new line of fan motors for the coming season. The desk and bracket fans for low frequency current have been improved by the addition of an automatic device which gives the motor a very desirable start and at the same time reduces the current consumption. An entirely new type of ceiling fan for low frequencies has also been brought out. The Emerson desk and bracket fans for high frequency current have been entirely redesigned and greatly improved, and a new type of trunnion desk and bracket fan for high frequencies has been added to the list.

THE NEELY ELECTRIC COMPANY, of 611 Fourteenth Street, N. W., Washington, D. C., has opened a thoroughly modern equipped electric establishment, probably one of the finest in the South. It has five distinct departments—electrical engineering and drafting, electrical machinery and motor, wholesale and jobbing, retail, construction and installing—in its new and commodious building. These departments are conducted and operated by experienced managers. The Neely Electric Company is unquestionably the largest Government contractor for things electrical. The location of the headquarters of this company, at the seat of the Government, no doubt, materially aids it in following the Government business and securing contracts.

REPAIRS OF ELECTRICAL APPARATUS.—A new firm in the repair business is that of the Charles G. Hose Electric Company, of New York City, who has oened a large repair shop for the express purpose of attending to the wants of all users of electric machinery. The president, Charles G. Hose, has had large experience, having been connected with the Brooklyn Rapid Transit Company for the past eight years in various capacities in the large repair shops of the company. The familiarity of Mr. Hose with all kinds of electrical apparatus from the practical side is supplemented by considerable business ability, and this, combined with the exceptional facilities possessed by the company, its machinery and operating force, have all resulted in a large amount of business. All kinds of work will be done, including the repairs on car controllers, commutators, generators, both alternating and direct current, and street railway and power motors, besides contracts for the complete wiring of buildings, car houses, offices, etc.

FREE SCHOLARSHIPS.—The Trustees of the American School of Correspondence are offering a few free scholarships in the engineering courses to deserving, energetic and intelligent young men. The course of study offers thorough instruction at home in mechanical, electrical, stationary, locomotive, marine and textile engineering, as well as heating, ventilation, plumbing and mechanical drawing, under instructors who are graduates of the great technical schools. Much of the instruction is under regular teachers in the technical schools for which Boston is famous. To the young man who has lacked the time and money to fit himself to be a master in his trade, such opportunities opens wide the doors to advancement and success. Though he may live hundreds of miles from an educational center, he nevertheless enjoys as a student in a correspondence school many of the advantages of the student paying $200 a year for tuition in the great technical schools. Indeed, it is one of the most important features of the American School that it is situated in close touch with institutions for technical training, and is thus enabled to engage exceptionally qualified instructors to supervise the work of the students. For the large handbook describing the courses, methods, etc., inquirers should address the Registrar of the American School of Correspondence, Boston, Mass.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 22, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

690,181. ELECTRIC ACCUMULATOR; Alfred Pouteau and Albert Wolff, Dijon, France. App. filed April 9, 1901. Perforated plates are separated by perforated partition bars, the interval between the two plates being filled with active material. Both the plates and partition bars are made of celluloid covered with a layer of caoutchouc. Within each compartment is a longitudinal core of conducting material, the cores of each element being connected at their projecting ends by a collector bar.

691,358. MEANS FOR DRIVING DYNAMOS FROM CAR AXLES; J. L. Creveling, New York, N. Y. App. filed Aug. 30, 1900. Mechanical devices are interposed between the driving axle and the armature shaft, whereby, if the car stops without breaking the circuit between the generator and the storage battery, no other effect will be produced than the conversion of the generator into a motor, the machine then running in the same direction as when acting as a generator.

691,359. MEANS FOR DRIVING GENERATORS PLACED UPON CARS BY POWER TAKEN FROM THE CARS; J. L. Creveling, New York, N. Y. App. filed May 10, 1901. A modification of the preceding invention.

691,360. ELECTRIC TRACTION; B. Cruvellier, Marseilles, France. App. filed Sept. 8, 1900. In an electric traction system, a contact-box provided with a closed chamber or cavity and an active electric circuit closer movable in said chamber or cavity and comprising a hollow sphere of conducting non-magnetic material, and loose magnetizable material inclosed in said sphere.

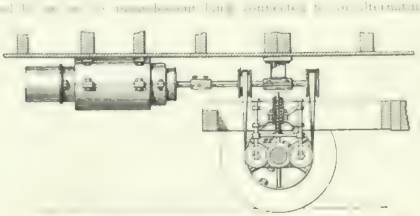
691,381. SUBTERRANEAN CURRENT TRANSMISSION FOR ELECTRIC TRAMWAYS OR RAILWAYS; A. Hrebicek, Bingerbruch, Germany. App. filed Sept. 12, 1899. The conduit is covered by plates having inclined grooves therein which are engaged by a projection carried by the car, whereby the plates are moved to uncover the conduit ahead of the collecting device and to close the conduit immediately behind it.

691,393. ELECTRICAL MEASURING INSTRUMENT; F. A. La Roche, New York, N. Y. App. filed April 29, 1901. The restraining spring of the movable coil is connected in shunt with the shaft or pivots upon which the movable system swings, so that the total current which is led into the instrument will be divided, one part of it passing through the scroll-wound spring and the other part through the pivots. The field of the movable element is a composite one, furnished by a permanent magnet, and by a pair of electro magnets in close proximity to the pole pieces, the permanent magnet being supplied with a coil for standardization. The two inductor electromagnets are in series and connected to the terminals of an ammeter shunt so that but a fraction of current passes through them. An optical method is employed for indicating the angular motion of the movable system.

691,394. ELECTRIC CUT-OUT; H. E. Leppert, New Britain, Conn. App. filed April 16, 1901. A rosette in which the cap is secured to the base by a threaded bushing passing through the cap and entering a thimble carried by the base. The cord passes through the bushing.

691,404. PORTABLE ELECTRIC WELDING MACHINE; H. E. Meyers, Butte, Mont. App. filed March 14, 1901. A box containing the primary and secondary and through the end of which the terminals of the secondary project, is constructed to be conveniently handled and carried about.

691,441. APPARATUS FOR DETERMINING THE FREQUENCY OF ALTERNATING CURRENTS; U. S. Carr, Lawrence, Kan. App. filed July 12, 1901. A stroboscopic disk is divided into alternate sectors with reflecting and non-reflecting surfaces. If the disk is revolved in the light [illegible]



691,442. Means for Driving Generators Placed Upon Cars from the Cars.

rent, slight fluctuations in the intensity of light will produce the illusion of a revolution of the sectors in one direction or the other whenever the current and the revolutions of the disk are not in synchronism. When the number of revolutions of the disk and the frequency of the current are the same, the sectors will appear stationary.

691,450. RECORDING SYSTEM; R. and W. H. Davis, Washington, D. C., and D. C. Woodbury, Hoboken, N. J. App. filed Feb. 16, 1901. (See page [illegible].)

691,470. METHOD OF MAKING ALUMINUM HYDRATE; H. W. Jordan, Syracuse, N. Y. App filed July 10, 1901. (See Current News and Notes.)

691,473. ELECTRIC TRACTION SYSTEM; C. M. J. Limb, Lyons, France. App. filed Jan. 26, 1901. The accumulators normally furnishing the propelling current are automatically recharged at every station, the starting after a stoppage at the station being effected by making use of the main charging current instead of the battery.

691,495. INSULATING CONDUIT FOR CONDUCTORS OF ELECTRIC TRAMWAYS; P. C. Seguy, Paris, France. App. filed March 5, 1901. The conduit comprises blocks of insulating material having a channel formed therein for the conductor and an opening in the bottom for the escape of water into a second block having a channel for carrying the water off.

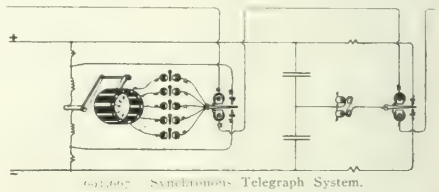
691,545. PORTABLE WATER PURIFIER AND FILTER; C. E. Holland, New York, N. Y. App. filed Jan. 9, 1901. Consists, essentially, of a water reservoir having, preferably, a filtering material therein at its upper end and surmounted by a cover. At one side of this reservoir is attached an electrolytic purifying apparatus which may be removed without removing the cover or otherwise disturbing the filtering portion of the apparatus.

691,549. ELECTRIC ARC LAMP; S. H. Johnson, Stratford, Eng. App. filed July 29, 1901. The regulation of the lamp is effected by means of a thermal metallic strip through which the current passes. There is a main slip clutch on the movable carbon, a rest for disengaging the main clutch at the minimum limit of its range, a second slip clutch encircling the movable carbon, and means for tilting and tripping this clutch and allowing it only a limited motion.

691,557. HANDLE FOR MAKING AND BREAKING CIRCUITS; R. E. Leve, New York, N. Y. App. filed Nov. 14, 1901. A handle adapted to be connected with electric machines, such as cloth cutters, provided with a push-rod adapted to rotate an internal switch, step by step, one motion closing the circuit and the next opening it, to start and stop the machine respectively.

691,563. LAMP SOCKET FOR INCANDESCENT ELECTRIC LAMPS; A. McKenzie, Providence, R. I. App. filed April 29, 1901. Details.

691,587. PUNCHING REGISTER; C. Berst, New Albany, Ind. App. filed July 12, 1900. The invention relates to punching registers especially adapted for use in connection with fire-alarm and police telegraph systems. The object of the invention is mainly to provide, in connection with suitable



691,667. Synchronous Telegraph System.

escapement devices, gearing, a main-spring wheel and an electro magnet, a punch of simple and efficient character having a positive return movement.

691,600. MANUFACTURE OF ELECTRICAL CONDENSERS; J. Coates, Lynn, Mass. App. filed Jan. 2, 1901, renewed Aug. 9, 1901. (See Current News and Notes.)

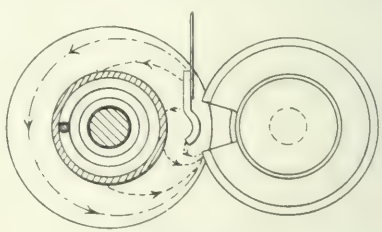
691,611. ELECTRIC BATTERY; A. De Dion and G. Bouton, Puteaux, France. App. filed Feb. 6, 1901. (See Current News and Notes.)

691,618. LOCKING DEVICE FOR MOTOR REVERSING SWITCHES; F. W. Garrett and E. W. Stull, Johnstown, Pa. App. filed June 28, 1901. The invention consists in the provision of co-operative locking members carried, respectively, by the regulating and reverse switches, the member carried by the reverse-switch having a fixed relation thereto and a corresponding number of locking positions, and the member carried by the regulating-switch having a movement independently thereof and so arranged and operated that it engages the first named member in such a manner as to lock the reversing-switch at all times except when the regulating-switch is at its off position.

691,664. TELEPHONE SYSTEM; G. Ritter, Stuttgart, Germany. App. filed Nov. 2, 1900. (See page 226.)

691,665. TELEPHONE SYSTEM; G. Ritter, Stuttgart, Germany. App. filed July 18, 1901. (See page 226.)

691,667. SYNCHRONOUS TELEGRAPH SYSTEM; H. A. Rowland, Baltimore, Md. App. filed Feb. 24, 1899. A plurality of condensers are ar-



691,693.—Spark Interrupter.

ranged in circuit with the synchronizing devices, said condensers being alternately discharged through the synchronizing devices, to regulate their motion.

691,675. MANUFACTURE OF ELECTRICAL CONDENSERS; E. Thomson, Swampscott, Mass. App. filed Jan. 2, 1901. (See Current News and Notes.)

691,683. AUTOMATIC ELECTRIC SIGNAL; F. E. Weinel, Apollo, Pa. App. filed March 26, 1901. A railway signal in which if an engine be reversed while in a block, the signals at the end of the block will be automatically changed.

691,692. CONTROLLING SYSTEM; T. Von Zweigbergk, Preston, England. App. filed July 8, 1901. Mechanism for operating a controller by means of compressed air governed electrically by one or more master controllers.

691,693. SPARK INTERRUPTER; T. Von Zweigbergk, Preston, England. App. filed Oct. 30, 1901. A spark interrupter in which the spark completely encircles the device and allows the interrupter to be placed directly in the sweep of the arc, a space which has heretofore been additional to the blow-out device.

11,961. MEANS FOR DRIVING DYNAMOS FROM CAR AXLES; J. L. Creveling, New York, N. Y. App. filed Sept. 23, 1901. The invention is designed to avoid the use of a pole changer in circuit with the dynamo, by compelling, through the employment of a single belt, the rotation of the armature in the same direction regardless of the direction of rotation of the car axle.

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GENERATORS EXTRAORDINARY.

In the new developments initiated on the Canadian side of the Niagara another high-water mark has been established in generator construction. Nothing show more strikingly the advance in electrical engineering during the last decade than the tremendous installation now under way. When the original plant was put in, the demand for 5000-hp generators rather staggered manufacturers for a time, but before the contracts had to be let, they had recovered their equanimity and turned out the huge machines with entire success. They were, however, for very moderate voltage, and the newness of the problems involved led to much caution in the mechanical design. It is difficult to see, at least in the light of subsequent development in design, any adequate reason for the plan of using an external revolving field. Of all possible designs it was the one rendering the armature most inaccessible, and with less skillful and substantial construction, this would have proved a serious fault. In the new machines just ordered, not only is the output doubled at one stroke, but the resulting machines will be directly in the line of progress of the ordinary best practice at the beginning of the twentieth century. Their efficiency will probably be a shade higher than the rest of the present machines, but at these huge outputs a few thousand horse-power one way or the other ought to make no perceptible difference in efficiency, and the monsters of 1902 may no more than equal their predecessors. The whole station arrangement will be much simplified and not a little cheapened by the use of 10,000-hp units which, from the standpoint of the total development in sight, must be considered small rather than large.

It seems strange to think of so enormous a power plant, that the largest dynamos ever built compel the use of what in any other station would be an unreasonably large number of units. The change from 5000 to 10,000 hp was an eminently wise one. But far more striking was the upward step from 2200 volts to 12,000 generated in the armature. When a plant reaches such superlative dimensions that the current at 2200 volts becomes of troublesome magnitude and involves all sorts of switchboard difficulties, it is surely time to move on, quite aside from any considerations involving the transmission lines. In fact, if transmission is undertaken from this plant upon a great scale, the line will carry so high a pressure, and the transformer units will be so huge, that a 12,000-volt winding for the low-pressure side will seem only an indication of reasonable symmetry in design. Working on such a scale there is not the slightest difficulty in winding the stationary armature for 12,000 volts, and indeed it would be no difficult matter to put the pressure up to 20,000. But this latter figure is to-day a very conservative datum for a long distance line, and viewing the matter in its proper perspective, the 12,000-volt armature is really only a matter of convenience in local distribution. For real transmission, 30,000 to 60,000 volts will be the figure. Another matter of interest is the admirable inherent regulation of these great machines. We hope such an example as this will put a permanent quietus on those who have strenuously insisted that the only generator to use was one that gave bad regulation. The real truth of the matter is that it is cheaper to build badly regulating generators under certain circumstances, but bad regulation in machines for power transmission is an evil first, last and always, never to be tolerated when it can be avoided at any reasonable cost.

The Day Load of a Moderate Sized Station.

It has been the general belief among central station men that the lighting of factories and shops where the light is only used until 6 P. M., after which the factory is shut down, is not a profitable class of business, and not worth the going after, for the reason that the lights in such factories are used only in the winter, and cause an addition to the 6-o'clock peak, which represents an investment in generating machinery installed simply to take care of the factory lighting peak for a few months each year, and for a few hours a day at that. This, of course, is largely a matter of local conditions, but the experience of Mr. J. H. Harding, of La Porte, Ind., as related in the discussion at the last Northwestern Electrical Association (see Electrical World and Engineer, Jan. 25, 1902, pages 162 and 163), may be considered with profit by other stations similarly situated. It seems that Mr. Harding operates a plant in a manufacturing town, and that he disregarded the orthodox teaching that a factory load of this kind is not profitable, and started out to get a load for a day circuit. He found that the peak load from the factories in his town would come up long before the peak due to residence lighting, and as the two classes of lighting do not coincide in point of time, whatever lighting is taken by the factories is a direct gain for the company. More than this, in going after this factory business, which required a day circuit, and which practically ceased at 6 P. M., he found an unexpected load of incandescent all-day lights, which was entirely new business, and due to the fact that an all-day service was available for those who wished to use it. The station being in the heating business, this day load is very desirable. It was the general experience of those at the convention that they never before heard of a peak load coming on at 3 or 4 o'clock on winter afternoons, as in the case cited by Mr. Harding, but that may simply prove that there are a few things to be learned by a number of central station managers yet as to the possibilities of their field.

The Future of Niagara Falls.

The immense installation on the Canadian side of Niagara Falls means an enormous growth in local and distant business. It must be remembered that splendid and tremendous as the Niagara development has been, it is up to date largely a local plant. It has not yet stretched out its web of conductors over any very considerable radius. Buffalo, of course, receives a large amount of power, but as power transmission to-day goes, the Buffalo circuit is only an incident possessed of no unusual interest. The greatest mission of the Niagara Power Company is as yet unfulfilled. In the light of our present knowledge, Cleveland, Detroit, Columbus, Cincinnati and even Chicago and New York are within striking distance of the Niagara central station. How far transmission of huge amounts of power to these points would pay is a matter which cannot yet be determined, but the next few years will show clearly enough how the work can be done when it becomes desirable to attempt it. The effect of the Niagara power on Buffalo and neighboring cities is already manifest, and perhaps the whole immense output of the plant can be ultimately utilized, not so much by transmitting power as by drawing, even as by the hand of Fate, great industries about it. Power transmission then means only local distribution to a manufacturing metropolis spread out over a thousand square miles of territory. But it is idle to speculate on such matter as these. Time has the answers for all such questions, and not one yet has ever been able to formulate rules for the shifting of centers of population.

But how about the great cataract itself? The voice of prophecy has been already raised to foretell the day when the fall itself will be only a trickling sheet, and when great national holidays may be celebrated by turning the water for a few brief hours from the canals back to its natural channel. The men who have created the splendid power developments there are called iconoclasts and vandals who rend Nature limb from limb for dirty pelf. But truth to tell, Niagara was from every æsthetic point of view wrecked long before the pick opened the work of the Niagara Power Company. Ill-kept factories, garish barns of hotels, patent medicine advertisements, shanties of evil aspect and worse repute, had made the greatest cataract in the world an eyesore and reproach years ago. Even the strong hand of the State was stretched out too late to save, and man's petty avarice had undone already Nature's best work. To turn the stream thus defiled into a blessing for the world's workers is a worthy deed, a thing to be applauded. Had wise men taken the Niagara region three-quarters of a century ago and guarded it so that none of man's handiwork should visibly infringe on the eternal majesty of the scene, then would the mighty fall have been saved to art. Failing in this, it has been redeemed from vandals to the great service of Industry. It will be many a year, perhaps many a century, before Niagara ceases to be a natural wonder of the world, and long ere that it will be the greatest monument of man's victory over natural forces. Why should any one wish a better fate for it, since it had been already cast aside. In fact, if one looks far into the future, the work of utilizing the cataract may be its salvation. Even within the memory of man it has suffered greatly from erosion, and sooner or later it was bound to work its way westward, bringing disaster unless saved by the interposition of human aid in controlling its fateful march. One day a future generation may wake to the realization that the Niagara tunnels saved the Great Lakes.

Magnetic Deflection of Long Steel-Wire Plumb Lines.

Dr. Hallock's article on this subject on page 263 is an interesting communication upon a subject of practical importance. When an engineer has to support a plumb bob by a very long line, he naturally thinks at once of a steel pianoforte wire, which, however, is a magnetic substance, and liable to magnetic attraction. The article does not state the length of the two wires used in the actual case of the Lake Superior mine, except that they were used in connection with a very deep shaft, so that the magnitudes of the apparent angular deviations are not forthcoming, but the total relative deviations observed between the two suspended plumb bobs are virtually stated to have been in the neighborhood of one inch. Under these circumstances the mutual or relative deviation could hardly be due to the earth's magnetic pull upon the wires, because the two wires would probably be equally and similarly magnetized, and the attraction of the earth would, therefore, be equal on both, giving rise to an equal deflection of both from the perpendicular with no mutual deviation. Consequently, deviations are only to be readily explained from a magnetic point of view by virtue of mutual attractions and repulsions. If the wires were uniformly magnetized parallel to their length, their poles would be formed exclusively at the extremities, and these extremities would have like polarity so that a repulsion would necessarily be exerted. In other words, mutual magnetic actions would, by their symmetry, inevitably push the lower ends of the wires apart and could not cause them to incline towards each other. If, however, the magnetization of the wires happened to be broken up into a section of irregular segments with consequent superficial poles, then, as the article indicates, these consequent poles, if of opposite name at adjacent points on the wires might give rise to attraction, while if of the same name at adjacent points, would increase the repulsion due to simple terminal poles.

Dr. Hallock appears to have found a magnetic deflection of a pianoforte wire or magnetizable plumb line amounting to about 1½ seconds of arc, although the mass of the plumb bob and, therefore,

the vertical force, is not stated, so that the equivalent simple horizontal deflecting force is not forthcoming. Apparently, however, this deflection could not be accounted for on the assumption of simple terminal polarity, and could only be accounted for magnetically by the additional deflecting force of similar consequent poles along the wire. It is difficult to see how consequent poles could increase the deflection of a single wire, and the inference from the article seems to be that it could only augment the mutual deviation of two parallel wires. Apart from the matter of theory, however, and the complete explanation of the phenomenon, it seems clear that when accuracy is important, a plumb line is not a plumb line.

Measuring the Variation of Speed of a Flywheel During One Revolution.

The direct connection of large alternators to steam engines means employing, in the present condition of steam engine practice, a series of steam-pressure impulses occurring only a comparatively small number of times in each second. This pulsation in the driving effort unavoidably produces some pulsation in the motion of the attached alternator and some corresponding variation in the frequency of the generated alternating e. m. f. The electrical and mechanical inertia of the moving parts tend, however, to reduce the pulsation, and it is often a matter of doubt as to just how much fluctuation exists in any particular direct-connected unit. An electro-mechanical apparatus is described on page 264 of this issue for measuring the pulsation, and also the angular variation of the moving parts involved. It consists essentially of two co-axial disks driven in opposite directions from the flywheel to be tested, one disk having as much inertia as can conveniently be given to it, and the other disk as little inertia as is conveniently possible. The former is driven elastically through a torsion wire in which variations of angular velocity are intended to be absorbed, while the latter is driven positively from the flywheel. The relative positions of the junctions of radial slits in these rapidly revolving disks is then observed optically.

The apparatus is ingenious, but its description suggests that some little mechanical skill may be necessary in adjusting and using it. The tell-tale spot of light would no doubt give its indications by trembling through a certain range on the scale, or giving a certain length of vibrational band, and any tremor or vibration in the instrument would be likely to increase the apparent amplitude of this band. It would, therefore, seem necessary that the apparatus should run very truly and smoothly in order to obtain reliable measurements. It would be interesting to have a report of an actual test with such an instrument and a comparison between the observed and calculated results.

Improved Illuminants.

It is now some years since the investigations of Langley on the light of fireflies aroused a keen interest in the possible improvement of artificial illuminants. The idea of "cold light" is a peculiarly attractive one, and workers in this field of investigation are many. But the problem has thus far been approached mostly from the electrical side; the chemical side, which is really a promising direction of attack, having been rather neglected. There is so much general misunderstanding of the physical problems involved in the production of "light without heat" that it is really pertinent and worth the while to look into them a bit. To begin with, any refractory solid when sufficiently heated emits light at first of the long wave lengths toward the red end of the spectrum, and then, as the temperature rises, more and more refrangible rays ending at the highest temperatures with the extreme ultra-violet rays quite invisible to the human eye and detected only by their chemical activity. Long before the body becomes perceptibly luminous it is hot to the touch, and is sending out large quantities of long heat waves, which grow more and more intense as the temperature rises and visible radiation begins. These heat waves can be easily detected by their very powerful effect on a thermo-pile or bolometer, and, indeed, can be photographed by the use of chemicals suited to the purpose, so that Abney actually photographed a teakettle of hot water by its own radiation. And the fundamental difficulty with heated solids as illuminants is that all the time they are also giving out a very large amount of invisible heat waves, and a smaller but very perceptible amount of ultra-violet rays.

The worst of the matter is that all solids behave very much alike with respect to their radiation when heated, so that in spite of minor differences in their radiating power we do not find any body showing light until it is sending out ultra-violet rays before it shows light. Only a few very rare substances show a marked tendency toward selective radiation of a kind that might prove practically useful. And even these do not give cleanly selective radiation, but merely show in their spectra points of maximum radiation producing bands brighter than the rest of the spectra. The only really hopeful process of improving the usefulness of heated solids as sources of light seems to be by driving up the temperature so that a somewhat larger proportion than usual of the radiation may lie within the limits of the visible spectrum. From this point of view, it becomes quite evident that no known substance gives much hope of very great efficiency in the sense of having a very large proportion of its total radiant energy of the visible kind. The more refractory the substance the higher the temperature to which it can be driven and the better the efficiency, but it will not be really high in any case. The most striking results along this line of operations have been the experiments on arcs formed between tiny pencils of such material as is used for the glowers of Nernst lamps.

A more interesting line of operations is that of which the Cooper-Hewitt tube, several times of late referred to in our columns, is a good example. We are glad to see from some patents recently issued and referred to in our issue of Jan. 25 that Mr. Hewitt is extending his lines of investigation into new directions that may obviate some of the obvious objections to a tube lamp. In the general type, the radiating body is a gas brought to incandescence by an electric arc or spark. Now, gases uniformly give the very condition one would like to secure with solids, i. e., selective radiation in a very marked degree. Their spectra are of bright bands or lines without a background of continuous spectrum. These radiation bands, however, extend into the region of dark heat, and also into the ultra-violet, so that there must still be waste energy from the standpoint of illumination, but not necessarily, though usually, in large amount. But the rub in this case is to get a good working amount of light out of incandescent gas. The Cooper-Hewitt lamp is an unusually successful attempt at getting this brilliancy, but it is worked at a pretty stiff temperature and its efficiency, small thanks to the ultra-violet and infra red radiation, is no greater than is obtained in the form of arc just referred to. Driving a gas to a brilliancy that gives a useful light seems to cause waste of energy. Very little if any work has been done on the distribution of energy in gaseous spectra under varying conditions, but such a line of research would give a great deal of valuable information regarding the possibilities of vacuum tube lamps. The use of gaseous radiating bodies seems, however, to be a more promising line of operations than driving up the temperature of solids, and we hope that other investigators who have been working on gas or vapor lamps, as several have, will soon give us the results of their labors. They have, of course, the difficulty of color to contend with, but perhaps to no greater extent than the early Welsbach burners, and in working with gases color can be far more easily modified than in the case of solids. But 100 per cent of efficiency is still afar off.

A. I. E. E. Annual Convention.

At the recent meeting of Council of the American Institute of Electrical Engineers, it was voted to hold the next annual convention June 24-27 at Great Barrington, Mass.

New York Central.

A bill has been introduced in the New York State Senate empowering the State Board of Railroad Commissioners in its discretion to set a date when the New York Central Railroad Company shall substitute electricity for steam in the Park Avenue tunnel. A similar bill was introduced in the Assembly by Chairman Rogers, of the Judiciary Committee. In the event that the bill compelling the Central to substitute electricity for steam passes, it is understood that the Central will present to the Legislature a bill giving it the right to construct an elevated road down Eleventh Avenue from a point below the Harlem River to Canal Street. If the Central can secure this concession, it will, it is said, abandon its Forty-second Street station and purchase property for a new station, either at Canal Street, Fourteenth Street or Twenty-third Street and Hudson River. It is said that the cost of this project would not be so greatly in excess of the cost of substituting electricity for steam that the Central would be glad of the opportunity to undertake it for the great advantages to be gained. The Central, it is said, in asking for the franchise to build a four-track elevated road on Eleventh Avenue, will make the claim that electricity will not give the desired safety in the tunnel, and that, therefore, the authorities ought to make it a concession which will enable it to do away with the tunnel dangers effectively. We learn, however, that the Central plans for electricity are being busily studied out.

Nernst Street Lamps in Farmington, Conn.

The Union Electric Light & Power Company, whose plant is located in the town of Farmington, Conn., is probably the first in the United States to adopt Nernst lamps exclusively for an extended system of street lighting. Unionville, the headquarters of this company, is a village in the town of Farmington, near the Farmington River, and about 10 miles from the main business section of Hartford. This village is reached from Hartford by the Farmington street railway, and is also on the line of a steam road. About two months ago the Union Electric Light & Power Company began the operation of an entirely new plant, and provided an extended system of street lighting with Nernst lamps. The generating plant of this company is driven mainly by water power, derived from the Farmington River.

The equipment comprises two three-phase generators, each with a capacity of 75 kw at 2400 volts and 7200 alternations per minute, one 27-inch horizontal turbine wheel and one steam engine of 100 hp capacity, with the necessary accessory apparatus. This machinery is housed in a new brick station of one story in height. From this station the Union Electric Light & Power Company supply public and commercial lighting in the village of Unionville and the Borough of Farmington, both of which are in the town of Farmington. Dynamos are belt connected to a shaft driven by the turbine wheel, or to the steam engine, according to the amount of available water power and the electrical load.

All energy is distributed from the station at the constant pressure of about 2400 volts, and is subsequently transformed to 224 or 112 volts constant pressure for street lighting and commercial service. For house lighting the 112-volt pressure is mostly used, but on business premises and for street lamps 224-volt lines are employed. Both street and commercial lighting are done from the same transformers and circuits, but an independent return is provided for street lamps so that they may be shut off independently of the commercial service. These independent return wires for the street lamps make it also possible to shut off all of those lamps connected to each transformer at a single point, instead of going to each individual lamp.

Nernst lamps to the number of 134 are now in use on this system for street lighting in the village and borough above named. Of these lamps, 120 have one glower each, and each consumes approximately 88 watts at 224 volts. The remaining 14 lamps are of the six-glower type, and each requires about 528 watts at 224 volts.

These street lamps are supplied from 12 transformers, located at different points about the town, and are connected to the same circuits that are used for commercial service. The greatest length of any 224-volt circuit supplying street lamps is a little less than one half mile from its transformer. Evidently this plant at Unionville is in a position to test the practical value of Nernst lamps for street lighting on a considerable scale, and the results of its experience should be of especial interest to managers of central stations.

Electrical Engineers of the Day—XXXII.

HENRY M. BRINCKERHOFF.

Henry Morton Brinckerhoff was born at Fishkill-on-Hudson, Dutchess County, N. Y. His technical education was received at Stevens Institute of Technology, Hoboken, N. J., from which he was graduated with the class of 1890. Upon graduation he entered the employ of the Thomson-Houston Electric Company in Boston, where he was put on construction work on the West End Street Railway of that city. There he served in various capacities, commencing as lineman's helper, and occupying nearly every position in line work, car equipment and power house operation. From November, 1891, to March, 1892, he was assistant engineer in the power house of the Utica Belt Line Street Railway. From the latter date, until July 1, 1892, he was engaged as foreman in charge of car equipment for the General Electric Company in Boston and on the Coney Island & Brooklyn Railway.



He thus supplemented a theoretical college education with two years as a workman in the various branches of electric railway work, which experience Mr. Brinckerhoff considers has been of the greatest value to him in after years. July 1, 1892, Mr. Brinckerhoff began his first work in heavy elevated electric railroading. At that time he was appointed assistant electrical engineer of the Intramural Railway at the World's Columbian Exposition, Chicago. In this position he assisted in designing and installing the electrical equipment on this the first third-rail elevated road of the country, and was joint patentee with the electrical engineer, Mr. C. H. Macloskie, of special apparatus designed for this system. During the operation of the road in the summer of 1893 Mr. Brinckerhoff had charge of the car equipment, power house and other electrical apparatus.

When the Metropolitan West Side Elevated road of Chicago decided to adopt electricity the following year, Mr. Brinckerhoff was naturally selected as one of the men best fitted to cope with the problem of equipping the first large elevated road for city transportation with electricity. On Aug. 1, 1894, Mr. Brinckerhoff entered the service of this company as electrical engineer, and as such had charge of the designing and installation of the electrical equipment for that road. Mr. Brinckerhoff has continued with this company ever since, having successively filled the position of superintendent of motive power and way, assistant general manager and, finally, general manager, which latter position he now occupies.

Mr. Brinckerhoff is a member of the American Institute of Electrical Engineers and of the Western Society of Engineers.



FIG. 1.—GENERAL VIEW OF SHAWINIGAN PROPERTY.

The Shawinigan Falls Electrical Development.

IN our issue of last week an outline description of the Shawinigan Falls power plant appeared, which we are now enabled to supplement with further information, particularly relating to the hydraulic portion of the plant, contained in a paper read Jan. 27 by Mr. Wallace C. Johnson, chief engineer of the plant, before the Canadian Society of Civil Engineers.

Mr. Wallace stated that the flow of water at Shawinigan Falls is seldom less than 20,000 cu. ft. per second, or sufficient to produce under the head available more than 200,000 effective horse-powers. As the St. Maurice River, flowing in a southerly direction, comes down to within about a half mile of the Falls, its course is diverted to the west and then to the north by some islands in the center of the river. The stream on the south side of these islands is very small; in fact, at the lowest stages of the river there is very little water flowing in it, but the stream flowing round to the north of the islands is quite rapid, and, having passed Melville Island, opens into a large bay, the area of which is something like 600 acres. Approaching the Falls there is a channel 1200 ft. long, about 600 ft. wide and about 20 ft. deep. At the crest of the Falls the water flows over a natural rock dam and then down in a southerly direction over the cascade, making a fall of perhaps 100 ft., then on toward the north in a narrow gorge through which the water rushes swiftly and in which there is a further fall of 50 ft., the water emptying into the lower bay which is over 1000 acres in extent.

The location of the entrance to the canal was chosen in this rather rapidly running stream at the crest of the falls, where the water is about 20 ft. deep, for the reason that at times of rather high water, when the ice is flowing out of the river, the current is expected to carry the ice past the mouth of the canal. The canal is about 1000 ft. long, 100 ft. wide and 20 ft. deep through the solid rock. The end of the canal where it comes out at the face of the hill is closed by a concrete wall into which penstocks are connected and from which the water is led down to the power house through the penstock pipes.

The means adopted for shutting the river out of the canal at the time of construction of the upper end of it was a cribwork cofferdam. This dam was built only of sufficient height to keep the water out at the lower stages of the river, which occur in winter time, the upper end of the canal being excavated in the winter time, and a higher crib dam was placed across the canal, further down toward the forebay, remaining in place during the summer. The lower end of the canal and the forebay were constructed during the summer season following. This forebay wall is 40 ft. high, about 30 ft. in thickness at the bottom and 12 ft. at the top. On top of this concrete wall are now set up hydraulic cylinders for lifting the headgates, and on top, covering the cylinders, is a brick gate house.

The cofferdam at the outlet of the tailrace was built of timber and post construction, and of such a slope that the weight of the water on the face of the dam practically held it in place, and very little loading with stone was required, the idea being principally to secure ease of removal. When it was ready to be taken out it was necessary simply to take the planks off and the timber out, when the whole thing floated.

The process of the manufacture of aluminum in use by the Pittsburg Reduction Company (the Royal Aluminum Company) requires the use of electric current in the form of direct current at 300 volts. This current is generated by special machines and fed directly to the furnaces. As the Reduction Company desire to have the generating of this current under their control, they have leased from the Shawinigan Water & Power Company power in the form of water delivered at the power house, which they have themselves built near the Shawinigan power house.

In the power house are two pairs of inward flow turbines, each pair developing 3000 hp. These turbines both take water from the same



penstock, each of them being connected through a 78-inch valve by means of which the water can be shut out of either wheel for examination or repairs without interfering with the operation of the other pair. To each pair of turbines two 1000-kw direct-current generators are direct coupled, one on each side. From the generators the current is taken directly to the furnace room, about 1000 ft. away, by conductors made up of aluminum rods 3/8 inch in diameter.

The power house and works of the Pittsburg Reduction Company have been built with a view to their extension to accommodate three

that purpose.

The penstocks by which the water is conducted from the forebay to the turbines are 9 ft. in diameter down to about 50 ft. from the turbines, where they enlarge to 11 ft. for the purpose of reducing the velocity of the water before it reaches the wheels. They are built up of soft steel plates, 5/8 inch thick at the upper end and increasing to 9-16 inch at the lower end. Each penstock is held against movement from expansion and contraction at the point where it passes through the wall of the power house. The wall is made 6 ft. thick at these points, and on each side of the wall, fitting closely to it, is a cast iron bracket 12 inches deep encircling the penstock and securely riveted to it. This is necessary because after passing into the power house each penstock opens into the side of the case of a pair of water-wheels.

Each waterwheel unit consists of a pair of "Francis" turbines on a horizontal shaft, capable of developing 6000 hp under a head of 125 ft. and running at 180 r. p. m. The wheel case is 16 ft. in diameter, and the distance between outside bearings is 31 ft. The runners are 6 ft. in diameter, and discharge through a central draft tube. They are made of gun-metal bronze, and the guide chutes of cast steel. The speed regulation is by means of gates in the draft tube, handled by a hydraulic governor. There is also a ring gate on the outside of the guides, by means of which the turbines will be stopped and started. This gate is operated by an electric motor, and is controlled by the operator at the controlling table on the switchboard gallery. This operator not only has the entire switchboard under his control, but all the waterwheels as well. To each waterwheel is direct connected a revolving field generator, capable of generating 3750 kw of electric current at 2200 volts, two-phase, and a frequency of 30 cycles.

Through a small penstock pipe water is supplied to two wheels, each of about 500 hp capacity, which will operate a direct-current generator for furnishing the exciting current for all of the generators in the power house. At present this wheel is running the machine which is lighting the buildings of the town, running our pumps and doing various other work beside furnishing current for the electric railroad and for operating the 50-ton electric traveling crane. The crane was erected in the power house before the roof, and was used as falsework on which to erect the roof trusses.

The power house will have a basement which will be below high water. On this account the lower part of the power house was built of concrete up to the window-sills, and it is expected that this will enable to be kept dry by means of a pump to take care of any leakage that may occur. The electric machinery is so arranged that it would not be disastrous to the working of the power house if the basement should be filled with water, although it would occasion some trouble and inconvenience. Above the level of the window-sills the power house is constructed of brick.

Along the bank of the Shawinigan River at its lower level is quit a tract of land, which is adapted for the building of mills desiring t use the water direct in wheels located in their mills rather than to l



FIG. 4.—A SECTION OF PENSTOCK

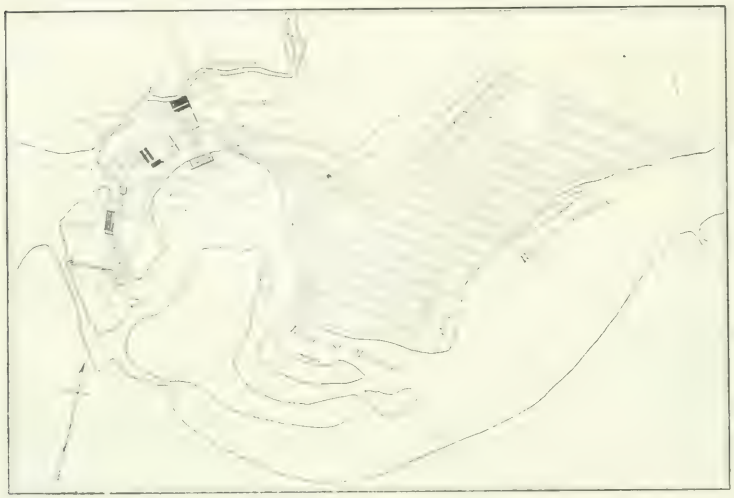


FIG. [illegible] OF SHAWINIGAN POWER AND [illegible]

furnished power by electric current, an particularly for the building of pap and pulp mills. The upper part of the S Maurice water-shed is well covered wi spruce timber. About eight miles abo perhaps the largest paper mill Canada is now in operation, and som thing over a year ago the Shawinig Company made a contract with t Belgo-Canadian Pulp Company by t provisions of which this company h proceeded to construct a pulp mill this lower ground, which is now in ope ation, and headworks have been co structed at this point on the north si of the upper bay by which water is tak through a narrow bank and down to t mill located on the Shawinigan Riv It is expected to extend the works rig along to the west, and to take water o for other mills, which we hope to loca further up the Shawinigan River.

The first thing which was done in t construction of the works for taking t water to this lower mill was the buil ing of a cofferdam. About 100 ft. o from the bank a cofferdam was bu about 250 ft. long, and from each e



FIG. 5.—ONE OF THE SIX PENSTOCKS

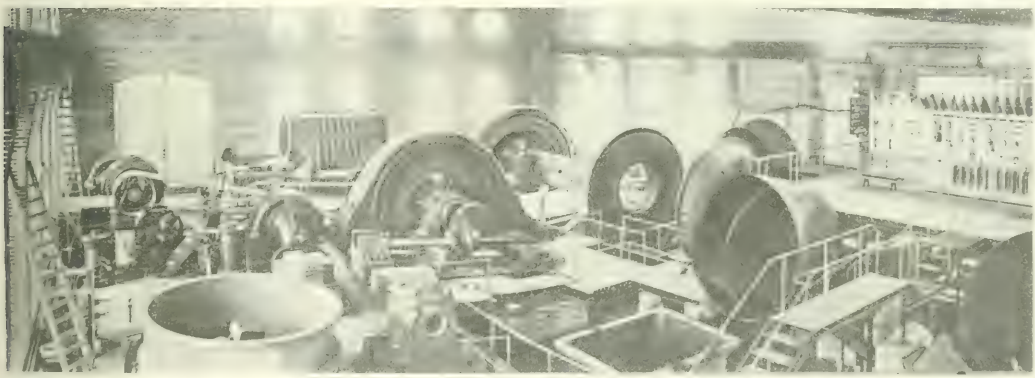
a crib joining into the bank and pumped the inside part between t front crib and the bank out dry, and built inside the walls. This i take being built of concrete and having to be built in the summ

e the cofferdam was necessarily built high enough to take care
e the high water, which occurs in the early part of the summer, and
vas, therefore, located in 40 ft. of water—quite an undertaking in
way of a cofferdam.
n this cofferdam there are two openings for two penstock pipes 12



Through this clay bank a tunnel was built and timbered up; the dimensions inside of the timbering being 18 ft., the penstock 12 ft.; that is, 3 ft. between the timbering and the penstock all round. This 200 ft. of tunnel through the clay bank was built without accident, and completed in one month from the time of starting the work on the tunnel. Having the tunnel completed and timbered the erection of the penstock pipe was commenced, beginning at the center. The ring in the center of the tunnel being erected first and then two rings put on to that in one direction, then concrete filled round while rings were being put on to the other side, the concrete gang going around to the other side and filling that while rings were being put on the other side.

The pipe was erected from the lower end, and the method which was adopted for supporting the penstock in this clay soil was as follows: Logs were laid close together along the trench lengthwise of it, and on top of these were cross beams supporting wooden saddles, which carried the penstock. About one-third of the way from the mill to the top of the banks, heavy anchorage of concrete was constructed, into which the penstock was fastened by means of cast iron brackets riveted around the penstock for holding it at this point and preventing any creeping due to expansion and contraction. About half way from this anchorage up to the tunnel is an expansion joint; between the anchorage and the mill are several bends in the pipe which give it sufficient elasticity to obviate the necessity of any expansion joint under the higher pressure; the expansion joint that ve used being for where there is only about 25 or 30 ft. head on the



ft. in diameter. The steel frames supporting the racks and affording guides for the gates were built complete by themselves, so they were erected before any concreting was done on top of a grillage of steel beams and concrete forming the base of this whole structure.

This concrete wall, 40 ft. in height, was obliged to be built upon a soft clay formation. The grillage was made of such an area that the pressure at no point exceeded 1½ tons per foot, which proved entirely sufficient, there having been no settling of the work at all. The wall was built of concrete with large rocks embedded in it.

This cofferdam was made a part of the permanent work. The water is taken through the cofferdam in 10 openings, about 8 ft. square, and the cofferdam itself is left in place as a protection against the ice. Only the part back of the racks is carried up to the full height. This represents the full height to which high water is expected to go. It is carried along about 5 ft. lower for a distance, then is stepped down still lower and brought eventually so that the inner slope of earth, which is intended to run from this wall to the railroad embankment about 35 ft. above, meets this lower wall, this wall being carried up high enough to guard the bank from the wash of the water as it comes in through the openings in the crib-work cofferdam.

On each side of this wall are two cut-off walls of concrete, which are built back and well into the bank to prevent the water coming around the end of the wall. This wall was built entire, and the head gates were in and very secure, in addition to the cofferdam, before any opening was made in the bank.



It may be remarked that incidental to the work which has been going on at Shawinigan Falls there has grown up a village of about 3000 inhabitants.

In the discussion which followed the reading of the paper, it was

asked if there are any conditions under which the penstock is likely to be emptied entirely of water, and if so, if provision has been made to prevent a collapse of the pipe. The member asking the question said he knew of a case where this occurred where the water was let out suddenly from the lower end of the pipe and the upper part closed, when the pipe collapsed for a considerable distance. It was, moreover, a very much smaller pipe than the Shawinigan pipe. In reply Mr. Johnson said that the collapse, of course, was due to the pressure of air on the outside, and that provision has been made for the entrance of air into the pipe as the gates close. In the main forebay there were five or six 12-inch pipes set into the masonry leading down to the front of the penstock back of the gates, and in the second forebay there is an opening about 3 ft. wide and some 12 ft. long, down which workmen can pass to the back of the gates and into the head of the penstock. With the penstock supported there is, of course, no danger of collapse except from the pressure of air on the outside when the penstock is empty not only of water but of air. The penstocks are often empty of air in the course of operation.



In reply to a question as to difficulty from ice, Mr. Johnson said that there had not been any as yet. Not much water is at present being used, but there has been no trouble whatever this winter

Replying to a question as to the power developed now, Mr. Johnson said the Pittsburg Reduction Company's power house is in operation and using 5000 hp; the Belgo-Canadian Pulp Company's pulp mill is in operation, using about 8000 hp, and the small wheel described is running in the power house. The large wheels are not yet in operation. One of the wheels is set up and about ready to start, and the other one is being set up. As to the concrete mixture used in the work, it was stated that a concrete of Portland cement has been used, and most of the proportions have been one of cement to three of sand. The proportion of stone has varied in different parts of the work. Where it was not necessary to be tight against water, as much as seven parts of stone have been used, but where it was intended that the work should be water-tight about five parts of stone were used

New York Electrical Society.

The members of the New York Telephone Company of the New York Electrical Society will be afforded an opportunity on the evening of Feb. 13 of inspecting the fine new "central battery" exchange at Cortlandt Street. Mr. John Carty and others will address the members.

Water Power Development in Colombia.

The Colombian Government has issued a report on the water power available in the republic. Colombian engineers have asserted that Colombia has more water power than any other country in the world. The report confirms this statement, which is abstracted in the *New York Sun*. Thus, within 20 miles of Bogota, the capital of the republic, there is more water power available than can be supplied by Niagara, the report says. Most of it comes from Tequendama Falls, near the city. These falls rank next to those of Niagara in volume, and have four times the height. More power can be drawn from Tequendama, it is said, than is at present used at both Buffalo and New York.

Colombian engineers even declare that it has been lucky for their country that railroads have never been extensively constructed there. With the immense water power at the service of the country the building of railroads for steam engines would have been labor lost. These engineers declare that the water power of Colombia is so great and so distributed throughout the republic that it can be utilized for the operation of electric roads in trunk systems even more extensively than steam power. As electric roads do not require the expensive grading and engineering that steam roads demand, it is pointed out that the loss of Colombia in the past through the absence of steam roads will be her gain in the future.

Most remarkable of all the possibilities pointed out by the Government's engineers are those connected with Bogota. This city, situated on an isolated plateau, has always heretofore been regarded as without means of progress. Owing to the steep acclivities of the plateau the building of railroads to Bogota has been declared impracticable. Now Colombian engineers come forward with a plan of not only saving the city from decadence, but of giving it better prospects than it ever expected.

At an expense of $1,000,000 they figure electric current equal to 200,000 hp can be generated at Tequendama and can be transmitted to Bogota at a loss of only 10 per cent. This vast power applied to the industries of the city will make it the most important manufacturing center on the South American continent. Electric roads to skirt the plateau of Bogota and connect with the navigable rivers can be built at a very small cost and operated inexpensively, bringing together a population of at least 300,000.

But the prosperity which would come to Colombia through the introduction of water and electric power would not be confined to Bogota. Within a radius of 50 miles from Bogota there are many waterfalls besides those of Tequendama. These falls, combined, are capable of generating as much power as Tequendama. For instance, the Magdalena River, 40 miles from Bogota Falls, in the course of 10 miles, a vertical distance of 200 ft. The great power derivable therefrom could be made to provide for the operation of electric roads for 150 miles, or far enough to connect them with other sources of power further on. To the east of Bogota, there are falls capable of generating power to operate electric roads to the Venezuelan frontier and to the head of navigation on streams emptying into the Caribbean Sea from Colombia.

But it is in the region known as the Mass of Colombia, where the great ranges of mountains come together, that the most remarkable waterfalls occur. With the exceptions of Niagara and Tequendama, these are the most valuable in the world. There, in a distance of 80 miles, the headwaters of the Magdalena River fall a distance of 7200 ft. The Cauca River descends over 8000 ft. in 70 miles without making a single precipitate plunge. It might also be said that the Mass of Colombia was upheaved in order to become the main power house of civilization. In the Mass of Colombia power can easily be developed to operate electric roads to the Pacific Ocean on the west, far beyond the Ecuadorian frontier on the south and very nearly to Venezuela on the east.

The northern part of Colombia is least provided with water power, yet it is more favored in this respect than most other regions of the world. While electric power would cost more to generate throughout Northern Colombia than elsewhere in the republic it can be obtained in quantities sufficient to supply a system of electric roads connecting the Caribbean shore with the interior. Along the Nechi River alone enough electricity could be developed to operate roads for hundreds of miles as well as mines, mills and factories.

The Wright Maximum Demand System.

By R. S. Hale.

REFERRING to your editorial on the Wright Demand System in your issue of Dec. 28, the statement, on the whole, is so clear and accurate that I wish to correct but one or two minor but very important points. The editorial says, "There must be considerable latitude in methods for charging for electricity, and while Mr. Wright's system sometimes works well, there are cases in which it might be disadvantageous against sharp competition."

Any inflexible system is at a disadvantage against sharp competition, and if some forms of the Wright system are used as an inflexible system they may be at a disadvantage; but it should be remembered that even if inflexibly applied, they will work better than any other inflexible system, and in some cases better than any other system whatsoever. Further, if it is found necessary to use a flexible system, one that can be changed to meet sharp competition, even then it is necessary for a station manager to follow the principles of the Wright system if he wishes to get his share of the profitable business. If a station manager is working on a contract system, so much per lamp per month or per year, he can best meet competition, not by cutting his rates to all his customers, but by cutting his rates to the short-hour customer. On a contract system it is the long-hour customers who are unprofitable, and the short-hour customers who pay the station a good profit. On a contract system the station gets enough for its fixed charges from each customer, but the long-hour customer uses more coal and costs the station more without paying more. In other words, the situation is the exact reverse of a meter system. If a manager is working on a meter system he will best meet competition, not by cutting his rates to all his customers, which will increase his unprofitable business as well as his profitable, but will cut his rates by giving a lower rate per kw-hour to the long-hour customers. Or, in a word, in both cases he will follow the principles of the Wright demand system if he meets the competition in the best way. Both of these methods of meeting competition are in exact accordance with the principles of the Wright system, and any station manager who fails to follow the principles of this system will do much of his business at a loss.

It is true, as you say, that a central station like any other business concern, must occasionally accept the situation and do a certain amount of business at a loss, but the less business that it does at a loss and the more business that it does at a profit, the better will be the net return to the stockholders; and the best way to reach the happy result of getting a reasonable profit on all the business will be to follow the principles of the Wright system in making up the scale of charges.

Another sentence in your editorial is also apt to lead to much misapprehension. The sentence is, "After all, the thing which counts when the books are balanced, is the average selling price of the product, and that must be kept where it will count against competition." I fear that there may be some of your readers who will understand this to mean the average selling price per kw-hour. What a central station plant really wants to sell, however, is not kw-hours, but the use of its plant for as many hours in the day as possible. A station that sold a million kw-hours every day in the year might do it at a loss, since it might require more than a million kilowatts of plant. A central station manager may make the price per kw-hour what he chooses, and if he makes it low enough may sell a great number of kw-hours, but if such sales are to short-hour customers, who require a big investment in plant, but leave that plant idle 90 per cent of the time, he will fail to earn a profit on the cost of the plant. He will make more money if he charges the short-hour customers a higher price, and then, if his competitor underbids him, he will use the plant these short-hour customers formerly monopolized, to supply the long-hour customers who may pay him a lower price per kw-hour, but will give him a better profit on the investment. It is no use to sell kw-hours at any price whatever unless the earnings show a net income above expenses and depreciation of $4 per $100 of investment, or, say, $20 to $40 net income per kilowatt of plant (maximum demand), for the ordinary small station.

Further, it should be noted that a scale of charges based on the Wright system will in many cases automatically adjust itself to meet competition of certain classes. For instance, the office building with light on all sides, which uses very little current except a few hours in the winter afternoons, finds the cost per kw-hour of its isolated plant high, and is willing to pay a high rate to the central station. On the other hand, the building with dark offices, or the power plant that generates current ten hours a day, finds the cost of current per kw-hour of its isolated plant comparatively low, but to such customers the Wright demand principles indicate a low rate and the Wright system gives it to them.

A central station must get a net return on its investment, and practically every central station that is doing many different kinds of business, such as power, supply residence lighting and street lighting, follows the principles of the Wright system in determinng the charges to these different classes of customers.

The details of the Wright system and the use of the Wright demand indicator help greatly in applying the principles of the system, and the cost of the indicator is far more than made up by its advantages; but neither the details of the system nor the use of the indicator are absolutely necessary in all cases.

It is very important, therefore, that central station managers should appreciate that whether they buy Wright demand indicators or not; whether they make two rates or discounts for long-hour customers, or special rates to special customers, they must, nevertheless, follow the principles of the Wright system to get the best results, must develop and encourage their profitable (long hour) business to the greatest extent, and should accept an unprofitable (short hour) business only as an advertisement or as a help towards getting really good business.

Magnetic Deflection of Long Steel-Wire Plumb-Lines

By Dr. Wm. Hallock.

IN the course of work in the very deep shaft of the Tamarack Mining Company on Lake Superior, it became desirable to plumb down two points to run off a cross cut to meet one started from another shaft. This was done in the latter part of last summer, and a very good account of the operation was given in the issue of Oct. 10, 1901, of the *Portage Lake Mining Gazette*.

The lines were of No. 24 piano wire, and the weights 50 lbs. of iron. At first they were 16.33 ft. apart at the top, but they were afterward moved to 17.58 ft. The remarkable observation was that in the first case they were 0.09 ft., and in the second case 0.07 ft. farther apart at the bottom than at the top. Naturally, the persons in charge were at a loss to explain the fact. The theory most persistently advanced was that the nearer wall pulled each bob toward it. Of course, this is not the case, for the potential in such a space is constant, and even if the attraction claimed were effective it would amount to only enough to move the bob less than 0.001 ft.

Being familiar with the very high magnetization found in the vertical casings in oil and gas wells it occurred to me that the observed deflection might be due to a magnetization of the wires and a consequent repulsion of the two north poles at the bottom. It will be remembered that the vertical component of the earth's field at Lake Superior must be about 0.9 (dip = 77 degs.), and a wire under such conditions of stretching and jarring and blending is in the best way to get magnetized.

A simple calculation will show, however, that the force of repulsion required is too great to be ascribed to a simple repulsion of the two poles at the ends of the wires, for any supposable degree of magnetization in such a wire, by such a field. It is, however, possible that the wires being not perfectly homogeneous would have consecutive poles along their length, and that these might add to the force, and, moreover, there are the masses of iron in the shaft in the way of elevators, ways, cables, etc., which would contribute one way or the other.

In order to test the possible applicability of this theory I made a number of experiments in the research shaft at Columbia University and have found much corroborative evidence.

A bar was mounted so that it could be rotated in a horizontal plane, about its middle point, and at one end a plumb line was placed which consisted of a fine copper wire carrying a non-magnetic bob. At the other end of the bar was another plumb-line, consisting of a soft iron wire about 0.02 inch diameter, with a similar bob. These plumb lines were 75 ft. long, and were about 4 inches apart, and their plane coincided with the magnetic meridian. Observation showed that the bobs were about 1-75 inch closer together when the iron was south of the copper than when it was north. In other words, the iron plumb line was pulled about 1-150 inch toward the north by the action of the horizontal component of the earth's field upon the iron wire.

The experiment was varied by taking two lines of the soft iron

wire, and measuring their distance apart at the top and bottom. Under these conditions the mutual repulsion gave a deflection of the same order as the pull of the earth's field.

Thus we undoubtedly have an effect upon the lines due to induced magnetism, but again too large to be due to a simple pole at the ends. It was consequently desirable to investigate whether there were poles along the line, and with a very small compass they were investigated along their whole length, with the following result:

wire.	*South wire.*	*North wire.*	*Effect.*
Top.....	Strong south.	Strong south.	Strong repulsion.
5 ft.....	Weak south.	Weak south.	Weak repulsion.
10 "	South.	South.	Repulsion.
15 "	Weak north.	South.	Weak attraction.
20 "	North.	North.	Repulsion.
25 "	North.	Neutral.	Neutral.
30 "	Weak south.	Neutral.	Neutral.
35 "	Weak north.	Neutral.	Neutral.
40 "	North.	North.	Repulsion.
45 "	South.	South.	Repulsion.
50 " bot...	Strong north.	Strong north.	Strong repulsion.

In the plumb lines the upper 25 ft. was of copper wire, that above the point referred to as the "top," in the above table, which is for the 50 ft. of iron wire forming the lower two-thirds in each plumb line.

The conclusion is evident. Iron or steel wire ought not to be used for plumb lines where accuracy is needed, as they are deflected by the earth's field as well as by each other. Probably phosphor-bronze would prove most available where great tensile strength is needed.

A New Apparatus for Measuring the Variation of Speed of a Flywheel During One Revolution.

By E. W. Mix.

CONSIDERABLE attention has of late been called to the problem of measuring conveniently the variation of speed during one revolution of a flywheel or revolving field of an alternating-current dynamo. The apparatus described herewith is very convenient for this work. The principle is the following:

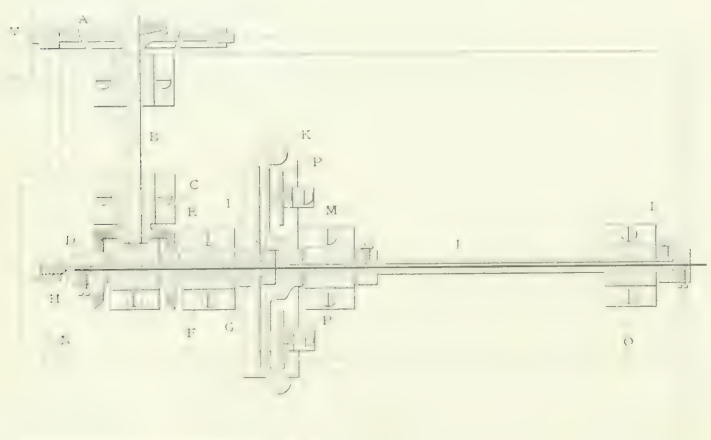


DIAGRAM OF APPARATUS FOR MEASURING VARIATIONS OF SPEED.

A small disk having considerable inertia is driven by means of a flexible coupling at a practically constant speed by means of the flywheel under observation, while a light aluminum disk is driven in the opposite direction at a speed proportional to the speed of the flywheel and obliged to follow all the variation of speed of the latter. These two disks are mounted side by side with their axes in the same line, and a radial slit is cut in each of them at the same distance from the center. When the two disks turn at exactly the same speed these two slits pass one another at the same point in space, but should one revolve faster than the other the point of passing of these slits will be displaced in one sense or the other, depending on which disk is revolving the faster.

By placing a lamp on one side of the disks and an opaque screen on the other a spot of light will be projected on this screen, and its displacement can be easily observed.

If, now, the aluminum disk be driven with an angular velocity, say, 40 times as great as that of the flywheel whose variations in speed are to be observed, and the disk with high inertia be driven by means of a flexible coupling from the same flywheel, the relation between the inertia of the disk and the flexibility of its coupling being such that the former will revolve at practically constant speed and proportionately to the mean speed of the flywheel, then the spot of light on the screen will move back and forth through an angle 40 times as great as the angular variation of speed of the flywheel. By thus multiplying the angular variations the measurements can be made with great accuracy.

The illustration herewith is made from a scale drawing of the apparatus as actually constructed. In this figure *V* represents a section of the rim of the flywheel, whose variations of speed are to be measured. The small disk or wheel *A*, made with as little inertia as possible, is provided with a rubber tire so as to be driven by friction against the rim of the flywheel. This wheel is mounted on one end of a shaft *B*, carrying at the other end a conical pinion *C* which drives two other conical pinion *D* and *E*, having an equal number of teeth.

The pinion *E* is mounted on one end of a hollow shaft *F*, which carries at the other end the light aluminum disk *G*. The pinion *D* is mounted on one end of the hollow shaft *H*, passing inside the shaft *F* and carrying at the other end a collar provided with a lug *I*. The disk *K*, provided with a heavy rim so as to give it considerable inertia, is mounted on one end of the hollow shaft *J*, the latter being mounted in line with the shaft *F*. The other end of *J* is provided with a collar *L* which can be fixed on the shaft, by means of a screw, in any angular position.

A small steel wire passes through the two hollow shafts *H* and *J*, one end being fastened by a screw in *H*, the other being held in the collar *L*. By twisting more or less this steel wire by means of the collar *L* the necessary turning moment for driving the disk *K* can be obtained. Inside the cavity in the hub of the disk *K* is a little lug *M*, which can come in contact with the lug *I* fixed to the end of the shaft *H*. By means of these two lugs the disk *K* can be brought up to speed without undue strain on the steel wire which normally drives the disk *K*.

The slits in the two disks are shown in line with the points *N* and *O*, *N* representing a lamp and *O* the eye of the observer. *P* is a ground glass circular scale divided into degrees of a circle on which the angular displacements of the spot of light produced by the passage of the slits in the two disks one before the other can be observed.

In case the rim of the flywheel under observation does not turn perfectly round it is necessary to make a flexible extension to the shaft *B* on which the driving disk *A* is mounted, so that this disk can follow the rim without being obliged to compress too much the rubber tire, as in the latter case the resultant circumference of the disk *A* would vary at different angular positions of the flywheel and so produce errors of observation of the same order as the angular variation of speed to be measured.

Should it be desired to register the variation of speed, this can be done by slightly separating the two disks *G* and *K*, and introducing between them a satellite pinion driven by two conical pinions, one mounted on each of the disks. An index carried by the axis of this satellite pinion can be made to describe a curve on a piece of paper driven before it at a uniform speed as is done in a recording ampere-meter.

The National Bureau of Standards.

In a circular just issued the National Bureau of Standards gives n account of its inception and organization, and an outline of the :ork it is at present prepared to perform for the public.

By an act of Congress approved March 3, 1901, the Office of Stand- rd Weights and Measures of the Treasury Department was, on July , 1901, superseded by the National Bureau of Standards, the func- ions of which are as follows: The custody of the standards; the omparison of the standards used in scientific investigations, engi- neering, manufacturing, commerce and educational institutions with he standards adopted or recognized by the Government; the con- :truction, when necessary, of standards, their multiples and sub- livisions; the testing and calibration of standard measuring appara- us; the solution of problems which arise in connection with stand- ards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient ac- curacy elsewhere.

The Bureau is authorized to exercise its functions for the Govern- ment of the United States, for any State or municipal government within the United States, or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuit requiring the use of standards or standard measuring instruments.

For all comparisons, calibrations, tests or investigations, except those performed for the Government of the United States or State governments, a resonable fee will be charged. Provision is also made for the purchase of a site and the erection of a suitable labora- tory, its equipment with the most improved facilities and the person- nel necessary for the organization of the Bureau.

A suitable site has been selected in Washington in a locality free from mechanical and electrical disturbances, and yet easy of access. Plans are being prepared for a physical laboratory which will be equipped with apparatus and conveniences for carrying on investi- gations, and for testing standards and measuring instruments of all kinds. Also a somewhat smaller building, to be known as a mechan- ical laboratory, which will contain the power and general electrical machinery, the instrument shop, refrigerating plant, storage batteries, dynamos for experimental purposes and laboratories for electrical measurements requiring heavy currents.

The construction of the buildings will be pushed as rapidly as possible, and it is expected that they will be ready for occupancy by Jan. 1, 1903. For the present, additional quarters have been secured in the building occupied by the former Office of Standard Weights and Measures, with a view to the organization of the Bureau and the immediate development of the more needed extensions of the work heretofore carried on, such as photometric measurments, the testing of instruments for determining high or low temperatures, clinical thermometers, chemical glass measuring apparatus, electrical ap- paratus used to measure alternating currents, pressure gauges and meteorological instruments.

For the present, however, the work of the Bureau will be limited to the comparison of the following standards and measuring instru- ments, either for commercial or scientific purposes:

Length Measures.—Standard bars from 1 to 10 ft., or from 1 decimeter to 5 meters; base bars, bench standards, leveling rods, graduated scales, engineers' and surveyors' metal tapes, 1 to 300 ft., or from 1 to 100 meters.

Weights.—From 0.01 grain to 50 lbs., or from 0.1 milligram to 20 kilograms.

Capacity Measures.—From 1 fluid ounce to 5 gallons, or from 1 milliliter to 10 liters.

Thermometers.—Between 32 degs. and 120 degs. F., or 0 deg. to 50 degs. C.

Polariscopic Apparatus.—Scales of polariscopes, quartz control plates and other accessory apparatus.

Hydrometers.—Alcoholometers, salinometers and saccharometers, whose scales correspond to densities between 0.85 and 1.20.

Resistances.—Standard coils of the following denominations: 1, 2, 5, 10, 100, 1000, 10,000, 100,000 ohms; low-resistance standards for current measurements of the following denominations: 0.1, 0.01, 0.001, 0.0001 ohm. Coils of resistance boxes, protentiometers, ratio coils.

Standards of Electromotive Force.—Clark and other standard cells.

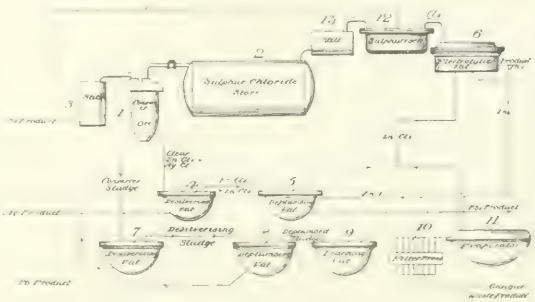
Direct-Current Measuring Apparatus.—Millivoltmeters and volt- meters up to 150 volts; ammeters up to 50 amperes.

It is the desire of the Bureau to co-operate with manufacturers, scientists and others in bringing about more satisfactory conditions relative to weights and measures in the broader meaning of the term, and to place at the disposal of those interested such information rela- tive to these subjects as may be in possession of the Bureau. All communications and articles should be addressed "National Bureau of Standards, Washington, D. C."

Reduction of Complex Sulphide Ores.

A patent to James Swinburne and Edgar Arthur Ashcroft issued under date of Jan. 28, relates to a process designed for the treatment of those complex sulphide ores which have so long proven a stum- bling block to metallurgists. The process is cyclical in character and simple in theory. Its chief novelty lies in the use as a chlorinating agent of chloride of sulphur, S_2Cl_2, applied in gaseous or liquid form to unroasted sulphide ore held in suspension in fused chloride of zinc.

The accompanying diagram will render clear the operation. The ores, for example, the Broken Hill sulphides carrying zinc, lead and silver, are held in suspension in molten chloride of zinc in the vessel 1, while chloride of sulphur is injected from the drum 2. The reaction, which is said to proceed readily, yields sulphur which is condensed in the "still" 3; mixed chlorides of the metals, which, after purification from iron and manganese, are desilvered in the vat



APPARATUS FOR REDUCTION OF SULPHIDE ORES.

4 by lead, deplumbed in 5 by zinc, and passed, still molten, to the electrolyzer 6; and a sludge consisting of the ore gangue mixed with molten chlorides. This sludge is desilverized and deplumbed in vats 7 and 8 by successive treatments with lead and zinc, and the re- sultant zinc chloride leached from the gangue, filtered, and evapor- ated with the addition of an alkali metal chloride, the resulting anhydrous double chloride of zinc and the alkali metal passing also to the electrolytic tank. Here the fused salt is electrolyzed with insoluble anodes, the zinc being collected, and the chlorine utilized in the "sulphurizer" 12 for the production of further quantities of the chloride of sulphur. This chloride, condensed at 13, returns to the reservoir 2, thus completing the cycle.

The process is thus regenerative in character, yielding zinc as pure metal, silver as a rich bullion, lead as metal or in alloy with zinc and sulphur. Concerning the velocity of the initial reaction and its completeness, no definite or satisfactory information is given, and these are crucial points.

Chicago Telephony.

Chicago druggists who have had the automatic dime-in-the-slot telephone pay stations in their stores for the benefit of the public are raising a protest against the nickel-in-the-slot party-line telephones which are being installed in such great numbers all over the city, as the nickel-in-the-slot business is said to be lessening the income of the dime telephones with a consequent reduction of druggist's com- mission. The druggists object to a discrimination of 5 cents against the individual circuit telephone in their stores, claiming that the ma- jority of people do not care to pay 5 cents extra for the privilege of talking over an individual in preference to a party-line telephone.

The Economic Design and Management of Telephone Exchanges—VII.

By ARTHUR V. ABBOTT, C. E.

III. DETERMINATION OF THE TELEPHONIC CENTER.

THIS demonstration of the preceding article gives rise to a very facile method for ascertaining the telephonic center for any given city. On any fairly good map, plot the location of existing or prospective subscribers. Find the total number thereof, then place a ruler parallel to one of the prevailing street directions, and move it over the map till it has crossed one-half the number of subscribers. A line drawn by the edge of this rule will be one axis. Place the rule at right angles to the first line and repeat the process, obtaining the second axis, with the telephonic center at the intersection of the two. To illustrate this method, refer to Fig. 3, in which

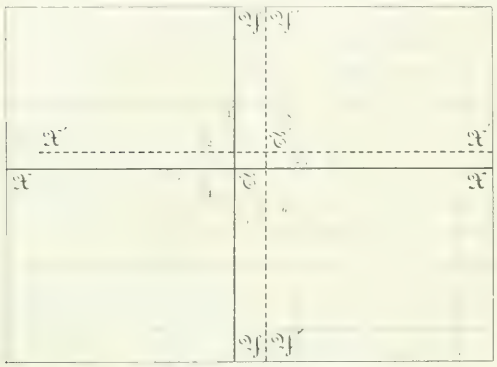


FIG. 3.—DETERMINATION OF TELEPHONIC CENTER.

the small black circles represent groups of subscribers. One subscriber is assumed to be placed at each of the points 1, 2, 3, 4, 5, 6, 7 and 8, but the reasoning is the same for any number of subscribers at these points. Assume the lines of the section paper to represent the prevailing direction of the streets. Then, by the preceding rule, the line $Y\ T\ Y$ must be drawn parallel with the lines of the section paper, and in such a location as to place four subscribers on the right hand of it, and four on the left hand. Similarly, the line $X\ T\ X$ must be drawn at right angles to $Y\ T\ Y$, and at such a location as to place four subscribers above the line and four below it. Then T is the telephonic center, $Y\ T\ Y$ and $X\ T\ X$ are the axes, shown in full black line in the figure, and the sum of the perpendicular distances from $Y\ T\ Y$ and $X\ T\ X$ to 1, 2, 3, 4, 5, 6, 7 and 8 is less than the sum of the same distances to any other pair of lines that can be drawn parallel to the section paper lines.

In this illustration subscribers 1 and 5 and 3 and 7 are supposed to lie infinitely near the axes of Y and X, respectively, but on opposite sides of these lines, so that if either line were moved slightly in either direction it would pass across one subscriber. Now, suppose the axis Y to shift parallel to itself one unit, say, to the right, then the perpendicular distances to subscribers 1, 2, 3, 4 and 5 will be *increased* one unit each, and the distances to 6, 7 and 8 will be *decreased* one unit each. There will, therefore, be a total gross increase of five units, and a decrease of three units or a net increase of two units to the total mileage of all subscribers from this axis. Assume that the amount that the axis is shifted *decreases* till it is equal to the smallest assignable quantity, then the net increase in mileage will correspondingly decrease, but it is evident that so long as the motion of the axis is greater than zero the increment to the mileage will be a positive quantity greater than zero, hence the position $Y\ T\ Y$ gives a minimum mileage. The same reasoning may be applied to the position of $X\ T\ X$, thus proving that T is the telephonic center. In Table 2 the perpendicular distances of the subscribers from the axes, in terms of the ruling of the section paper as a unit, is given both for the location through the telephonic center and a new location at $X^1\ T^1\ X^1$ and $Y^1\ T^1\ Y^1$, shown in dotted lines. In this example the Y axis was shifted ten divisions of the section paper, and the X axis five. The resulting increase in mileage is 30 units, but if the motion of either axis is varied in any amount, it is easy to see that the mileage increment will be proportionally changed.

TABLE II. COMPARISON OF WIRE MILEAGE FOR FIG. 3.

Subscriber's number	Distance from. $Y\ /\ Y$	$X\ /\ X$	$Y^1\ T^1\ Y^1$	$X^1\ T^1 X^1$
1	0	19	10	14
2	9	9	10	4
3	10	1	20	5
4	9	6	19	11
5	0	14	10	19
6	14	9	4	14
7	10	0	0	5
8	14	13	4	8
Totals	84	70	104	80
		84		104
Total distance from axes		154		184
				154
Increase				30

If there are an uneven number of subscribers in the territory the preceding rule of drawing the axes in such a manner that numerically one-half the subscribers lie on each side of each axis still holds true. For, in order to place an *equal* number of subscribers, one *each side* of *each axis*, each axis must pass *through* at least one subscriber. When a subscriber is located *on an axis* the *distance* from that axis to the subscriber becomes zero, and the function of x or y, as the case may be, vanishes, and in so far as the axis under consideration is concerned the subscriber vanishes, and thus the condition of (Eq. 22) holds true for those that remain, requiring one-half the *balance* to be placed on each side. To illustrate, turn to Fig. 4. As-

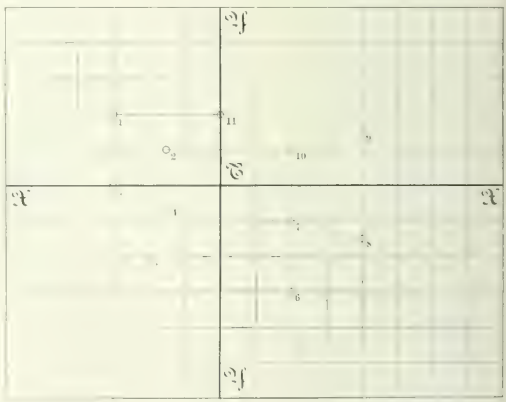


FIG. 4.—DETERMINATION OF TELEPHONIC CENTER.

sume the plane of the paper to represent any territory, and the black circles numbered from 1 to 11, inclusive, to stand for the subscribers, one at each point, and that the section paper lines coincides with the general direction of streets. Enumerating the subscribers 11 are found. To locate the line $Y\ T\ Y$, so that there shall be an equal number of subscribers on each side of and parallel to the section lines can only be done by drawing it to pass through No. 11. $X\ T\ X$ must be drawn perpendicularly to $Y\ T\ Y$, and so situated as to place half the subscribers above the line and half below it. This can only be done by drawing it through No. 3, and the telephonic center is found at the point T. In this illustration the ordinate of No. 11 is 20, using the squares of the section paper as units, and the abscissa 0, and for No. 3 the ordinate is 0 and the abscissa 30. Now, by reasoning in a similar manner to that used in the preceding example it is easy to see that if either axis, say, $Y\ T\ Y$, be shifted, say, one unit to the right and abscissæ to Nos. 1, 2, 3, 4, 5 and 11 will be *increased* one unit each, while the abscissæ to No. 6, 7, 8, 9 and 10 will be *decreased* one unit each. Hence there will be a gross *increase* of six units and a gross *decrease* of five, or a net increase of one unit. The same argument applies equally to the other axis. So the shifting

of either by any assignable quantity in either direction causes a positive increase in the sum of all the perpendicular distances of the subscribers from the axes.

It is now desirable to consider the application of this method to such distributions of subscribers as are commonly encountered, together with some special cases that are of interest. In Fig. 5 is given an example of the solution of the problem of finding the telephonic center under conditions that probably most frequently ob-

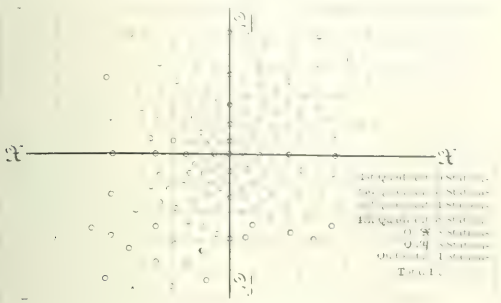


FIG. 5.—DETERMINATION OF TELEPHONIC CENTER.

tain, that is, a group of subscribers distributed over an approximately circular area in which the subscribers' density, or number of subscribers per unit of area, is greatest at about the center of the territory, and decreases with sensible regularity in all directions toward the circumference. In all the following examples the section lines indicate the prevailing directions of the streets, and consequently that of the axes, while the small circles represent the subscribers. In this case there are 153 subscribers, and according to the preceding principles the axis y must pass through one subscriber, and put 76 on the left hand and 76 on the right hand. On trial, however, it is found that the nearest approximation that can be made is to draw Y through nine stations, leaving 144 to be divided between the two sides, and the line is so located as to place 72 on each side of it. The axis of X is located in a similar manner. After the axes are drawn, it seems that there are thirty stations in the upper left-hand quadrant, five on the axis of y above the axis of x, 37 stations in upper right-hand quadrant, four stations on x to the right of y, 31 stations in the lower right-hand quadrant, three stations on y below x, 38 stations in the lower left-hand quadrant, four stations on y to the left of x, and one station at the telephonic center.

Take the distribution illustrated in Fig. 6. Here the stations fall

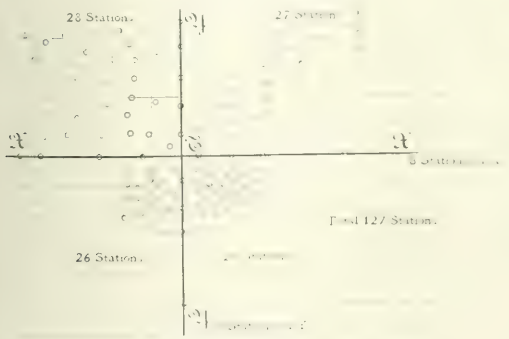


FIG. 6.—DETERMINATION OF TELEPHONIC CENTER.

into four irregular lots—two small compact groups, and two in which the density is low, one nearly rectangular in outline and the other long and linear. There is a total of 127 stations. The nearest approximation that can be made is to draw y y so as to cut nine stations, putting 58 on the left side and 60 on the other, and x x to cut eight stations, placing 60 above this axis and 59 below, giving the telephonic center T at the intersection of the two lines. To test the correctness of this location, suppose y y to move one unit to the right, then the distance to the 58 stations to the left will be increased one unit. As the axis has moved one unit away from the nine stations that it previously cut, the mileage to each of them will be increased one unit, or there will be a total increase of 67 units. The motion of the axis will be toward the 60 stations on the right of it, hence there will be a decrease of 60 units on this side, or a total net increase of seven units. In the same manner, it is easy to see that if x x moves one unit, say, upward, there will be an increase of seven units. Hence, neither line can move any assignable quantity without increasing the mileage.

When, therefore, such considerations as are thus illustrated are taken into account, the rule for locating the telephonic cetner is as follows: Draw a line through the group of stations parallel to one of the given directions, at such a location as will place as nearly as possible half the subscribers on one side and half on the other. Draw a second line perpendicular to the first at such a place as will again place as nearly as possible half the stations on one side thereof and half on the other. The telephonic center is at the intersection of the two lines.

Switch Operated by Compressed Air in the United States House of Representatives.

During the last few months the House of Representatives, at the National Capitol, Washington, has been equipped with an entirely new ventilating and heating system consisting of a number of large steel fans driven by electric motors and new steam coils, controlled by the system of temperature regulation, installed by the Johnson Electric Service Company, of Milwaukee, Wis. This system con-



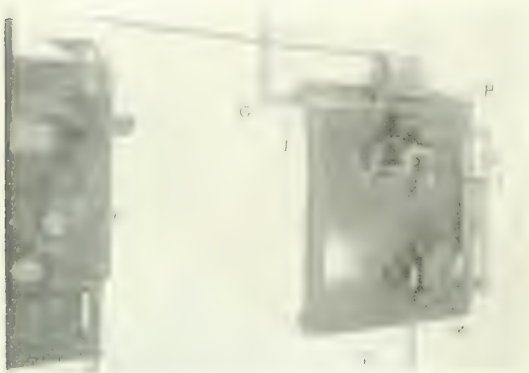
FIG. 1.—MOTOR DRIVEN AIR COMPRESSOR.

sists, essentially, in controlling steam valves and dampers through the means of thermostats located in various places in the House wing of the Capitol, using compressed air as the motive power. A pressure of about 15 lbs. of air is sent to the thermostats. By means of expansion or contraction of the two metals of which the thermostat is made, the compressed air is controlled, and is of sufficient force to move any valve or damper of whatever size. The compressing plant is shown in Fig. 1, in which A is a power air compressor of neat design, placed on a solid cement concrete foundation. This compressor is unique, in the sense that the cylinder is oscillating on center trunnions, these trunnions being hollow, so that the incoming air with that which has been compressed passes out through the trunnions. Compressor A is connected by a belt to a series-wound motor B. The motor B has a normal speed of 600 r. p. m., which low rate in so small a motor is secured by winding a large frame to half its normal rated horse-power. This becomes necessary, as an air compressor cannot be properly operated at too high a speed, and a reduction of speed from a motor through a series of belts would be impracticable in many ways.

C is a speed regulator for the motor. The air after being com-

pressed, is stored in the cylinder *D*, from which it is supplied to various parts of the building as required.

E is a supplementary hydraulic air compressor which may be used in an emergency. Another unusual feature of the air compressing plant is the governor *F*, which is shown in more detail in Fig. 2. A normal air compressor, from 13 to 15 lbs., is necessary for operating the various heating appliances. There must be, therefore, some means of stopping and starting the motor or a safety valve for releasing the air above normal pressure. The latter method would be wasteful, since the motor would be running continuously at full load. In order to prevent this, the governing apparatus *F* has been provided. *G* is an air pipe leading from the reservoir *D*, and connected to a peculiar pneumatic apparatus enclosed in *H*. When the pressure of 15 lbs. is reached, this pressure enters the chamber *I*, and pressing down



upon the lever *J*, through the means of a diaphragm *K*, expands the retractile springs *L* and opens the rotary switch *M*, thus stopping the motor. When the pressure in the reservoir *D* falls to 13 lbs. per square inch, the pneumatic mechanism in *H* exhausts the air from the chamber *I*, relieving the pressure on the lever *J*. The retractile springs *L*, then throw the switch in the opposite direction and close the circuit. This rotary switch is four-poled, and the movements which it makes, both in closing and opening circuits, are instantaneous, hence no burning at the poles can ever occur. The apparatus is very compact, entirely automatic, and in operation is nearly noiseless. It can be seen at a glance that the field of usefulness of this governor is a wide one, especially in plants using a number of compressed air valves for regulating purposes.

A Report Against Municipal Ownership at Worcester, Mass.

At Worcester, Mass., a report of the joint standing committee on street lighting against the proposed plan of municipal ownership has been filed with the city council. After investigating the conditions in many other cities, the committee found a certainty of increased cost over the present contract rate, if municipal ownership were adopted, and recommended that it was not expedient to establish a city electric light plant. The committee asked the following 29 questions:

1. Date of installation? 2. Original cost of plant? 3. Cost of plant to date? 4. Was the plant paid for by bonds? 5. What interest is paid? 6. What part of above investment is used for street lighting purposes exclusively? 7. Number of street lights used in 1900? 8. How many hours did they burn? 9. What candle-power are the lamps? 10. Are they open or closed arcs? 11. What motive power is used at your station? 12. What fuel? 13. Price of coal per ton of 2200 lbs.? 14. What did your street lights cost per lamp during 1900? 15. Does this cost include any expense outside the station? 16. If so, what items? 17. Does this cost include interest on bonds? 18. If so, what amount? 19. Does this cost include any depreciation? 20. If so, what amount? 21. Does it include anything for taxes lost? 22. What is the tax rate in your city? 23. Is the electric lighting plant run in connection with any other city department? 24. If so, how is the cost of maintenance divided? 25. Was your city lighted by electricity previous to the installation of your own plant? 26. How many lamps were furnished under contract? 27. What price was paid per lamp-year? 28. What candle-power were the lamps? 29. How many hours per year did they burn?

The resultant report in full is as follows:

In considering the subject matter under this order, your committee has endeavored to discover, first, the results attained by cities already owning municipal electric light plants, as shown by their cost per lamp-hour of street arcs; and, second, the probable cost to the city of Worcester of the plant of the Worcester Electric Light Company and the cost of maintaining this plant under municipal control.

As the cost of fuel, hour of burning and electric energy used in the lamps differ in nearly every city, as the items of interest paid on account of the plant, depreciation of machinery, etc., and of taxes lost, are usually ignored in the printed reports sent out from these plants, and as it is necessary to figure these costs upon a Worcester basis, in order to reach an intelligent conclusion in comparing the results arrived at in other cities with our own, your committee caused blank inquiries sent to 50 cities and towns owning and operating municipal lighting plants, outside the state of Massachusetts (see above).

The territory covered by these inquiries included practically the entire United States, and the replies were expected to clearly indicate the local conditions and cost of street lighting in the municipal plants of this country.

Unfortunately for this purpose, 17 cities only replied to the questions asked; of these 17, the replies received from nine were so incomplete as to render the data of no value, leaving only eight plants, outside the State, the data from which were sufficient as to be of use in making this report.

The cost of street lights as reported by these eight cities, plus the difference in cost of coal in these cities and in Worcester, plus the items of interest paid, depreciation and taxes lost (which were omitted in every case), show the average cost per lamp-hour would be 3.4 cents if the plants were located in this city and burned on our schedule.

Inasmuch as the price paid by this city for street arcs is 2.8 cents per lamp-hour, or .6 cent cheaper than the cost of the same light, burned under equal conditions, in the municipal plants outside the State, your committee took up the municipal plants within the State.

Massachusetts cities and towns owning their own lighting plants are obliged to keep their books according to a system adopted by the State Board of Gas and Electric Light Commissioners and to charge items of expense to the general account designated by the board.

This system is identical with that prescribed by the board for the companies, and affords the only correct basis of comparing the costs of the municipal plants and the companies.

The average cost per lamp-hour of the street arcs furnished by the municipal plants in this State, as shown by the reports of the board is 4.34 cents, while the price paid in this city is 2.8 cents per lamp-hour since July 1, 1901. It must not be forgotten that, with two exceptions, the municipal plants in Massachusetts burn a 300-watt lamp, while we use a 500-watt lamp in this city.

Adding the cost of coal necessary to produce a 500 instead of a 300-watt lamp, the cost per lamp-hour would be increased from 4.34 to 4.58 cents, a sum very nearly double that now paid for street lights.

It is undoubtedly true that the cost of street lights in the cities of this State, operating municipal plants, is largely affected by the amount of commercial business done by the plant, as a large deficit in commercial operation adds to the original cost of the street lights, while a small deficit, in commercial lighting, correspondingly lessens the cost of the street service.

It is also true that the condition and amount of commercial business in this city would be more favorable to the success of the plant than in many cities of the State, for the reason that the commercial business taken by the city, with the plant of the Worcester Electric Light Company, is relatively greater, when compared with the street lighting, than that done by many municipal plants noted.

In Taunton the ratio seems to be very nearly equal to that in this city.

Taunton has 227 street lights and the equivalent of 5046 16-cp commercial lamps, while Worcester has 700 street arcs and a commercial business of 10,000 16-cp lamps.

From data supplied this committee by the officers of the Taunton plant, the following facts appear:

The plant was purchased July 1, 1897, at a cost of $125,000. The

investment in the plant to date [illegible] to $152,000. $26,000 having been added during 3½ years.

They have 227 street lights of 1200 cp burning 3900 hours per year, the reported cost of which is $72.96 per lamp-year. Reducing this reported cost to Worcester basis as regards the price of coal, adding taxes lost and the additional coal necessary to burn 2000 instead of 1200 candle lamps, the cost per lamp-hour would be 2.85 cents, as against our price of 2.8 cents, and it is no secret in electrical circles that the city of Taunton will soon be obliged to spend at least $50,000 on their plant, in order to bring it up to the duty required of it.

The additional requirements for interest, etc., made necessary by this investment, will increase the cost of street arcs in Taunton to 3 cents per lamp-hour.

That the consideration of this matter of municipal ownership is not new to the cities in this State, but has been thoroughly investigated by business men from a business point of view, is shown by the action of the city of Boston.

After a thoruogh investigation of the matter during Mayor Matthews' administration, in which several estimates of both cost and maintenance were made, a contract was made by Mayor Quincy for 10 years' service on a sliding scale ranging from 35 cents per light per night for 2749 lamps to 30 cents for 5000 lamps, all lights to use 500 watts energy and to burn, as in this city, 3900 hours per year.

The town of Brookline, too, after careful inquiry into the probable cost of electric street lights under municipal ownership, conducted by experts of the highest standing, contracted for 500-watt lamps burned 3900 hours per year, costing 35 cents per light per night.

The city of Springfield investigated the subject of municipal ownership; and, after careful consideration, renewed its contract with the local company.

On the other hand, the town of Hudson acquired its electric light plant under the law, and their cost per lamp-hour, for the lights used on their streets, is more than three times that paid in this city.

The experience of the town of Wakefield has its lesson, according to data furnished this committee by the municipal plant of that town, the price formerly paid under contract was $75 per lamp-year for 1200-cp lamps burning 5½ hours per night. Their plant was established in 1894 at an original cost of $164,000. The investment in the plant to date is $180,000. They use 1200 candle lamps burning six hours per night, and the reported cost is $74.68 per lamp-year. The town, plainly, loses the taxes formerly paid by the corporation, which amounts to $12.14 per lamp-year, making their true cost $86.82 per lamp-year with the municipal plant, as against $75 per lamp-year under contract, the burn being practically the same.

It has been noted that the local conditions in Worcester are different, in some respects, from those existing in many cities of the State where municipal plants have been established.

The really important point, then, is the probable cost of acquiring the Electric Light Company's plant and the cost of operating it when it is acquired.

The exact wording of the paragraph of Chapter 370, Acts of 1891, which fixes the value of plants taken, is:

"And the price to be paid therefor (i. e., the existing plant) shall be its fair market value for the purposes of its use, no portion of such plant to be estimated, however, at less than its fair market value for any other purpose, including, as an element of value, the earning capacity of such plant based upon the actual earnings being derived from such use at the time of the final vote of such city or town to establish a plant and also of any locations or similar rights acquired from private persons connected therewith."

Your committee have been unable to obtain a construction of this paragraph from the City Solicitor, and, after careful consideration and consultation with several parties of practical experience in transactions of this sort, can see no other fair interpretation of the above quoted statute than that the probable value of the plant is indicated by the market value of the company's stock at the date of the final vote in favor of the taking, as the investing public take all the elements of value named in the statute into consideration in naming the price which they are willing to pay for shares in the company. In this case, the stock of the Worcester Electric Light Company is worth at least $210 per share, that being the price at which the last issue sold in open market. The company is capitalized for $600,000, and has no bonds outstanding.

This makes the property worth, according to the judgment of investors, $1,260,000, which is the minimum amount the city would probably be obliged to pay for the plant if taken under the statute.

The legal requirements for interest, sinking funds and depreciation aggregate 12 per cent of this amount or $151,200 per year, as the minimum of fixed charges which must be earned under municipal ownership.

As the city can work their men only eight hours per day, and the company calls 10 hours a day's work, it would be necessary to add at least 25 per cent to the present pay-roll of the company.

The city certainly cannot, under these conditions, operate the plant more cheaply than the corporation has been able to do.

Taking then the running expenses of the plant under its present management as a very conservative basis for estimate, we find that the running expenses of the company last year, exclusive of dividends and depreciation, with no interest to pay, was, in round numbers, $124,000, to which add the $151,200 required for sinking funds, interest and legal depreciation, making a total of $275,200, which it will cost to operate the plant under municipal control.

The total business of the company last year, including the amount paid it by all the city departments, amounted to $236,000 only, showing that the entire business of the company was $39,000 less last year than the amount needed to operate the plant and pay the legal charges upon it under municipal control.

If, following their usual custom, the State board charge the deficit in commercial operation to the cost of the street lights, the cost of the street lighting service, in the event of this city's acquiring the Electric Light Company's plant, will be increased from $79,000 to $118,000 per year for the electric lights alone; the cost of the arcs will advance from $109.50 to $168 per lamp-year and from 2.8 cents to 4.95 cents per lamp-hour.

No reference is made in the foregoing calculation to the taxes now paid by the company into the city treasury, adding not less than $8,000 per year to the deficit already noted.

Your committee believe that the same conditions and reasoning apply with equal force to the property and business of the Gas Light Company.

This company is capitalized at $500,000, and has assets according to their last report, $733,000. Their stock is worth not less than $225 per share on the market, thus making their property too valuable for us to acquire under the statute.

As the result of the foregoing investigation, your committee recommend that it is not expedient for the city of Worcester to exercise the authority conferred in Chapter 370 of the Acts of 1891 and Acts in Amendment thereto, in the matter of acquiring a municipal electric light plant.

Automobile Industry in France.

Mr. Thornwell Haynes, U. S. Consul at Rouen, France, states that it is estimated that outside coal mining and the large metallurgical industries, automobilism, directly or indirectly, maintains more people in France than any other industry. All the factories have tripled their output during the last three years, and manufacturers formerly making cycles now produce automobiles. At first, Paris was the only city where autos were made, but now Lyons, Bordeaux, Marseilles, Lille, St. Etienne, Nantes and Rouen have factories to supply local demands. Mr. Leon Auscher, in one of the Paris journals, mentions the following branches that are benefited by this industry: Foundries for the production of cylinders and other castings; copper boiler works, factories for oilers, tubes, connections, etc.; aluminum foundries, which work exclusively for the automobile industry; spring and spindle works, whose output has increased fivefold since 1898; factories for bolts, screws, rivets and other small hardware; wheelwrights' shops, which depend in a certain measure on automobile factories; india rubber factories; nickel and copper shops; aluminum carriage building trade and allied industries; automobile painting trade; automobile upholstery trade, which employs morocco-dressed cowhide to such an extent that the French tanyards can meet the demand, and English and German products are also used; lamp trade, which furnishes two and sometimes five lights for each vehicle; the small industries allied to the carriage building trade—the leather worker, the enameler, the cabinetmaker—all contributing certain details before any single vehicle is complete; accumulator factories; specialties in measuring apparatus, ampere meters, voltmeters, resistance measurement apparatus, etc.; manufacturing, rectifying and canning automobile mineral fuel and preparing cans of

oil and non-liquid grease. "By reckoning all these workmen," adds Mr. Auscher, "a grand total is obtained of nearly 200,000 persons in France dependent upon automobilism."

The following is also worthy of note: "The use of the motor car has during recent years made such strides in France that it has given rise to a more important and ever-increasing industry. Thousands of mechanics are now employed in the construction of motors, cars and their component parts, and it is not too much to say that France is ahead of any other country in this line of manufacture. The consequences of this industry are also far-reaching, owing to the numerous subsidiary industries which it either creates or fosters." These remarks are from the report of Mr. A. P. Inglis, British Consul General, in a report on the trade of France issued by the Foreign Office. He illustrates the growth of the motor industry by pointing out that the race which was run last year between Paris and Berlin brought orders to French firms valued at 108,000,000 francs.

Canadian Niagara Power Development.

Vice-President W. B. Rankine, of the Canadian Niagara Power Company ,announces that the company has awarded the contract for the construction of the big wheel pit and the intake canal, in the Queen Victoria Falls Park, to the firm of Dawson & Reilly, of St. Catherines, Ont. This contract involves the expenditure of over half a million dollars. The wheel pit will be 175 ft. long, 160 ft. deep and 20 ft. wide. It will parallel the river, and the intake canal will be some 600 ft. wide, bringing the water direct to the penstocks in the wheel pit. Arrangements are making for the proposed power transmission line to Toronto and cities en route, a bank of 11 transformers having been ordered from the Canadian General Electric Company. The company can be ready to supply power for this transmission by October of the current year, temporarily securing current from the Niagara Falls Power Company on the American side. The 10,000-hp generators for the Canadian plant are to be made by the General Electric Company, as noted in our last issue.

The Toronto City Council proposes to petition the Ontario Legislature for special legislation to empower it to engage in the power business on its own behalf, with a view to supplying electric power to the public at a minimum price. It is proposed that the city construct and own a line of wire from Niagara Falls, or other point within a radius of 150 miles of Toronto, for the purpose of bringing electric energy to the city. The election of Colonel H. M. Pellatt and Mr. Frederick Nicholls to the directorate of the Toronto Railway Company, is regarded as an important step in the direction of the establishment of a community of interest between the three big electric concerns of the city of Toronto, which now have interchangeable directors. They can work together towards the securing of a common power supply, which will eventually come from Niagara Falls. It is admitted that such an ultimate consummation is now in view. It is possible that the three local companies will form a fourth and separate company for the object of bringing electric power from the Falls for their own use and for sale. The Niagara Power Company will likely be interested.

Electric Light Plants in Nicaragua.

Mr. Chester Donaldson, United States Consul at Managua, Nicaragua, writes:

The Government of Nicaragua has granted to Mr. T. M. Solomon, an American citizen, and Mr. J. Santos Ramirez, a Nicaraguan, a concession for installing electric-light systems at Managua, Masaya, Granada, and Leon.

Managua is to be the first city lighted. The motive power is to be steam. Meanwhile, the concessionnaires will construct a dam to utilize the water power of Tipitapa Falls, where a plant sufficient to supply the needs of the first three cities will be erected. The steam plant at Managua will then be moved to Leon.

It has been decided that by constructing a dam about 5 ft. high at the edge of Tipitapa Falls, Lake Managua (of which the Tipitapa River is the outlet) can be maintained at a sufficiently high level to always give an ample supply of water for the power required. Mr. Warren B. Reed, the concessionnaires' electrical engineer, calculates that by raising the lake 1 ft. more than its annual evaporation, about 20,000,000,000 cu. ft. of water will be secured; and that by placing the power house about 500 yards below the falls, at the foot of the rapids, a fall of 18 ft. will be obtained, which will give sufficient power to run the plant for four consecutive years, even if there should be no rain during that time.

The Government has also granted Messrs. Solomon & Ramirez exemption from import duties on all materials to be used in the enterprise and on provisions and clothing for their employes.

The contract provides the following rates for each light installed:

Description.	Rate.	
	Pesos.	
One 16 cp ...	6.50	$1.85
One button and switch	3.00	.85
100 ft. of wire	18.50	5.28
Monthly charge	3.00	.85

*Value in United States gold at present rate of exchange.

Bids are being received for the poles, and machinery has already been ordered from the United States. The plant is to be in working order within six months from date.

New Telephone Patents.

Telephone patents for the issue of Jan. 28 number two only, and neither is likely to revolutionize the art of telephony. Mr. Charles F. Butte, of San Francisco, Calif., patents a self-ejecting plug for telephone switchboards, which is an extremely simple device, as the diagram (Fig. 1) shows, but which for various reasons stands little chance of adoption in practice. Each jack has mounted above it an electromagnet having for its armature a bell crank lever, the free end of which is adapted to engage in a shoulder of the plug. When the magnet is energized by the disconnection signal relay, it attracts the armature, ejecting the plug from the jack by the action of the lever against the shoulder. As the magnet is included in the cord circuit the ejection of the plug breaks the circuit between the battery and the magnet, de-energizing the latter.

One trouble with this device would be that in order to ensure firm contacts a plug has to fit pretty snugly into the jack and to eject a properly made plug from a properly made jack by means of a right-angled lever would require a very powerful electromagnet. Further, the space required for the magnets would debar such a device from

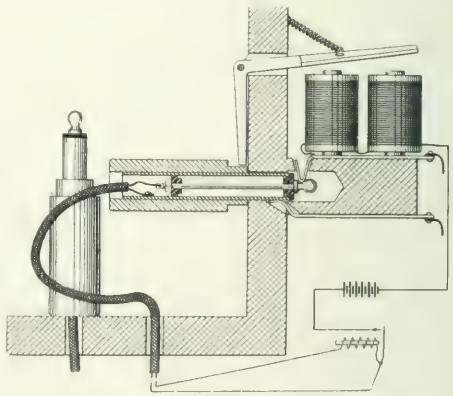


FIG. 1.—BUTTE'S TELEPHONE SWITCHBOARD.

large switchboards, and in small ones it would be of little advantage, since the operator generally has plenty of spare time.

Mr. Albert K. Andrians, of San Francisco, Calif., patents and assigns to the Automatic Interconnecting Telephone Company, of the same place, a switching mechanism for interconnecting telephone lines adapted for use on telephone systems composed of a comparatively small number of lines combined for operation on the interconnecting plan. The invention provides a switch mechanism of enlarged capacity, capable of affording connection with a considerable number of lines and of such compact form that the line contacts and entire switch mechanism can be contained in the base of a portable telephone stand for the desk or table. The switching mechanism is locked when the receiver is on the hook, and can be moved off the

"home" contact only when the receiver is lifted from the hook, and is automatically returned to the "home" contact when the receiver is hung up after connection with another line has been had.

Figs. 2, 3 and 4 show pretty clearly the construction and mechanism of this ingenious device. A number of stationary contacts are ar-

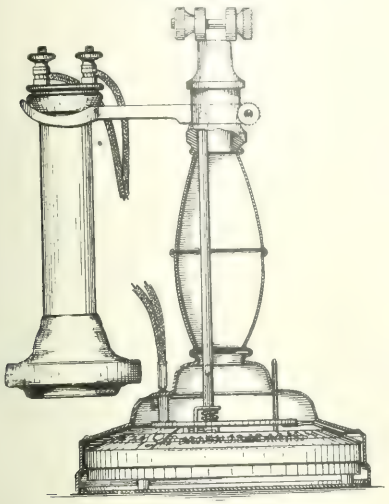
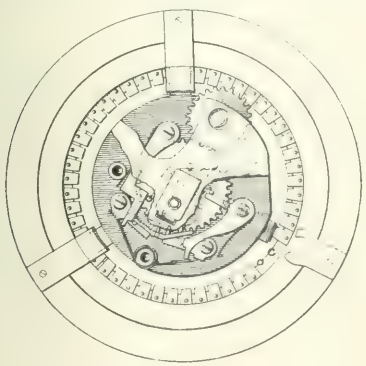
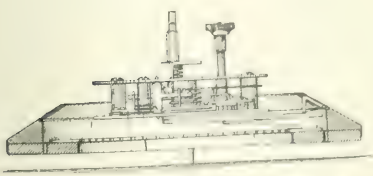


FIG. 2.—ANDRIANO'S SWITCHING MECHANISM

ranged in a circle on the base block, and a contact arm is carried on a separate frame with the setting and locking mechanism. An annular dial plate turned by means of shaft connects by gear and pinion with the shaft carrying the contact arm. When the arm is turned to the required contact it is locked by a dog, which holds it on the selected contact until the receiver is replaced on the hook, when a rod releases the dog and the coiled spring returns to zero





FIGS. 3 AND 4

or "home" contact. The dog then locks the arm until the next connection is it by the raising of the switch hook. It is thus necessary to take the receiver from the hook before the arm can be operated, and when the receiver is replaced the switch is automatically restored to zero.

CURRENT NEWS AND NOTES.

PACIFIC CABLE.—A brisk pamphlet, which includes some of the documents in the case, has been issued to the public by the Commercial Pacific Cable Company, in support of its work for laying an unsubsidized Pacific cable and against the plan for a United States Government cable.

NEW LONDON (CONN.) MUNICIPALIZING.—The New London Board of Trade has appointed a committee of five to consider the purchase by the city of the New London Street Railway property, and the local electric and gas plants. The sentiment of the board was strongly in favor of the purchase. The railway company holds practically a franchise for the whole city.

GERMAN WOMEN EMPLOYES. Beginning with the new year, Germany has taken a long step forward in employing woman labor in all Government departments, and especially so in two. Between Jan. 1, 1902, and Dec. 31, 1905—that is, in four years—5000 women and girls are to be employed in the State railway offices and in the post, telegraph and telephone services, the number of girls employed to be raised from 7000 to 25,000.

UNITED STATES PATENT OFFICE.—Commissioner of Patents Allen reports that the number of patents issued last year was 27,373, the largest in the history of the department. The issue of certificates of registration of trade marks, prints and labels also reached the unprecedented number of 2965. Cash receipts of the office during 1901 were $1,249,198, exceeding those of any previous year by nearly $100,000. The State whose citizens received the largest number of patents during the year was New York, with 4008, next in order came Pennsylvania with 2837, Illinois with 2430 and Massachusetts with 1905.

INVENTION OF WIRELESS TELEGRAPHY.—According to a press cablegram, Marconi's claims to the invention of wireless telegraphy were severely criticised at a meeting last week of the French Academy of Sciences. According to documentary evidence adduced credit for the invention is due, first, to Feddersen and Maxwell, both Englishmen; then to Hertz, of Germany; but principally to Professor Branly, a Frenchman, who conceived and constructed in 1890 the receiver for electric waves which is used by Marconi; and next to Professor Lodge, an Englishman, who read a paper before the Electrical Congress of 1894 pointing out the possibility of transmitting telegraphic signals with the Hertz apparatus and receiving them with the Branly tube of metallic fillings, which possibility was actually put into practice by the Russian scientist, Popoff, in 1896. It was further asserted that most of Marconi's patents are worthless, owing to the foregoing facts. Finally, it was pointed out that neither the French nor the German Army nor the English Navy is using the Marconi system, though results are obtained equal to those obtained with his apparatus, except transmission across the ocean, which the scientists unanimously decided is yet unproved.

TEXAS FUEL OIL TESTS.—A Texas oil company has printed a report of Professor J. E. Denton, of Stevens Institute, upon tests at Beaumont, Texas, of crude petroleum as fuel, made for the company. The tests were made in a horizontal return tubular boiler 6 ft. in diameter, 18 ft. long, and having a grate surface of 45.5 sq. ft. In the tests, data for comparative purposes were obtained from the same boiler when burning buckwheat anthracite coal. With Beaumont crude oil the equivalent evaporation from and at 212 degs. was 15.49 lbs. of water per pound of oil. The corresponding figure when using buckwheat coal was 11.79 lbs. of water per pound of combustible, and 8.94 per pound of coal. The efficiency of the boiler determined by the oil tests was 78.5 per cent, and by the coal tests 77.6 per cent. A quantity of steam varying from 3.1 to 4.8 per cent was consumed in the oil blast. In the two tests with coal the horsepower developed by the boiler was 92.6 and 119.1. In the five tests with oil the horse-power varied from 112.7 to 220.1 hp, the evaporation per pound of oil from and at 212 degs. in the first-mentioned case being 15.05 and in the second 14.75. These figures are considerable less than those that have been obtained with Eastern crude petroleum, which range above 18 lbs. of water per pound of oil.

ELECTRIC LIGHT ON TRAINS.—Mr. G. W. Roosevelt, United States Consul at Brussels, reports that owing to the very satisfactory results obtained with the Stone system of electric lighting on 205 cars, it has been decided by the Belgian State Railways to equip another 141 cars in the same manner.

A. I. E. E.—The new membership list of the American Institute of Electrical Engineers has just been issued. It now includes 1412 names, comprising 2 honorary members, 393 full members, and 1017 associate. Seventy-five per cent of the membership is outside New York City. There are 52 members in England, 38 in the Dominion, 12 in Australia, 11 in Japan, 13 in France and 14 in Germany.

SYNCHRONIZING ALTERNATORS.—In a patent issued Jan. 28 to J. E. Woodbridge, a method of synchronizing alternators is described, which is claimed to be superior to the methods of synchronization in which corresponding phases are connected in conjunction or in opposition. It is stated that when machines are synchronized by means of corresponding phases in opposition and thereby producing a maximum e. m. f. at synchronism, considerable variations of phase angle may occur without appreciably altering the resultant; while in synchronizing by connecting in opposition the occurrence of minimum or zero e. m. f. is difficult to determine. To overcome these objections, instead of combining corresponding phases of the machines to be synchronized, the e. m. f.'s employed are obtained by connection with phases which are not in phase when the machines are in synchronism. In the case of two-phase generators, for example, the *A* phase of one machine is employed in combination with the *B* phase of another machine. By this method, at the instant of synchronism the resultant e. m. f. due to the combination has a comparatively large value, which may be easily read by indicating instruments, and in addition is sensitive to even slight changes in phase relation of the machines.

REGULATION OF ROTARY CONVERTER E. M. F.—A means of regulating the e. m. f. of rotary converters by the employment of an induction motor is the subject of a patent issued Jan. 28 to B. G. Lamme. The rotor of an induction motor is mounted on the same shaft with the armature of the converter, and has a larger number of poles than that of the converter. As indicated in the drawing, the motor has six poles and the rotary converter four poles. Assuming a three-phase circuit, the stator of the motor has three independent windings, which windings are in series with the collector brushes of the converter; that is to say, the windings form part of the alternating-current supply circuit of the converter. Since the converter is operated from an approximately constant potential circuit, its speed and that of the motor, and consequently the slip of the latter will be approximately constant for all loads. When an induction motor is rotated either above or below synchronous speed, any variation in current input or output must be caused by a variation in voltage, the slip being constant as in the present case. It follows, therefore, that as the load on the direct-current side of the converter varies, the alternating current to supply the load varies, and such current variation is in turn dependent upon voltage variations of the motor, which reinforce the e. m. f. component of the converter in accordance with the changes in load on the converter. If the currents to the converter are of such volume that an inconvenient winding would be required on the motor, the latter may be supplied from the secondaries of transformers, the primaries of which are in the alternating-current supply leads to the converter.

LETTERS TO THE EDITORS.

Distribution and Meter Losses.

Sirs.—I have read with very great interest the editorial on page 113 of ELECTRICAL WORLD AND ENGINEER of Dec. 21, 1901, dealing with the question of line losses, and more particularly meter losses. Having devoted the greater portion of the past 15 years to the study of electric meters and things kindred to them, I feel somewhat justified in venturing to comment on, and in some measure to differ with, the statements made in these editorial paragraphs.

I am familiar with the fact that there is a strong tendency among some central station managements to attribute a very heavy percentage of loss to the meter system. I am ready also to admit without argument that a very considerable percentage of loss is justifiably attributable to this part of equipment.

The figures cited in your editorial, showing from 17 per cent loss for an efficiently managed direct-current meter system, to 25 per cent for an alternating-current meter system are, in my opinion, very excessive and hardly to be found at all in modern practice.

It would be very rash for me to challenge such figures on the score of my opinion and judgment alone, and I do not do so. It has been my privilege to see a very large number of tests, representing the performance of thousands of meters in commercial service, of all ages and at widely scattered points, and at all loads. When one has inspected a sufficient number of such tests, and has compared their showing with the average relation of meter capacity to the load curve of the station under consideration, one can readily form a very close approximation of the actual losses; a much closer approximation in my opinion than can be made in any other way now available to us.

We must remember that the present so-called method of determining the meter losses of an entire system is a process of elimination. The first point of weakness in the method of determining the data lies in the accuracy with which the gross output of the station is measured. The devices by which such determinations are made are commonly as fallible as the customers' recording meters, but in the opposite direction. When central station total output meters or central station managers err they commonly read high, whilst the reverse is true of the meter on the customer's premises. If the output is determined by recording meters they are commonly of the same general type as those which are being used on the customer's premises, and they are equally fallible. They are, however, being used under more adverse conditions, they are under heavier vibration and are more likely to be exposed to stray fields of a deranging kind, etc. If, on the other hand, the output is determined by periodic readings of ammeters and voltmeters, we have the errors of the instruments, errors which unfortunately are by no means unusual and which are generally high; and we have also the errors of integration and of observation.

I submit, therefore, that the first opportunity for error in this matter lies in the determination of total output. Having determined the total output billed current, line losses and all other losses are subtracted one after the other, as known and fixed quantities, and this process of elimination having been carried to its conclusion, the remainder is regarded as the loss chargeable to the unfortunate meter system. This practice has been borrowed from the school of the gas engineer, who for years has been accustomed to determine his pipe leakages in just this way, by elimination; and in the case of the gas engineer, the meter loss is subtracted as a more or less known value; generally, I believe, at about 5 per cent.

What I desire to point out, therefore, is that the 17 per cent or the 25 per cent cited in the editorial, or any other value which may be obtained by the process of elimination as the true value of meter losses, in reality does not represent meter losses, but meter losses plus the sum of the errors of determination of all of the other factors considered. I have actually seen meter losses determined by the system of elimination when one of the known factors deducted from the total output was a "very accurate estimate of energy supplied to contract customers without meters."

As to the greater or less efficiency of an alternating or direct-current meter system, there is, in my opinion, little or nothing to choose between the two, *per se*. I do not doubt that the gravest difference can be found in favor of direct or in favor of alternating plants, which are close neighbors and under equally management. Very large alternating-current systems are frequently handicapped by a large number of very old and, therefore, relatively primitive recording meters. Alternating-current meters have been on the market a very long time, and were rapidly purchased on their first introduction. Such meters necessarily have a short range of accuracy and under-record heavily on light loads. This situation handicaps the average alternating-current meter system.

On the other hand, inductive loads are very common, and during certain portions of the load curve constitute a large proportion of the load of most alternating-current stations.

Meters of the induction type which are accurate on inductive loads have only been available for a relatively brief time. Prior

to the time when they became available such meters had errors either fast or slow on inductive loads, generally fast; in some cases very fast. Consequently, inductive loads have doubtless in many cases served to offset natural slow operation to a very appreciable degree, amounting to a good deal, in the betterment of general meter efficiency, though hardly in a way which one would advocate. The actual meter loss of a well managed system to-day may be as low as 6 or 7 per cent, and should not and rarely does not exceed 10 per cent. Much but not all of this is controllable.

I indorse heartily that portion of your editorial notes which deals with the question of meter maintenance. For the average central station periodic visits on the premises are probably the most economical and efficacious means of up-keep. Conditions, however, do exist in some large cities where the test on the premises is probably less desirable than the test by removal, but such cases are, I believe, rare, and I should be reluctant to advise any practice except the test on the premises without a special and very careful investigation.

The term "test on the premises" is here used more in the sense of inspection than literally a test. A test of a meter with ammeter and voltmeter, or the equivalent, is comparatively unimportant as compared with a careful mechanical inspection and an accurate adjustment of the friction compensation with which most modern meters are provided. The elimination of loose dust or dirt, the up-keep of jewels and bearings, and the adjustment of light load accuracy by the means provided, are the secrets of meter efficiency. The magnets rarely require to be touchd at all and should only be touched under considerable provocation. In the case of commutator meters the cleaning of the commutator so long advised is no longer regarded as desirable save in the exceptional cases where actual building up of rough particles due to sparking has taken place. It is now a well established fact that the average meter commutator reaches practically a permanent condition of friction after three to six months of use. That is, the light load accuracy has in this period depreciated all that it will depreciate on the score of the commutator. It is expedient, therefore, not to destroy this permanent condition of the commutator, but to leave it as it is and adjust the friction compensation until the meter is restored to a condition of accuracy on light loads, which it should then retain.

SCHENECTADY, N. Y. CARYL D. HASKINS.

Death by Electricity

To the Editors of Electrical World and Engineer:

Sirs.—I read with much interest your editorial comments on my communication in your issue of Jan. 25. I have, however, failed to note in any reports of autopsies that I have read any important organic changes in vital organs, not even the great nerve centers. The only important change noted has seemed to be a fluid state of the blood, and a preponderance of white corpuscles in the blood. Now, as in my opinion, death, when it does result from an electric shock, occurs from paralysis of the heart and nerve centers of respiration. This very fact of the fluidity of the blood is in itself an argument that resuscitation is possible, as the mere fact of the heart's action ceasing does not determine the fact of death unless the blood coagulates. I believe a very interesting experiment was recently made by a European doctor of inducing life in a man supposedly dead by manipulating the heart itself by the hands.

Another fact that renders it an easier task to resuscitate the victim of an electric shock than one of drowning is the fact that in the former case the lungs are free of water, and, therefore, more readily respond to artificial respiration. Of course, while I do not hold that death does not result from an electric shock, yet I affirm that in the majority of cases where the amperage has not been heavy enough to produce lesions of vital organs, the methods I have mentioned should never be given up while the body is still pliable, and I have no hesitancy in stating my belief that many valuable lives have been lost through a lack of knowledge of this subject. I speak of the amperage as it is the *quantity* that passes that would produce lesions at a high pressure, as enormous pressures have been taken through the body in infinitesimal quantities without harm. Of course, in the case of a prolonged application of current, as in the case of an electrical execution, the Joulean effect or raising of temperature might cause internal burns sufficiently severe to cause death beyond all chance of recovery, as very slight external burns over a large surface do, but I have never, to my recollection, read of this point being demonstrated at the autopsies. But in any case when the contact has been momentary, as the majority of the accidentally received are, the efforts to revive should be unceasing while a spark of hope remains, i. e., until *rigor mortis* actually sets in.

LORAIN, OHIO. C. H. HINES.

[In the case of unconsciousness from electric shock, it would be well-nigh criminal to neglect measures of resuscitation, for undoubtedly in most cases the patient can be revived if the treatment for the drowned be applied. Some years ago this journal distributed to central stations and other electrical generating plants many thousand copies of a sheet of instructions for the resuscitation of those rendered unconscious by an electric shock, and soon after several cases were reported to us where the application of these instructions resulted in the saving of life. As to electrocution, in 1895 Governor Flower, at the request of this journal, appointed Dr. A. E. Kennelly and the eminent therapeutist, Dr. A. H. Goelet, to witness and report on the electrical execution of a criminal at Sing Sing. The report, which was printed in our issue of Feb. 16, 1895, is decisive as to physiological death. There was extravasion of blood in all parts of the body, tissues of the brain and blood vessels were ruptured, and it was estimated that at least two quarts of blood escaped from the scalp and cranium in removing the brain.—EDS.]

Induction Coils.

To the Editors of Electrical World and Engineer:

Sirs.—The editorial in your issue of Jan. 25, entitled "The Function of the Condenser in the Induction Coil," suggests that a large experimental field presents itself for the complete investigation of induction coil phenomena.

There are perhaps few who better realize to what an extent such an investigation could be carried than those persons who are daily experimenting with induction coils of various types and sizes. While from a theoretical standpoint such an investigation would no doubt prove of great value, in that definite rules might be laid down to secure any desired result, nevertheless, from a manufacturer's standpoint, the various relations existing between primary, secondary and condenser have been looked into so extensively that the output of a coil can be estimated beforehand with considerable accuracy.

Several years ago a manufacturing company undertook the construction of two induction coils, each to give a 1-meter spark, which construction was preceded by an extended series of tests to determine fully the functions of and the relations existing between the primary, secondary and condenser.

These experiments were conducted in a most careful manner, and from the results obtained many surprising and interesting conclusions were drawn. Curves of primary currents were plotted, showing oscillations in the circuit when it was opened, lasting from .01 second to .05 second; curves illustrating the rise and fall of the potential at the condenser terminals, and its effect upon the primary current; curves showing the changes in primary and secondary oscillations as condenser capacity was varied. In fact, the investigation was as complete as was considered necessary to develop all the detail requisite in coil construction. However, there were many interesting points, not deemed to be essential in commercial work, which were merely touched upon, and which would require extended investigation to make complete.

At that time, the writer proposed to a professor in one of our leading scientific institutions that a careful study of these phenomena would form an excellent subject for a graduation thesis.

It is quite possible that at no distant date the results obtained at that time will be published, and I feel sure that they would prove of value to those interested in this line of work.

PHILADELPHIA, PA. WM. B. HOGG.

A Winter Use for Fans.

To the Editors of Electrical World and Engineer:

Sirs.—The thermometer to-day is registering six below zero here in Chicago. Passing along Van Buren Street I noticed the windows of the shops were so thickly encrusted with frost that it was impossible to tell what business the proprietor of any shop was engaged in without consulting the signs. Suddenly at Wabash Avenue a large, attractive-looking window of a sporting goods house burst into full view with everything in the window as plainly visible as it would be on a bright mid-summer's day, only more prominently emphasized on account of the indistinct condition of every other window one

could see on the block. My attention was arrested by the phenomena, and pausing I noticed in the window a 14-inch electric fan running full blast. I stepped in and asked the proprietor if the fan was being employed to keep his window free of frost, and he stated that that was its object, and it did its work splendidly; that they had tried it last winter and found it worked so successfully that they had not taken down their fans, but always on a very cold day, when they found their windows encrusted with frost and ice in the morning they turned on the breeze, which rapidly cleared the windows and kept them dry and clean all day.

It struck me as a novel use for an electric fan, and one which would commend itself to many shopkeepers as an aid to displaying their goods during the cold weather.

[illegible] HERBERT CLARK.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Calculation of the Voltage Drop of Alternating-Current Generators.—FISCHER-HINNEN.—A long article with various diagrams and tables. For the calculation of the voltage drop of an alternator two methods have been in use—that of Behn-Eschenburg, who determines the voltage at the terminals from the no-load voltage and the e. m. f. of self-induction; and that of Rothert, who combines the m. m. f.'s. In general, the former method gives the voltage at the terminals smaller than found by experiment, and it is smaller the more saturated the machine is and the greater the phase difference. On the other hand, the voltage at the terminals, as calculated by the method of Rothert, is generally greater than that found by experiment. Recently Potier has developed a third method which may be regarded as a combination of the above two methods. He makes two calculations. From the ampere-turns of the magnets and the ampere-turns of the armature he first determines the resulting m. m. f. The e. m. f., taken from the no-load curve for the resulting excitation, is then combined with the e. m. f. of armature straying. He has examined the three methods for 15 different machines, the results being given in two tables, which show that Potier's method gives quite satisfactory and much better results than the two former methods. The calculation by Potier's method is, however, somewhat long and inconvenient for the practice. The present author has, therefore, calculated two tables, which facilitate the application of Potier's method in practice. Some numerical examples are given.—*Elek. Zeit.*, Dec. 26.

Induction Motor with Adjustable Speed.—An illustrated article on an induction motor, made by Wuest & Co., which gives a certain power at greatly varying speed with an approximately good efficiency. The motor consists of three parallel and co-axial three-phase stators, placed in a case, having a four-pole, six-pole and eight-pole winding, respectively, while the rotors of the squirrel cage type are mounted on a common axle. With three-phase currents of 50 periods, and if the three different windings are used separately, speeds of 1500 to 1400, 1000 to 900, 750 to 700 can be obtained. Each of the three separate motors is said to give a certain power at nearly equal efficiency. When two or three of the separate motors are connected in parallel, it is claimed that the power is doubled or tripled, respectively, under fair economical conditions, the speed being 800 to 700 in both cases. The results of some preliminary tests are given.—*Zeit. f. Elek.*, Dec. 29.

Rectifying Alternating-Currents.—An illustrated description of the Batten rectifier, which has been designed primarily to charge accumulators from alternating-current sources. The disadvantage of a synchronous vibrating armature, like a vibrating reed or tongue, for commutating alternating current, has the disadvantage that the vibrations of the reed lag in phase behind the alternations of e. m. f., with the result that the reed does not commence its movement in any period until the e. m. f. has risen to a considerable portion of its ultimate value, and a spark takes place at the point where the circuit is broken. In the Batten rectifier this disadvantage is said to be avoided. "The current driving the armature is taken direct from the mains, through a lamp which reduces the current to an amount not more than sufficient for the purpose. The primary of a small transformer is also connected to the above-mentioned mains, the secondary of the transformer providing the current to be rectified. It thus happens that the lag in phase of the secondary current behind the primary current compensates for the lag in movement, due to the mechanical inertia of the armature, and the small self-induction of the driving electro-magnet. In practice the lag in the transformer is not quite sufficient for the purpose, but to 'tune up' a condenser is put across the terminals of the lamp in the driving circuit, and the result is that no spark whatever occurs, even with a load of 6 amperes, as the contact is made and broken at equal periods on either side of the zero potential line, so that the e. m. f. had insufficient time to rise to any appreciable value." —Lond. *Elec. Rev.*, Jan. 3.

REFERENCES.

Capacity Limits of Direct-Current Dynamos and Motors.—ADAMS.—A general discussion of the various safe capacity limits of direct dynamos and motors, as fixed by speeds of armature rotation, by the allowable rise in temperature of the windings, commutator and brushes, by the effect of armature reaction to lower the voltage, by the permissible sparking at the commutator and by the ability of their insulation to withstand voltage.—*The Eng.*, Jan. 1.

Electric Motors.—WHITE.—A continuation of his article on the testing and management of electric motors. This part deals mainly with the management. He discusses the motor connections and gives some practical rules.—Lond. *Elec. Rev.*, Jan. 3.

POWER

Water Power Developments in Europe.—MAHN.—A short and summary of recent developments. In Italy there are no less than 2,640,000 hp available for industrial use; 300,000 hp of this total has already been developed. The power now running to waste in the rivers of France is estimated by Tavernier at 3,000,000 to 5,000,000 hp, and only 200,000 hp of this enormous total has yet been utilized. As regards the costs of the hp-year measured at the turbine wheel, the average cost in Switzerland is $20, in Savoy $9, and in Italy over $20. In Norway and Sweden the three largest falls represent over 244,000 hp; only 22,000 hp of this total has been developed. Near Christiana, the Glommen River might be utilized for a development of 92,000 hp, and the River Drammen for an additional 28,000 hp. Works were commenced there last year, but the power station is not yet completed. In Germany a new water-power station has recently been completed at Gersthofen, near Augsburg, where 7500 hp is available. An interesting feature of this station is that 3000-kw, direct-current, is generated, and is transmitted by underground aluminum cables to color works at Hoechst.—*Zeit. f. Elektrochemie*, Dec. 5; abstracted in Lond. *Elec.*, Jan. 17.

Some editorial notes of the prospects of commercial development of the above water power. In some cases the permanent expenditure in civil engineering costs would be so heavy that remunerative return would be impossible. In more favorable situations the return would be a fair manufacturing percentage, and "in selected instances with cheap and constant power, accessibility of site and nearness of raw materials, there is the mechanical equivalent of a gold mine to be annexed by the enterprising. The utilization of the power is more difficult than the winning of it. These vast quantities of energy are more than can be absorbed in any profitable way except by the aid of electro-chemistry." * * * "Even now, with the shortest time for experiment ever accorded the pioneer of a new technos, the electro-chemist is competent to handle this power to commercial advantage." —Lond. *Elec.*, Jan. 17.

Torsional Oscillations in High-Speed Engine Shafts.—LEAKE.—A communication referring to a recent paper of Frith and Lamb. He points out that dangerous oscillations may be set up without exact synchronism, between the turning moment and the natural oscilla-

tions, so that for every set there is a range of speeds such that dangerous oscillations are set up at any speed. He gives particulars of some sets which have given trouble due to such oscillations. The capacities were 350, 400, 450, 500 kw, respectively; the normal speed 318, 295, 300, 330 revolutions; the critical speed calculated by him 331, 293, 278, 321 revolutions. "These four sets are of usual design, and include the work of five well-known manufacturers. By critical speed is meant the speed at which the amplitude of torsional oscillations should theoretically be a maximum, and it will be noticed that these do not differ much from the normal speeds. In the case of three of the above sets signs of trouble appeared, and finally the shafts cracked." These mechanical oscillations afford a close analogy to the oscillations which occur in the parallel operation of synchronous alternating-current machinery.—Lond. *Elec.*, Jan. 3.

LAMB and FRITH.—A reply by the authors of the original paper. They agree in most points with Leake.—Lond. *Elec.*, Jan. 10.

Another reply by Leake in Lond. *Elec.*, Jan. 17.

The Dynamo as an Adjunct [illegible].—An article in which he says that in all blast furnace installations there should be an electric plant, the output of which would be controlled by the possibilities of application. One use would be to supply current for arc lamps for the general lighting of the founding shed and the exposed places and incandescent lamps for the office. The dynamo would probably be designed to give 220 volts, and if capable to give from 160 to 1000 amperes, it can be used for effecting many cases of repair and remedying accidental irregularities of the furnace. For fusion or welding by the electric arc the usual voltage is 50 to 80, so that rotary transformers or resistances are to be applied. It is essential that the voltage should be regulated between 50 and 80 to suit the requirements. Grammer has used the electric arc to burn open the tuyeres and iron-notch of a blast furnace on occasions when, owing to some accidental occurrence, the iron has become chilled, in place of their having to be opened by the long and laborious method of hammer and drill or the application of the kerosene blowpipe. Foster has given an instance of the repairing of an eccentric rod of a large reversing engine by electric welding, the engine being at work the morning after the breakdown; also of the slot link of a reversing engine, in which case the engine was working again within an hour; cutting holes in iron or steel castings, plates, etc., in situ can readily be performed.—Lond. *Elec. Rev.*, Jan. 3.

REFERENCE.

Electric Winch.—A description of a winch used in an English colliery plant. It consists of a motor directly connected to a winch by an automatic attachment. An electric brake is put on the drum as soon as the current is switched off of the motor, and this brake is released when the current is put on the motor.—*St. R'y Jour.*, Int. Ed., Jan.

TRACTION.

Elevated Railway Repair Shop Methods in Chicago.—An illustrated article. The motor cars on this road are each equipped with four G. E. 55 motors, in which the field frame is not divided in halves as usual, but has an opening in the end of the case through which the armature is taken out. The armature is removed from the field frame by a special machine. The process is rather a slow one, however, and it is believed that that employed on the Lake Street road, described below, is superior. In the Metropolitan shops the room under the crane is not sufficient to allow of the method used in the Lake Street road. In this latter the motor is set on end with pinion up, and the armature is hoisted directly out of the case. Some excellent records have been made with the G. E. 55 motors used on the road. Both pinions and the pinion bearings have run for more than 133,000 miles, with very little wear. On the Northwestern Elevated Road a special mixture of armature bearing metal is used consisting of 100 parts of lead to 7 of antimony. This mixture is also used on the truck journal box bearings for both the Lake Street and Northwestern Elevated roads. Oil is used on these bearings. The method of feeding the oil to the bearings is described.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

Large Power Station for Manchester.—A brief article on this station, which will contain six cross compound engines of 3000 hp capacity, each direct coupled to three-phase generators of 6 to 500 volts. The condensers, fans, coal carriers, etc., will be operated by direct-current motors supplied by three 230-kw engines and generators. The three-phase generators will be excited by this auxiliary plant at starting and afterwards by direct-current generators driven by induction motors. The sub-station will contain 30 motor-generators of 350-kw each, 18 of which will be used for traction and 12 for lighting purposes. The electric equipment will be supplied by the General Electric Company, of Berlin.—*St. R'y Jour.*, Int. Ed., Jan.

Electric Traction.—BELL.—An article on "Present tendencies in electric traction." The two branches of urban traction, surface and other, are both growing along sound and fairly steady lines. The suburban and interurban lines are rapidly opening an operative gap between themselves and the urban systems. The interurban roads "must choose implicitly, if not openly and under compulsion, whether they will conform to tramway limitations as to speed and equipment and enjoy the immunities of tramways, or take openly the position and duties of passenger railways operated by electric motors." The hundred-mile-an-hour train is a matter which stands by itself, and cannot be regarded as an extension of present tramway practice. He speaks well of the German experiments on the Zossen railroad, and "is strongly of the opinion that for high-speed work on a large scale the use of polyphase distribution directly to the motors, presents so great advantages as to make any other method yet suggested of more than dubious utility."—*Elec. Rev.*, Jan. 11.

Device for Cutting Sleet on Third Rail in Electric Railways.—An illustrated description of a device used in Chicago. The blades of the brush are 3-16 inch thick, and they are held in a block of iron, which is cast around them. They are pressed down on the rail when desired by a long plate spring.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

REFERENCES.

Interurban Railway.—KIBBE.—A long illustrated description of the Chicago & Joliet interurban electric railway.—*St. R'y Rev.*, Jan. 15.

Brighton.—A short illustrated description of the municipal tramways of Brighton, England.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

Worcester.—An illustrated article on the re-arrangement of the power generating and distributing scheme for traction at Worcester, Mass.—*St. R'y Rev.*, Jan. 15.

Street Car Platforms.—PARTRIDGE.—A continuation of his article He illustrates and comments on 19 different types of platforms, pointing out the advantages and disadvantages of each.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

Automobiles.—An illustrated description of the electric automobiles, exhibited at the fourth international automobile exhibition, held in Paris last December.—*L'Ind. Elec.*, Dec. 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Modern Tendencies in Electrical Distribution.—An editorial in which the old alternating versus direct-current controversy is said to take at present this form: Given that the electrical energy is generated as two or three-phase high-pressure current in a plant at a distance from the main area of supply, should the current be distributed as alternating current after a simple transformation in stationary transformers, or should it be converted to direct current by rotary converters? In Great Britain, out of a total of 56 new stations started during 1901, only two small ones were on the single-phase system, while several that are already running are now supplying two-phase and direct current in addition to single-phase alternating. "If large works, such as those of the Metropolitan Elec. Supply Co., the City of London Electric Lighting Co., and the municipal electricity works at Leeds, Sheffield, Bristol, Huddersfield and Worcester were built to-day, they would probably not put in one single-phase machine, although at present the supply is wholly on this system in some of these works, and to a large extent in the remainder. The conditions in the United States differ to some extent, however, from those obtaining in this country. There the practice of 'scrapping' plant wholesale, in order to substitute modern machinery and methods accords more with the inherent character of the people, and is accentuated by the high cost of labor, both skilled and unskilled. On the other hand, the extremely slow introduction of a consumers' pressure of 220 volts amounts almost to a conservatism, which is the last thing one would expect to meet with in the States. Perhaps it is to a certain extent due to the habit of attributing less importance to saving material than to saving labor." A review is given of the papers of Ferguson, Scott and Emmet, read some time ago before the Am. Inst. Elec. Eng.—Lond. *Elec.*, Jan. 10.

British Central Station Statistics.—A statistical article with two tables and 12 diagrams on electricity supply works' costs in 1899 and

1900 in municipal and company plants in Great Britain. The important feature of the year 1900 was the abnormally high price of coal. The following are average values of some of the principal municipal plants: Units sold per 8-cp lamps capacity, 20.8 in 1900, against 19.8 in 1899; fuel costs in cents per unit sold, 1.94, against 1.48; total revenue in cents per unit sold, 7.44, against 7.88; total costs in cents per unit sold 4.48, against 4.30; ratio of total revenue in per cent 62, against 56. The corresponding average values for company plants are: Units sold per 8-cp lamp capacity 21.3 in 1900, against 19.4 in 1899; fuel costs in cents per unit sold 2.20, against 1.94; total revenue in cents per unit sold 10.18, against 11.20; total costs in cents per unit sold 5.36, against 5.64; ratio of total costs to total revenue in per cents 54, against 51. Several features of the statistics of the last five years are well brought out in diagrams. In the case of municipal plants the total revenue in 1900 was equal to the total costs plus 5 per cent of the mean capital expended, while for the companies their average total revenue was equivalent to their average total costs plus 5.6 per cent of their mean expended capital. The curves relating costs per unit with output, and per unit with load factor, show that if "the payments out of revenue in respect of capital charges were according to the above scale," i. e., 5 and 5.6 per cent, respectively, of the mean expended capital, there would in general be a deficit for the small and a surplus for the large undertakings.—Lond. *Elec.*, Jan. 3.

The very large annual table of all the central stations in the United Kingdom, which are in operation or are being erected, with a large amount of statistical information; also a summary with diagrams. The total connections in London now amount to 129,400 kw, against 105,400 kw last year. The connections to provincial stations have increased at a far greater rate than the London ones, largely to be accounted for by the increased tramway load on the combined lighting and traction stations. The grand total for London and provinces approaches 400,000 kw, or about 13,000,000 8-cp lamps, an increase of 3,000,000 over last year.—Lond. *Elec.*, Jan. 10.

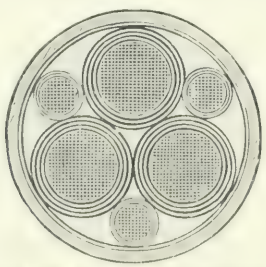
La Bourboule.—An illustrated description of the new power plant of the City of La Bourboule in France, by the Fives-Lille Company. There is a 100-kw direct-current dynamo, and two 3200-volt, three-phase generators, one of 100 kw and one of 150 kw. The switchboard and the phase indicator for connecting the alternators in parallel are described. The Dobrowolsky system is used for supplying a three-wire system from a single dynamo. It has been described before in the Digest.—*L'Ind. Elec.*, Dec. 25.

REFERENCE.

New York.—A well illustrated description of the new waterside station of the New York Edison Co.—*Power*, Jan.

Three-Phase Distribution for Power and Lighting.—Woodfield.—An illustrated article in which he discusses the advantage of the three-phase system for power and light supply, and describes several methods of applying the three-phase system.—Lond. *Elec. Rev.*, Jan. 3.

Distribution Cable for Three-Phase Working.—An article in which the well-known fact is first proved that the use of a fourth neutral wire in three-phase working allows a great saving of copper. The



problem is how to best place the neutral wire relatively to the three principal conductors in a cable. It has been proposed to strand this conductor over the three main cores after they have been laid up, but this considerably increases the outside diameter of the cable, at the same time making the joint very difficult, while another proposal has been to strand the fourth conductor up with the other three, which arrangement is unsymmetrical and will throw out the balance of the system, besides making the outside of the cable larger than it need be. In Esson's cable, which is shown in the adjoining diagram, the neutral conductor is divided into three parts, and with regard to the principal conductors these are placed each in the external recess formed between the contiguous principal conductor, so that, like the principal conductors, they are disposed in triangular form. In manufacturing the cable, the separate constituent conductors are laid or twisted along with the three principal conductors, and may or may not be separately insulated. If separately insulated, the covering may be less heavy than that of the principal conductors. The cable thus formed is lapped outside and lead-covered in the usual way, the space between the conductors and the lead being packed with jute or other filling. The three constituent conductors of the neutral wire are united at each joint box in a very simple way, and one of the consumers' connections is made to this, and the other by an ordinary T-joint to one of the principal conductors. The space which in this cable is taken up by the fourth wire, would in an ordinary three-core cable be filled with jute or other worming.—Lond. *Elec. Rev.*, Jan. 10.

Electro-Physics and Magnetism.

Sparking in Dielectrics.—Bagart.—A description of a general method of producing sparks in electrolytes in a simple and certain manner. He reduces the exposed surface of the electrodes to a small amount by using thin wires, cased in ebonite, up to near their ends. To produce the discharge he uses two Leyden jars, whose internal armatures are joined to an influence machine, and to the two branches of an exciter immersed in a liquid. This liquid maintains by its conductivity the equality of the potentials of the two armatures as long as the charge is comparatively slow. But if the exciter is adjusted for a sufficiently high-spark potential, as soon as there is a discharge of the internal armatures, the sudden discharge which tends to take place between the external armatures cannot take place by simple electrolytic conduction, and a spark breaks across the dielectric.—*Comptes Rendus*, Dec. 9; abstracted in Lond. *Elec.*, Jan. 3.

REFERENCE.

Electrostatics.—Pomey.—A purely mathematical article on a special case of electrostatic equilibrium, that of two parallel circular cylinders of different diameters.—*L'Eclairage Elec.*, Dec. 28.

Electro-Chemistry and Batteries.

Electro-Chemical and Electro-Metallurgical Industries.—J. B. C. Kershaw.—The conclusion of his serial. He deals with Switzerland, Russia, Austria, Italy, Spain, Norway and Sweden. With the exception of Russia, all these countries are well provided with water power. At Sarpsfos, in Norway, power is sold to the two carbide plants for $11.50 per ehp-year, and at Hagnek, in Switzerland, the ehp-year is sold for $12. In the other countries the outlay on water-power installations has been higher. At Paderna, near Milan, where 13,000 hp has been developed, $28.80 is charged per ehp-year, but this is still much lower than the cost of steam power in Italy. Austria has at Hallein a cellulose and wood pulp factory where 20 tons of bleached pulp are produced per day. The process of C. Kellner for the production of alkalies, chlorates and bleach does not seem to have been successful. Calcium carbide is made at several places. Of interest is the statement that at Aussig a company is working the bell or gravity process for the manufacture of alkalies and bleach with success, and that with 600 hp an output of 8 tons per day has been obtained. The only electro-metallurgical industry which has developed to any extent in Italy, is the manufacture of calcium carbide. An interesting development is the proposal to use the electric furnace for smelting iron ores, and for the direct production of steel in one operation. The Stassano process was tried near Rome, upon a small industrial scale, in 1899 and 1900, and the results obtained in the preliminary trials are said to have justified the erection of a large plant at Darfo in northern Italy, where 1500 hp is available. An output of 4000 tons steel per year is expected. If the steel produced in this way can compete in price and quality with that manufactured by the older methods, the Stassano process is likely to extend rapidly in Italy. At Rome and Milan hydrogen and oxygen gases are produced upon an industrial scale by electrolysis of dilute solutions of caustic alkali. The gases obtained in this way are compressed and sold in steel cylinders of the usual type. The most successful electro-chemical industry yet developed in Norway and Sweden is that of the manufacture of chlorates. There are also carbide plants, a wood pulp factory, and experiments are proceeding in the reduction of iron ores and the direct production of steel. Russia has three copper refineries, three alkali plants and one carbide plant. Spain has one

carbide plant and one alkali plant. Switzerland has plants for the production of chlorate, aluminum, carbide, alkalies and chlorine. In conclusion it is said that the new electro-chemical and electro-metallurgical industries may at no very distant date represent a greater aggregate of ehp than all the lighting and traction stations now in existence. An estimate of the power utilized in 1900 gave an aggregate of 215,000 hp, and this total will undoubtedly grow with each succeeding year. But speculation, over-capitalization and over-production in practical industries must be guarded against.—*Elec. Rev.*, Jan. 11.

Electrolysis of Fused Salts.—LORENZ.—An article in which he discusses the differences between his and Garrard's theories of the electrolysis of fused lead chloride. Garrard, on measuring the decomposition voltage of fused salts of the type of chloride of lead, found two kink points at 0.8 and 1.2 volts, and concluded that such salts are doubly dissociated—in the one case into one bivalent positive Pb ion and two monovalent negative Cl ions; in the other case into one monovalent positive Pb Cl ion and one monovalent negative Cl ion. According to Garrard these two reactions correspond to the two kink points in the curve found by him. On the other hand, according to Lorenz's theory, the second kink point at 1.2 volt, corresponds to the decomposition of lead chloride in one bivalent Pb and two monovalent Cl ions, while the first kink at 0.8 volt is caused by polarization phenomena due to the diffusion of "metal fog," as has been noticed at length before in the Digest. He discusses both the rival theories and points out the facts which are in favor of his view. He is of the opinion that practical results speak well for his theory. With the help of it many observations can be easily explained. The advantage of cooling the cathode and of the use of certain additions to the fused electrolytes are apparent, in that they diminish the solubility of the metal and also the tendency to form "fog." Hereby, in accordance with his theory, the depolarization is diminished and the current yield increased. It also explains why the use of high-current density—in spite of this being contrary to the cooling principle—is recommended. "The velocity of depolarization must be nearly constant in the practical cases of electrolysis of fused salts. It follows that the current yield must be increased by depositing a large number of ions in the unit of time, and in a small space, in which only a small surface is presented to the solvent. This, however, means using a large current density."—*The Elec. Chem. and Met.*, Dec.

Electrolytic Deposition of Copper.—SAYER and SPIERS.—A continuation of their article. They deal with the influence of impurities in the electrolyte in the process of copper refining. The crude metal anode contains two kinds of impurities: First, the less electro-positive elements, which form insoluble slimes and which include gold, platinum, silver, lead, bismuth, tin, antimony, selenium, tellurium; second, the more electropositive elements which go into solution, as iron, zinc, nickel, cobalt, arsenic, antimony, etc. Arsenic dissolves until the bath is saturated after which, if such a stage be reached, it deposits as a slime on the cathode. Antimony first goes into the anodic slime, but eventually redissolves. Both, arsenic and antimony, in neutral or nearly neutral baths, may form cathode sludges consisting of salts of their respective acids. Iron, zinc, nickel and cobalt all go into solution as their respective sulphates. Four methods are briefly described for purifying the electrolyte from arsenic, antimony and bismuth. To obtain the deposited copper quite free from antimony, great care must be taken that but the merest trace of the latter should be in solution. The separation of zinc, nickel and cobalt from the solution is much more troublesome, and their presence is much more harmful, for their presence not only makes the solution relatively poorer in acid, but also relatively poorer in copper. It is very important when a stage is reached at which the concentration of the impurities becomes considerable, to keep the decomposition voltage below that capable of depositing the foreign elements, which, even if their presence were not otherwise harmful, nevertheless render the deposit limp and brittle. The effect of chlorine in the solution is to discolor the copper; 6 cc. of hydrochloric acid in a liter of saturated copper sulphate renders the copper quite black. According to Swan, a most remarkable effect is produced by the addition of a minute proportion of a solution of gelatine in dilute nitric acid to an ordinary copper sulphate solution composed of two-thirds saturated solution with 5 per cent of sulphuric acid. If so much of the gelatine solution as represents 1 part of gelatine to 30,000,000 parts of the copper solution be added instead of the deposit being pliant and crystalline, it will, under the proper condition of temperature and current density, be smooth, bright and elas- [illegible] gelatine be in excess, the deposit will be extremely hard and brittle.—*The Elec. Chem. and Met.*, Dec.

Instantaneous Chemical Reactions and the Theory of Electrolytic Dissociation.—KAHLENBERG.—A brief abstract of a paper read before the Am. Chem. Society. The oleates of the metals are soluble in perfectly dry benzine, and from these solutions the anhydrous chlorides are instantly precipitated by a dry benzine solution of hydrochloric acid. These solutions in benzine are practically non-ductive of electricity, consequently electrolytic dissociation cannot be supposed to have taken place, yet the reactions appear to be exactly parallel to those in aqueous solutions which the advocates of the electrolytic dissociation theory have tried to explain as being due to the action of ions.—*Science*, Jan. 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Limitations of Wireless Telegraphy.—A long and rather sarcastic editorial. "There are many competent to form an opinion who consider that Mr. Marconi was deceived in believing that he heard faintly in a telephone the expected signal from Cornwall; but even admitting that he can telegraph the entire Morse alphabet, his difficulties are only commencing." If he commences with one station at each side of the Atlantic, there will be the following difficulties: "The enormous power used for that long distance will probably make it impossible to send more than four, or at most, five, words per minute. The great height of his poles will expose him to frequent interruption from storms, and he will be liable to have his signals rendered illegible at any moment by the ether waves sent off from any ocean liner using the same wave-length, and happening to be comparatively near either of his stations." In order to increase the volume of traffic it will be necessary to erect more stations on either side, using these in pairs, with a special wave-length for each syntonized pair of stations. "As a matter of practical experience there are not more than 10 tones which can be used simultaneously with syntonized apparatus without mutual intreference. It comes to this, then, that the greatest number of stations Mr. Marconi can erect for transatlantic signaling would be 10 stations on either side, these possibly giving conjointly a maximum of 50 words per minute." But in doing so, "he will have succeeded in damaging all his useful marine intercommunication from ship to ship and from ship to shore," and this is really the most valuable application of wireless telegraphy. Moreover, there will be no secrecy. All over Europe it will be possible to "tap" messages sent from England to America. When other countries proceed in the same way in erecting wireless telegraph stations, there will be endless confusion. At the end of the editorial the writer imagines that for the last 50 years or so no submarine cable existed, but all communication across the Atlantic was wireless by ether waves. If now a discoverer would arise, bringing forth the gutta-percha submarine cable, "with what rapturous delight would that new invention be hailed the whole world over! The electric cable—that takes the message straight to its destination, and does not allow it to be scattered in all directions—the speedy, certain, secret electric cable! What a marvelous improvement upon the ether wave! A new era for telegraphy is inaugurated, and ether telegraphy is doomed."—Lond. *Elec.*, Jan. 17.

Photographone, or Electric Arc Kinematograph.—RUHMER.—A description of a very interesting new instrument. The speaking arcs of Simon and of Duddell have induced him to turn the Kinematograph on the arc. The arc is produced between two horizontal carbons on a 220-volt circuit with resistance in series. The arc circuit further comprises an induction coil and a microphone or a liquid interrupter in a shunt, thus intermittent currents are superposed upon the continuous current. In front of the arc is a slit, further off is the kinematograph. The slit produces an image of the two carbons on the ground glass. When the kinematograph is in motion, the arc appears as a bright, continuous band. When the arc hisses the band becomes wavy. The liquid interrupter cuts the band into rectangles of varying lengths. When the experimenter whistled into the microphone some 1500 vibrations could be counted on the band of the arc image. He finally talked into the arc, the apparatus being so arranged that a lens produced an image of the steady arc in the shape of a very fine bright line running right across the film, which was traveling at the rate of 3 meters per second. To reproduce the impression thus obtained, he uses the same box camera, with its two pulleys, the upper one of which is rotated by an electric motor. But the arc now serves as the projector lamp, and the film travels with the same speed as during the exposition, in front of the selenium

cell of high sensitiveness. The variations in the light intensity of the photo-phonogram are then converted into variations in the resistance of the selenium cell and of the current intensities in its circuit, and speech is reproduced in two telephones coupled in series, with surprising distinctness.—*Ann. d. Phys.*, 1901, v. 5, p. 803; abstracted in Lond. *Eng'ing*, Jan. 3.

MISCELLANEOUS.

New [illegible] Spheres.—Appliances.—A brief article. In a former article he described a simple method for calculating the change in weight of a wire, corresponding to a definite small change of diameter. He had shown that "for any given material a constant can be found which, when multiplied by the number representing the diameter of a given wire in mils, expresses the weight in the change of unit length of the wire in pounds." This "mil-constant" is used by manufacturers as a ready means of determining the error in weight of wires, produced by an error in the die, or by the stretch, in the process of drawing or covering it. Conversely, it enables cable makers, from the actual weight of a trial length, to calculate by simple division the corresponding number of mils, to be added or deducted from the next run of work, in order to attain accuracy of weight. In the present article he applies the same principle to the manufacture of spheres and shows that the "mil-constant" may be of valuable aid, especially in the design of dies and other tools intended to produce spheres of given gauge and weight.—Lond. *Elec. Rev.*, Jan. 3.

REFERENCES.

Visit of British Electricians to Germany.—A reprint of the report of the committee on traction, light and power distribution, from last year's visit of the Brit. Inst. of Elec. Eng. to Germany. The report deals with ownership of works, prime movers, boilers, generators, motors, storage batteries, cables, tramways, the experimental high-speed railway, and the Langen suspended railway in Elberfeld.—Lond. *Elec.*, Jan. 10.

Decimal System.—Raverot.—An illustrated article on the decimal system and the measurement of time and angles.—*L'Eclairage Elec.*, Dec. 28.

New Books.

Instruments et Methodes de Mesures Electriques Industrielles. By H. Armagnat. Second Edition. Paris: C. Naud. 614 pages, 230 illustrations. Price, 15 francs.

The first of the three principal parts into which this volume is divided treats of laboratory apparatus and standards. The matter is of the kind that would naturally be expected, i. e., dissertations on various types and forms of galvanometers, the best form of their coils, the use of shunts and the making up of standard cells and resistances. There is also a section of brief but instructive notes on the installation of galvanometers in places where vibration is present.

Part II. concerns commercial measuring apparatus, such as indicating voltmeters and ammeters, integrating meters, etc., and cannot be said to be very complete whether taken as a review showing the evolution of types or as a description of modern apparatus.

It would seem that the author's plan has been simply to mention the fundamental principles underlying the different classes of meters, but even then it surely does not seem to be expecting too much to ask that the D'Arsonval type of instruments, for instance—among which the form adopted by Weston stands prominent—should be exemplified by other than a few lone illustrations of a primitive form of a French instrument with four brief pages of descriptive matter; and the almost endless varieties of electromagnetic meters so extensively used abroad and lately brought to a high degree of perfection by Lord Kelvin, should be entitled to more mention than is given by three pages and three outline cuts showing no make in particular. True recording, or, as they are called in France, registering meters, i. e., the kind that make graphic records, are still more cavalierly handled, and when we come to integrating meters we find that this line, in which there is at the present day perhaps greater activity and a greater variety of types than any other, is illustrated by the little-known O'Keenan type, the Thompson, an A. E. G., an Aron, and the old type Shallenberger instruments.

The third and last section of the book is on methods of measurements of not only electrical but magnetic units. For information regarding the former the reviewer would prefer to turn to his Kempe, but for the latter the present volume assembles in a convenient form much matter that is ordinarily to be found only by searching through scattered volumes.

Taking it all in all, while the book is probably not the one that would be selected by an engineer were he restricted to but a single volume on the subject, it has a place in every well stocked library, perhaps as much because of the information it gives on European practice as for any other reason.

Elektrische Kraftubertragund und Kraftverteilung. By C. Arldt, Chief Engineer, Allgemeine Elektricitats-Gesellschaft. Berlin: Julius Springer. 387 pages, 257 illustrations. Price, 4 marks.

This is the third edition of a novel form of catalogue illustrating the dynamos, motors and auxiliary apparatus made by the Allgemeine Electricitats-Gesellschaft, of Berlin. Instead of being a price list pure and simple, the book has been written along elementary text-book lines, numerous ingenious if not always strictly accurate analogies being made use of to make clear to the non-technical reader the general subject of the use of electricity for transmitting and distributing power. Of course, A. E. G. apparatus is the only make illustrated or mentioned, but their line is so extensive that the scope of the work is not narrowed by this course. Probably the most interesting matter of American readers will be the hundred-odd pages showing the application of both direct and alternating-current motors for driving various machines and tools. Induction motors seem to be freely used even for such work as driving lathes, milling machines and cranes, for which in this country direct-current apparatus has been by some engineers considered essential.

In the book are found full sets of tables giving the important dimensions of all standard sizes and types of A. E. G. dynamos and motors and a brief, but very interesting and valuable section giving in detail the approximate amount of the purchase and installation costs of the boilers, engines, dynamos and accessories for small isolated plants of from 6.6 to 100 kw capacity.

The volume should help the Allgemeine Electricitats-Gesellschaft to effect sales, and their idea is one that it would seem could be followed to advantage by our manufacturers.

BOOKS RECEIVED.

Wireless Telegraphy. A Popular Exposition. Second Edition. By C. W. Tunzelman, B. Sc. London: Office of Knowledge. 104 pages, 30 illustrations. Price, 1 shilling 6 pence.

The Electric Installation of the Natural Food Factory at Niagara Falls, N. Y.

By Arthur B. Weeks.

All observing visitors to Niagara Falls will note at once the immense modern structure of buff pressed brick, occupying a prominent and beautiful site at the upper end of the State Reservation, and attracting much notice and favorable comment because of its great size and architectural beauty. This is the plant of the Natural Food Company, manufacturing the widely known Shredded Wheat Biscuit. This factory, one of the latest consumers of Niagara Falls power, possesses a unique and ingenious electric installation, complete and up to date in every particular, including both direct and alternating current, storage battery, a miniature electric railway, private telephone and telegraph wires, and specially designed machinery for each of the many processes by which their product is prepared for use.

There are two transformer rooms, designated as the east and the west, current being received into the east transformer room from the power house of the Niagara Falls Power Company, at 2200 volts, two-phase, through the panel shown in Fig. 1. This panel has the Westinghouse leaf contact circuit breaker, with flat carbons to receive the arc. The switches are double-bladed and make sufficient and positive contact, obviating entirely one objectionable feature of some switches, which work loose in the lower connections, and, when closed with the long, hardwood lever hooking into the eye at the upper part, frequently slip along the outside of the switch jaw, instead of entering properly. Below the breakers are integrating wattmeters.

Static transformers step down the current from 2200 to 110 volts for lighting, and to 440 volts for power purposes. Fig. 2 shows both high and low-potential panels for power and lighting circuits. One

of the features of this switchboard is its ground detector. All contacts and connections are upon the back of the switchboard, and from this a rod passes to the front of the board and is attached to the operating handle, which carries an indicating pointer over a dial plate. If a ground appears upon any conductor of the two-phase system, it is so indicated upon a voltmeter. Fig. 3 illustrates this attachment, and shows in detail the wiring and connections for the voltmeter switch and ground detector. Figs. 4 and 5 show the lighting boards of the east transformer room. The power panels are of the same design. At the left is the high-tension panel, with marble



FIG. 11.—ELECTRICAL KITCHEN AND RAILWAY.

barriers between the single element knife-blade switches and lignum vitæ fuse box. A rear view of this switchboard is shown in Fig. 6.

In this east transformer room is also a Westinghouse 150-kw rotary converter (Fig. 7), producing 220 volts on its direct-current side. The current thus generated is used in operating four electric elevators, of double screw Otis pattern, of the style used in the Electric Tower at the Pan-American Exposition This rotary converter represents the latest design of Westinghouse make, having many improvements. The induction motor for starting is of a size sufficient for bringing the armature up to synchronism without overheating, and its current can be taken from any source for either side of the starting switch. One side may be used for starting, and the



other thrown to the opposite side for running. The round meters at the top are alternating-current ammeters for each phase. The field rheostat is placed upon the rear of the panel, there being no available space upon the direct-current board. This field rheostat, after the rotary has been synchronized, is not used for the regulation voltage. It is possible to vary the voltage about 10 volts by means of the rheostat, yet it is only used to acquire the proper power factor. What little regulation of voltage may be necessary is accomplished by means of an alternating-current regulator, connected to each phase in the primary circuit. Instead of the four-plug switches for the motor and four for the alternating-current side of the rotary as formerly made, both phases for each are controlled by one lever, simplifying materially the operations of stopping and starting. To the left of this panel are shown the white dial and pointers of the Lincoln synchronizer, described in a recent issue of this journal. The direct-current panel at the right has the usual equipment for the direct-current side of a rotary transformer.

In the west transformer room is another electric equipment. Here is a Holtzer-Cabot generator, shown in Fig. 8, of 12 kw capacity, 30 volts, 400 amperes, speed 710 revolutions, and driven by a Westinghouse induction motor, 10 hp, 400 volts. This motor generator set is used for charging storage batteries for telephones and annunciators, and for operating the miniature electric railroad. The right-hand panel of the board (Fig. 9) shows the generator set instruments, the other panel being reserved for the numerous battery circuits. In this transformer room are two switchboards of the same design as those of the light and power panels in the east transformer room. Fig. 10 shows one of four risers located in appropriate places between the walls from basement to sixth floor. The space on the right is to be used for future additional installation. The running of the lead-sheathed cables and other wires is done in the most thorough and

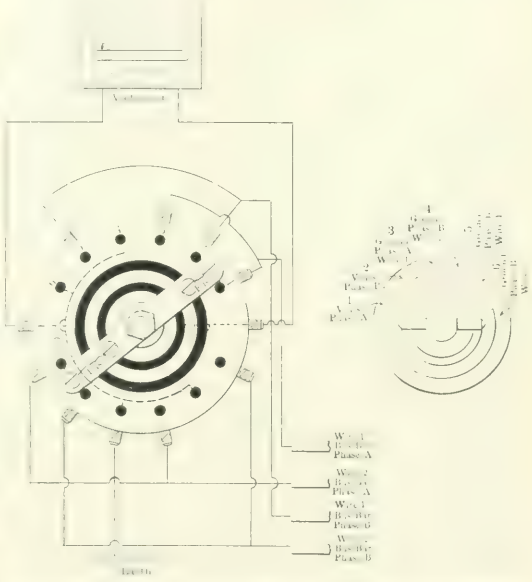


FIG. 3.—WIRING DIAGRAM OF VOLTMETER SWITCH AND GROUND DETECTOR.

approved manner, every precaution being taken to prevent short circuit. Cabinet cut-outs are placed at convenient points throughout the building.

In this great building, containing 5½ acres of floor space, there are to be 130 motors used. The individual motors are all of Westinghouse induction type, and located, some on the floor and others on the ceiling, according to the nature of their office. They are built for three rates of speed—1700, 700 and 470.

One of the most complete electrical kitchens in the world is shown in Fig. 11, and it is as unique as many other details in connection with the Natural Food Company's plant. It is located upon an arched bridge which spans the rotunda of the main floor from gallery to gallery, and here are prepared for demonstration the innumerable "shredded wheat biscuit" dishes. All heat for cooking is supplied by electricity.

Around the balcony of this main floor runs the miniature railway, fully equipped with tracks, switches, stations and guards, for the purpose of serving dainty luncheons to visitors. The guest seats himself at what seems to be a small white table, but which is in reality one of the tiny cars of this ingenious little railway (shown in Fig. 12). A desk at the left of each seat contains a menu card from which a luncheon may be chosen and noted on an order slip. An electric but-

ton is then pushed, which lights a tiny lamp on a switchboard in the kitchen, indicating that at a certain station some one is waiting to be served. The switchboard operator closes the switch in connection with this station, and the car immediately starts off and proceeds directly to the kitchen. The order completed, the car moves back automatically to the station from which it started, bearing the luncheon attractively served, and itself serving as a dainty table for the convenience of the visitor. There are no wrecks on this railway, the block system used preventing all disasters. Fig. 13 shows the switchboard in connection with the miniature railway service.

Looking out on the upper Niagara River at the front of this great building, is a dining hall for women operatives, an immense, brilliantly lighted apartment, tastefully furnished with circular tables, comfortable chairs, and an open piano. Artistic tiled fireplaces lend attractiveness, and an important and interesting feature of the room is the electric cooking equipment, shown in Fig. 14, and occupying prominent positions on either side of the entrance. Here are tables fitted with the most approved electric cooking utensils, coffee and tea urns, chafing dishes, and so on, while at one side stands a row of covered compartments heated by resistance coils placed within lengths of pipe, over which food may be kept hot. In the electric kitchen a very complete electrical cooking equipment is in operation, and appetizing dishes of various kinds are served to employes.

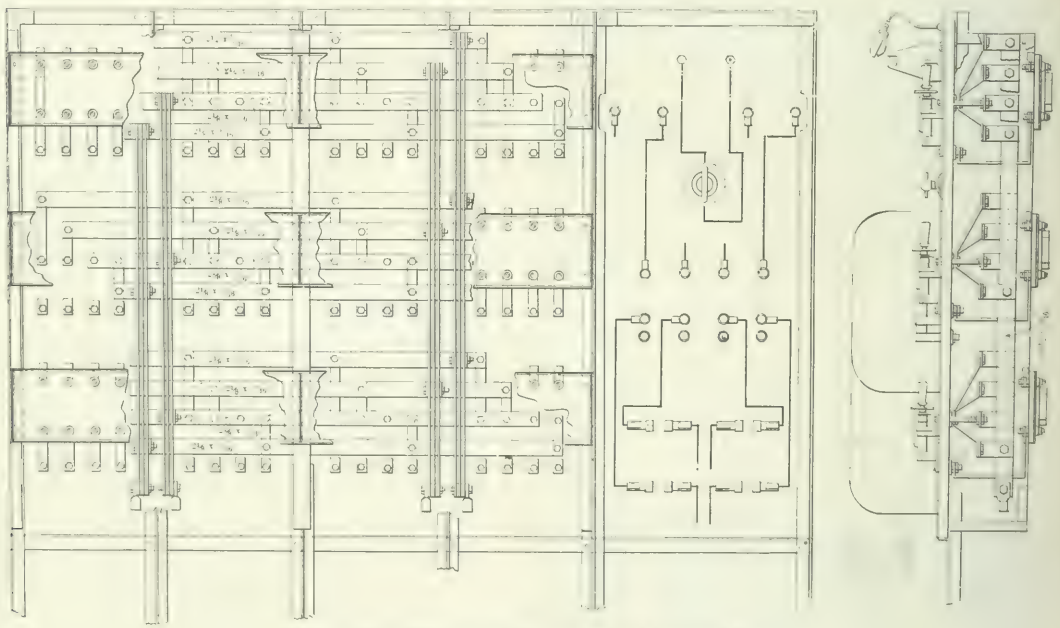
Below this dining hall is a large and well furnished lecture room, in the wall at the back of which is an electrical device for operating a stereopticon. A 220-volt direct-current lighting circuit, and another of alternating current, occupy enclosed chambers beside it, and corresponding ones are stationed in the floor of the lecture platform for use in any lecture requiring the demonstration of electric cooking or other devices. The lighting is artistic and beautiful, the electric candelabra consisting of chain pendants supporting incandescent lamps in groups.

The offices and building throughout are heated with hot air. A unique device in each office regulates the temperature and air for ventilating purposes; a valve automatically controlled admitting hot air and shutting off cold, or vice versa, according to a predetermined temperature. Air for ventilation is supplied by fan blowers 16 ft. in diameter, the entire air supply being renewed every 7½ minutes. In the offices are plug receptacles placed at different points along the walls, to which the individual telephones may be instantly transferred, should a change in the location of desks be desirable, and receptacles for electric desk lights and messenger service calls are also stationed in different parts of the room for the same purpose.

The manufacture of shredded wheat biscuit, for which purpose this great plant with its intricate and specially contrived machinery has been devised and erected, is an interesting process. Every step, from the receiving of the grain to the loading of packed cases for shipment is carried on under this extensive roof. The wheat, when unloaded from the wagons on the ground floor, is carried upward by chain conveyors to vast hoppers, where, by a fanning process, motor operated, it is thoroughly cleansed. It then descends through a long, box-like chute to a rubber belt, 14 inches wide and slightly concave in the center, which carries it in a continuous stream through a long, narrow tunnel to the cooking room, shown in part in Fig. 15. Here the wheat is placed in immense cylindrical "tumblers," which are lowered by an electric crane into great vats of boiling sterilized water, in which the open-work, wheat-filled cylinders are revolved for 30 minutes by a geared induction motor, at the end of which time the grain is thoroughly cooked. The electric crane, made by the Case Manufacturing Company, of Columbus, Ohio, is of 2000 lbs. capacity, operated by three induction motors, one running north and south, one east and west, and the third for hoisting.

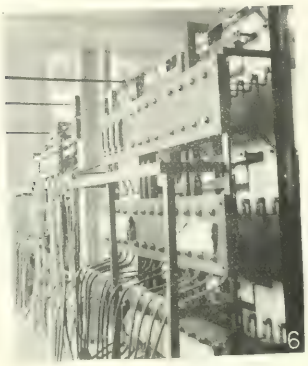
Current is conducted to the crane by four bare wires, and taken off for the motors by contact rollers. From the rollers the current is conducted to the operator's platform and connected to an auto-starter and the several switches that control the movements of the crane. Each operating two-phase switch is double-throw, giving a certain movement when closed on one side, and the reverse direction when the opposite side is closed. The slow revolution of the cylinders of wheat in the tanks of boiling water is obtained through a set of reducing gears. The motor is placed upon the floor, and clutches are used to control each tumbler, or cylinder. From the vats, the moist wheat is carried, still smoking hot, through chutes to the next room, where it is spread out in large, oblong cases lined with white cotton cloth. It is left there 12 hours, being turned eight times, and is then free from moisture and ready for the next process—that of shredding.

The shredding machines (Fig. 16) consist of 36 small hoppers, into which the cooked grain is automatically run. These stand in a long row and feed the wheat to a device consisting of two rolls, one having a smooth and the other a grooved surface. Pressure between these rolls draws the wheat out into long, fleecy threads, each set forming one layer of the biscuit. Fig. 17 shows a 40-hp induction motor belted to a shredding machine by means of a Renold steel link belt. The



FIGS. 4 AND 5.—DIAGRAM OF REAR AND END OF LIGHTING BOARD.















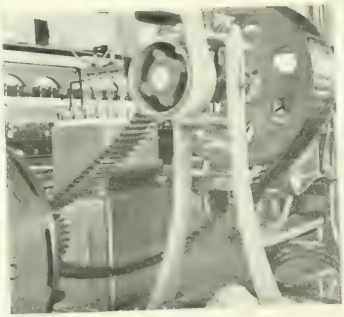










Fig. 1. Receiving Room, Substation and Switchboard.
Fig. 2. Substation and Switchboard.
Fig. 3. Rotary Converters.
Fig. 4. Rear of Switchboard.
Fig. 5. High and Low Pressure Panels.
Fig. 6. Exciter Panels.
Fig. 7. Generator Panels.
Fig. 8. Generating Set.
Fig. 9. Grain Cooking Room.
Fig. 10.—Risers from Basement to Sixth Floor.
Fig. 11. Grain Shredding Room.
Fig. 12. Grain Flaking Room.
Fig. 13. Electric Railway Switchboard.
Fig. 17.—Motor-driven Shredding Machine.
Fig. 19. Motor-driven Chain Conveyer for Cartons.

ELECTRIC INSTALLATION OF THE NATURAL FOOD FACTORY, NIAGARA FALLS, N. Y.

gear on the shredder has a rising shield on either side to prevent the displacement of the belt. The motor makes 700 r. p. m., and the running of the chain is practically noiseless. The Renold belt, as recently described in these pages, is made up of parallel layers of steel punchings riveted together and free to move on the pin connecting them. The teeth of the chain mesh into the gears, while the outside surface is smooth. This chain belt is similar in construction to leather link belts, with the exception of the teeth. The steel belt is used on motors both on the floors and on the ceilings. That here described was made in England, and installed by the Link Belt Engineering Company, of Nicetown, Pa., who now manufacture it in this country.



FIG. 14.—SHREDDING MACHINE.

All along the carrying plate on which the shredded wheat is transported from one hopper to the next, are slots, the width of a biscuit apart. When the last hopper has been passed, this plate moves over a set of knives, which, passing upward through the mass of fleecy threads, cuts them into neat, oblong biscuits. Here the biscuits leave the carrying plate and are held up by an air suction until in a certain position above a great baking pan, when a reverse action blows them downward, and the receiving pan moves automatically along to receive the next row in like manner, and so on, until the tray is filled. Another pan takes its place, and the filled pan is placed on one of

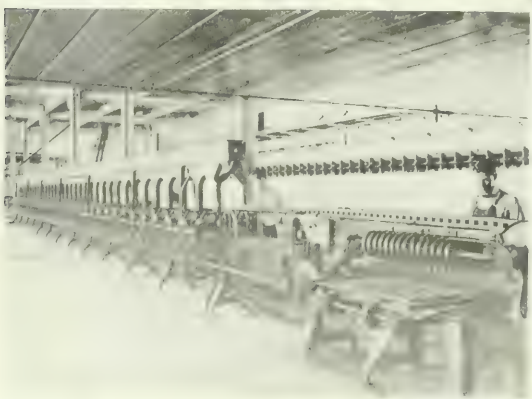


FIG. 15.—ELECTRICALLY-HEATED BAKING MACHINE.

the shelves of an enormous "Ferris' wheel," containing 12 paddles, or shelves, holding eight pans of biscuit each, and revolving in an immense heated oven. Each of these Ferris wheels is operated by a motor-driven worm gear (Fig. 18) placed outside the oven.

When the biscuit have acquired an even golden-brown tint, the trays are passed into a long, hot-air evaporator, containing two rows of 19 shelves each, where they travel slowly through the tunnel-like chamber, taking one and three-quarter hours in transit, and coming out at the farther end, thoroughly baked and delicious. This evaporator is operated by a motor from the ceiling of the room beneath.

The trays are now carried automatically along a rack, down a long table between a double row of young women who pack the biscuit into cartons. At no other time during the entire process are the biscuits touched by hand. The filled cartons are packed in a carrying device resembling a long, narrow ladder, the exact width of the cartons, which lifts them up an incline to the floor above. Here they are passed through an automatic sealing apparatus, and on between two parallel belts down a farther extension of the chain conveyor to the lower end of the room, where they are discharged at the end shown in Fig. 19. By the time their destination is reached, the paste used in sealing is quite dry, and the cartons are ready to be packed in the wooden cases which are coming down constantly through chutes from the nailing room on the floor above. These cases are sent up "knocked down" on a motor-driven conveyor from the ground floor, and are nailed together by automatic nailers driven by induction motors.

For the accompanying diagrams we are indebted to the courtesy of the Crouse-Hinds Electric Company, of Syracuse, N. Y., by whom were furnished and installed the lighting and power panels of this most modern and up-to-date electrical equipment. The electric heating and cooking apparatus was installed by the American Electric Heating Corporation, of Cambridgeport, Mass., Mr. J. I. Ayer giving considerable personal attention to the design and installation. The current is derived from the huge power plant of the Niagara Falls Power Company

The Moore Telephone System and Apparatus.

The Moore Telephone System, which has been operating for some few years past in the Eastern part of Michigan, and whose lines are connected with those of the Michigan Bell and the independent networks as well, is supplied with apparatus built by the Moore Telephone Manufacturing Company, of Caro, Mich., of which Mr. W. J. Moore is general manager. The apparatus is herewith illustrated.

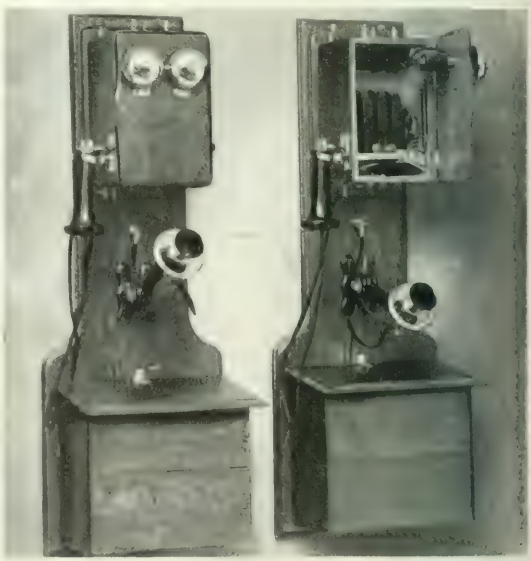


FIG. 1.—TELEPHONE.

In the accompanying cuts, Fig. 1 shows the telephone used, which is made either bridging or for series work. The receiver is multipolar, the switch is of hard-drawn copper, brass and bronze, no castings being used. It is on the lines of the familiar Bell-Watson switch. The ringing apparatus has the generator with either chain or cog gear. The armature is made with a soft laminated iron core and steel shaft. All the woodwork is done in oak. The transmitter is placed on a universal arm. In the cut, on the closed telephone, the transmitter arm is partly in its raised position, while in the open

telephone the transmitter arm is lowered towards its lowest position to show the working of the arm.

Fig. 2 shows the desk set outfit, the principal advantages being



FIG. 2.—DESK OUTFIT.

the placing of an induction coil in a special box (not in the base of the stand) in which the bell is also placed. The connections are so arranged so that it cannot be easily connected wrong, as each binding post has names or numbers stamped on them.

Fig. 3 shows the transmitter and transmitter arm. This arm is so arranged that it holds the transmitter always in the same position. It is enameled in black, with all the trimmings nickel-plated, and makes a very neat appearance. It is arranged to take any transmitter, and has the advantage that it is not necessary to be long in order to be raised up and down as far as it is necessary, but always holds the transmitter in the same *vertical* position.

The Moore transmitter does not use granular carbon, but instead employs small balls. The face piece is of turned brass (not pressed nor spun), the diaphragm is carbon, as Mr. Moore believes that as good results cannot be obtained with the metal diaphragm.

Fig. 4 shows the repeating coil, with the coil which goes in the box



FIG. 8.—SWITCHBOARD.

lying on top. This coil is fastened in the box with brass straps or sealed in paraffine wax preferred, and is wound to any resistance. Fig. 5 shows a bank of 10 drops, such as are used in the Moore switchboards. The drops and other switchboard apparatus are made to cater to the requirements of small exchanges of 300 drops or less,

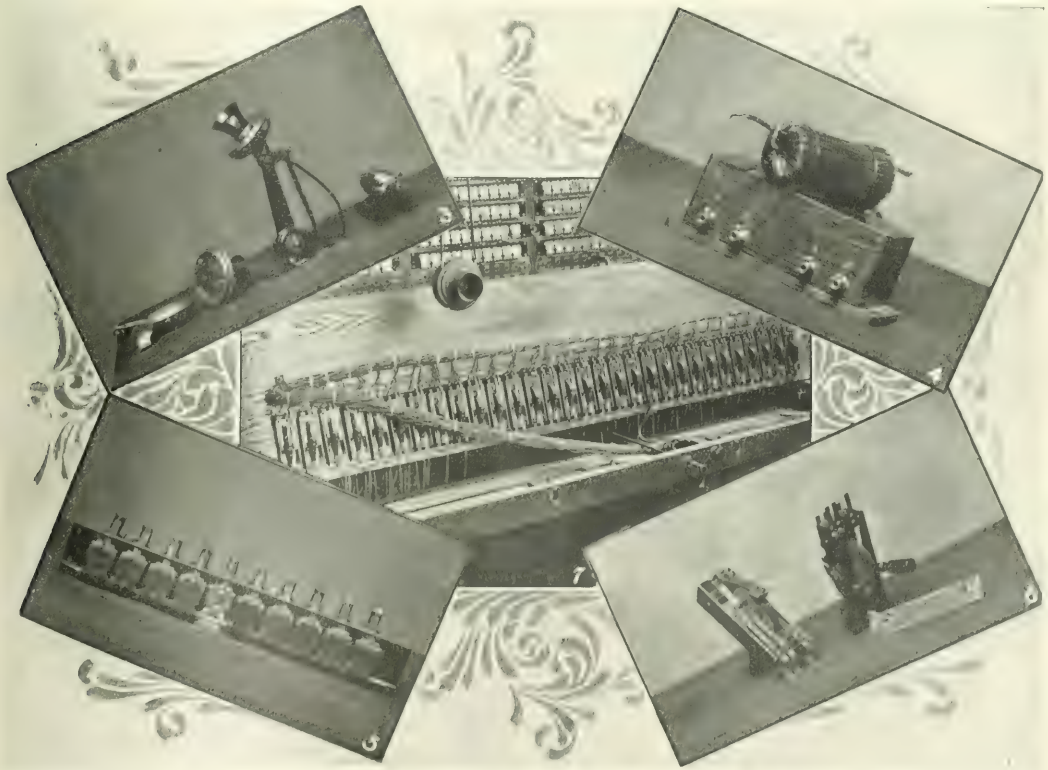


FIG. 3.—TRANSMITTER AND TRANSMITTER ARM. FIG. 4.—REPEATING COIL. FIG. 5.—BANK OF TEN DROPS. FIG. 6.—RINGING AND LISTENING KEY. FIG. 7.—BOTTOM OF KEYS IN BOARD.

and are simplicity itself. The shutters are very heavy, assuring positive night bell connections. The coils are hand-wound, and the drops are said to be better for small boards than those made for use on large as well as small switchboards. The jacks are also put up in banks of 10.

Fig. 6 shows the ringing and listening key. All contacts are rubbing contacts. There are only eight contact springs on it. It will ring either plug, and will not continue to ring when the lever is released. With it there are no metal parts exposed on top of the table, not even a screw. Fig. 7 shows the appearance of the bottom of the keys as they appear when placed on the board, while the upper appearance of the table may be seen in Fig. 8, which shows the largest Moore switchboard made, and was photographed while in actual operation. These switchboards are made in sizes from 10 to 300 drops, the company making this range its special field of occupation. It will be gathered that improvements and advances in all this apparatus have come directly as the fruit of experience gathered during six years of active manufacturing and exchange work since 1896.

Protection of Secondary Circuits.

That without suitable protection secondary alternating-current circuits may be a source of danger, cannot be denied. The ordinary transformer primary fuse, in case of failure of insulation between the secondary and primary will lead to a short circuit in one of the coils, thereby increasing the primary current and blowing the fuse, but this action may sometimes fail. Ground shields are sometimes provided—that is, a conductor interposed between the primary and the secondary and grounded so that the primary current necessarily makes connection with this shield before reaching the secondary circuit; and in like manner the secondary itself has either been permanently grounded or arrangements have been introduced between it and the ground, which, under the abnormal increase of potential due to the failure of the insulation between the two coils, would short circuit, causing a ground. To a certain extent this protection is successful in that it lessens the risk consequent upon touching the transformer or the secondary circuit. It, however, causes a dead ground upon one side of the primary line, and thereby increases the danger throughout the

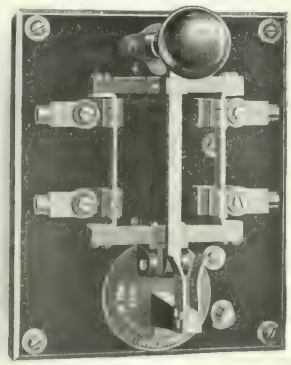


FIG. 1.—SECONDARY FUSE BOX, CLOSED.

rest of the system, since all the other transformers in the system are subjected to abnormal strains, and the risk of coming into contact with the live side of the circuit or other transformers is increased. To insure entire safety, when the high potential, through any cause, becomes connected to the secondary wiring, the injured transformer should be disconnected from either the primary or secondary wires, or both.

The accompanying engravings illustrate the S. K. C. secondary protector, otherwise known as the "sneak current detector and breaker." This combination contains an electrostatic device in connection with a solenoid so arranged that a connection between secondary and primary operates an automatic switch opening the secondary circuit. The operation of this combination is entirely positive and can be relied upon with implicit confidence.

On 1000-volt lines the automatic switch will operate when there is ground on one side of the primary and the transformer is broken down on the other side. On 2000-volt (or over) lines, the automatic switch will operate as soon as the transformer is broken down, whether there is or is not a ground on the primary. Depending upon an electrostatic device for its operation, the secondary protector consumes no energy except momentarily at the instant of operation. The shunt circuit through the solenoid is opened when the automatic switch opens.

On the first page of the *New York Times* of July 21, 1901, there appeared an article headed "Incandescent Lamp May Cause Death," dealing with certain testimony given before a coroner's jury on the subject of dangers incident to the use of alternating current for house lighting.

The testimony was given in detail, explaining how the users of

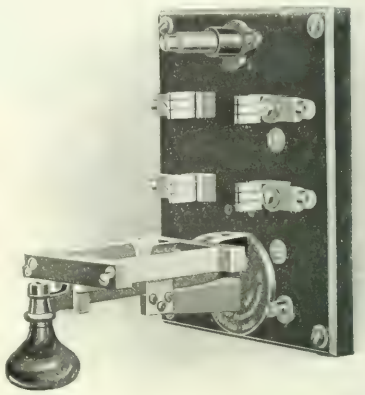


FIG. 2.—SECONDARY FUSE BOX, OPEN.

electric lights have no protection whatever against the accidental charging of the low-pressure house wires by the high-tension line wires, and that under conditions each lamp in the house may become a veritable death trap for any one coming in contact with same. The testimony indicated further that these conditions might occur without any one in the power house or anywhere being the wiser for the accident and nothing suspected of being wrong until some luckless victim drops dead upon touching the highly-charged lamp.

It must be admitted that even in the present enlightened day the ordinary alternating-current installation is susceptible to the danger indicated.

Self-Indicating Fuses.

The new indicator recently brought out by the D. & W. Fuse Company for their enclosed fuses is quite unique among this class of apparatus. They have designated it the "Bull's-Eye Indicator," on



FIG. 3.—SELF-INDICATING FUSE BEFORE BLOWING.

account of its appearance and construction. It is in every way flashless, quiet and reliable. The fuses bear sticker labels with a small circular target, which is without mark and clear. After blowing, a small black spot or "bull's-eye" appears, showing that the fuse has



FIG. 4.—SELF-INDICATING FUSE AFTER BLOWING.

operated and needs renewal. This has been adopted as standard by that company, and is meeting with very general approval of all who have tried it. It is a very ingenious and satisfactory little device.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was easier and offered by brokers on liberal terms. The closing rates were 3½ per cent for 30 to 60 days; 4 per cent for 90 days and 4@4¼ for four months. In the stock market there was a decidedly strong undertone, and although public speculation was quiet the bond market was active and higher on investment buying, which extended to dividend stocks as well. Appreciable, though irregular, advances are noted in railroad and industrial shares, due partially to the recovery in copper and rise in copper stocks, as well as the easing of money, and other favorable circumstances. The United States Steel Corporation's annual report was favorably received, but did not result in activity or advance in its stocks. The traction and electric lists shared the stronger tone of the general market, although the advances were only fractional in most instances. Brooklyn Rapid Transit closed at 65¾, a net gain of ¾, the number of shares sold being 23,095; Metropolitan Street Railway made a net gain of 2⅛ points, closing at 171¾; Manhattan Elevated closed at 135½, being a net gain of ½ point. General Electric remains practically unchanged as to closing price, which was 280, the sales aggregating only 1900 shares. Westinghouse common made a net gain of 1¾, while 1st preferred is quoted at 180. Western Union was dealt in sparingly, the sales aggregating 2510 shares, the closing figure being 91⅜, a net gain of ⅜ point. Following are the closing quotations of Feb. 4:

NEW YORK.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
American Tel. & Cable...	—	90	General Electric	[illegible]	[illegible]
American Dist. Tel.....	—	36	General Carriage	1	1
Brooklyn Rapid Transit.	66	66	Hudson River Tel.	—	—
Chic. & Pot. Telephone..	—	—	Metropolitan Street Ry.	170	171
Commercial Cable.....	168	168	N. J. Elec. Veh. Trans.	—	—
Electric Boat.....	25	26	N. Y. Elec. Veh. Tran...	12¾	14½
Electric Boat pfd.....	47	48	N. Y. & N. J. Tel.	—	—
Electric Lead Reduc'n.	2½	2½	Tel. & Tel. Co. America	—	—
Electric Vehicle.....	1¼	1¼	Western Union Tel.	91⅛	91
Electric Vehicle pfd.....	4	4¾	West. E. & M. Co.....175½		174
			West. E. & M. Co., pfd..	—	175

BOSTON.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
Am. Tel. & Tel.....	158	158½	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone	—	14
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	87⅛	86
Erie Telephone.....	20	20	Westinghouse Elec. pfd	—	180
General Electric pfd.....	280	280¼			

PHILADELPHIA.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
American Railways.....	44½	44	Phila. Traction.....	98¼	98
Electric Storage Battery.	56	58	Philadelphia Electric....	3⅞	4
Elec. Storage Batt'y pfd.	56	58	Pa. Electric Vehicle.....	—	—
Elec. Co. of America...	6	6	Pa. Elec. Veh. pfd	—	—

CHICAGO.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
Central Union Telephone.	—	86	National Carbon pfd....	83	83
Chicago Edison.....	164	163	Northwest Elev. com....	35	38
Chicago City Ry.....	190	193	Union Traction.....	11¼	11¾
Chicago Telep. Co.....	185	—	Union Traction pfd.....	47	47
National Carbon.....	18¼	18½			

ELECTRIC TUNNEL ROAD.—The Union Terminal Company, of New York, has been incorporated with the Secretary of State with a capital of $100,000, to construct and operate an electrical tunnel road between 9 and 10 miles long between New York and Kings counties. The road is to begin beneath the intersection of Varick and Montrose avenues, Brooklyn, and is to run westerly, underground and under the East River to and under Fourteenth Street, Manhattan Borough ,and under the Hudson River to a point on the boundary lines of the States of New York and New Jersey, due west from the west end of the center line of Fourteenth Street, Manhattan Borough, there to connect with a railway to be built under the authority of the State of New Jersey, continuing westerly in the same general direction to connect with the various railroads entering Jersey City and Hoboken, with branches from Fourteenth Street and Broadway under Broadway, Madison Square, and Madison Avenue to Forty-second Street, to the Grand Central Depot, and from Fourteenth and Hudson Street, southward under Hudson Street, College Place and Greenwich Street to Battery Place, to and around Bowling Green. The directors are Francis H. Leggett, Frederick P. Voorhees, Roy Stone, Charles F. Smillie, Louis L. Stanton, William C. Cox, M. E. Robinson, Appleton D. Palmer and John A. Stewart, of New York City. The project of a terminal company is a revival of a plan proposed in 1891. This contemplated furnishing a Manhattan terminal for all railroads entering Jersey City. Frederick P. Voorhees, Louis L. Stanton and William C. Cox, mentioned in the incorporation papers, are all connected with the Standard Trust Company, of 25 Broad Street.

EVERETT-MOORE SYNDICATE AFFAIRS.—The bankers' committee in charge of the Everett-Moore syndicate's affairs report that conditions are growing more favorable every day. According to latest reports, out of $11,500,000 of credits, extensions have been granted by creditors representing more than $10,000,000, and it is believed that the consents of the remaining creditors will be secured. The Strang Construction Company, which secured the first receiver for the Detroit & Toledo Shore Line Railway, has withdrawn its application, and Receiver Allen F. Edwards, who was appointed through the efforts of Mr. Everett, is now in full charge of the property. The Strang Construction Company will complete the road as soon as possible. The banker's committee expects to dominate to a certain extent, in the affairs of all of the constituent companies controlled by the syndicate. Under its direction, R. W. Judd has been appointed to succeed John Sherwin as treasurer of the Federal Telephone Company, the United States Telephone Company, the Cuyahoga Telephone Company and the Reserve Construction Company. Representation will be arranged for on the boards of the various railway companies, this having already been accomplished in the cases of the Cleveland Electric Railway and the Northern Ohio Traction Company. The committee has practically decided that it will be well for the syndicate to dispose of its interest in the London (Ontario) Street Railway.

ERIE TELEPHONE.—At a meeting of Erie Telephone stockholders it was voted to reduce the board of directors from 15 members to five. The following will constitute the new board of directors: Francis R. Hart, Albert B. Chandler, William Endicott, Jr., Reginald Foster and Philip Dexter. It is stated that Mr. C. W. Morse received $20 per share for the 21,000 shares of Erie Telegraph & Telephone Company stock controlled by him through his ownership of the Telephone, Telegraph & Cable Company, or $420,000. This leaves Mr. Morse with the independent properties of New York and Boston against the $4,000,000 capitalization of the Telephone, Telegraph & Cable Company, for which he paid some time ago $50 per share for a controlling interest, or about $2,000,000. The amount of money spent in New York and Boston by the independent interests thus far is estimated at about $800,000. In order to make this asset of value, it will be necessary to complete the New York and Boston plants and establish a line between the two cities.

ELECTRIC COMPANY OF AMERICA.—The Electric Company of America has submitted an advance statement to stockholders for the fiscal year ended Dec. 31, 1901, in which it is stated that the net earnings from operating their companies will exceed $327,000, which, after deducting the interest on the bonds of the subsidiary companies, will leave a total of over $275,000 applicable to dividends, or more than 9 per cent on the paid in capital. In this statement for the year 1901 two of the plants, Canton and Auburn, have been owned and operated for five months of the year. The officials confidently expect the net earnings from operating the plants to exceed $300,000 in the year 1902. The company is without floating debt of any kind, with the exception of bills for current expenses, which are paid every month. It has no bonded indebtedness whatever, and has largely reduced that of its subsidiary companies. The annual meeting will be held at the company's office, Camden, N. J., on Tuesday, April 22, 1902.

CONSOLIDATED RAILWAY LIGHTING.—After 5½ hours of argument and voting last week, Mr. Isaac F. Rice, president of the Consolidated Railway Lighting & Refrigerating Company, received a vote of approval from the special meeting of the stockholders held at the company's office, in Jersey City. The meeting was called by those who oppose the methods of the president to require him to answer charges that he had received 10,000 shares of the company's stock to which he was not entitled; that he had refused to sign checks authorized by the board of directors, and that he had, in violation of the by-laws, and without authority, procured the payment of upward of $5,000 of the company's money on an order signed only by himself for the payment of an obligation contracted by himself.

CLEVELAND CITY RAILWAY.—The shareholders of the Cleveland City Railway on Jan. 20 authorized the increase of the capital stock from $8,000,000 to $9,000,000. The new stock, it is stated, will be offered at once to present stockholders to provide for improvements, new equipment and extensions.

INCREASE OF CAPITAL.—The Ft. Wayne Electrical Corporation has increased its capital stock from $500,000 to $800,000, the money to be spent in enlarging its present plant.

LEASE OF METROPOLITAN.—It is stated from Philadelphia that a new company has been formed by the Whitney-Widener-Elkins-Dolan combination to lease the Metropolitan Street Railway system, of New York. The new organization, it is asserted, will be a securities company, so formed as to permit it to hold the stock of any corporation. Its capital will be $30,000,000, which may be increased as necessity arises. It is not the purpose of the company to attempt at this time to effect a consolidation of the other great New York systems—Manhattan and Brooklyn Rapid Transit—with the Metropolitan, but it is admitted that such a merger is ultimately hoped for. The money raised will be used to turn 100 miles of horse railway lines into a modern underground trolley system, and the new securities will guarantee an annual dividend of 7 per cent on the Metropolitan stock, shareholders of the latter to have the right to subscribe to $20,000,000 of the new capital at par to the extent of 45 per cent of their present holdings. The entire issue of capital has been underwritten by Kuhn, Loeb & Co., of New York. The terms of the deal were all settled this week at a conference in New York, and a formal circular of announcement is now being prepared. This will be issued in a few days. Directors living in Philadelphia decline to state the nature of the new corporation or to say who will be its president. It was asserted positively that H. H. Vreeland, president of the Metropolitan, would not be the head of the new corporation.

HUDSON RIVER TELEPHONE.—The Hudson River Telephone Company has issued a circular announcing that the board of directors has voted to issue at par 4000 shares of new stock to stockholders of record at the close of business, Feb. 8. Shareholders will be entitled to subscribe for the new stock in the proportion of one new share for every eight shares now held. The funds received from the sale of the new stock will go for new construction work.

AMERICAN TELEPHONE & TELEGRAPH.—The subscribers for $10,000 or less American Telephone & Telegraph collateral trust bonds have been allotted their subscriptions in full. Those who have subscribed for over $10,000 of the bonds have been allotted 75 to 80 per cent of their subscriptions. The total offered was $10,000,000.

ELECTRIC HEATERS.—The incorporation is announced in Delaware of the Ellisson Brown Electric Heater Company, of Philadelphia, to construct apparatus for the generation and development of heat by electricity. Capital stock, $250,000.

DIVIDENDS.—The Boston Elevated directors have declared a semi-annual dividend of 3 per cent. Six months ago 3½ per cent was declared, and a year ago 2¼ per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—The heavy snowfalls during the past week, according to advices received by the mercantile agencies, tended to check buying, except of purely seasonable goods at retail, and to limit slightly the volume of demand in wholesale lines. The snow, however, has bettered the crop situation, and the outlook for spring trade as a whole is greatly improved. No diminution in confidence in a large spring business is reported, though Southern trade advices continue unsatisfactory. Other developments of the week are in the main favorable; railway earnings continue satisfactory. Although the car situation is somewhat improved and the iron furnaces in the Chicago district have generally resumed, the acute conditions as to actual supplies of pig iron have been little changed at all markets, with premium paid for quick delivery. The rail mills of the country are filled with orders and are not seeking outside contracts. Among the other metals, a feature has been the marked change in the copper situation, several sharp upward movements of prices occurring. It is claimed that a large business was done on the 11-cent basis, the demand being for consumptive and export account. It is the general belief, however, that a lower level of prices is to prevail for some time to come and that the present upward movement, which has speculative earmarks, will not endure any great length of time. The closing prices were 11⅞ cents for spot Lake, 11¾ cents for electrolytic and 11½ cents for casting. The business failures for the week, as reported by *Bradstreet's*, aggregated 303, as against 292 the week previous, and 238 the same week last year.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., makers of electric cranes, advise that business conditions are satisfactory, and more than usually so in the volume of orders. This firm has obtained, it is said, the largest order ever placed by one company at one time for electric cranes. This was placed by Allis-Chalmers Company, Edw. P. Allis Works, Milwaukee, Wis., for the new factory buildings at West Allis, and specifies 35 cranes, ranging in capacity from 5 to 75 tons. In addition to this order, Pawling & Harnischfeger have recently booked contracts for 43 electric cranes from other well-known firms, among which are the following: The Aultman & Taylor Machinery Company, Mansfield, O., one 10-ton; Hecla Portland Cement & Coal Company, West Bay City, Mich., three 15-ton; La Belle Iron Works, Steubenville, Ohio, one 10-ton; McMyler Manufacturing Company, Cleveland, Ohio, one 10-ton; the Glamorgan Pipe & Foundry Company, Lynchburg, Va., one 15-ton; Wheeling Steel & Iron Company, Wheeling, W. Va., one 7-ton; the Lorain Steel Company, Johnstown, Pa., four 7-ton; Puget Sound Naval Station, Bremerton, Wash., one 10-ton; Enterprise Manufacturing Company of Pennsylvania, Philadelphia, Pa., one 10-ton; Baltimore Copper Smelting & Rolling Company, Baltimore, Md., one 5-ton; the Midvale Steel Company, Philadelphia, Pa., one 10-ton and two 5-ton jibs; Grand Trunk Railway System, Portland, Me., one 2-ton; C. W. Hunt Company, West New Brighton, N. Y., one 2½-ton; John Bogart, New York, N. Y., one 14-ton.

KELLOGG TELEPHONE EXCHANGES.—A party of representative telephone men from South Bend and Logansport, Ind., telephone exchanges, consisting of the following: Hon. W. J. Vesey, W. E. Massman, G. W. Pixley, C. H. Warden, E. H. Yarnell, S. M. Foster and C. A. Wiley, were in Chicago on Jan. 29, where they visited the plants of the leading telephone manufacturers, including that of the Kellogg Switchboard & Supply Company, from whom they recently bought a 3000-line common battery exchange for Logansport, and which is about ready for operation. These parties are also about ready to install an exchange of 2000-line capacity at South Bend, Ind. The Illinois Telephone Company, of Jacksonville, Ill., awarded contract Jan. 28 to the Kellogg Switchboard & Supply Company for all necessary apparatus for its new common battery telephone exchange of 2500 ultimate capacity. It is anticipated that within a year it will have 2500 local subscribers.

BIDS FOR TRANSMISSION PLANT.—The Kern Power Company, of Los Angeles, Calif., which is to install a water power electric transmission plant costing about $5,000,000, during the next two years, has called for bids for electrical machinery. According to the specifications, bids will be received up to Feb. 10 next. R. S. Masson, of San Francisco, is the company's consulting electrical engineer. There will be ten 2000-kw generators and 15 900-kw transformers at 26,000 volts. The transmission line from the generating station to Los Angeles will be 110 miles in length, and current will be transmitted at 45,000 volts. The specifications call for several alternate bids, giving the company an opportunity to choose between bar-wound generators at 176 r. p. m. and wire-wound at 231 r. p. m.

RAILWAY LIGHTING & EQUIPMENT.—Vice-President John N. Abbott, of the Consolidated Railway Electric Lighting & Equipment Company, has issued to the stockholders a report of the work thus far accomplished by the company. It shows that the company's system of car lighting by power derived from the axle has been introduced upon 29 railways in the United States and Canada. Recently, the report states, the Pullman Company has entered into a contract with the Equipment Company to equip all of its private cars with the axle system of electric lighting. In addition to this contract, the company during the past month has closed contracts with the Chicago Great Western, the St. Louis & San Francisco, and the Missouri Pacific.

CATALOGUES AND SAMPLES FOR THE AZORES.—Consul Pickerell reports from St. Michaels, Dec. 10, 1901, that he is requested by Mr. Cæsar d'Oliveira, of that island, to secure for his use catalogues and samples as per following memorandum. This gentleman, adds the consul, has had a number of years' experience as a salesman for continental houses. He desires to hear directly from the houses sending catalogues as to prices, discounts, etc. For the present, he expects to pay cash. The catalogues wanted include electrical apparatus, and the samples asked for include bare and insulated copper wire.

COOK'S TELEPHONE DEVICES.—Mr. Frank B. Cook has sold his interest in the Sterling Electric Company, of Lafayette, Ind., to a syndicate headed by H. A. Taylor, of Lafayette, and A. F. Remy, of Crawfordsville. The company will pay royalties for the use of Cook's patents. Walter E. Doolittle will be made president and H. S. Bullock general manager of the new company.

BYTTON BROTHERS, 117 Pearl Street, New York City, have just shipped to their branch house, Abraham & Co, Manaos, Brazil, a large number of Bernstein "Lowatt" lamps, and of Enterprise coffee mills, driven by General Electric motors.

ELECTRIC DRILLS.—The Canterbury Mining Company, of Leadville, Colo., is open for bids on all matters pertaining to electric drills. The company will install a new battery of boilers and electric light plant, and it is thought it will probably install an electric drilling plant.

ELECTRIC HOIST BRIDGE WANTED.—The City Council, of Chillicothe, Ohio, will call for bids on an electric hoist bridge to replace the present Main Street draw.

BUYING COPPER.—The Boston Elevated Railway Company has taken advantage of the low price for copper and has purchased 1,000,000 lbs. of trolley wire on the basis of 11 cents per pound for copper. This is sufficient to last the company a year.

HUGE POWER PLANT IN BALTIMORE.—The United Railways & Electric Company, of Baltimore, Md., has closed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for four electric generators of 2000 kw, or about 2800 hp each. The United Company is operating the old World's Fair Westinghouse machines, which are rated at 750 hp each. These machines were among the most noteworthy exhibits at the Chicago World's Fair, and at that time were the largest lighting generators in the world. The new machines will generate three-phase current at 13,000 volts and 3000 alternations per minute. This current will be transmitted through light cables to sub-stations where, by means of transformers and rotary converters, it will be "stepped down" to direct current at 550 volts for the trolley wires. The contract includes transformers, rotary converters, switchboards and all necessary auxiliary apparatus. This contract is one of a large number of sales of extraordinary size and importance which have recently been made by the Westinghouse Company. The eight 5000-kw alternators for the Manhattan Railway Company, of New York, are the largest in the world, and the contract secured by them for the equipment of the power house for the New York Rapid Transit Subway was also unprecedented in size and the amount of money involved. The New York Rapid Transit power house vies with the one planned for the Underground Railways, of London, in being the largest ever projected. The London power house will also be equipped with Westinghouse machinery. It is worthy of note that the 5000-kw generators furnished to the Manhattan Company and being built for the New York and London Underground railways broke a record which had previously been held by their builders. The 5000-hp alternators at Niagara, which had previously held the record as being the largest in the world, were also built by this company.

A NEW INSULATING MATERIAL.—The defects in inferior marble, slate and other stone of like character when used for a high-tension switchboard have long been an annoyance to electrical designers. A new variety of stone has recently been employed for this purpose, and the results obtained are reported most satisfactory. This stone has in general the appearance of an asbestos fibre, which has been pressed into a solid mass, and the structure of the material is entirely homogeneous. Large quantities of this stone, which is known as "actinolite," have been found in the deposits, and a company known as the North American Actinolite & Asbestites Company has been formed to manufacture articles containing the substance as an insulating material, and has a factory at Tottenville, S. I. Some interesting tests have already been made on the mechanical and electrical properties of actinolite. A large piece of the stone was subjected to a temperature of 3500 degs. for three hours, and was taken from the furnace to be plunged immediately into cold water. This treatment left the stone in exactly the same condition as before the test, proving conclusively its immunity from injury by fire. The electrical properties have also been tested, and have been found to indicate that actinolite is one of the most perfect natural insulators so far discovered. The weight of the stone is about 175 lbs. per cu. ft. The officers of the company are J. A. Bill, president and treasurer; Michael Seitz, secretary, and H. C. Harding, superintendent.

HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., through its New York offices, report receipt of a number of foreign and domestic orders during January. The foreign list includes a 150-hp standard belted engine for Manila, where the machine will be used for lighting purposes. The domestic sales made last month comprise two 600-hp Harrisburg standard tandem compound four-valve engines for the Hopewell (N. J.) Electric Light, Heat & Power Company. These engines are to be each direct connected to 400-kw generators. A 450-hp standard belted engine has been sold for a Seattle (Wash.) plant, intended to drive a General Electric 300-kw alternating-current generator. The Flatiron Building in Twenty-third Street, Broadway and Fifth Avenue, New York, is to be installed with three 160-hp standard engines direct connected to 100-kw Bullock generators. The Ampere Electro-Chemical Company, of Rochester, N. Y., is to be furnished with a 75-hp standard type engine for direct connection to a 50-kw General Electric generator. The General Chemical Company, of Laurel Hill, L. I., has ordered a 50-hp standard belted engine. Two 40-hp direct-connected engines will be installed for lighting in the new building, Albany and Greenwich streets, New York City, and the Kinney Brothers' plant of the American Tobacco Company will be equipped with a small direct-connected Ideal engine for lighting purposes.

THE CANADIAN NIAGARA POWER COMPANY has placed an order with the Canadian General Electric Company, of Toronto, for nine oil immersed water-cooled transformers for transforming from the primary voltage of 11,000 volts, which will be the generated voltage of the new 10,000 ehp generators at Niagara, Ont., to the transmission line voltage of either 22,000, 38,000 or 57,000 volts. These transformers will be used in banks of three transformers for three-phase current, and will carry an overload of 50 per cent for a half hour without undue heating. The insulation between the primary coils and the core, and between the primary and secondary coils will stand a test of 114,000 volts alternating current for one minute, and between the secondary coils and the core a test of 76,000 volts for the same length of time. The transformers will have efficiencies at full load of 98.2, and are to be wound for 25 cycles, which is the frequency of the Niagara current. The details of the big General Electric generators for this Canadian plant were given in our last issue.

MANNING, MAXWELL & MOORE, of 85 Liberty Street, New York City, have this week been awarded an important contract for electric cranes, which are intended to be installed in the New Juniata Locomotive Works and the locomotive repair shops at Altoona of the Pennsylvania Railroad. The cranes, which will be manufactured by the Shaw Electric Crane Company, of Muskegon, Mich., are to be four in number—two for each shop—and will be special overhead travelers of 65-ton capacity. Each of the cranes will have two 7½-ton automatic hoists, one each side of the main hook. They will each be equipped with five motors, aggregating 150 hp. The motors are also to be built at the Shaw works. The value of the contract is about $52,000. There are at present 10 Shaw cranes, varying in capacity from 12½ tons to 60 tons, installed in the same road's Juniata and Altoona shops. The new ordnance shops of the Midvale Steel Company, at Philadelphia, are being equipped with two 60-ton and a similar number of 25-ton Shaw cranes.

CAHALL BOILERS FOR NEW ENGLAND PLANTS.—The Massachusetts Electric Companies, of Boston, have placed contracts with Thayer & Co.'s Boston office for a 2000-hp Cahall horizontal water-tube boiler plant for the Boston & Northern Street Railway Company's plant, and a 1500-hp equipment, which is intended to be installed in the new power station of the Newport & Fall River Street Railway at Newport, R. I. The Thayer Company have also taken an order for a 500-hp plant for an extension of the Lexington & Boston road. The boilers will be built at the Mansfield (Ohio) works of the Aultman & Taylor Company.

CRANE FOR SANDY HOOK.—The C & C Electric Company has just begun work on the installation of a complete electrical equipment for operating the big gantry crane at the Sandy Hook proving ground. The plant will consist of a pair of 30-kw direct-connected generators, and a lot of special weather-proof motors, all of which will be mounted directly on the crane. The specifications were prepared by and the installation will be under the supervision of Mr. E. R. Knowles, the civil and electrical engineer. It will be the first equipment of its kind in this country.

WESTINGHOUSE NIAGARA TRANSFORMERS. — The Cataract Power & Conduit Company, of Niagara Falls, has recently awarded to the Westinghouse Electric & Manufacturing Company a contract for seven 2500-hp, oil-insulated, water-cooled transformers. These transformers will be wound for 2200 volts, two-phase, to 11,000 or 22,000 volts, three-phase, and will duplicate the present equipment in the transformer house at Niagara Falls.

POWER AT RICHMOND, VA.—The Virginia Electric Railway & Development Company, at Richmond, are advertising for bids on new work connected with their power plant, part of which is already in operation. About $200,000 is now to be spent. It is said that the plant as it stands represents a cost of about $1,300,000. E. L. Bemis is president, W. M. Habliston vice-president, and Everett Waddey secretary and treasurer.

FIRE AT WATERBURY, CONN.—A great fire apparently of incendiary origin has occurred at Waterbury, Conn., doing damage estimated from two to five millions. The New England Engineering Company lost its office building, and the Connecticut Railway & Lighting Company has had a lot of trouble from interrupted service and broken circuits, etc. Mr. A. M. Young is prominently interested in these enterprises.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, is busy with foreign shipments of its exhaust heads and the Cross oil filter. Manaos, Brazil, was the southern extreme on the month's shipments, while six large oil filters were sent to Finland. Other important foreign shipments were to London, England, and Vienna, Austria.

TELEPHONES FOR BRITISH INDIA.—The Acme Telephone Company, of 42 Dey Street, New York City, has secured an order through the East Indian house of Tata & Co., 25 William Street, for the telephone equipment of the Victoria office building, Bombay, owned by Mr. Jamsetji N. Tata, the senior partner of that firm

THE BENNETT BUILDING, Omaha, Neb., is to have a very complete electric service plant, which will consist of two tandem compound engines built by the Ball Engine Company, Erie, Pa., direct connected to Northern Electric generators.

CABLE FOR MEXICAN TRAMWAYS.—The Morris Electric Company, of 15 Cortlandt Street, will to-day make shipment of some $14,000 worth of weather-proof cable to the Mexican Tramways Company, Limited, City of Mexico.

General News.

THE TELEPHONE.

[illegible] system in its exchange at Sheffield. The long-distance line is also being com-[illegible]

[illegible] granted a franchise to maintain a telephone line between Sonora, Carters, and Stent.

SAN FRANCISCO, CALIF.—A telephone line will be constructed by the California Central Gas & Electric Company, which will connect Petaluma, Santa Rosa, Napa and the company's power-house on the Napa River.

SAN FRANCISCO, CALIF.—The Imperial Telephone Company of California has been purchased by A. G. Whalen, manager of the Woodill-Hulse Electric Company, of Los Angeles, and C. R. Johnson, of Riverside. Local and long-distance business will be carried on by the new owners.

SAN FRANCISCO, CALIF.—The Alaska & Pacific States Telephone Company has been incorporated by Messrs. W. H. Parry, A. L. Kasson, F. A. Wing, S. B. Hicks and C. O'B Redeen. Its purposes are to acquire, build and maintain telephone lines in any of the Pacific Coast States, Alaska and Mexico.

SAN FRANCISCO, CALIF. The Pacific States Telephone & Telegraph Company will construct a telephone line from Jerome to Flagstaff, Ariz., a distance of nearly 40 miles. It will also build from Prescott to Crown King during the coming season. The company has no intention of closing up the gap between its California and Arizona systems in the near future.

GREELEY, COLO.—The Morgan County Telephone Company, capital stock $35,000, has been incorporated by D. E. Gray, George E. Settle and E. J. M. Murray.

CHICAGO, ILL.—The Brimfield Telephone Company, of Brimfield, has increased its capital stock to $5,000.

PETERSBURG, ILL.—A private telephone company wants a franchise in this city to compete with the Central Union.

LINCOLN, ILL.—It is stated that the Logan County Telephone Company will seek a franchise from the Pekin, Ill., City Council.

KEMPTON, ILL.—The Kempton Telephone Company has been incorporated, with a capital stock of $1,200 by Carl Schultz, John Bergan and J. T. Corkill.

BUDA, ILL.—The Buda Bradford Telephone Company, capital stock $5,000, has been incorporated by George A. Carper, Parker N. Mason and John J. Gundrich.

CAMPBELL, ILL.—Farmington Citizens' Mutual Telephone Company, capital stock $2,500, has been incorporated by W. H. Smith, J. S. Armstrong, J. R. Orismore.

CANTON, ILL.—The Canton, Sugarville & Fairview Telephone Company, capital stock $2,000, has been incorporated by H. W. Standard, H. A. Kyser and Henry Ellis.

CERRO GORDO, ILL.—The Cerro Gordo Telephone Company has incorporated with $15,000 capital stock. Melvin Welty, A. C. Doyle and Oscar Yarnell are the incorporators.

ELGIN, ILL.—The Elgin Telephone Company may extend its system in the spring. It now has a Stromberg-Carlson switchboard capacity of 40 lines, Swedish-American telephones being used.

ALTON, ILL.—A recent fire destroyed 300 Blake transmitters, thirty-five long distance instruments and about $800 worth of cross arms, wire and other supplies of the Central Union Telephone Company.

EUREKA, ILL.—A telephone company has been organized at Metamora. It will establish a central office and connect with Eureka, Washington, Roanoke, Spring Bay, Cazenovia, Low Point and other places.

SPRINGFIELD, ILL.—The Interstate Independent Telephone Company, incorporated under the laws of New Jersey, with a capital of $3,000,000, has made application to the Secretary of State to do business in the State of Illinois, with a capital stock of $600,000.

CARLINVILLE, ILL.—The presidents of the several companies filed a consolidation bond Jan. 14 in the circuit clerk's office, consolidating the following-named companies: Girard Telephone Company, Modento Telephone Company, Virden Telephone Company, Palmyra Telephone Company, Waverly Telephone Company, and the Hittick Telephone Company. The consolidation is for twenty years, and the fees and rates are fixed without power to change, save by a board of arbitration, which is named and provided. No traffic agreement can be made with any other line. It is said the Kinloch company, of St. Louis, is a part of [illegible]

STREATOR, ILL.—The Streator Independent Telephone Company has a present capacity of 560 drops, using Stromberg-Carlson apparatus. It now has 455 subscribers and is a prosperous organization. The company has recently increased the capacity of its underground cables to 1200 metallic lines and it expects to secure that number of subscribers. The company expects to put in a farmers' line switchboard and 500 telephones in the surrounding country this spring, and the indications are that it will have about 1500 telephones in operation in this territory by the end of the year. The company started business [illegible] Mr. Albert Schultz manager of the [illegible]

BUCKGROVE, IND.—A telephone line will be erected from Arion to Buck Grove as soon as the weather will permit.

[illegible] The National Telephone & Telegraph Company will in a short time build a third line between Fort Wayne and Van Wert, Ohio.

STINESVILLE, IND.—Farmers in the eastern part of this county are erect-[illegible]

PRINCETON, IND.—The Independent Telephone Company which is now establishing a plant and exchange here, expects to have the same in operation [illegible]

NORTH MANCHESTER, IND.—The two independent telephone companies operating in this city and the surrounding country have locked horns over patronage and a bitter war is raging.

INDIANAPOLIS, IND.—The Indiana Central Telephone Company has been incorporated. The initial capital is $10,000. The company proposes to build a telephone line through Brown, Lawrence, Monroe and adjoining counties.

SUGAR GROVE, IND.—The farmers of this place and vicinity are organizing a mutual telephone association and about fifty will subscribe. The exchange will be at Dunlaps and there connection will be made with the Home Telephone company's lines.

INDIANAPOLIS, IND.—It is reported that the officials of several of the railroads centering here will in the course of a short time equip all of the principal stations along its line with telephone wires for the use of officials and employes in transmitting orders and messages of the company.

ANDERSON, IND.—Local officials of the Anderson Telephone Company completed the formal transfer of its property to the Delaware & Madison County Telephone Company, during the week. This property is to form a part of the system of the telephone combination recently organized at Ft. Wayne by George W. Beers and others.

ALBANY, IND.—The Albany Telephone Company has been organized here with capital stock of $10,000. The concern is largely backed by Indianapolis capitalists. The company will construct a system to connect with Redkey, Parker, Farmland, Winchester and other towns that already have independent plants. The farmers' lines surrounding the city will also be connected with the local exchange.

OAKLANDON, IND.—The farmers in this vicinity have organized a telephone company and elected the following officers: President, William Hamilton; secretary, John Sellers; treasurer, Cyrus Stoner. They have six miles of the line completed, and are serving about twenty families. They have made connection with the South Morrison Company lines at Oaklandon. The system promises substantial results.

WARSAW, IND.—To enable the independent telephone companies to compete for business with larger corporations, a meeting was recently held in this city, by managers of companies operating in seven important county seats of Northern Indiana, and arrangements were made to construct copper lines on the coöperative plan connecting Fort Wayne, Columbia City, Warsaw, Plymouth, Rochester, Logansport, and South Bend.

ALBANY, IND.—Albany citizens have organized an independent telephone company with $10,000 capital stock. The construction of a plant to cover the town and surrounding country, and to connect with the toll lines running over the State, will begin at once. The company will pay special attention to the construction of farmers' lines. Isadore Duddleson has been elected president of the company and E. H. Carter secretary.

WAUKON, IA.—The Standard Telephone Company has increased its capital from $100,000 to $200,000.

CALEDONIA, IA.—A telephone company was organized here for the purpose of building a new farm line to Mt. Ayr.

MELBOURNE, IA.—The Melbourne Telephone Company, capital stock $10,000, has been incorporated by J. E. Retz and others.

CLEARFIELD, IA.—The Clearfield & Lenox Telephone Company will build another line from Clearfield to Lenox in the near future.

WEST BEND, IA.—The West Bend Telephone Company, capital stock $10,000, has been incorporated by Phil Dorweiler and others.

GRUNDY CENTER, IA.—The Farmers' Mutual Telephone Company, which has organized to build a line from here to Monteith, held a meeting and elected O. F. Smith president.

EARLVILLE, IA.—The Standard Telephone Company, of Dubuque, Ia., has bought out the local telephone company which was organized a short time ago and will put in an exchange.

HOPKINSTON, IA.—The Hopkinston Telephone Company expects to increase its business about 100 per cent during the present year. It has at present a 100-drop switchboard and 110 subscribers. Mr. F. C. Reeve is secretary of the company.

POTEAU, I. T.—The Poteau Telephone Company has completed its line to Cameron and contemplates building on to Fort Smith.

TOPEKA, KAN.—The Tonganoxie Telephone Company has been chartered, with a capital of $10,000.

NEW ORLEANS, LA.—The City Council of New Orleans has under consideration the granting of the telephone franchise.

HOWELL, MICH.—The Livingston Home Telephone Company, with main offices at Howell, will establish an exchange at Williamston.

DETROIT, MICH.—The Co-operative Telephone Company has been organized and capitalized at $250,000 for the purpose of establishing an independent telephone system. The officers are: F. F. Ingram, president; Hamilton Carhart, vice-president; Wilbur Brotherton, secretary; C. M. Burton, treasurer. The Co-Operative Company will equip a telephone system in opposition to the Bell company, and when the municipal government is in a position to own a plant of this kind will turn its management over to the city.

LIBBY, MONT. D. P. Bowers, who owns the Snowshoe mine, is attempting to get all the mine owners in the Libby district interested in a proposition to establish a telephone line to each of the properties where any work is now being carried on and to make Libby the central office of the system.

TRENTON, N. J. The Printing Telegraph Company has been incorporated; capital, $5,000. Incorporators: Henry G. Stephens, Benj. Rosenthal, Herman Lewis.

JERSEY CITY, N. J.—The Occidental Telephone & Telegraph Company has [illegible] capital stock. Incorporators: Russell Robb, Howard [illegible] P. [illegible] W. [illegible]

NEW YORK, N. Y.—Plans were filed with the Building Bureau for a four-story telephone exchange building, to be erected at 110 East Fifty-eighth Street. It is to cost $125,000.

ATHENS, OHIO.—The Grigsville Telephone Company, capital stock $3,000, has been incorporated by H. S. Hoskinton and others.

BATAVIA, OHIO.—The Citizens' Telephone Company, of this place, has been organized, and elected B. W. Gilfillen, Columbus, Ohio, president; J. W. Ranson, Batavia, vice-president, and W. H. Baum, treasurer and general manager.

PLEASANTON, OHIO.—The Pleasanton Telephone Company has been organized by C. M. Pierce, William Pierce, John Cowan and others. They will build a line from Pleasanton to Athens, thus connecting up a number of farmers' lines in this vicinity with the outside world.

GALLIPOLIS, OHIO.—The United States Telephone Company has completed its line from Gallipolis to Ironton, giving Gallipolis connections with all towns in the State. The Gallipolis Telephone Company is planning to build farmers' lines through Bidwell, Vinton, Addison, Cheshire, Perter and Kerr as soon as weather permits.

HAMILTON, OHIO.—The Southern Ohio Telephone & Telegraph Company has been granted a franchise in Hamilton for an independent exchange. O. M. Bake is at the head of the company, which will have long-distance connections through the lines of the United States Telephone Company. The company will commence work in the spring.

SPRINGFIELD, OHIO.—In reply to the general complaint of bad service, Manager Miller of the Central Union Telephone Company, states that within a year the list has been increased from 1500 to 2500. New switchboards have been ordered but have not yet arrived, and until they are installed the service is likely to be somewhat unsatisfactory.

COLUMBUS, OHIO.—Hon. E. J. Bracken, of Franklin County, has introduced a bill in the House providing for the municipal ownership of telephones. It provides that villages and towns may issue bonds for the purpose of building or purchasing telephone plants. Another bill will shortly be introduced fixing the rate of telephone charges throughout the State.

LIMA, OHIO.—J. C. Nolen and F. J. Mason, of Chicago, representing the Columbia Telephone Manufacturing Company of that city, have submitted a proposition to Lima business men with a view to removing the company's headquarters to that city. The company agrees to employ 200 men at the start. It claims to have orders aggregating $150,000 on its books.

CLEVELAND, OHIO.—Dr. Emil Dorn, of Chicago, who has applied for telephone franchises in a number of cities in Ohio, is seeking a grant in Cleveland. He desires to operate the system on a co-operative plan, asking all citizens to become members of the company. Business rates are to be $3 per month and residence $1.50 per month. He has forwarded a draft of his proposed ordinance.

COLUMBUS, OHIO.—Prominent local citizens are endeavoring to form a syndicate with a view to purchasing the stock owned by the Everett-Moore syndicate in the Columbus Citizens' Telephone Company. The holdings of the Cleveland people amount to 60 per cent of the stock. The company has about 6000 telephones in operation and is the best paying property under control of the Federal company, having paid dividends from the start. It is generally believed that the Columbus people will not be able to carry out their plans.

TOLEDO, OHIO.—Judge Wing of the United States Circuit Court, has decided that the National District Telegraph Company, a branch of the Western Union, must secure a franchise before it can operate a call box system throughout the city. The case has been in court for a number of years and has been fought out before five Federal judges. The Western Union company claimed that it owned the District company, and that the call boxes were in reality miniature telegraph offices, and that the company was doing business under a Federal telegraph franchise. The company is now endeavoring to secure a franchise.

BATAVIA, OHIO.—The Batavia Citizens' Telephone Company has elected officers as follows: B. W. Gilfillen, president; J. W. Ranson, vice-president; Wm. Baum, secretary-treasurer and general manager. The company will proceed with the construction of new lines throughout the county as rapidly as possible. Bethel will be wired within the next few weeks and connection will be made with Blanchester, giving long-distance connection throughout the State. Felicity, Chilo, Neville and Moscow will be connected with the lines already built in New Richmond, and it is expected that by July 1 the company will have 500 telephones in Clermont county alone.

MOUNT MORRIS, PA.—The Mount Morris Telephone Exchange Company has been incorporated, with a capital stock of $3,000.

CASTLEWOOD, S. D.—The Castlewood Telephone Company, capital stock $7,000, has been incorporated by Aubrey Lawrence, F. A. Cheever, H. H. Curtis and J. B. Van Horn.

LIVINGSTON, WIS.—The Spitzer-Livingston Telephone Company has filed an amendment changing its name to the Grant County Telephone Company.

SPRING GREEN, WIS.—The Big Hollow Telephone Company, capital stock $1,500, has been incorporated by Martin Hansen, Henry J. Ellefson and Andrew Frederickson.

JANESVILLE, WIS.—The annual meeting of the Badger State Long-Distance Telephone Company was held in this city Jan. 23. The $33,000 indebtedness was cleared up and the head office of the company changed from Milwaukee to Janesville. C. W. Twining was elected president and F. W. Coon secretary.

ELECTRIC LIGHT AND POWER.

MOBILE, ALA.—The general council has accepted the offer of the Electric Lighting Company of Mobile to continue lighting the streets for five years at the rate of $75 per lamp per year. This gives a quietus to municipal and other lighting projects. Mr. George S. Leatherbee is applying for further street railway franchises.

TOMBSTONE, ARIZ.—The Tombstone Consolidated Mines Company has ordered machinery for an electric light and telephone system to be constructed here.

KINGMAN, ARIZ.—A franchise has been granted by the Board of Supervisors of Kingman, Ariz., to H. W. Kemper for lighting the town by electricity for a period of five years. The electric plant must be completed and in operation within nine months.

HIGHLAND, CALIF., has two projected electric lighting propositions. Dr. Baldwin purposes to generate electric power from Mill Creek. A water power electric transmission has been planned by the Arrowhead Reservoir Company in connection with its water system.

SAN FRANCISCO, CALIF.—The Standard Electric Company expects to be ready to test its new electric generating plant at Electra within a short time, and may be ready for commercial business in March next. The power-house equipment includes five 2000-kw, 3-phase generators and step-up transformers for raising the voltage to 60,000 volts for transmission 145 miles to San Francisco. The pole-line extends from the power-house in Amador County to Stockton, thence to Livermore, and to Mission San Jose sub-station. Thence, to the sub-station in Alviso and on to San Francisco, where a sub-station is nearly completed. Here, instead of rotary transformers, there will be five synchronous motors and generators that will produce current of a lower voltage for distribution.

SAN FRANCISCO, CALIF.—The United Electric, Gas & Power Company has sold a controlling interest in its property to a syndicate of capitalists and F. H. Rindge, G. I. Cochrane, Harry Gray and H. C. Merritt. Among the holdings of the corporation are the Santa Barbara street railway system, the bath-house in Los Banos, Calif.; the gas and electric plants in Santa Barbara, Santa Monica, Redondo, Inglewood, Monrovia, San Pedro, Terminal Island and Long Beach, Calif. The officers of the company are: Hulett C. Merritt, president and treasurer; Frederick H. Rindge and B. V. Carter, vice-presidents; George I. Cochrane, secretary and general counsel; J. J. Davis, superintendent; Harry Gray, Louis J. Merritt, Fred. T. Bueneman and Charles E. Scheide, of New York.

SAN FRANCISCO, CALIF.—A number of farmers, residing in the San Gabriel Valley, who use the waters of the San Gabriel River and its tributaries, have sent petitions to Washington, D. C., to strengthen the case of the irrigators against the electric companies, which is now before the General Land Office. The claim is set forth that heretofore and since the government reservation of lands within the San Gabriel forest reserve, made in 1891, the Electric Water Company and the Electric Power Company have unlawfully entered upon the reservation, cut trails and taken possession of properties in the reserved lands; that they have cut undergrowth and threaten to impair the water supply of the irrigators. If this case is settled in favor of the irrigators, it is said that the electric light and power companies, now doing business in the San Gabriel Canyon and furnishing Los Angeles and other California cities with electricity, will be forced to shut down their water-power electric plants.

MITCHELL, IND.—The Lehigh Cement Company at this point is erecting a large plant, including an electric light and power equipment greater in capacity than ordinarily required to light a city of 5000 inhabitants.

MARION, IND.—The Marion Light & Heat Company has purchased and taken over the Mead Electric Light plant of this city. The latter plant has been the subject of much litigation, having been in court for two years, and was in the hands of a receiver.

INDIANAPOLIS, IND.—The American Light & Power Company, of Hartford City, has filed articles of incorporation. The directors are H. C. Uhler, S. V. Perrott and A. G. Perrott. The Summittville Light & Power Company has filed articles of incorporation; capital stock, $3,600. The directors are Jno. N. Gordon, William C. Gordon and Homer E. Howard.

INDIANAPOLIS, IND.—The Board of Public Works is insisting on inserting a clause providing for municipal ownership in all franchises granted for electric light, heating or power plants, if the city wishes to buy them at the expiration of the franchise period. It is said that the clause will be applied to the new city lighting contract, which is to be let in the early spring.

SOUTH BEND, IND.—The St. Joseph & Elkhart Power Company is progressing rapidly with the construction of the dam in St. Joe River near here, to furnish power for an immense electric plant to supply the four interurban manufacturing cities of South Bend, Mishawaka, Elkhart and Goshen. The company has contracted for 250,000 lbs. of copper wire, at a cost of $30,000.

LAKE CHARLES, LA.—Petitions are being circulated to decide whether or not an election will be held on the question of issuing $40,000 improvement bonds for water, light and sewerage.

CANTON, OHIO.—The Central Heat & Power Company has been granted a franchise to build a lighting and heating system in this city.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has applied for a franchise in Fostoria for an electric lighting and steam heating plant to be operated in connection with its power station. The move is the result of the unpopularity of the local lighting company, which is fighting the town.

STEUBENVILLE, OHIO.—The Central District & Printing Telegraph Company is planning to make improvements in this city during the coming year that will cost $100,000. A new exchange building to cost $25,000 will be erected, a new switchboard will be installed, and a large portion of the present overhead system will be placed underground.

OTTAWA, ONT.—The Capital Power Company, of Ottawa, is about to enlarge its water-power plant at Deschenes. A large submarine cut is being made by which the company will be in a position to supply 1250 electric horse-power,

part of the year to complete it, the cutting being made through solid rock.

MANCHESTER, VA.—After opening bids it has been decided to recommend to the Council the acceptance of the bid of the Richmond Passenger & Power Company for furnishing lights to the city. The competition was very strong, and this company offered not more than seventy lights free of charge, for five years. This company desires, it is said, to keep out of Manchester the Virginia Electrical Railway & Development Company.

WAUKESHA, WIS.—A petition is being circulated asking that a committee be appointed to investigate municipal ownership of the city electric lighting plant. The movement seems to be a popular one and is receiving considerable support.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—The Huntsville Railway, Light & Power Company has made arrangements to install $25,000 of new machinery to duplicate that already in use.

LA SALLE, ILL.—Fire destroyed the power-house of the City Electric Railway Company. But two cars remain of the once well-equipped plant. Loss, $60,000; partially covered by insurance.

INDIANAPOLIS, IND.—The Indianapolis & Eastern Traction Company, formerly the Indianapolis & Greenfield Company, has filed a mortgage in favor of the Central Trust Company to secure a loan of $200,000. The money will be applied to construct the extension to Knightstown, and thence to Richmond.

PITTSFIELD, MASS.—Residents of this city, Westfield and Springfield will incorporate the Western Massachusetts Street Railway Company, to operate a street railway from Westfield to Lee. The length of the road will be 40 miles and the capital stock $300,000.

WILMINGTON, N. C.—The Wilmington Street Railway Company, made up of combined interests previously existing, has effected a reorganization with Hugh MacRae, president, and C. P. Bolles, Jr., M. F. H. Gouverneur, W. W. Randolph and Junius Davis, directors. The capitalization is $200,000.

TRENTON, N. J.—The Electric Railways Corporation has been incorporated in Trenton with a capital stock of $100,000 to carry on a general business of controlling or directing electric railways. The company will examine and report on questions arising in connection with the organization, location, franchises, rights of way, character and cost of construction and traffic of electric lines. The incorporators are Louis S. Phillips and Horace B. Hord, New York, and Suydam F. Wheeler, Jersey City.

SEA CLIFF, N. Y.—The Nassau County Railway Company has filed its certificate of incorporation at Albany, with a capital stock of $25,000.

HALIFAX, N. S.—It is the intention of the Halifax Tramway Company to make extensive improvements to the lighting department of its plant. It is also proposed to install another battery of boilers.

CANTON, OHIO.—At the annual meeting of the Canton-Akron Railway Company the old officers and directors were re-elected.

FINDLAY, OHIO.—The Findlay & Marion Electric Railway Company has been granted a 25-year franchise into the center of Findlay.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway has completed arrangements for the absorption of the Elyria, Grafton & Southern Railway.

BRILLIANT, OHIO.—Directors of the Wheeling Traction Company have decided to locate the car barns and power station for the Steubenville-Wheeling line at Brilliant.

OTTAWA, OHIO.—It is reported that the Toledo & Lima Traction Company and the Defiance, Ottawa, Kenton & Columbus Railway are figuring on building a joint power-house in this place.

CINCINNATI, OHIO.—The Indiana & Ohio Traction Company of Brookville, Ind., has been incorporated. George M. Shirk, A. Mucker, J. C. Shirk, G. E. Bennett and A. E. Showalter, Brookville, are directors. Capital, $100,000.

SPRINGFIELD, OHIO.—The Springfield & Western Railway to New Carlisle is to be extended to connect with the line which is to be built from Springfield to Piqua by way of Lawrenceburg, North Hampton, Addison and Casstown.

COLUMBUS, OHIO.—W. A. Cullen, of Newark, N. J., who has the contract for building the Urbana, Mechanicsburg & Columbus Railway, has secured a site for the power-house near Plain City and will commence work on the building about March 1.

CLEVELAND, OHIO.—The appointment of Allen F. Edwards as receiver of the Detroit & Toledo Shore Line has been confirmed by Judge F. J. Wing, of the United States Circuit Court, Cleveland. The receiver will complete the work on the line as soon as possible.

KENTON, OHIO.—The Dayton & Kenton Traction Company has elected officers as follows: E. M. Hopkins, New York, president; W. W. Steelee, Detroit, vice-president; H. S. Forgy, New Carlisle, Ohio, secretary; C. L. Hubbard, Dayton, treasurer, and B. H. Rannels, Dayton, general manager.

DAYTON, OHIO.—The Dayton & [illegible] right of way from Xenia to Washington C. H., with a franchise to enter the latter place. The company is also considering extending its Spring Valley line [illegible] many improvements to its existing lines.

COLUMBUS, OHIO.—The annual meeting of the Columbus, London & Springfield Railway held a few days ago, resulted in the election of the following officers: J. S. Harshman, president; John G. Webb, vice-president; A. E. Appleyard, treasurer; E. J. Green, secretary, and H. A. Fisher, general manager. Cars will be placed in operation from Columbus to West Jefferson within [illegible]

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company is pre[illegible] completed the present station at Edinburg will be used as a sub-station. Plans are also being prepared for a fine passenger and freight station to be erected at the New Castle terminus. The New Castle extension will be placed in operation about Feb. 1.

COLUMBUS, OHIO.—The Appleyard syndicate is preparing to erect at Hebron a large three-phase generating station which will furnish power for the Columbus, Buckeye Lake & Newark Traction Company's line and other roads running out of Columbus. It will operate in connection with a similar station now located on the Columbus, London & Springfield Railway. Sub-stations will be erected on the various lines at intervals of fifteen miles.

DAYTON, OHIO.—Stockholders of the Ft. Wayne, Dayton & Cincinnati Traction Company have elected the following-named officers: Dr. S. George, president; D. W. Le Fetra, New York, vice-president; Charles L. Hyde, Pierre, S. D., second vice-president; Charles W. Gebhart, secretary-treasurer, and Clifford E. Swayne, auditor, the last two mentioned of Dayton. The directors have increased the capital stock from $1,000,000 to $5,000,000.

CHILLICOTHE, OHIO.—The Chillicothe Electric Railway, Light & Power Company has elected officers as follows: W. A. Story, president; M. Kramer, vice-president; George A. Vaughters, secretary-treasurer, and Joseph Myers, general manager. The company will commence work in the near future on a power-house to be located near the center of the city. It will be equipped with two large units, and the present station will be used as an auxiliary plant.

CLEVELAND, OHIO.—The Cleveland & Southern Railway Company has elected officers as follows: W. H. Lamprecht, president; A. H. Pomeroy and A. E. Aikins, vice-presidents; F. L. Fuller, secretary; F. T. Pomeroy, treasurer.

CLEVELAND, OHIO.—Stockholders of the Cleveland & Eastern Railway, the Cleveland & Chagrin Falls Railway and the Chagrin Falls & Eastern Railway have ratified the merger of the three properties into the Eastern Ohio Traction Company. A permanent organization will be effected in a short time.

CLEVELAND, OHIO.—The Cleveland City Railway Company held its annual meeting Jan. 20. J. B. Hanna and Dan P. Eells were dropped from the board of directors. The directors are J. H. Wade, G. G. Mulhurn, L. W. Prior, W. B. Sanders, R. R. Rhodes, Chas. A. Otis, H. E. Andrews and C. F. Emery. Senator Mark Hanna was elected president; C. F. Emery, vice-president; John Ehrhardt, secretary-treasurer and George Mulhern, general superintendent.

OTTAWA, ONT.—It is said to be the intention of the Velvet Mines, Limited, of Rossland, B. C., to apply to the British Columbia Legislature for a charter to construct an electric railway between Rossland and the Red Mountain Railroad, a distance of thirty miles. The charter will also ask for the establishment of telegraph and telephone systems. The estimated cost is placed at $300,000.

OTTAWA, ONT.—Several electric railway systems are outlined in the notices of applications to the Ontario Legislature. The largest is intended to make a network of the locality between London, Goderich and Owen Sound, Ont. The London (Ont.) Railway Company asks incorporation and power to construct and operate electric railways from London, Ont., to Glencoe, from Delaware to Strathroy and from London to Ingersoll; also power to construct radial extensions from any of the points mentioned. The Morrisburg Electric Railway seeks incorporation, and power to construct and operate a system from Morrisburg to Winchester, Ont., and a branch line to Chesterville and Morewood.

TITUSVILLE, PA.—The Titusville Electric Street Railway has passed into the hands of a company of New York capitalists. W. R. Brown, a New York promoter, financed the transaction, and represents Charles Pfeifer and other capitalists. It is understood that the new company will extend the line to Meadville.

QUEBEC, QUE.—Mr. Holman, of Quebec, manager of the Canadian Electric Light Company, has, on behalf of certain capitalists, offered to build an electric railway in the town of Levis, Que.

JOHNSON CITY, TENN.—Citizens of Johnson City are considering a street railway franchise.

CHATTANOOGA, TENN.—The officials of the Chattanooga Railway Company have decided, it is reported, to construct a line to Rossville, Ga.

JONESBORO, TENN.—A franchise has been granted to a company to build an electric railway from Jonesboro, in Washington County, to Johnson City via the Soldiers' Home.

AUSTIN, TEX.—The Northern Texas Traction Company, of Forth Worth, has increased its capital stock from $2,000,000 to $2,500,000.

SALT LAKE CITY, UTAH.—The Oregon Electric Company has completed the purchase of lands extending up the Clackamas River, a distance of six miles. The management announces that surveyors will locate a trolley line from Portland south. The line will be completed to Garfield, a distance of 25 miles, by Nov. 1, 1902. It is estimated that 2400 horse-power can be generated from the falls.

RICHMOND, VA.—At a meeting of the stockholders of the Passenger & Power Company the old officers were re-elected.

WILLIAMSBURG, VA.—The Hampton & Yorktown, and the Jamestown & Williamsburg Electric Railways are now said to be assured, and that work on both lines will begin early in the year.

RICHMOND, VA.—It is stated that the financial embarrassment of the Everett-Moore Syndicate, of Cleveland, Ohio, will have no effect whatever upon the Petersburg-Richmond electric line, which is being built by the Cleveland Construction Company, in which the Everett-Moore Company is interested. The Everett-Moore Syndicate owns or controls a number of telephone lines in Virginia.

THE AUTOMOBILE.

MR. FRICK'S AUTOMOBILES.—Mr. H. C. Frick [illegible] steel [illegible] recently [illegible] from [illegible], which came direct to [illegible] Paris. The machines are said to cost $15,000 in Paris.

ELECTRIC AUTOMOBILES.—The Carlton Hotel, London, has made a big stride to the advantage of its guests. It has inaugurated a day and night electric carriage service for the hotel at the ordinary rates charged for a hired horse carriage. The first to order one of these electric landaulettes, with their smart lemon and black bodies, was Lady Brassey. Mr. Paris Singer, of the City & Suburban Electric Carriage Company, has inaugurated a system which will save

trouble to the town users of these carriages. His firm houses, cleans, and cares for a purchaser's machine, renews its parts, charges its batteries, and does everything for it—including insuring it against fire and accidents—for a fixed sum per annum.

COLORADO SPRINGS, COLO.—Gen. William J. Palmer, the millionaire railroad builder, who recently distributed $3,000,000 among old employes, dislikes the present style of automobiles, no matter what pattern or make, and is willing to let the world know where he stands on the horseless carriage proposition. In a deed conveying to the city of Colorado Springs a tract of ground northeast of this city, known as the Austin Bluffs Park site, he has inserted this clause: "Until horseless carriages shall be improved so that they are as noiseless and odorless as horse-drawn vehicles, horseless carriages shall not be permitted to enter or travel over or through any portion of said property herein conveyed for purposes of a park." This shows a decided preference for electrics.

A LONG RUN.—Messrs. F. F. Cimiotti and nephew, Ferd. Cimiotti, of New York City, have arrived in Staunton, Va., having made the entire trip in a Toledo steam carriage over frozen country roads, a distance of over 400 miles. They made the trip in four days, taking it in easy stages and without mishap. The best stretch of road they encountered was the Valley pike, a distance of some 120 miles, and over this road they frequently made record breaking speed; in some instances equaling the speed of the local passenger trains, which paralleled them and in sight most of the way. This is the best long-distance test the automobile has had in Virginia, and seems to thoroughly demonstrate the practicability of the machine wherever good roads exist. Mr. Cimiotti, the senior, is owner of extensive mineral properties from Buffalo Gap to Variety Springs.

NEW INDUSTRIAL COMPANIES.

THE MARION COUNTY CONSTRUCTION COMPANY, of Indianapolis, Ind., has been incorporated to construct, repair electric railways, etc. The incorporators are G. W. Seibert, W. E. Smith and C. W. Wells.

THE GREEN TELEPHONE & ELECTRIC MANUFACTURING COMPANY has filed articles of incorporation in Milwaukee, Wis. The incorporators are J. H. Green, C. Hensing and T. J. Seeley. The capital is $3,000.

THE ELECTRICAL CONSTRUCTION COMPANY, which was recently incorporated, with San Francisco as the principal place of business, and a capital stock of $25,000, fully paid up, has opened offices and warerooms at 29 New Montgomery Street. Mr. F. B. Williams is president and W. S. Hochstadter secretary of the new corporation.

LEGAL.

CANNOT TAX FRANCHISES.—The New Jersey Court of Errors and Appeals has reversed the Supreme Court decision and decided that municipalities cannot tax franchises. A supplemental opinion sets forth that a franchise is property and taxable as such, but the right to tax has been reserved by the State and not delegated to the municipalities.

EICKEMEYER WINDING.—The U. S. Circuit Court of Appeals has reversed the decree of the Circuit Court and dismissed the plaintiff's bill in the case of the General Electric Company against the Webster & Dudley Street Railway Company. The subject matter of the suit was on the question whether the Eickemeyer coil winding for dynamo electric machines was infringed.

OBITUARY.

MR. H. D. BENNETT.—The death is announced of Mr. Herbert D. Bennett, president of the American District Telegraph Company of Columbus, Ohio.

MR. JAMES MILLIKEN, a director of the Western Union Telegraph Company, died in New York on Feb. 3. He was born in 1824, and was for a long time a leading merchant and citizen of Philadelphia. He retired from business after the Civil War. He was unmarried.

PERSONAL.

DR. HENRY A. EVERETT, of the Everett-Moore syndicate, has been re-elected president of the Cleveland Electric Railway Company.

MR. ANSON W. BURCHARD, a consulting engineer of the General Electric Company, has been elected second vice-president of the Greene Consolidated Copper Company.

MR. HEULINGS LIPPINCOTT, president of the National State Bank of Camden, has been elected a director of the American Railways Company, vice E. J. Mathews, deceased.

MR. MYRON T. HERRICK, the Cleveland electrical and street railway manager and banker, has declined the Ambassadorship to Italy on the ground of great pressure of private business.

MR. C. E. KAMMEYER announces that he has purchased control of the *Telephone Magazine* of Chicago, and will again appear as its editor and manager. New offices have been taken in the Medinah Temple.

DR. OLIVER LODGE, as president of the Society of Psychical Research, delivered a remarkable address last week, when he held that it was impossible to deny the probability of the existence in space of an immense range of life and intelligence of which at present we knew nothing really convincing as to evidence in its behalf.

MR. W. C. WHITNEY has just announced his intention of retiring from active business life, saying with regard to Metropolitan Street Railway that it is in the excellent management of Mr. Vreeland. Estimates put Mr. Whitney's fortune at $25,000,000, and even more.

PROF. W. L. ROBB, who for seventeen years has held the chair of Physics in Trinity College, Hartford, Conn., is considering a call to establish a department of electrical science in the Rensselaer Polytechnic Institute, Troy, N. Y. He graduated from Columbia University in 1880, and from Berlin University in 1883.

MR. J. J. BELLMAN, who has been one of the assistant engineers with Westinghouse, Church, Kerr & Company for the past two years, has entered on new duties with H. B. Coho & Company at 149 Broadway. Mr. Coho is to be congratulated on securing a partner having the wide experience in the engineering field which Mr. Bellman's connection with the Crocker-Wheeler Company and the Westinghouse companies has given him. It is their intention to make a specialty of high class installations for private lighting plants.

MR. ALBERT A. CARY, the well known mechanical engineer, writes to the *New York Times* questioning the statement of Mr. W. B. Parsons that forced draft will not remove vitiated air from the New York Central tunnel. He calls attention to the plans laid by him for the District Attorney before the Grand Jury. By this system, with a series of electrically driven, exhaust fans, placed in the parkways above the tunnel and with a proper distribution of fresh air intakes, the air in the tunnel can be kept in such condition that the carbonic acid present would not exceed 12 parts per 10,000. Contractors are willing to do the work under guarantee and forfeiture.

Trade Notes.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has recently closed a contract for a large generator and several motors for a new municipal plant at East Grand Forks, Minn.

THE ELECTRIC APPLIANCE COMPANY, Chicago, general western agent for Richmondt conduit, is busy these days taking care of the orders. The January sales of this conduit have been larger than ever before in the history of the agency.

CHASE-SHAWMUT FIRE.—Under date of Feb. 1 the Chase-Shawmut Company, Boston, Mass., announces that a serious fire in its factory has completely crippled it, and that it will be unable to fill any orders for the present. The company will reconstruct its factory at once.

DYNAMOS AND MOTORS.—The Eck Dynamo & Motor Works, Belleville, N. J., describes and illustrates the construction of its dynamos and motors for direct current, in Bulletin No. 21, issued during January. The construction of these machines is very clearly illustrated, and the dimensions of the various types are given in tabular form.

POCKET TELEPHONE DIRECTORY.—A very handy telephone directory of electrical concerns and individuals in Chicago has been issued by the Guarantee Electric Company of that city. The fact that this is the sixth edition of this directory is evidence that it is very popular. The booklet is vest pocket size, and it gives the street addresses as well as the telephone numbers.

AUTOMOBILE GRAPHITE.—The Joseph Dixon Crucible Company, Jersey City, N. J., has gotten out a booklet containing 51 testimonial letters from well-known doctors, professional men and others, regarding the use of graphite in the lubrication of the working parts of automobiles. This lubricant is equally well adapted to all classes of automobiles whether they are propelled by steam, gasoline or electricity.

A MODERN FACTORY.—One of the most completely equipped factories for the manufacture of electrical and mechanical apparatus is that of Frederick Pearce, 18 and 20 Rose Street, New York. In addition to the latest machinery and appliances, he has the best of talent in the engineering and development line, and is able to turn out the best of workmanship for electrical concerns. His facilities are of great benefit to inventors wishing to develop their inventions.

PHILLIPS'S MORSE AUTOMATIC TELEGRAPH.—Messrs. J. H. Bunnell & Company, 20 Park Place, New York, are pushing Phillips's Morse Automatic telegraph apparatus. This instrument enables a person to learn telegraphy at home. The sending is automatic, and in receiving the speed can be slowed down to suit the beginner. The instrument can be used as well for automatic rapid telegraphy, and is very responsive to high speed signals. Bunnell & Company issue a neat circular giving a lot of interesting information about this apparatus. Mr. Phillips is a master of art of telegraphy and his "friendly talk with beginners" which forms a part of the contents of this circular will be read with much interest and pleasure by old as well as new telegraphers.

"STAINOFF."—This is the name of a preparation now being introduced by the D. M. Steward Manufacturing Company, Chattanooga, Tenn., to clean the hands of dirt, stains, etc. It is recommended for the removal of ink and shop stains, and it is stated that engineers and machinists can go home with clean hands if they use "Stainoff." According to a leaflet published by the Steward Company this substance will remove all kinds of stain and dirt from the hands, and it is said to be perfectly harmless to the skin. It is recommended for stenographers, typewriters, bookkeepers, housekeepers, painters, printers, artists and engravers, besides machinists and engineers. "Stainoff" is stated to be such a universal cleansing agent that there is hardly anything that it cannot be used for, where cleanliness is desired. The company's New York office is at 107 Chambers Street.

THE GREGORY ELECTRIC COMPANY, of Chicago, of which A. O. Kuehmsted is president, has found it necessary to enlarge its quarters. This great electric "bargain house" of the West finds its business in second-hand apparatus growing commensurately with the wonderful growth shown in all other lines of trade. The enlargement of power houses with prosperous times has put more good second-hand electrical machinery than ever into this company's warerooms, and the demand is of course good for machinery that can be delivered at once without the long wait necessary to fill factory orders for new dynamos, motors and transformers. When such second-hand machinery can be bought for immediate delivery from such a large and long-established house as the Gregory Electric Company, accompanied by that company's guarantee, which is an assurance that the machinery has been thoroughly overhauled, and is as good as ever, it is not strange that this company does a large and increasing business. The stock it has constantly on hand to select from is so large that it is strange if the need cannot be met unless very large units are wanted. The repair department is large, well equipped and well supervised, and turns out a high class of work not only in repairing the second-hand apparatus bought, but in repairing for customers. The concern is a standing testimony to the business genius and enterprise of the Messrs. Kuehmsted, who have conducted it for some years past.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 28, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

691,739. ELECTRICAL COMMUTATOR; E. Batault, Geneva, Switzerland. [illegible] the commutator turns.

691,742. RANGE INDICATOR; A. LeBlanc, New York, N. Y. App. filed May 4, 1901. An apparatus by which the range and azimuth can be speedily and accurately transmitted from the range finder to the guns. The receiving instruments are galvanometers giving direct readings of the required measurements, and they are affected from the transmitting station by varying the difference of potential across the terminals of the galvanometer circuits in proportion to the measurements to be indicated.

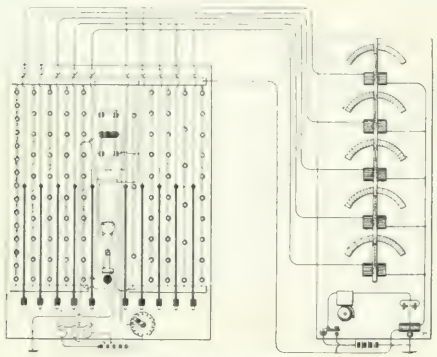
691,766. ELECTRIC SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Jan. 12, 1900. Details of construction.

691,780. ELECTRICAL SWITCH; C. J. Kintner, New York, N. Y. App. filed Oct. 29, 1900. The movable terminal of the switch is a spring so arranged when the circuit is closed, that its free end bears endwise against the fixed terminal, thus causing the spring to be bent or buckled under pressure, so that when it is forced away from the fixed terminal, it will leave the same with a sudden or snap action.

691,793. INSULATION; W. S. Moody, Schenectady, N. Y. App. filed Jan. 28, 1899. An oil insulator is provided with trays of chlorid of calcium over which atmospheric air leading into the insulator, passes, and by which the air is robbed of its moisture. The object is to keep the oil free from moisture.

691,808. COLLECTOR FOR SURFACE-CONTACT RAILWAYS; William B. Potter, Schenectady, N. Y. App. filed June 12, 1899.

691,809. ELECTRIC CONTROLLER; William B. Potter, Schenectady, N. Y. App. filed July 19, 1900.



691,742.—Range Indicator.

691,810. ELECTRIC RAILWAY SYSTEM; William B. Potter, Schenectady, N. Y. App. filed Sept. 20, 1899.

691,815. COHERER; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 16, 1901. The granular material in the tube is subjected to the action of a pair of solenoids which are energized each time the impulse traverses the tube.

691,820. ELECTROMEDICAL BELT; S. J. Spalding, Canton, Ohio. App. filed Aug. 23, 1899. Details.

691,821. ELECTRICAL ARC LAMP; H. C. Spinney, Lynn, Mass. App. filed July 20 ,1898. A floor for the clutch is mounted just above the cap of the inner globe and retains the cap at its normal position when the globe is removed.

691,824. CONTROLLING APPARATUS FOR ELEVATORS OR HOISTS; A. Sundh, Yonkers, N. Y. App. filed Sept. 6, 1901. A controlling apparatus especially adapted for dumb waiters, wherein devices on the car itself are first operated to predetermine the limit of travel of the car, and then the car is started by closing the door of the shaft or operating other controlling devices at the floor where the car happens to be.

691,834. METHOD OF SYNCHRONIZING ALTERNATORS; J. E. Woodbridge, Schenectady, N. Y. App. filed July 30, 1900. (See Current News and Notes.)

691,851. ELECTRICAL ARC LAMP; H. E. Etheridge, McKeesport, Pa. App. filed Sept. 28, 1901. Means are provided in the gas check for automatically aligning the carbon and laterally adjusting it to permit it to freely move through the gas check.

691,871. INSULATING AND PACKING MATERIAL AND PROCESS OF MANUFACTURING SAME; M. Raphael, L. Elias, Breslau, Germany. App. filed Oct. 11, 1900. A layer of asbestos is covered by a layer of mica formed of small pieces of mica arranged like the scales of a fish.

691,874. SWITCH OUTLET AND RECEPTACLE BOX; M. Robertson, New[illegible] A switch receptacle or outlet box having ears or lugs, provided with leveling screws and attaching screws for securing the box directly to the lath of other woodwork entirely independent of the plaster.

691,949. SUPPORT FOR ELECTRIC CONDUCTORS AND RESISTANCE; H. W. Leonard, New York, N. Y. App. filed Jan. 10, 1901. A metallic conductor arranged upon a support of mineral insulating material, the conductor being secured to the support by means of a vitreous glaze having a fusing-point so low that it melts before the difference between the expansion of the conductor and the support causes the conductor to become so loose on the support as to materially change its position thereon.

692,004. SELF-EJECTING PLUG FOR TELEPHONE SWITCHBOARDS; Charles F. Butte, San Francisco, Calif. App. filed April 30, 1901. (See page 270.)

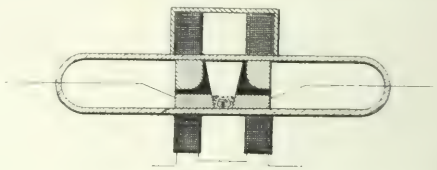
692,005. AUTOMATIC ELECTRIC SWITCH; C. F. Butte, San Francisco, Calif. App. filed May 1, 1901. A switchboard plug containing an electromagnet and a latch which automatically ejects itself from the socket.

692,007. GAS DETECTOR; O. Freymann and C. Tolman, Brooklyn, N. Y. App. filed April 15, 1901. A circuit closer sensitive to heat is treated with a chemical composition which becomes heated when exposed to the action of gas.

692,012. COVERING ELECTRIC CONDUCTORS WITH INSULATING MATERIAL; G. E. Heyl-Dia, Manchester, England. App. filed Dec. 17, 1900. The invention consists in covering the cable with pure rubber and vulcanized rubber in one operation, by coating the vulcanized rubber on one side with pure rubber before applying it to the cable.

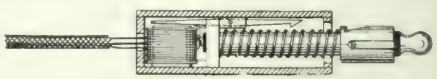
692,013. INSULATING COVERING MATERIAL FOR ELECTRIC CABLES, CONDUCTORS, ETC. G. E. Heyl-Dia, Manchester, England. App. filed Nov. 1, 1901. Covers the article of manufacture described in the preceding method patent.

692,021. REGULATION OF ROTARY CONVERTER E. M. F.; B. G. Lamme, Pittsburg, Pa. App. filed April 17, 1901. (See Current News and Notes.)



691,815.—Coherer.

692,[illegible] WINDING FOR ELECTRIC MACHINES; B. G. Lamme, Pittsburg, Pa. App. filed June 26, 1901. A slotted core having short outer bars and long inner bars and double strap end connectors, the strap ends being separated and fastened to both sides of the bar ends and those which are fastened to the short bars being both located at one side of the long bars.



692,005.—Automatic Electric Switch.

692,054. ELECTRICAL CLOCK; F. Frick, Waynesboro, Pa. App. filed June 29, 1901. Details.

692,085. ELECTRIC SIGNAL MECHANISM FOR OVERHEAD TROLLEY SYSTEMS; W. R. Sterns, Portland, Oregon. App. filed Sept. 14, 1901. A signal system in which current is delivered to a signal line from the trolley wire by the passing of a trolley, the invention residing in the details of the cutting-out and cutthing-in devices.

692,118. REVERSING DEVICE FOR OVERHEAD ELECTRIC CARRIERS; A. S. Clift, East Orange, N. J. App. filed April 19, 1901. A bell crank on the carrier is struck by a projection and the reversing switch on the carrier thus thrown.

692,121. ALTERNATING CURRENT MOTOR; D. E. Coulson, Galesburg, Ill. App. filed March [illegible] 1901. The circuit of the starting coils is opened by a switch operated by centrifugal force, when the normal speed is attained.

692,130. MEANS FOR REGULATING SPEED OF CARS ON OVERHEAD ELECTRIC RAILWAYS; H. M. Harding, Englewood, N. J. App. filed April 19, 1901. The invention consists in insulating the line at portions where it is desired to reduce the speed, allowing the current to pass around the insulated portion through a shunt circuit and connecting the insulated portion with the shunt circuit by a resistance of the required amount.

692,131. SUPPORT FOR TROLLEY AND TRACK WIRES FOR SUSPENDED CABLE ROADS; H. M. Harding, Englewood, N. J. App. filed April 19, 1901. A curved hanger is supported from a cable and itself supports the trolley and track wires of a carrier system.

692,189. SWITCHING MECHANISM FOR INTERCONNECTING TELEPHONE LINES; Albert K. Andriano, San Francisco, Cal. App. filed April 16, 1900. (See page 270.)

692,217. SNAP SWITCH; A. Sundh, Yonkers, N. Y. App. filed July 31, 1901. The snap action in both directions is caused by a magnet acting on the movable part of the switch instead of the spring commonly used.

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DETROIT MUNICIPAL PLANT.

Last week we published in full the report of the city council committee of Worcester, Mass., pronouncing dead against a municipal electric light plant, after a thorough investigation of the subject and of the reports of a number of existing city plants. This week we present the figures for the past year of the Detroit Municipal Plant, with our analysis of them. It will be remembered that this plant when it started some six years ago with such a flourish of trumpets was to be kept wholly clear of "politics." If we judge the situation aright, and accept the admission of one of the commissioners, the plant is to-day quite a lively political issue, with all that that means.

It is not the first time that we have felt constrained to offer some criticism on the Detroit figures for the valid reason that they have been used not alone to glorify the triumphs of municipal ownership but because they have been employed as a club for beating down the rates asked by private plants under their contracts with municipalities. The latter consideration goes with the other, for the exactions of companies are thus held up to scorn as compared with the economies of municipal administration. In our analysis this week, we have endeavored with all fairness and moderation to show how far from accuracy the vaunted Detroit figures are, and if we are anywhere in error it will afford us much pleasure to correct our views and estimates. As it is, we do not find economy, we do not find saving, we do not find due or even decent allowance for depreciation, we do not find a true statement of the actual cost of the lighting to the city. In the course of our analysis, further data than is now presented and of even more serious character as to the outlook of the plant, has accumulated, but the investigation as now submitted convinces us at least that if the cause of municipal ownership rests on the Detroit example it has but slim support.

THE PATERSON FIRE.

There have been too many large fires lately, and the loss that has fallen upon the public and the insurance companies is very heavy. The latest of these fires, that at Paterson, will involve a loss, it is estimated, of not less than $8,000,000, half of which is insured. So far, however, as we have been able to ascertain, hardly any one of these fires has been traceable or attributable to electricity, but we regret to note that the *New York Herald* is again at its old malicious trick of trying to lay the blame of them all against the electric current. We have had to complain of this before, the *Herald* simply going out of its way and "rubbing it in" whenever it gets or can create a chance. There may be some one on that journal with a grudge or a prejudice against electricity; but the animus is only too apparent.

In the case of the Paterson fire, it appears from several of the papers, and is not disproved, that late on Saturday night one of the conductors ran into an old car barn one of the old cars with a coal stove, which, not being damped down or emptied, soon became overheated and set fire to the car. It is by no means the first time such an incident has occurred. Yet the *Herald* has the nerve to assert that "like many of the greatest conflagrations of recent times, that which devastated Paterson had its origin, so far as can be determined, from the defective insulation of electric feed wires." This statement is, we believe, absolutely without any proof or truth whatsoever. Electricity has without doubt caused fires, and where carelessness exists will cause them again, but it remains one of the safest of agents, and there is no need to pile up such accusations, nor to misrepresent

things. In a great many suspicious cases that we have tried to follow out, where electricity was blamed, it soon appeared that the charge was groundless. We note this week in our columns the report of an insurance inspector at Hartford, Conn., who, in giving data to prove that there are proportionately more electrical installations in that city than anywhere else in the world, states that but one small fire in a whole year was attributable to the use of electric current. The *Herald* will not succeed in giving a bad name to its pet aversion.

Energy Consumption and Automobile Performance.

Mr. Alden's article on the influence of energy consumption on electric automobile performance calls attention to the importance of a high efficiency in the motors and gearing. If the watt-hours consumed per ton-mile can be reduced in a certain ratio, say, halved, by an imaginary improvement in efficiency, it is evident that if the storage battery had a constant output of energy under all conditions of working, then the range of the vehicle would be doubled, because the same amount of battery energy at half the expenditure per ton-mile would double the miles. But, as a matter of fact, any improvement in the efficiency means a reduced current strength, and reduced power for the same speed, and consequently the battery will have an increased output. A halved expenditure of energy per ton-mile would, therefore, more than double the range of the vehicle. Improvements in automobile motors and automobile storage batteries react upon the capability of the machine at compound interest.

The Metric System.

On another page of this issue will be found a copy of the report of the committee appointed by the Franklin Institute to consider the question of the adoption of the metric system. The committee was evidently composed of men in different callings, and included both manufacturers and professional men, so that the personnel of the committee did not favor any particular bias or sectional view. It will be seen that the report is heartily in favor of the universal adoption of the metric system, and recommends in particular such legislative action by Congress as will ensure the adoption of the metric system by all departments and bureaus of the Government as soon as possible. Electrical engineers and electrical workers are particularly in favor of the metric system, for the reason that all the practical electrical units, such as the ohm, volt, ampere, joule, watt, etc., now in international and universal use, are metric units. The advantage conceded to the use of these units is in large measure due to the fact that they are metric units, or are an extension of the metric system of weights and measures into the departments of electrical science and art. The use and application of these units would be much simplified, if the units of weights and measures in every-day use were metric, instead of those now customary in this country.

We heartily indorse the report of the Franklin Institute committee. We are unreservedly in favor of the metric system, not only for the electrical units, which are already metric, but also for the every-day units of weights and measures which, unfortunately, are not yet metric in this country. We believe that the great majority of our readers are of the same opinion. As a matter of fact, there are no less than 64 units of measure existing in the United States at the present time. Seventeen of them are linear units, such as the inch, foot, yard, mile, etc.; 15 are weight units, such as the scruple, ounce, pound, etc.; 21 are volume units, such as the cubic inch, pint, gallon, etc., and 11 are surface measures, such as the square foot, acre, etc. This congeries of units is interlaced and connected by a system of numerical ratios so harsh and complex that it is most rare to find any one who knows them all. There are very few people in the country that can write down from memory the whole system of weights and measures in use in the United States. Add to this complexity the fact, that the British imperial gallon, quart, pint, bushel, peck, fluid drachm and fluid ounce, all differ more or less from the United States quantities of the same denomination, and it is evident that confusion often exists in literature published in the States on one hand or in Canada and Great Britain on the other.

Contrasted with the cumbersome and complex existing system of 64 units, stands the international metric system with less than half a dozen units, and these so closely connected with the metre as practically to involve that unit alone. All the numerical ratios between the units of the metric system are decimal ratios. Just as the currency system of dollars and cents in the United States and Canada is superior to the original British system of pounds, shillings and pounds which it superseded, so the metric system of weights and measures is superior to the British system. Strenuous efforts have been, and are now being made in Great Britain by leading merchants, scientists and men of affairs to introduce the metric system into Great Britain. Commencing with France at the beginning of the nineteenth century, one civilized country after another has thrown over its original system of national weights and measures in favor of the metric system, until now Great Britain is practically the only civilized country, outside of the United States, which retains the original medley. In view of this fact, and the tendency of all things to become international in the course of civilization and progress, it cannot be doubted that sooner or later the metric system will be used all over the world, and it is only a question of how soon the change shall be made in the United States. As the matter stands to-day, practically all modern text-books in technology teach in the metric system, and nearly all the accurate scientific work of the country is to-day recorded and carried on in the metric system.

It seems safe to say that hardly any enlightened or progressive man in the United States to-day, who has studied this question here and abroad, will deny the advantage of the metric system for every-day use, and the importance of substituting it for our medley. The only question is as to how the change should be accomplished. Any general change, no matter how beneficial it may be, necessitates inconvenience during the period of transition. The inconvenience and expense of attempting to force the metric system upon all citizens of the United States at 24 hours' notice, for example, would be so great as to be simply prohibitive. Price lists would have to be changed, contracts and machinery would have to be changed, and some minor modification would run through all the machinery of life. It is essential that such changes must come about gradually and with ample time for preparation. Once the change is made every one will be benefited. We could all think more clearly from a quantitative standpoint; we could use arithmetic in all the affairs of life with less labor and waste of time, and we could understand both our friends and our foreign neighbors more readily.

Every effort should be made to bring about the change with the minimum inconvenience, confusion and expense. On the one hand, every year the change is deferred makes the labor of the transfer greater, because the country becomes greater and the things to be changed become more numerous. On the other hand, too sudden a change is simply so expensive as to be out of the question. Between these limits lies the path of prudence. The ideal method would be for the United States to enter into an agreement with Great Britain and her colonies, whereby on and after a certain date, the existing medley should be replaced by the metric system in all official documents, both here and abroad, by mutual consent. But whatever happens, it is highly important that Congress should pass a bill at this session making the adoption of the metric system obligatory on the part of the Government Departments and Bureaus without delay, so far as may be consistent with public welfare. If one division of the

great English-speaking nations officially adopts the metric system the other divisions will doubtless speedily follow. We hope that the bills now under the consideration of committee in the House of Representatives will be favorably reported and acted on by Congress, it being understood that ample time should be allowed for the general adoption of the system, and that its use should not, under any circumstances, be compulsory on the public. No citizen should be denied the right to talk of yards and gallons instead of meters and liters if he prefers to be unprogressive after the country has officially adopted the new system.

Phenomena of Radio-Activity.

The investigation of the remarkable group of phenomena which are connected with radio-activity opens some of the most interesting theoretical questions to be found in the realm of physics. The startling work of Becquerel, Madame Curie and others is really of the most extraordinary character, although so much of it has been published in the form of brief notes that it is difficult to view the matter in proper perspective. Of peculiar importance are the relations between the Röntgen rays and the occult forms of radiation of which we are speaking. The elusive substance "radium" itself, seems little less marvelous than the mysterious chemical that figures in "Dr. Jekyll and Mr. Hyde." Whether element, or allotropic modification of an element as the later investigations seem to suggest, its properties are sufficient extraordinary to merit the most searching examination. To what they are due is a most puzzling question, and every fresh research deepens the mystery. At the start, the rays seemed to be merely analogous of those of Röntgen and Lenard. But as time has gone on they have developed extraordinary peculiarities, and while upon the corpuscular theory now in vogue one may rest content with the idea of emanation of particles too minute to be disproved, the field of investigation seems to be broadening in a very embarrassing way. The fact is that the resources of photography are extending radioactivity to a point where one is tempted to call a halt and inquire whether in fact radioactivity, whether it be due to a form of radiant energy or of radiant matter, is not a normal property of matter in general, more striking in some substances than in others, just as one metal is heavier or more ductile than another. The molecular theory, whether modified from the standpoint of corpuscular action or from that of radiant energy, would suggest such a conclusion and the recent work abroad points strongly to it.

From this point of view the phenomenon may be far more uniform in different kinds of matter than appears on the surface, since for the most part the evidence is photographic, and the substances photographically most active for this particular kind of radiation are quite unknown to us. Some of the phenomena are, of course, readily visible to the eye, but the photographic plate, integrating as it does the effect of radiations received over a considerable time, is a vastly more potent means of investigation. Photography has already revolutionized astronomy, not only rendering plainly discernible faint objects barely visible to the eye in the largest telescopes, but bringing within our grasp stars and nebulæ that are probably forever beyond the powers of human vision. In a precisely similar way photography promises to revolutionize our knowledge of the constitution of matter, and it is by no means improbable that a systematic search for proper sensitizing substances will open up a new field in molecular radiation. The recent work in this line brings to our mind some experiments performed a few years since in England which, although unpublished, have wandered across the water via the wireless telegraph that unites the laboratories of the world. The facts as we had them from close and trustworthy authority, are as follows: If we recollect correctly they were mentioned at an Institute meeting a year or two ago. A brilliant young English physician, just out of the medical school, being greatly interested in the physiology of vision, conceived the idea of secluding himself in absolute darkness for some days to test the effect upon visual sensitiveness. Then among other experiments he had his servant bring in to him, through the elaborate system of screens that preserved complete darkness, a tray containing a number of beakers marked merely for identification in a way invisible to him, each containing a small quantity of some especial chemical. Just above the surface of each he detected a distinct aureole of highly characteristic appearance, and was able regularly and repeatedly to arrange the beakers in a definite order by this indication alone. This result and others similarly obtained seemed so extraordinary that the experimenter did not make them public. If he still lives and this should chance to meet his eyes, he would do a positive service to science by reporting his work in full. It falls precisely into line with the trend of recent investigations, and in view of the general facts of radioactivity, seems entirely to be expected.

The existence of these radioactive phenomena has a direct bearing upon some of the curious facts of chemistry, as in the singular class of reactions where two substances are completely inert toward each other until a minute trace of a third substance entirely inert toward both is added. Of the exact character of the stresses that make for electrical energy we know next to nothing, of those that determine chemical action still less, and here we have thrust upon us a new set of most potent activities as yet quite uncorrelated with other physical forces. The subject is really tremendously important and should be followed up with untiring energy. We may sooner or later find it intimately connected with many strange and unexplained phenomena that lie on the borderland of experimental science. The recent work on the pressure of light should not be forgotten in this connection, and there are, too, some experiments tending to show that weight is a function of chemical composition, which have never been fully confirmed but were too carefully made to throw aside. These might well be overhauled in view of radioactivity with a chance of finding an explanation. In the same connection, too, one must not forget the probable composite nature of the so-called elements. The spectroscope evidence on this matter has been gradually accumulating for a score of years or more, and some of the recent evidence is much too strong to be disregarded.

There is a vast mass of uncollected facts which will some day find a natural classification in view of the extension of the molecular theory which is now being evolved. The corpuscular doctrine lately so much amplified is a useful working hypothesis in some of these investigations, albeit it is by no means the only one properly tenable. The fact is that during the last ten years the number of very extraordinary phenomena brought to light has been enormous. The details have piled up faster than they can be sifted and classified, and unless there is a greater concentration of effort than there has been in the past, there will be confusion for some time to come. Of late much of the best scientific effort has been bent to practical ends, and some of the keenest minds have been lost to theoretical investigation. We cannot properly regret this, but it is high time that some great investigator should arise and undertake the work of co-ordination. Maxwell forth-fared now nearly a quarter of a century ago, and while it is far too much to hope for a Maxwell every 25 years, it is his spirit and his wide view that physical science most needs to-day. We have workers enough and to spare, but they are all in too great a hurry for great reflective generalizations. Things practical have been pushed ahead, it is true—not too far or too fast, but so far and so fast that there is danger that they may have to wait a bit for their supply trains to come up.

The Institute Election.

Nomination blanks have just been issued for the annual election of the American Institute of Electrical Engineers. Unusual interest attaches to this election from the fact that it is the first under the new constitution adopted last year, by which eligibility to the presidency and vice-presidency is now limited to members, although associates are eligible for election as "managers," which makes them officers on the council. Another feature is that after this preliminary ballot, the council in sending out its sheet of nominations is required to put in two names for the presidency selected from the first four names having the highest votes. A further provision is that the vice-presidents shall be nominated with an eye to geographical distribution.

It would appear that electioneering has already begun for the higher offices, and a number of well-known men are suggested by their friends, those finding widest support being Dr. M. I. Pupin, C. F. Scott, C. O. Mailloux, J. W. Lieb, Jr., L. B. Stillwell and Dr. S. S. Wheeler, who is also spoken of as a vice-president, there being a general recognition of his active interest in the Institute at all times, and his recent generous gift of the Latimer Clark library, beginning a new regime in Institute affairs. Dr. Pupin is widely mentioned, but it has been pointed out that having so far remained an associate member he is ineligible for both offices. Possibly this defect can be cured in time in behalf of one who is so prominent.

Up to the present time few men have been suggested for managers, but Mr. R. T. Lozier is already "running strong." He came within a vote or two of the nomination last year, and since that time has added largely to his excellent work for the Institute whenever an opportunity has presented itself.

Franklin Institute Favors Metric System.

At a meeting last week of the Franklin Institute a special committee appointed to consider the feasibility and advisability of the adoption of the metric system in the United States, reported strongly in favor of the adoption of the system, as follows:

Whereas, It is desirable to obtain an international standard of weights and measures, also to simplify and regulate some of our existing standards; and, whereas, the metric system is commendable not only as a suitable international standard, but also for facility of computation, convenience in memorizing and simplicity of enumeration. Resolved, That the Franklin Institute approves of any movement which will promote the universal introductoin of the metric system with the least confusion and expense. Resolved, That the National Government should enact such laws as will ensure the adoption of the metric system of weights and measures as the sole standard in its various departments as rapidly as may be consistent with the public service.

Among the signatures are those of a number of prominent engineers and James Christie, of the American Bridge Company; Wilfred Lewis, president Tabor Machine Company, and S. M. Vauclain, superintendent Baldwin Locomotive Works.

Electrical Engineers of the Day—XXXIII.

J. S. PECK.

John Sedgwick Peck was born at New Haven, Conn., in 1871. On the paternal side he is descended from the Sedgwicks and on the maternal from the Tuckers, both of whom were among the prominent and early settlers of the Connecticut Valley. He prepared for college at the Stanton Military Academy, Stanton, Virginia, and entered Cornell University in the fall of 1888, from which he was graduated in June, 1892, receiving the degree of mechanical engineer. In the fall of 1892 he began work in the shops of the Eddy Electric Company, of Hartford, Conn., and some months later was transferred to the draughting room. In the spring of 1893 he entered the student's course in the shops of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., and in due time worked his way through the shops to the testing department. Shortly after he was promoted to assistant in the laboratory and assigned to the work of calibrating and testing measuring apparatus. His work here was of such a character as to result in advancement to the engineering force, where he was finally entrusted with the serious and exacting duties connected with the design and construction of transformers, and in a general way, with their installation and operation.

All the original transformer work done by the Westinghouse Company in the last seven years has been under the supervision of Mr. Peck. During this period the transformer business of the Westinghouse Company has increased enormously, the annual output growing from a few hundred to over 200,000 kilowatts. In the same time the size of the largest unit has grown from 100 to 2750 kw. This increase in the size of unit seems a remarkable one, but so great has been the improvement in manufacturing facilities, and so sure are the engineers of their ground, that the manufacture of the largest transformers demanded by the growth of electrical development is undertaken without hesitation, and the performance of the completed apparatus predicteтd with the greatest accuracy. For this satisfactory condition no small amount of credit is due to the work of Mr. Peck. In the Buffalo terminal station of the Niagara Falls Power Company there are seven 2250-kw oil-insulated transformers, the largest of their type ever constructed. At the plant of the Chambly Manufacturing Company in Montreal, Canada, there are now being installed twenty 2750-kw air-blast transformers, the largest of any type ever made. These transformers were designed and built under the personal supervision of Mr. Peck.

Of standard types, Mr. Peck designed the Westinghouse O. D. air-blast, oil-insulated self-cooling, and oil-insulated water-cooled, transformers—apparatus known over all the world as models of electrical



design and economical operation. With his knowledge broadened by a wide experience in this particular line of electrical activity, he has acquired the critical judgment that comes only after years of patient laboring in a field involving the exercise of trained faculties.

In the development of the transformer Mr. Peck has devised many useful and ingenious methods of constructing, connecting and testing transformers. An article on a method devised by Mr. Peck for testing the largest types of transformers appeared in these columns some months ago, which is notable both for its accuracy and simplicity. A recent patent issued to him covers the cross connecting of three transformers used for supplying a three-phase rotary converter. It is well known that when three transformers with secondaries connected in star supply a rotary converter, a wire may be carried from the common point of the windings of the three transformers to form the neutral wire of a three-wire direct-current circuit. By the method of Mr. Peck, the secondaries of his transformers are cross connected in such a manner that the direct current in the neutral wire passes in opposite directions around the core of each transformer, thereby producing no resultant magnetism in the core.

Mr. Peck is a member of the American Institute of Electrical Engineers, and is an occasional contributor to the electrical press. He is past president of the Amber Club, of Pittsburg, an organization established on the same lines as a college fraternity, and founded 15 years ago by the young engineers connected with the various Westinghouse companies. Most of the prominent Westinghouse engineers have been connected with this club at one time or another.

Storage Batteries in the Baltimore Belt Line Tunnel Power Plant.

N the operation of the Baltimore Belt Line by electric locomotives, it was found that at times a maximum load came on the power station which severely taxed its capacity. The haul is about 3.6 iles, and all up grade, the south bound trains being permitted to coast own the grade, which attains 1.8 per cent. One electric locomotive used at a time, the passenger trains being hauled from Camden ation to Mt. Royal station, which is situated at about the middle of e line. In addition to this, the freight trains are pushed from Mt. oyal station to the end of the line. The power station is situated ear Camden station, and the haulage to Mt. Royal station was oper- ed at about 575 volts. When the locomotive worked beyond that oint the voltage was raised by a simple booster.

Wattmeter readings in the station showed, for 36 trains, an aver- ge load throughout the day of 175 kw, an average load while the lo- omotive was in service of 525 kw, and a maximum load of 1300 kw. Moreover, the maximum comes at the starting of the locomotive, nd is, therefore, an impact load on the station. The resulting strain as so great that when the locomotive load only was on the station it was found necessary to keep three 500-kw generators in service.

When the question of the storage battery was taken up, it was noted at once that the load was in no way similar to that of the street railway, but closely analagous to that of an electric elevator, the curve of performance showing a heavy initial load, a sharp descent due to rapid acceleration and a practically steady load throughout the run. This was especially noticeable on the through express trains, as the acceleration on them was much greater than on the freight trains. The former, however, would consume about four minutes in going through the tunnel, while it would take the latter sometimes 26 minutes to go over the entire line. Moreover, one train would often follow another, starting as soon as the preceding one dropped its locomotive. In this manner there was a load for 1 hour and 15 minutes, practically without intermission, averaging about 1200 amperes.

It was, therefore, necessary to consider a battery, not only capable of taking the fluctuation due to starting, but of a capacity sufficient to carry a steady load due to continuous haul. The operation of two trains simultaneously, one from Camden and one from Mt. Royal station, was also considered, and had to be allowed for in determining the size of the containing tanks.

The battery was installed by the Electric Storage Battery Com-



FIG. 1.—BATTERY HOUSE.



FIG. 2.—BATTERY ROOM.



FIG. 3.—VIEW OF ELECTRIC LOCOMOTIVE AND TRAIN ON BALTIMORE BELT LINE.

pany, and consists of 320 cells of chloride accumulator, in tanks of suitable size to contain 51 plates. It has a present capacity of 1520 amperes, and an ultimate capacity of 2000 amperes at the hour rate of discharge. It is situated at Mt. Royal station, and is, consequently, at about the middle of the line.

erator voltage, is sufficient to overcome the drop in the line at that current, and give at the battery a voltage of 800, which is the charging rate when the battery is fully charged. The greater part of the time the booster will work about midway between the two extremes

In calculating the distribution, the question resolved itself into

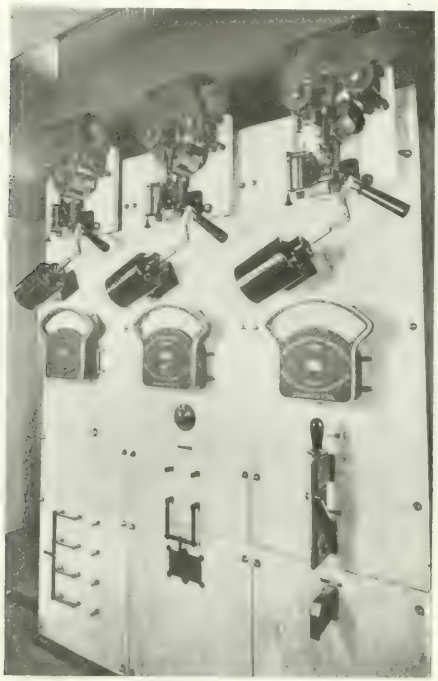


FIG. 4.—SWITCH BOARD.

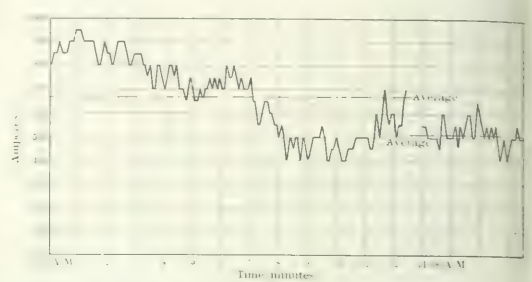


FIG. 7.—FLUCTUATIONS ON ONE GENERATOR UNDER STREET RAILWAY LOAD ONLY.

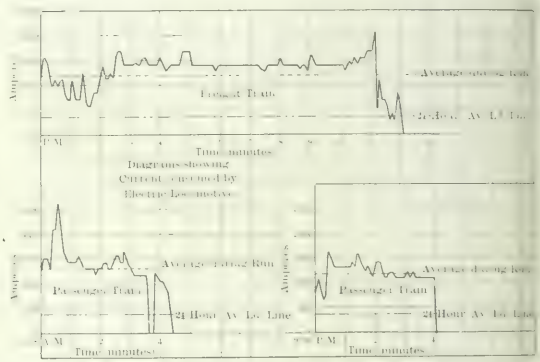


FIG. 6.—CURRENT CONSUMED BY ELECTRIC LOCOMOTIVE.

The booster is of the constant-current type, having a shunt field fed from the main busses and a reversed series field. As the generators are of a capacity of 500 kw, it was deemed advisable for the present to use that capacity in regulation in order to decrease the size of the best disposition of the feed-wire on hand, which was found to be amply sufficient. These facts were taken into consideration: The heaviest load comes at Camden station, the greater part of the haulage is between Camden station and Mt. Royal station, at Huntingdon

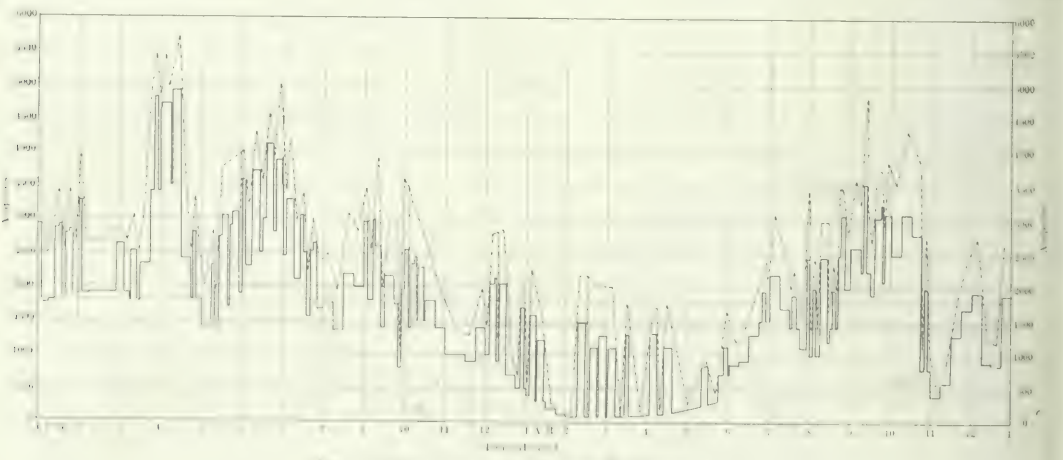


FIG. [illegible]—TYPICAL LOAD AND DERIVED FLUCTUATIONS.

the battery. The series field was, therefore, made weak enough to allow a current of 900 amperes to pass through the booster at 100 volts, which, with the generator voltage, is enough to overcome the drop in the line at that current and equal the battery voltage at discharge. At 300 amperes the boost is 300 volts, which, with the generator voltage, is sufficient to overcome the drop in the line at that current, and give at the battery a voltage of 800, which is the charging rate when the battery is fully charged. The greater part of the time the booster will work about midway between the two extremes

Avenue the grade lightens. The results obtained from the distribution as laid out have been excellent, the voltage at no time dropping below 575.

The switchboard has an interesting feature, in that the circuit-breakers can be operated from the signal tower, thus obviating the

ecessity of having a man continually at the battery house. This is :complished by attaching the handle of the circuit breaker to the ·mature of a solenoid magnet in circuit between the booster feeder id the ground. Electric lamps in the circuit controlled by each ·eaker indicate when it is tripped. The signal operator can then ose the circuit breaker by pressing a push-button switch.

With regard to the accompanying diagrams, Fig. 5 represents the tal load on the generators due to the street railway load, and the comotive load. The dotted line is derived by adding the fluctuaon at the locomotive load during the run. Fig. 6 represents the rrents consumed by locomotives under different conditions. The p curve is that obtained when a heavy freight train is being hauled rough the tunnel at a low rate of speed. The lower left-hand curve that when the Royal Limited is hauled through at high speed. ote the fluctuation due to acceleration. The lower right-hand curve that when an ordinary passenger train is hauled through at a ghtly lower rate that speed than the Royal Limited. Fig. 7 repreents the load on each generators due to the street railway load alone. : should be noted that this task equals the capacity of the generator 500 kw, 525 volts), and, therefore, the locomotive load comes on ie station entirely as an overload.

Since the battery has been installed the voltage has been mainined at a much higher and steadier rate, and the express schedule rough the tunnel has been lowered about three-quarters of a inute. An exceptional service was called for some few months ago, hen, owing to a cave-in of one of the tunnels on the Philadelphia, Vilmington & Baltimore R. R., the Pennsylvania R. R. traffic was dicrted through the Belt Tunnel, and 165 trains were hauled through y the locomotives in one day. The battery showed no ill effects, lthough it was only erected to take care of 35 trains, and the service as so excellent that the question of the advisability of running all ennsylvania through trains by way of the Belt Tunnel has been aised. Recently the power station was put out of service for four ours in order to make certain connections, and the entire load was arried by the battery without trouble.

Induction Wireless Telegraphy.

By V. H. Emerson.

I HAVE read several interviews had with Mr. Thos. A. Edison in reference to Marconi's wireless telegraph system, but have not seen a statement from him in reference to his own work in this ield; and no one would know from these interviews that he had ever lone anything in this line himself. It was, however, Mr. Thomas A. Edison's system of wireless telegraphy that was in full operation on he Lehigh Valley road during the years 1886 and 1887. I am interested in the matter because I was chief operator on the first commercially successful wireless induction telegraph system. A short resume of the progress of the art may be of interest.

During the year of 1885 Mr. L. J. Phelps invented what was known as the induction system of wireless telegraphy, and the company which controlled his patent constructed an experimental line on the Mott Haven Branch of the N. Y., N. H. & H. R. R. This system was operated as follows: The line extended from Mott Haven to New Rochelle—a distance of about 12 miles. The line was connected with about 200 Bunsen cells, and the signals were sent over the main line with a pole-changing key. The baggage cars on the road were wound with a No. 14 coil of wire of about 50 convolutions, which coil was connected with a polarized relay. The signals sent from the main station induced similar currents in the coil on the car and operated the polarized relay, which in turn operated a regular Morse sounder connected in its regular circuit.

The signals from the trains to the main station, however, were not sent with the regular telegraph apparatus, but by connecting in the main circuit of the car a buzzer. This buzzer broke the current into several hundred vibrations per second, and produced a musical tone which was broken up into dots and dashes. These musical dots were induced into the main line from the car circuit and the operator at the central station at Mott Haven having a telephone strapped to his ear could read the signals from the train.

While this system was in operation, Mr. Thomas A. Edison was developing his system of wireless telegraphy on an Illinois railroad. The system on the N. Y., N. H. & H. R. R. was subsequently placed on the Lehigh Valley Railroad. The line wire was strung between the fish-plates on the west-bound track. This proved to be bad policy for the reason that in the summer time, when the heat expanded the wire, it would sag, and as the heavy 40-ton engines passed along the heavy pressure would press the rail down into the tie, and leaving the heads of the spikes free, the wire would slip under them. When the train passed on the rail would again come up and clip the copper wire. Many other means were also tried, but were failures.

At this point Mr. Edison came to our rescue with his system, and the result was the discarding of all the various plans that had been tried for the one developed by him. When the alterations to his system were completed the main station for the system was at Flemington Junction, N. J., and the line ran east to Perth Amboy and west to Easton, Pa. The *modus operandi* was as follows: The central office was equipped with an induction coil which had a buzzer connected in the primary circuit; the secondary was connected east and west on the main line, which line was built on 12-ft. poles and was situated about 6 ft. from the west-bound track. The musical tone of the buzzer was broken into regular Morse system signals by means of a regular telegraph key. The main line being charged by the operator would in turn statically charge the tin roof of the car if it were anywhere on this division. The signals were read by the operator on the car by using a regular telephone receiver connected between the tin roof and the truck of the car where the current went to ground through the rails. I include here an interesting telegram copied from the original of one of the very first messages sent by wireless telegraphy at this time, and addressed to Sir John Pender, at London, England, by Colonel Gourand:

"I am sending you this message while comfortably seated in a chair-car on the Lehigh Valley Railroad, while flying through the beautiful valley of that name at the rate of over 50 miles per hour. The messages are sent by the Edison and Phelps' system of wireless telegraph, there being, of course, no contact between the train and the line wire, the current jumping through space to the wire alongside the railroad track. Among the interested spectators to this marvelous exhibition are Mr. Edison and Mr. Cheever, who send their kindest regards."

By this system we subsequently connected to the wires alongside of the track and by shunting the telegraph keys in the stations along the line with condensers we used the line already constructed, although at times it disappeared in the valley and at other times ran up on top of hills. This was all accomplished with two Leclanche cells, and with a coil of 2 ohms in the primary and 10 ohms in the secondary.

Messages have often been received by me on a wire fence 10 miles from the main line wire. During the blizzard of 1887 the Lehigh Valley Road had communication with all of its trains on the Perth Amboy Division, although our uninsulated wire was blown down and buried under snow in at least 20 different places. The current, in this case, was induced on the regular wires alongside the track, and then reinduced back on our lines across the break. One of the operators was on a train when it was wrecked between "Three Bridges" and Neshamie, and two engineers were killed, and by sitting on a snowbank and attaching to the roof of an overturned car called for assistance within one minute after the disaster occurred. In addition to the above practical application experiments were conducted on Long Island Sound by Mr. Phelps for the purpose of telegraphing to boats from the shore, and messages were sent from Mott Haven to the other side of North Brothers' Island. This was done during the winter of 1885. In subsequent experiments a large induction coil similar to that used by Marconi was used, and 10 to 20-mile messages were of common occurrence.

A Pleasing Experiment.

In an interesting sketch of his own pioneer work, Lt. Col. R. E. B. Crompton has this little story in *Electrical Investments*, a London financial paper: "On one occasion during the same year, Dr. Wm. Siemens was lecturing on arc lamps at the Royal Institution, and in these days it was the custom to work lamps with very short arcs. Owing to the fact that it was not appreciated that 45 volts were necessary for arc lamps, makers only allowed 35 volts, so that the lamps were always fizzing and hissing and forming 'mushrooms' or 'cauliflowers' on the negative carbon. Dr. Siemens was lecturing on the arc lamp when one of these cauliflowers fell off one of his own lamps on to the center of his head—which was bald—and produced a most remarkable effect. I do not think the Royal Institution ever witnessed a more pleasing experiment."

Rotary Disks.

By Alfred G. Dell.

I HAVE recently made some further experiments with the rotary disk arrangement, which I described in the issue of March 30, 1901. This arrangement consists of a horizontal lacquered mica disk on a perpendicular axle, with a spark-gap underneath on the one side. It may be recalled that these disks were shown to be very sensitive to anything interfering with the discharges, as indicated either by changes in the direction of the rotation or their velocities.

I have found that needle points are not as favorable as small rounded points, for the reason, it would appear, that the discharges take place mostly from around the sides of the points and not from the points themselves; and as the sparks appear always to discharge initially perpendicular to the surfaces, with needle points they have to bend considerably to reach from one electrode to the other. I found the same results concerning the use of rounded points in experimenting with electric waves, as I published in the *Electrical World*, of Jan. 12, 1895.

In the digest of the London *Electrician* of a late date, there appears an account of some experiments on "Point Discharges," in which the author states "The influence of moisture is very straight until the percentage reaches over 50, when the retarding effect of the moisture begins to make itself decidedly felt."

The agreement with my results is remarkable. As I stated in the former article, the disks would not rotate when there was present above 50 per cent of moisture, and commenced to rotate below 50. The author of the article seems to have failed to locate entirely the effects of the moisture. He gives it as a retarding effect.

After many experiments with the rotating disks extending over some months I have found the moisture affects the disks, the discharges, but particularly the charges on the non-conducting substances on which the electrode plates rest. It may be recalled that I have used small plates of metal, brass or zinc, resting on a presumably non-conducting substance. The small sheets of metal were extended into rounded points under the disks, and all placed in a tight box in which low humidity was maintained by the presence of calcium chloride. I recognized there is always an accumulation of the impulse before sparking, and that the impulse would rush, if no other attraction present, as near to the spark-gap as possible, and there accumulate if there was sufficient metal capacity to hold it. I found not only a dissipation of the impulses from humidity collected on non-conducting substances, such as cardboard or wood used under the small plates mentioned above, but also condenser effects which were discovered by the disks swinging backward and forward, although the humidity in the box was low. The moisture collected on the non-conducting substance, especially wood, was very difficult to remove, it requiring a strong, dry heat and frequent applications of it.

There appeared frequently in the boxes streamers such as are seen in a Crookes tube with low vacuum. The streamers appear to come from sharp edges or extremely small points on the electrodes near the spark-gap.

Nearly all substances, such as paper, wood, etc., are perfect non-conductors when absolutely free from all moisture. I tried mica, rubber cloth, etc., under the electrodes, not extending it under the disks, but found that the condenser effect was increased, and it was almost impossible, with the temperature I dared use, to remove the thin film of moisture that would collect thereon; and with even low humidity in the boxes the charges seemed partly to stick to them.

I finally found that a porous substance, such as cardboard or wood was the most suitable. It is much easier to remove the moisture from the cardboard than from wood, but where the spark-gap is adjustable, it is better to use some porous wood. In wireless telegraphy, I would suppose, that if the spark-gap and the metal capacities near the gap were as far as possible placed in a box containing dry air, the arrangement would work with greater constancy. I think it would be advisable to try it.

There is another thing connected with the rotating disks that I have failed entirely to understand. I stated in the former article that the light from a gas jet shining on the spark-gap and disk seemed to increase the rotations. I find that sunshine has the opposite effect. I long ago found that sunshine affected the sparks between points, reducing their number.

In the above I state that the impulse accumulates near the spark-gap before discharge, and if the electrodes rest on any non-conducting substance and there is humidity present, there is dissipation in space, and also condensation of a portion of the charges, the charges not appearing in full in the spark. The following experiment was made on this point.

I took one of the boxes containing a rotating disk and made the plates, zinc in this instance, of a smaller size than usual, placing them on wood of a porous nature. After driving out the moisture by frequent heating of the whole arrangement, excepting the disk (which I did not dare to heat as the heat would displace it on its axle), I found after many trials that when I attached it to the coil it would rotate all right until I let it stand, say, over night, for instance, and then there would be a swinging backward and forward of the disk before it would start to rotate in direction from + to —; but after once it fairly started it would continue to rotate in that direction, and if started from — to + with a fair velocity, it would continue so to rotate. When the disk was forced to rest by the blower, it would continue to slowly swing some little time. I tried all means of which I could think, excepting increasing the size of the plates, to make it rotate without swinging, like another one I have with larger electrodes, and which does not swing at all. This I entirely failed to accomplish. At last I attached a small plate of zinc, about ½ by 1 inch to each wire about 1½ inches from the electrode, so all would be on the inside of the box of low humidity. With the addition of this metal capacity the swinging nearly if not entirely ceased, and the disk started to rotate from + to — at the start.

I also found when I widened the spark-gap under the disk or increased the primary current in the coil, the spark-gap being arranged so I could adjust it from the outside of the box, that in both cases the swinging was increased before I added the capacity.

It is perfectly clear to my mind that when I heated the arrangement I also dried out the moisture from around the leading-in wires on the outside of the box, they for some little distance being sealed in with wax; thus the outside wires acted as capacity and no moisture being present on them they did not condense part of the charges thereon. When, however, they remained for some time, moisture collected about the wires on the non-conducting substances, and the inside plates being too small to well hold the charges, part was accumulated on the outside wires. When I widened the gap under the disk or increased the primary current in the coil, in the first case the delaying of the discharge forced the charges to a more full accumulation, and in the second case the charges were increased still more and forced more to the outside of the box.

It is very plain to my mind, having seen the experiments in all their changes, that the + and — parts of the impulses from an induction coil are almost, if not entirely, separate from each other as regards the coil direction, and are forced out separately.

There also seemed to be a tendency when the small plates were used for the disk to rotate a little more readily in the direction in which it formerly rotated; for instance, say it was rotating from + to —, and I shut off the current and stopped the disk with the blower, and then at once turned on the current, it would then start more readily from + to — than if left alone for some time and then started by turning on the current.

If rotating from + to — and then the current in the primary of the coil was reversed, it, of course, still continued to rotate in the same direction, but if I stopped the current and quickly stopped the disk, and at once turned on the current in the former direction so that it would rotate from + to — again or the same direction, the swinging of the disk would be increased over that of the first-mentioned condition.

I will state that I have used three disks, changing frequently from one to the other, and have found the swinging with all alike; and when there was no swinging with one there would be none with the others. This experiment was made to detect any imperfection in the arrangement of the construction.

Several times when the connecting wires in the box were cotton-covered I have corrected the swinging of the disk, and also improved its rotations, by burning off the cotton, showing that the cotton was acting as a condenser. In this case, in the dark the cotton-covered wires would appear lighted up at every spark discharge under the disk. At other times the cotton covering made no difference, and no light was seen about it. It is evident it was the moisture collected in the cotton in the first case, which I had failed to remove by heating. Calcium chloride will finally remove the moisture almost entirely, but it takes a long while, if no heat has been at first applied. The difference between the effects of the + and — dis-

harges from the points shows itself, and stands out very prominently. n my article of March 30, 1901, on "Rotations from Electric Sparks," state, "I am quite sure that if nearly all moisture were removed om a box containing a disk, it would bring the two forces to an ualization; and if all were removed the minus would possibly edominate." Believing it was important to test thoroughly again ie above, last summer I placed a disk in a tight box with calcium loride, where it has remained ever since. It has never been opened xcept to renew the absorbent, and then carefully tilted, and has een kept in a warm, dry place. With this the above was again completely verified. The disk now starts at once when energized by the oil (there being no swinging) from + to —, and quickly reaches a onstant spinning velocity. If the rubber used to make it rotate from - to + is but slightly pressed while the disk is at rest, giving it a elocity from — to +, the use of a lens is almost required to detect starting spinning in that direction when sparks pass under it. The - will surely finally predominate if the calcium chloride has not eached its final limit as an absorbent.

Energy Consumption and Electric Automobile Performance

By H. W. Alden.

THE recent editorial in this journal regarding the importance of increasing the mechanical efficiency of an automobile as well as increasing the battery capacity has led the writer to offer he following graphical illustration of the extreme and evidently ot altogether fully appreciated value of the above suggestion.

From traction data collected during some years, the attempt has een made to show plainly the effect of mechanical energy of proulsion upon the speed and mileage of an electric automobile, the attery equipment remaining constant. The effect where other systems are used is just as great, but not so manifest. By "mechanical nergy" for the present article, which does not pretend to be analytically complete, we will understand as including motor efficiency, gearing, bearing and tire losses. It would be interesting to take up hese items separately and study their individual effect, but that is ot the present purpose.

Two sets of curves have been prepared, one (Fig. 1) showing the effect of variations of energy on a given vehicle, no changes being considered other than those in mechanical operation of the parts above referred to. The curves have been reduced to a watt-hour basis, that is, the energy in watt-hours required to propel 1000 lbs. 1 mile. It is more convenient to handle this quantity than the energy per ton-mile. This energy, then, is represented by the following formula:

$$w = \frac{Amp. \times Volts}{Veh.\ wt. \times speed\ in\ m.\ p.\ h.} \times 1000$$

Reduction in energy means reduction in current, and hence a certain increase in motor and vehicle speed, other things remaining the same. In the calculations, each set of determinations was so made that the vehicle speed corresponding to a certain assumed energy corresponds exactly to the motor speed at that current. Hence each point on the curve represents actual working conditions, the variations in motor speed being taken from actual motor tests.

The battery capacity in watt-hours per pound has been assumed at a conservative figure, there being several batteries on the market of higher capacity. No desire, however, has existed to show fictitious or "gilt-edged" conditions.

In Fig. 1 will be found two sets of curves giving speed, current and mileage—one (solid lines) representing ideal conditions of level asphalt or macadam others (dot and dash lines) representing congested city traffic or ordinary cross-country work. The increase in current has been taken as 25 per cent, which is the result of some careful tests of a few years ago and can be taken as approximately correct This current increase cannot be legitimately charged to "wattage," as it is beyond the control of the manufacturer or the operator, and can only be considered as an unavoidable adjunct of operating conditions.

The decrease in speed has been taken as 10 per cent, this also from experience. Due to increased speeds on down grades above the normal level speed, the average speed will not fall in proportion to the increase of current. In fact, if one cares to take chances in coasting hills, he can run over a fairly hilly course at an average speed higher than the level speed of the vehicle I have repeatedly done this over a 10-mile course. Ten per cent decrease in speed, then, would seem to be a fair figure.

The battery capacity has been taken as a variable, depending upon the discharge rate, there being a large variation in capacity from a discharge rate of 60 per cent normal to that at 150 per cent normal.

The range of energy has been taken from 30 to 70, as representing a very low commercial figure and a prohibitively high figure. Were the calculations carried below 30 the mileage would mount up very rapidly.

The results shown by the curves speak for themselves, and need little clinching. A decrease in energy from 60 to 30 increases the

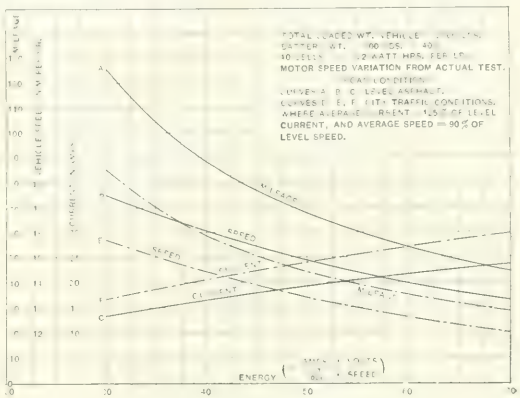


FIG. 1.—SPEED, CURRENT AND MILEAGE CURVES.

mileage not 2 times, but from 54 to 126, or 2.33 times, the speed going up from 14 miles per hour to 15.7 miles per hour. These facts clearly show that "circumstances alter cases," at least for automobiles, and that the best is none too good.

Fig. 2 has been based on the same assumptions, except that for each variation of energy the gearing or motor speed has been assumed to be altered to maintain a uniform speed of 14 miles per hour. The main difference in resulting mileage is that the mileage mounts up faster on low rates of energy, the mileage increase from 60 to 30 being from 53 to 133, or 2.51 times. This shows what the builder can do who strives for the lowest possible energy consumption and then designs his motor and gearing to match.

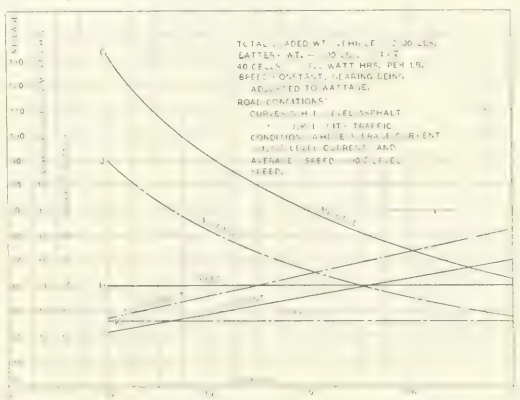


FIG. 2.—SPEED, CURRENT AND MILEAGE CURVES.

The second set of curves of Fig. 2 correspond to the second set of Fig. 1; that is, mileage, speed and current under service conditions.

As previously stated, no attempt herein has been made to analyse the individual effect of different mechanical elements of an automobile, but the above graphical representation is intended only to emphasize what can be done for the electric automobile by the manufacturer of the vehicle, the motor builder, the tire manufacturer, the road commissioner and, lastly, the owner and operator of the vehicle. In just so far as it jars these various individuals and gets a line on their sins of omission and commission, in just so far it has been successful.

The Debt of Electrical Engineering to C. E. L. Brown—IX.

By B. A. Behrend.

INDUCTION MOTORS.

EARLY in 1890 Mr. Brown designed his first induction motors. After a good deal of experimenting with smooth and slotted cores and various kinds of rotors he had made up his mind that his tunnel winding was the most advantageous for stator and rotor. So he developed the modern motor. A drawing of one of his first motors is shown in Figs. 53 and 54. It was a 20-hp, four-pole, three-phase motor for 80 volts and 40 cycles, which was exhibited at the Frankfort Exposition in 1891. Fig. 55 shows the three-phase Y-connected stator winding, while Fig. 56 is a perspective view of the squirrel-cage rotor. We wish to call our readers' attention to the fact—perhaps surprising—that we are talking of a motor completed just ten years ago, and not of one of yesterday. More data of this motor may not be uninteresting. The bore of the stator was 380 mm., the length of the core was 200 mm. The diameter of the rotor was 378 mm., this leaving a clearance of 1 mm. There were in the stator winding 30 conductors per phase in series. Thus the flux per pole was 1.81×10^6 gauses. The experimental results on this motor,

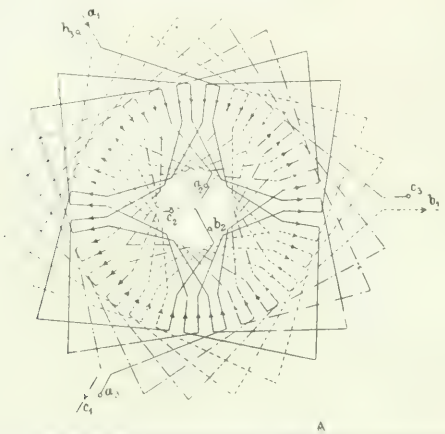


FIG. 55.—THREE-PHASE WINDING OF 20-HP INDUCTION MOTOR, 1891.

which agree well with the calculation, are given in the following tables:

NO-LOAD CURRENT.

Volts.	Amperes.	Cycles.
41	15	40
50½	22	..
71	34	..
80.5	40	..
101	57	..

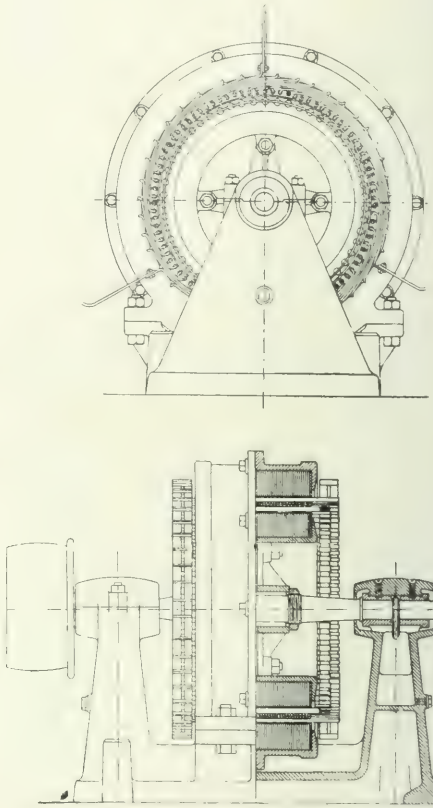
LOAD TESTS.

Pressure at motor terminals.	Current of induction motor.	Output of induction motor.	Apparent efficiency of induction motor.
Volts	*Amperes.*	*Watts.*	
50	200	12,000	.695
60	160	12,600	.76
70	135	12,900	.79
80	125	14,000	.81
90	110	13,350	.775
100	105	13,500	.74

These figures require no comment. The motor had about 90 per cent efficiency and 90 per cent power factor, and a glance at the design will bear this out to the eyes of an expert.

The heating of the motor was very small, the rise of the stator iron after three hours' run having been only 21 degs. C.; the rise of the stator winding was only 16 degs. C.; the rotor temperature was even lower, the core rising 60 degs. C., and the copper 11 degs C.

Fig. 57 shows the application of Mr. Brown's double layer winding to induction motors. The diagram of the connections is also given, showing the entirely symmetrical arrangement of the winding in delta or in star. The figure is taken from an English patent specification of November, 1892. All modern induction motors in this country are now built according to the Fig. 57.



FIGS. 53 AND 54.—20-HP THREE PHASE INDUCTION MOTOR, 1891.

To adduce more proofs of the excellence and rational design of earlier motors seems unnecessary, we will, therefore, give some illustrations of particularly fine modern designs of Mr. Brown.

Fig. 58 shows a 90-hp, six-pole, three-phase motor for 345 volts and 50 cycles. The performance of this motor is given in Fig. 59. At 130 hp both efficiency and power factor reach their maximum

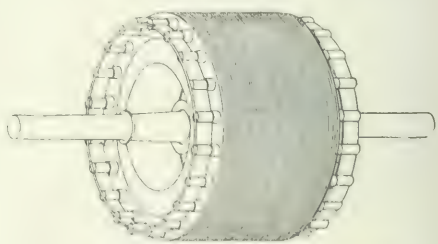


FIG. 56.—ROTOR OF 20-HP INDUCTION MOTOR, 1891.

of 93.7 per cent. The magnetizing current of this motor is 43 amperes, the short-circuit current is 1330 amperes. From these data follows a maximum power factor of 93.8 per cent. The high power factor of this motor is obtained with a clearance of 1.25 mm., and there is no humbug about it, as there is only too often about measurements of

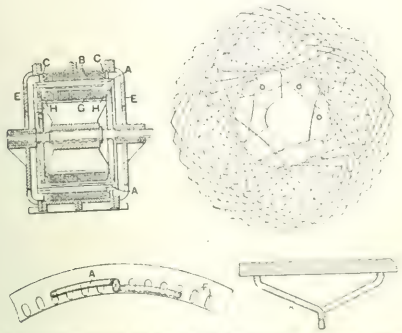


FIG. 57.—WINDINGS OF BROWN'S INDUCTION MOTORS, 1892.

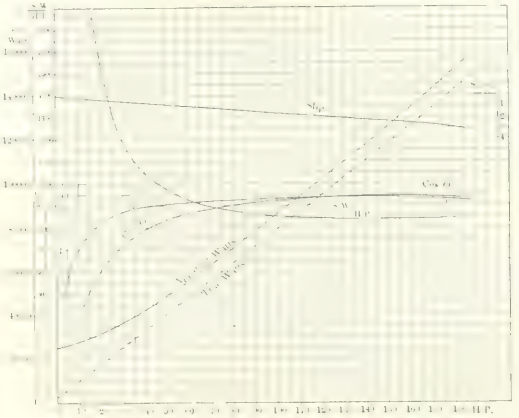


FIG. 59.—PERFORMANCE CURVES OF 90-HP INDUCTION MOTOR.



FIG. 58.—90-HP INDUCTION MOTOR.

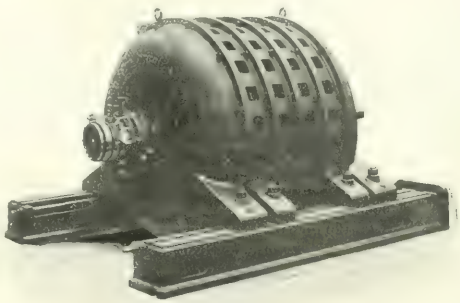
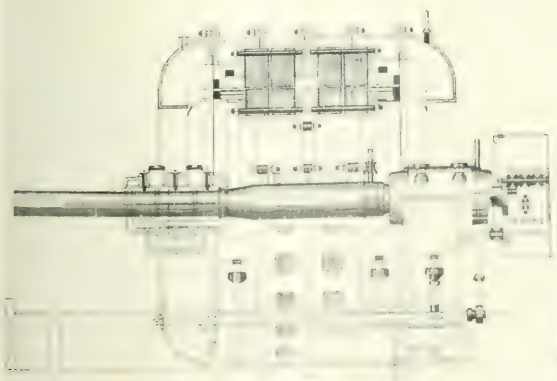


FIG. 60.—1000-HP INDUCTION MOTOR.



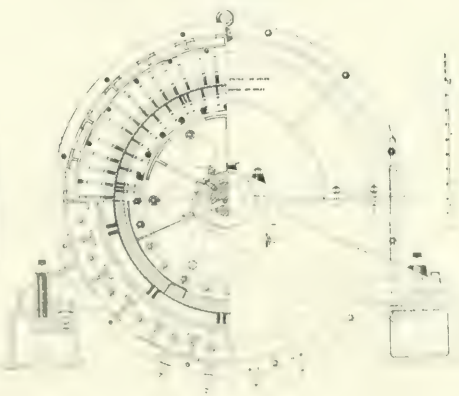


FIG. 61.—1000-HP INDUCTION MOTOR.

INDUCTION MOTORS DESIGNED BY C. E. L. BROWN.

the power factor which are not checked by the magnetizing and short-circuit currents.

1000-HP INDUCTION MOTOR.

In 1897 Mr. Brown designed a 1000-hp, two-phase induction motor for direct connection to a centrifugal pump in Geneva. The motor has ten poles, the frequency being 46 cycles. The diameter of the rotor is 155 cm., the peripheral speed is thus almost 9000 ft. per minute. The clearance is very large, viz., 3 mm. The results obtained on this motor are shown in the following table:

Horse-power output.	Apparent efficiency.
200	45
400	66
600	75
800	79
1000	81
1200	81

The weight of the complete motor is 60,000 lbs. Figs. 60 and 61 give a view and a diagrammatic drawing of the motor.

An Analysis of the Sixth Detroit Municipal Plant Report.

WE have received recently the sixth annual report of the Detroit Public Lighting Commission, and find that is worthy of more than passing casual attention. These reports have been previously studied in our columns, and this sixth annual one has a special interest to the electrical community. These reports have always been interesting and valuable in that the detailed analysis of expense which they embody has permitted any one interested to make all the comparisons and to draw all the conclusions that he could wish. The conclusions which the commissioners have furnished with their annual accountings have often been challenged; but there has been no doubt about the appreciation of the cold figures which formed the bulk of the publications.

For the usual reasons this report is interesting, but its exceptional interest lies in its showing the first results of the changed policy and the changed control of the celebrated Detroit City Lighting plant. In the beginning the Detroit authorities were wise in that they placed their new public lighting system in the hands of a non-partisan commission, who, in turn, selected trained and trustworthy engineers as their executive officers. For over seven years Detroit, in this respect, set a good example to all other cities. Two years ago there came the inevitable reversion to political methods. The reversion was for a time denied, but its evidences would seem to be indisputable and finally even the commissioners admitted it, one of them going on record with the statement that it was "all politics in the lighting plant," and that his belief in the desirability of municipal ownership was consequently badly shattered.

It was "Reform" which brought about the establishment of the Detroit public lighting plant. Much of the blame must lie on the local electric light men who failed to understand the public temper of their own city. It is now "Reform" that has put the Public Lighting Plant of Detroit into politics. This report covers the first fiscal year of the second era. That the reform is comprehensive is evident by the fact that the survivors of the former commission resigned almost in a body and so made it possible for the present Mayor to name every one of the six members of the board. In the usual course of events one member is nominated on the 4th of April of each year to serve for six years, and a board may contain appointees of several mayors. That the change is effective in the operating force is shown by the fact that not one of the old heads of departments remains in place. New men, appointees of the new board, took charge in April, 1900, and had doubtless familiarized themselves with the system before the beginning of the fiscal year on July 1. Not one of the new men had technical training. The general superintendent, according to his own published statement, had no experience in electric lighting nor in any similar industry before he took charge. Some of his assistants had experience in minor positions, but none of them had held responsibilities comparable to those their new duties entailed. This selection of employes was not accidental. The new president was on record as believing that the plant as previously operated was over-officered; that half the "bosses" could be dispensed with, the men be treated more generously, and still 20 per cent of the pay-roll be saved. Another of the new commissioners announced, when the competence of the new staff was questioned in the press, that "making electricity is a good deal like making flour—it is all done by machinery."

From a management which proposes to save 20 per cent of the pay-roll and which is satisfied that the operation of a public lighting service is merely a matter of machinery, much is to be expected. The new president's published criticisms of his predecessors touched also on the subject of supplies. He had said that "Our purchases have not been made in a business-like way. We do not avail ourselves of the benefit of competition." With all these openings for the reduction of costs already remarkably low, with a new theory and a new commission and a new force, great expectation would naturally be aroused.

The sixth annual report begins with apologies for a slight increase in the cost of operation for the year, namely, 86 cents per arc light, gross cost, and $2.29 per arc light, cash cost. It attributes this increase to the high prices for labor and supplies, particularly coal, during the year and adds: "It must also be borne in mind that as the age of the plant increases the necessary cost of repairs and replacing of parts, which is added to the cost of operation, must also increase."

The gross cost includes the cash cost, that is to say, the operating and repair expense amounting to $42.59, together with interest at 4 per cent on the investment, depreciation at 3 per cent, and an allowance for lost taxes, which represents taxes which the city would collect from a private plant performing similar street lighting service. The cash cost of $42.59 is compared with the reported cash cost of $40.30 for the preceding year. The gross cost of $67.31 is compared with the preceding year's gross cost of $66.45.

FIXED CHARGES.

The lower amount of fixed charges per arc light is due chiefly to the operation of an average of 2035 lights during the year, as against 1963 during the preceding year. This increase of service has been obtained by running reserve plant, and, therefore, does not carry with it an increase of the investment. The reduction of fixed charges is due also to some extent to the reduction in the general tax rate of the city during the year reported on, which, of course, reduces the calculated amount of taxes lost. It is notable, however, that while the report announces the installation during the year of a 600-kw direct-connected engine and alternator and a 175-kw alternator without an engine; and also states that the total investment has been increased from $828,088 to $851,654.83, the figure quoted as the probable assessed value remains unchanged from last year at $351,885. The effect on the total cost of a proportional increase in the valuation would not be great, but the unchanged assessment of the property and the use of the term "probable assessed value" justifies the idea that the estimate of amount of lost taxes is not as reliable as it should be. The valuation should be made by the regular assessors by their regular rules, and "probability" should be eliminated.

DEPRECIATION CHARGE.

As in all former reports the commission estimates depreciation at 3 per cent. That this figure is ridiculously low is so well known to our readers that we will not discuss it again.

The commissioners have now adopted the policy of substitution of enclosed-alternating series arcs for their open arcs. The arc dynamos and lamps displaced by this improvement stand on the books to-day at their cost price of 1894 less 18 per cent—that is to say, less six yearly depreciation allowances of 3 per cent. The other 82 per cent of their original price will have to be taken care of in an early balance sheet. This and other changes of the character which have made depreciation such a large item in electric light expenses will soon make the depreciation of the Detroit plant a concrete instead of an abstract proposition.

The construction account is not spread on the record in such detail as is the operating expense. On page 23, however, there are tabulated additional investments amounting to $23,566.83. There is no division between materials and labor. The figures are mystifying when read in connection with the statement already quoted that a new engine and two alternators have been added to the equipment; because the additions to the incandescent plant and steam plant accounts amount to but $930.73, which amount would not pay for the foundations alone of such new apparatus. The heavy item is an addition of $17,073.68 to the investment in cables. This is for cables used to

replace overhead pole lines and wires taken down. Against lines and poles there appears an increase of investment of $3,297.80. The depreciation account on the same page contains only the usual 3 per cent theoretical charge. It does not show anything that would represent the wiping out of the investment in lines and poles, and the entire cost of the cables appears to be considered a betterment. Electric lighting companies, which have been compelled to put their wires underground, and to remove expensive pole lines, will hardly admit that the operation can be carried through without something being charged off from the lines and poles account.

The construction account to June 30, 1901, stands at $851,654.83. The investment is stated to be $721,861.56. The difference is shown on page 23 to be the 3 per cent depreciation charged off annually for six years. The bonded debt is $650,000, which debt is secured by a lien on the municipality as a whole. The present value of the property is certainly not in excess of the bond issue, although it is doubtless greater than the probable assessed value used in figuring lost taxes. The city should take inventory of its property before another annual report is issued. These figures differ too much.

OPERATING EXPENSE.

To return to the operating expense. The admitted increase of $2.29 per arc over the preceding year, of which coal expense alone was $1.69, means more than is immediately apparent. The increase in the number of lights, which reduced the fixed charge per light, ought to have reduced the operating charges by a definite proportion of general expenses. Moreover, the new commission had economized in the last quarter of the previous year by cutting down its executive expenses to the extent of $1.92 per light. This was an installment of the proposed 20 per cent reduction of the pay-roll, and was made up, according to newspaper reports, as follows: The plant formerly had a chief engineer at a salary of $1,500. His duties were assigned to the new city electrician. The offices of secretary and assistant secretary were consolidated, and the new secretary employed at $1,200, as against the $2,700 formerly paid to two men. The positions of outside superintendent and chief lineman, drawing $1,200 and $900, were given to one man at $1,200. Total economy, $3,900 per annum, or $1.92 per light. Some of this saving ought to be credited to the incandescent light department, and some would affect the three last months of the year compared with, but the remainder ought to have extinguished the $1.69 additional for coal.

Operating supples other than coal cost less than during the preceding year. The largest supply item after coal in such a plant is carbons for the arc lamps. In spite of the increased output the expense for carbons is $184.08 less than during the preceding year. This is accounted for by a lower contract price. Another large item, oil, also shows a decrease of $152.37, which is accounted for in the same way. These reductions of price were not due to any new methods of purchase, but were general throughout the country.

REPAIR ACCOUNT.

It is in the maintenance account that the increased expense appears. Here we find an increase of some $1,200 in wages and $2,500 in supplies. The wages items and the supply items of the maintenance account disagree in a peculiar manner. For instance, there is but a small increase in the wages spent on buildings, and a large increase in supplies. On repairs to steam plants the wages expense is reduced $500, and on electric plant it is practically the same as last year, but the supplies purchased on these two accounts are much in excess. It is understood that this discrepancy is due to charging up bills of outside repair shops as "supplies," though naturally there must be labor items in these bills. The wages account only includes the wages paid directly by the commission.

On lines and cables there is an increase in labor account of about $950, and on arc lamps an increase of $730, with comparatively small expenditures for supplies. This is natural in these departments.

The total figures for maintenance do not bear out the claim that there has been extraordinary expenditure on repairs. The reports show that while in this year the total repair expense is $18,143.74, it was two years earlier $17,413.59, and three years earlier $16,305.61. In these earlier years the output was considerably less and the expense should be proportionately smaller. The only year in which there is a relatively lower expenditure is the year ending June 30, 1900, in which the maintenance account was kept down to $14,461.12. It may be inferred that the amount expended for repairs in the past year was not far from the average expenditure, and our observations on the Detroit situation indicate that this average expenditure is too little. For instance, the arc lamps and the fixtures on which they are hung—two items the care of which should make up a considerable portion of the proper expenditure of a city lighting plant—are generally, we are informed, in bad condition. The belief of the commissioners that the Detroit repair account is likely to increase seems to be founded on fact.

It is not certain that even this inadequate expenditure is fully shown. It is an old failing of municipal boards to charge to construction account, when such an account is open, expenses that belong in maintenance. An examination of the list of employes in the maintenance department (page 36) leads to the conclusion that it is not excessively long, particularly when it is noted that the working day is only eight hours. The annual compensation of these 26 employes foots up $15,732.50; but the total expenditure for the year charged to maintenance account is but $11,288.67. Doubtless the men do not make full time. On the other hand, there must be rush repairs which make overtime. Allowing for these uncertainties there remains a difference of $3,500, or thereabouts, to be explained. Men who ought to know say that this difference covers time of these employes charged to construction, the excuse being that they were actually employed more or less on construction work. This excuse should not stand. If the plant were debarred from making any extensions these employes would necessarily remain on the pay-roll and their pay would be charged to operating expense. Such a charge would add about $1.75 per lamp to the maintenance account of the plant.

It appears, then, that the slight increase of the report is the sign of an increase actually quite large. The growing repair expenses of the plant have eaten up the savings made in executive expenses, in carbons, and in oil, and have even required some part of funds meant for construction.

WHAT CONSTITUTES A 2000-CP ARC LIGHT PER ANNUM.

So far all our statements of expense have been on the basis of the commission's report, which is in terms of 2000-cp arc lights operated for one year. It is now in order to inquire what the commission supplies to the city of Detroit as a 2000-cp arc light. Such a light is generally understood to be one absorbing at the lamp terminals about 450 watts and utilizing about 435 watts in the arc. The commission's report—page 9—states that the total output of the plant for the year for arc lighting is 3,475,389 kw-hours. On the same page the average number of 2000-cp arc lights is stated to have been 2035. On page 24 the annual hours of burning are set forth as 3729 hours 30 minutes. Multiplying the two latter the figures give a result of 7,589,532 arc lamp-hours. Using this as a divisor of the output for arc lighting, we find that the average power at the switchboard for each arc lamp is 458 watts.

This will not do. The transmission from the switchboard to the lamps requires considerable power. The system being a series system throughout, it is possible to estimate the power required from the mileage of wire in use. A careful estimate shows that this power lost in transmission is about 9 per cent of the total. This reduces the 458 watts at the switchboard to 417 watts at each lamp.

Four hundred and seventeen watts per arc means inferior lighting. The lighting of Detroit several years ago in the early days of the plant was noticeably good, the current and the carbons being both what they should be. Observations on two occasions during the year just past, lead to the conclusion that either the current or the carbons, or both, are now inferior. The consumption of carbons in a night's run is less than it should be. The arcs in different lamps differ materially from one another, and, as a rule, are less brilliant than they should be, and we are satisfied that the power does not much exceed the calculated 417 watts. If so, it would obviously be unfair to compare light for light, the street lighting of Detroit today with the street lighting of cities where contractors are compelled, under watchful scrutiny, to give full measure of service.

The reckoning of 2035 lamps includes some 55 lamps operated in the beautiful Belle Isle Park. It is proper that lights on the paths and avenues of this island should be considered as part of the street lighting system, but inasmuch as they are only operated until midnight—that is to say, half the time of the regular street lighting—it is improper that they should be reckoned at their full value in estimating the number of lamps operated during the year. At least half of this number—say, 27 out of the 55—should be cut off from the figure 2035 used as a divisor of the annual operating expense, reducing that figure to 2008 and proportionately increasing the expense per lamp operated.

It appears also from an examination of the statement of arc lamps

on page 31, that 26 lamps in buildings and not on the streets, are included in the calculation. This includes evidently seven lamps in the Public Lighting Commission's own building and yard which cannot be considered as forming any part of the street lighting. The Public Lighting Commission in all its reports has included as part of its output the current used in lighting its own station and offices. This is clearly wrong. The lighting of these buildings is an operating expense. To include it as part of the output in estimates of average cost per arc light is just as absurd as if a contractor should bill to a city the arc lamps he used in his own power house. A further deduction of 7, bringing the average number of arc lamps down to 2001 is, therefore, necessary.

This same item of light in buildings includes apparently about a dozen or 16 alternating arc lamps supplied from the incandescent system. These are used in lighting the Ferry Dock and other places at Belle Isle. They burn until 11.30 or midnight. If these lamps are to be counted as street lights they should only be considered as half-time lights. But we are informed that the current for these lights is included in the incandescent lighting output of the plant, and the commission deducts from its total expense before figuring the cost per street light, an amount proportionate to the incandescent light output. If we are rightly informed about this, there should be a deduction of these 12 lamps also from the divisor of 2035. This double credit to the plant is doubtless a mistake and will be corrected in future reports; but the assumption of credit for the lighting of the Public Lighting buildings is not accidental, and the reduction necessary on account of half-time lights on Belle Isle is indisputable.

In conclusion, it appears that the Public Lighting Commission of the city of Detroit furnishes not more than 2001 street lights on the average during the last fiscal year, and that the cost of these was greater by several important charges than shown by the report. The commission, on page 9, reports the total cost of arc lighting for the year as $136,977.22. As we have shown, there should be added to this $3,500 erroneously charged to construction account, and really representing indispensable repairs. To give the commission the benefit of the doubt and to get the result in round numbers, we will say that the cost of arc lighting for the year was $140,070, or $70 per arc light per annum. And this result is only obtained by estimating depreciation at 3 per cent in a plant which is seven years old, and which has definitely entered on the policy of changing old-style electric equipment for new and substituting underground cables for overhead lines.

Evidently the last state of the Detroit Public Lighting plant is worse than the first. The first year for which we have figures is that ending June 30, 1897. This was also the first year wherein the plant carried its regular load throughout the year. The expenditures for maintenance were reported to be $12.58 per arc lamp. In the succeeding years they fell to $8.48, $8.37, $6.47, and now they have risen again to $7.80. Possibly if there had been a persistent expenditure at the original rate the condition of the property might have been better to-day. It is certain that the cash cost of the first year, namely, $64.19, is much nearer the necessary expense of such a plant than any return made afterwards. There were plenty of disputants who protested that the $89.42 which the commission of 1897 reported as the total cost per arc, was too low, but that figure would be more readily believed to-day than the reported $67.31. ELECTRICAL WORLD AND ENGINEER cannot even allow that the revised figure of $70 represents the present cost to the Detroit taxpayers. It has already contested this point more than once.

Official Recommendation of Electricity for Central Tunnel.

The New York State Railroad Commission in a report on the fatal collision in the New York Central tunnel, signed by Messrs. Ashley W. Cole, F. M. Baker and G. W. Damm, finds the New York Central Railroad wholly responsible for the disaster, and states that electricity is the most desirable motive power for use on that part of the system. The report discusses the accident in detail, points out various improvements possible in signaling, and in the present system generally, and says with regard to electric traction:

"The tunnel itself is not especially difficult for the operation of the trains, except as it is obstructed by steam and gases from combustion, and by occasional fogs, taken in connection with the immense volume of traffic which passes through it to the immediately adjacent terminal and train yard. The railroad company has year by year during the past 10 years felt the absolute necessity of escaping from its cramped environment at that terminal; yet, when it but recently made improvements in the Grand Central station in the line of comfort and elegance, it unwisely extended the station northerly some 70 ft., thus reducing by that amount the length of the tracks in the train yard proper. This was, in the opinion of this board, a step in the wrong direction.

"The size and available shape of the yard is such that nearly all traffic going into or emerging from the tunnel, over its four tracks, must go over but two tracks for several hundred feet, in the yard between Fifty-fifth Street and Forty-eighth Street, and these two main line tracks are crossed more or less frequently by practically every outgoing regular train or shop train or engine. This cramped condition as to yard room is the main source of the present troubles in operating the tunnel itself, because it necessitates the passing of nearly all of the regular trains back and forth, empty, between the station yards and the shops and yards at Mott Haven, for cleaning and storage. The testimony is conclusive that this 'shuttling' of empty trains and light engines through the tunnel in both directions occasions not less than 40 per cent of the present daily movements in the tunnel, and creates likewise 40 per cent of the obstruction to view arising from steam and gases. The 323 regularly scheduled trains could be managed with comparative cases if the yard room was ample.

"The railroad company has felt this need for at least three years past, and it has been the subject of much public discussion, more particularly in connection with the intolerable atmospheric conditions which affect passengers in passing through the tunnel in the summer. The rejoinder of the officials to this criticism has been that the required real estate for the enlargement of the yards could not be obtained, and that as to electricity there was then no feasible system by which the volume of traffic could be handled. Now, however, partly owing to its awkward sense of its own business necessities and partly to the recent rapid advances in electrical engineering, the company has been forced into bringing forward a plan for improvements which will embrace an increase of the yard room and the separation of the suburban traffic from the through traffic by carrying suburban trains underground from the tunnel by a loop system to an independent station, and operating the local trains by the multiple-unit electric plan.

"This appears to this board to be the solution of the problem of to-day, but unfortunately it cannot be immediately carried out, nor can it be done in much less than two years. The newly acquired surface area, added to the present yard through recent purchases, will give some relief by affording more room for car storage, and the board urges emphatically upon the company the pressing necessity, as well as duty of the corporation, to put this relief into effect without delay. The board believes that this modicum of betterment should be accomplished within a few months."

Kinsman Block System for Control of Railway Trains.

The recent New York Central tunnel disaster has directed attention forcibly toward train control, the tunnel accident having demonstrated the vital necessity of a reliable system. Such a system is embodied in one that has been devised and used by Mr. F. E. Kinsman, whose name has been favorably identified with electrical engineering from the pioneer period.

One of the advantages of the Kinsman system is that it can be gradually applied to both track and engines, first at the most dangerous points and on the highest speed engines, then its application extended as the exigencies of a situation demand. The system is claimed to be far more preferable than "derailing switches," and fully as effective, while it has the advantage of leaving the engine and train on the track after the train stops.

Referring to the illustrations on pages 307 and 308, *A* represents the throttle valve lever in use on American locomotives, *B* the balanced throttle valve in the steam dome *D*, and *E* the standard engineer's valve of the Westinghouse type, for operating the train air brakes.

The steam throttle valve and the engineer's brake valve are too well known to need description.

The Kinsman method of automatic control of trains includes the use of a cylinder *C*, with piston *H*, attached to the throttle stem *B'* at *g*. The cab end of the piston *H* contains four clutches of approximately 200 lbs. each, with the corners of the lugs, *h h'*, next to the throttle valve slightly beveled. In their normal position these lugs clutch the throttle stem *A'* at *V*, with an aggregate pressure of 800

lbs. Any one of these lugs clutches the stem A' with sufficient force to open or close the throttle valve B, when the lever A is manually operated, the remaining three constituting a "margin of safety."

The square shoulder at Y makes an accidental opening of the throttle valve impossible, whatever may be the position of the level A; consequently any movement of the lever must be accompanied by a similar movement of the piston H. The air-port K contains a tortuous passage through which any air which finds its way into the cylinder C may escape when it is uncovered by the forward movement of the piston H.

The valves V connects with the train pipe F', and is controlled by the magnet M. Thus when the piston H is near the cab end of the cylinder C the operation of the valve V' allows the pressure in the train pipe to enter the cylinder C, and impinge against the face of the piston H, which offers sufficient surface to cause the air pressure to overcome the resistance of the lugs h h', and cause them to travel up the incline at Y; this movement carries the piston past the port K and allows the train pipe pressure to escape the same as though it were allowed to pass through the service port of the engineer's valve V; the forward movement of the piston H, attached as it is to the throttle stem B' at g, closes the throttle valve B the same as though it had been done by the engineer with the throttle lever. Furthermore, the forward movement of the piston, as a consequence of the admission of air from the train pipe F', causes a service application of the brakes in the proper order, namely, after the motive power has been cut off, thus obviating the skidding of the wheels on down grades or slippery track, and tending to bring the train to a full and comfortable stop. If the engineer does not wish to come to a full stop, he can almost instantly reopen the throttle valve B by throwing forward the lever A to a point which allows the clutches h, h', to re-engage the throttle stem at Y. The act of throwing forward the lever causes the pall O to depress the small valve arm J and the plunger n in its passage over the high point on the arm J. This admits air pressure from the main air reservoir through the valve V' to the small cylinder C', which forces the plunger X against the rack lever T, which in turn re-sets the lever L in its normal position against the armature of the magnet M.

This shuts off the train-pipe pressure from the cylinder C, thereby releasing the brakes and leaving the engineer free to operate his train as he sees fit. This can be done so quickly that very little of the train's momentum need be lost. There is, however, no chance of the engineer mistaking the character of the signal thus given. If he should be so incapacitated as not to be able to act upon the information thus conveyed to his mind, the Kinsman block system would bring the train to a full stop without any act on his part or any damage to the train or passengers.

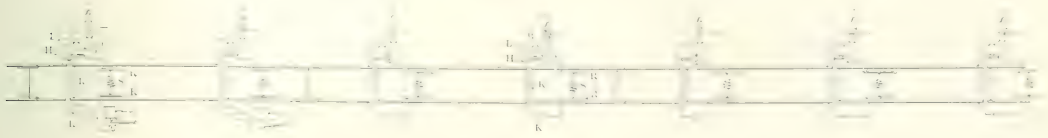


FIG. 1.—ARRANGEMENT OF TRACK CIRCUITS.

The track equipment for this system consists of guard or contact rails located along the whole line or in the vicinity of the present visual signals, if such are in use; otherwise, the amount of traffic and the general character of the road at the various points to be protected should govern their location. When the system is used in connection with automatic or manually operated visual signals, the wires are connected to or looped into the circuit of such signals without interfering with their normal operation, as shown in the accompanying illustration. In Figs. 1 and 2 is illustrated a system of supplementary battery equipment, which is not, however, essential to the system.

When the track circuit B is disrupted or short circuited for any reason, the armature H_2 hauls away from the magnet L_2, making contact through h' to the guard rail R on one side and the battery K and guard rail R' on the other. A small portion of the current passes through the resistance S, and the disrupting of the electric circuit at h causes the semaphore arm S_3 to indicate danger. The current which has passed through the magnet Y, before reaching the guard-rail R and R'—in small quantity, owing to the combined resistance of magnet Y and resistance S—is then present in an increased quantitiy in the guard rails R and R', and communicates with the magnet M on the locomotive upon the passage of the engine. On the engine are mounted contact wheels 3 and 3'; collectors 6 and 6', are in constant contact with these wheels, which are insulated from the axle I by a composite ring 9, composed of some substantial insulating material compressed between two steel rings, the outer one being flanged to engage the bore of the wheel 3; and from the traffic wheel 2 and the key seated clutch 8 by composite insulating flanges or washers 10, 10'.

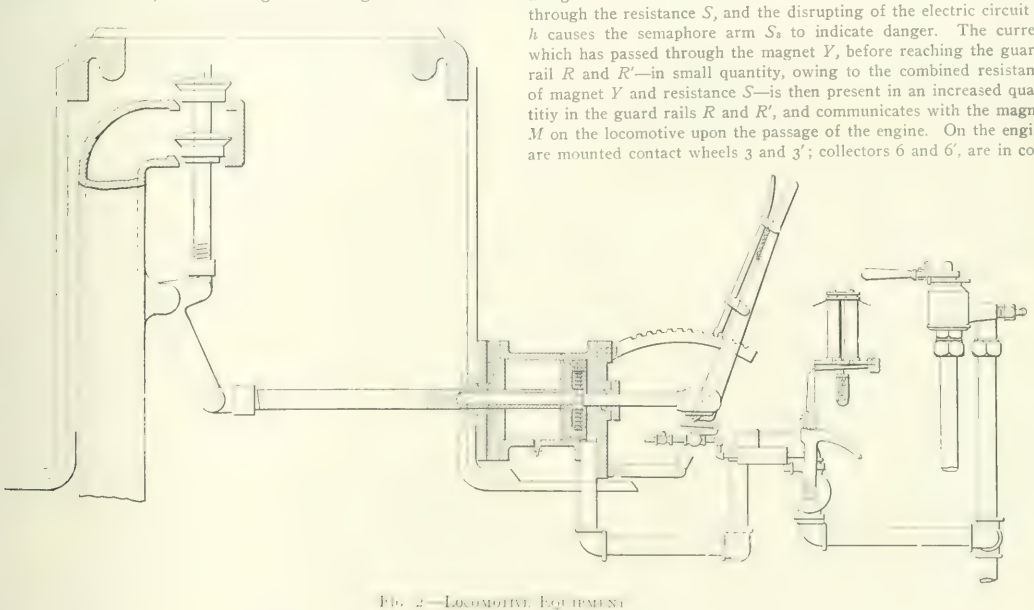


FIG. 2.—LOCOMOTIVE EQUIPMENT.

The guard or contact rails R and R', and the traffic rails r, r', are mounted on properly constructed tie plates II and II', which raise R and R' slightly above the level of the traffic rails so that the contact wheels 3 and 3' avoid all cross-overs and frogs. By the use of the

tie plates the traffic and contact rails will always maintain the same relative position and height. The ends of the guard rails are slightly bent downward, which, with the rolling motion of the contact wheels, prevents any injurious shock, such as would follow the use of any trigger or tripping device.

It will be seen that there is nothing movable on the roadbed to be clogged, broken or displaced, and owing to the formation of the contact wheels, the guard rail cannot become ineffective by reason of snow, ice or other like obstruction, which is a great advantage from a maintainance standpoint.

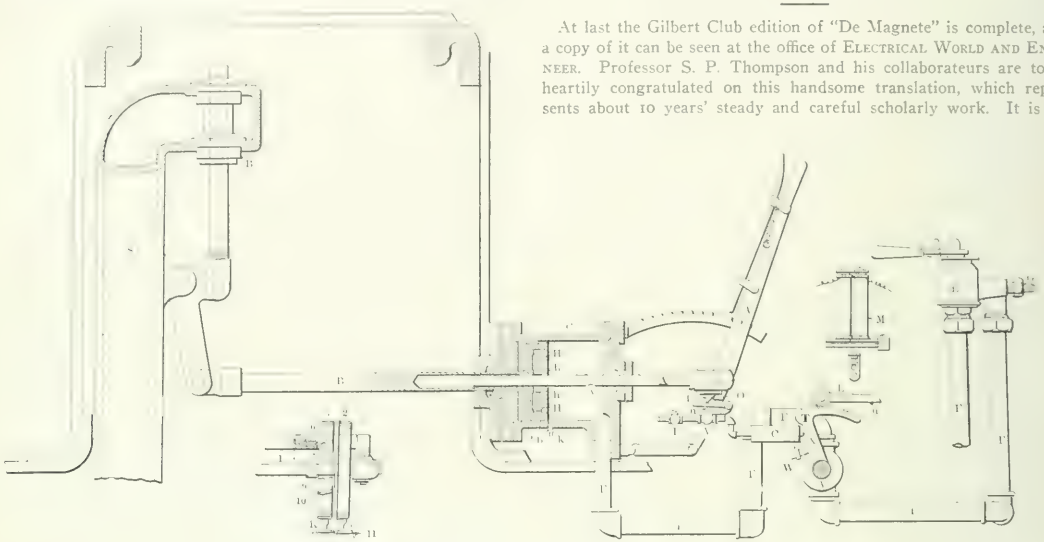


FIG. 3.—LOCOMOTIVE EQUIPMENT.

The guard rails *R* and *R'* should be of old steel, and about 60 ft. in length, the whole spiked to the ties in the same manner as the main or traffic rails. Thus placed, there is nothing to in any way interfere with the operation of any engine or train, as only such trains as are equipped with the system are in any way affected by the track installation.

Large Financing for New York Trolleys.

As noted in our columns last week, large plans are afoot for financing New York and Philadelphia electric railway systems, and it is understood that Mr. J. P. Morgan will be interested in the project. The Manhattan Securities Company is intended primarily and for the present to finance the unfunded debt and the new capital requirements of the Metropolitan. Later, it is expected to take charge of the operations of the subway companies and probably other companies. For immediate purposes the new company is to raise $30,000,000, of which about $10,000,000 are to be provided by people identified with the new company, while $20,000,000 will come from Metropolitan stockholders, who are to be allowed to take 40 shares in the new company for each 100 shares of Metropolitan which they now own, or in the event that stockholders should not take their allotment, the same amount will be furnished by the underwriting syndicate. The $30,000,000 thus obtained is to be used in taking care of the unfunded debt of Metropolitan and in converting about 80 miles of horse car lines into mechanical traction. The new company will guarantee 7 per cent on Metropolitan stock. It is expected to receive from Metropolitan some of the assets of the company, which will be used as the basis of additional financing.

Another report from Philadelphia says: Mr. Morgan has had a conference with promoters of the local traction merger, and was shown figures bearing on Union Traction. He thought the proposition so good that he promised to finance it. The securities company, to take over Metropolitan, in New York, was also gone over thoroughly, and Mr. Morgan agreed to give his aid to that project. The new Philadelphia Company is to have $20,000,000 and $15,000,000 bonds, and the New York Company will be capitalized at $30,000,000 stock and $15,000,000 bonds. The New York stock will receive 7 per cent dividends, and the bonds will bear 4 per cent interest.

The Gilbert Club "De Magnete."

At last the Gilbert Club edition of "De Magnete" is complete, and a copy of it can be seen at the office of ELECTRICAL WORLD AND ENGINEER. Professor S. P. Thompson and his collaborateurs are to be heartily congratulated on this handsome translation, which represents about 10 years' steady and careful scholarly work. It is intended to be as nearly as possible an imitation of the fine folio edition of 1600, and would virtually be a fac-simile, if in Latin. The edition is limited—probably around 200 copies—and already the demand for it promises to be keen. It is a dignified volume a little thicker than the Latin folio, being on rather stouter paper, and is issued in two bindings, one in boards at the original club subscription price of $5, and one in whole vellum at $7.50. To this in America must be added freight and customs charges, making the prices perhaps $7.50 and $10. Subscribers for the vellum copies can, if they desire, secure 60 pages of notes bound in, which have been printed at Professor Thompson's expense. Whoever secures the book in either style has a great literary prize. The matter in this country was originally in the hands of Mr. C. L. Clarke, the well-known electrical bibliophile, who has asked us to assist him in disposing of the copies allotted here. About 10 were taken up originally, and we hope to secure those and a few more for America, as some of the original English and American members of the club and subscribers are dead. If any of our readers would like to have an opportunity to obtain copies that may remain free, we shall be glad to hear from them at once, and will enter their applications in the order of receipt. No copy will be delivered unless paid for in advance, nor can any copy here be guaranteed to any one except the original subscribing members. Requests must be addressed to the editors of this journal.

The Telephone on Steam Railroads.

A special dispatch from Kankakee, Ill., of Feb. 7, says: The experiment of telephoning over telegraph wires was successful on the Southwestern branch of the Illinois Central Railroad between Kankakee and Kempton, a distance of 26 miles, yesterday. The test was made by Superintendent of Telegraph Dugan, Assistant Superintendent Amett, of the Illinois Central; Thomas O'Neill, foreman of electric signals of the Chicago Terminal, and J. V. Miller, who is installing a system of automatic electric light block signals on the Chicago & Eastern Illinois Railroad. The experiments were made with a telephone instrument in the engine cab. A number of stops were made

between Kankakee and Kempton along the route, and at several stations a wire was strung from the engine to the telegraph line and telephone communication established with the train dispatcher's office in Kankakee. The tests were successful in every case, and the telephoning done over telegraph wires was without interference with the telegraphic service. It is intended to furnish all Illinois Central trains with telephonic equipment, the instruments to be placed in baggage cars of passenger trains and engines or cabooses of freights. It is not the intention to displace the telegraph by telephones in the operation of the road's trains. The telephone will be used as an auxiliary service, largely for emergency purposes.

New Telephone Patents.

Telephony is represented by two patents in the issue of Feb. 4, one relating to the ever-sought but never-caught telephone relay, the other to the more practical object of a novel method of party-line ringing. Mr. Severn D. Sprong, of Metuchen, N. J., has invented a telephone relay which contains various expensive and elaborate features, such as iron particles coated with carbon, electrode plates of gold. This relay is of that steadily increasing class which suffer from the fatal handicap of being single-track machines, and consequently of practically no commercial application. Mr. Sprong's invention has been built up with considerable care and ingenuity, however, and at least merits description for the benefit of those who may be working along the same lines. The essence of the device is the employment, for varying the resistance of the local circuit, of carbon particles having iron cores which are normally held in more or less fixed relation to each other by being placed within the influence of a permanent magnetic field; surrounding the tube carrying the iron-cored carbon granules is a coil connected to the line, which acts to vary the lines of force acting on the granules when traversed by a current. Referring to Fig. 1 the instrument is enclosed in a brass box, and on a bracket extending from the rear wall is a permanent magnet secured adjustably by a screw and lock nuts. The magnet poles have also, as shown, a horizontally adjustable part, and a swinging part. Placed between the plose is a copper cylinder open at both ends, enclosing a coil and glass tube. Within the glass tube, which is exhausted, are placed the iron-cored carbon particles which make contact with the cylindrical carbon electrodes at the ends of the tubes, and having an outer coating of gold to which are soldered platinum leads fused in the ends of the tube. The magnet may be

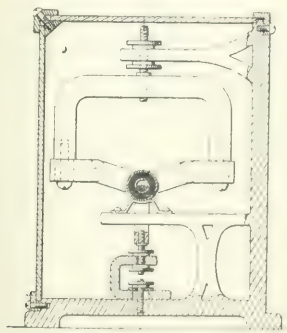


FIG. 1.—SPRONG TELEPHONE REPEATER OR RELAY.

either a permanent one or a piece of soft iron having the coil *F* interposed between its ends. It is adjustable by means of a screw fitting in the bracket.

The operation of the device is as follows: The carbon particles, having iron cores, are held lengthwise between the poles of the permanent magnet. A battery maintains a uniform flow of current through the said particles and primary of an induction coil, the secondary being connected to the receiving or outgoing line. The lines of force set up by the incoming telephone current through the line connected to the coil about the tube are at right angles to the lines of force of the controlling magnet. Therefore, the telephonic current circulating about the tube causes the particles to move from their position of rest, in movements corresponding to the undulations of the current, with a consequent variation in resistance and in current flow in the primary circuit in which the tube is included, resulting in amplified currents in the secondary circuit and line, thereby "producing," says the inventor, "loud and clear articulation over a line of any required length."

Mr. W. W. Dean, of Chicago, patents and assigns to the Western Electric Company a system of ringing for two-party lines, the principal feature of which is the placing of the call bell at the sub-station in a branch to ground controlled by a relay which is normally bridged across the metallic circuit, but is short circuited when the receiver is taken off the hook. In party-line systems heretofore designed, it has been usual to provide call bells of high resistance adapted to respond to pulsating currents of given polarity in grounded branches from the line conductors, but in modern exchanges employing automatic signals these grounded branches have interfered with the operation of the signals. To prevent this it has been attempted to include the condenser in the grounded branch with the bell, but the condenser has the effect of changing the pulsating into alternating current, impairing the ringing. The remedy is to place a relay and condenser in bridge across the line and to connect the call bell in a normally open ground branch from one leg of the line adapted to be closed by the switch contacts of the relay, which is responsive to pulsating current.

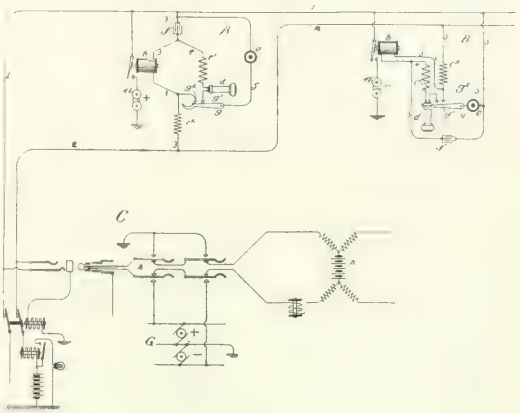


FIG. 2.—DEAN'S CALLING APPARATUS.

The present invention is an improvement on this system, the circuits and apparatus being so arranged that the relay may be successfully used without being liable to accidental operation, and in particular so that it cannot be operated by the direct current supplied to the line for talking. Referring to the diagram it will be seen that substation *A* is illustrated in a somewhat different manner from substation *B*, but the circuits are exactly the same. The signal bell *a* is connected in a grounded branch normally open at the contacts of relay *b*, which is in bridge 3 across the line, including condenser *f* and secondary C^2 of induction coil *c*. Secondary C^2 also forms part of bridge 35, containing transmitter *e*, this bridge 35 being controlled at contact g^2 of switch *g* interposed between C^2 and *e*. The switch also has contact g^1, terminating shunt-wire 4 connected to bridge 3 between condenser *f* and relay *b*. Wire 4 includes the winding C^1 and the receiver *d*, and is in shunt of relay *b*, and also, together with condenser *f* is in shunt of transmitter *e*. The wire 5 shunts the relay and the condenser.

The relay is thus normally, with the condenser, in a bridge of the line, but is out of the path of the direct current since when the hook is up it short circuits *b* by closing contacts g^1 g^2. In calling pulsating current is sent on one line, the other line being grounded by the ringing key. The relays at both stations are energized, connecting the bells to line, but only the bell of proper polarity will respond.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN ALASKA.—Our San Francisco correspondent states that a strong effort will be made to introduce wireless telegraphy in Alaska and Northwest Territory. It is reported that W. F. Thompson, of Yukon, will go to Ottawa to obtain a concession for the purpose of installing a wireless system that would open communication between a number of prominent points.

NATIONAL ELECTRICAL CONTRACTORS.—The annual meeting of the directors of the National Electrical Contractors' Association was held in St. Louis last week. It opened Monday, and was concluded Tuesday night. Monday was devoted to meeting local electrical construction and supply men, and a banquet was given Tuesday night. This association was organized in Buffalo last July, an account of the meeting being given in ELECTRICAL WORLD AND ENGINEER of July 27, 1901.

LONDON UNDERGROUND VIBRATION.—A cable dispatch from London, of Feb. 7, says: A Government committee appointed to inquire into the vibration caused in houses along the line of the tube railway has reported that the vibration is sufficient to cause serious annoyance. The chief recommendation for a remedy is the adoption of locomotives in which the bulk of the load is carried on springs. The commission also recommends that the tracks of the projected new underground electric railways be constructed with deeper rails.

ELECTRICITY IN HARTFORD, CONN.—At the annual meeting of the Board of Fire Underwriters of Hartford, Mr. Charles R. Reynolds, electrical inspector for the board, declared that "Hartford stands far in the lead of any other city in the world in the use of electricity for light and power per capita." He showed that at present in the city there are 2300 separate electrical installations, not including isolated plants, and that there is a total of 77,000 incandescent and 1934 arc lights, and 3650 hp in motors. Inspector Reynolds says that during last year only one fire could be directly traced to electricity.

PARIS TRAMWAYS.—A recent Paris dispatch says: Parisians are convinced that the Rockefeller-Westinghouse Company is negotiating for the purchase of its electric tramways. If this be true, they will surely succeed, for the traction company is hard up and needs money. The Paris tramways are built without any consideration for the needs of the public. They are laid wholly outside the city, and people have often to wait an hour for a tram. Shares of the company, once worth $60, are now quoted at $6. It is reported that the price asked of the Americans of the entire plant is $60,000,000. Paris is hopeful that the trams will soon be Americanized, and that an efficient and swift service will be provided to enable work people to live in the suburbs.

PREPARING FOR PRINCE HENRY.—When Prince Henry of Prussia reaches New York on the steamship *Kronprinz Wilhelm,* the new pier at West Thirty-fourth Street, on which he will land, will be elaborately equipped with electric lights and the interior of the pier shed will be converted into a palm garden. Gustav H. Schwab, of the North German Lloyd Line, acting under instructions from Bremen, has made a contract with electricians, carpenters and builders to carry out the plans, the expense of which will be borne by the North German Lloyd Company. The intention is to have 34 arc electric lights, 6 four-clusters, 5 five-clusters, and 15 drop lights, as well as a steam-heating plant and 15 telephones installed on the pier, which is 699 ft. long and 100 ft. wide. Its single-story shed has a length of 600 ft.

TESLA'S TALL TOWER.—The *New York Sun* reports from Wardenclyffe, L. I., that "work is being pushed on the plant here for Tesla. The power house, built of pressed brick and 100 ft. square, is completed, and the big tower is under course of construction. The tower will be 100 ft. in diameter at the base and 216 ft. high. It will be 80 ft. wide at the top. The materials used are wood and iron. Inside the tower will be a well 120 ft. deep, with a staircase leading down into it. Transversely across the bottom of the well will be a series of four tunnels, each 100 ft. long. These are being excavated now. The electrical equipment is nearly finished, and Mr. Tesla, it is stated, expects to be ready to begin experiments in wireless telegraphy in the early spring." This plant ought to be able to shout across the Atlantic.

SUBMARINE BOAT "PLUNGER."—Some 500 people witnessed the launching of the Holland submarine boat "Plunger" at the Nixon shipyards, Elizabethport, N. J., on Feb. 1. Mrs. Myron T. Herrick, of Cleveland, Ohio, broke a bottle of wine over the "Plunger's" nose and called out at the top of her voice: "I christen thee the 'Plunger,' and may you prove a terror to evildoers." The "Plunger" is a sister ship of the "Adder," "Moccasin," "Porpoise," "Shark" and "Fulton," and of the "Grampus" and "Pike" now building at the Union Iron Works, San Francisco. The boat will have a surface speed of eight knots, with a radius of action of about 500 miles. The underwater speed will be seven knots, with a radius of 40 miles. The crew will number seven men. She will be fitted with one torpedo tube and will carry three of the new long Whitehead torpedoes instead of the old 11 ft. 9-inch style carried by other vessels of this type.

YERKES IN LONDON.—A recent special cable dispatch from London says: "No portion of the Metropolitan Company's property shall be handed over to Mr. Yerkes and his associates as the price of union with the District Railway," was the burden of the directors' statement at the meeting of the Metropolitan Railway Company. The anticipated split in favor of handing over the control of the road to Mr. Yerkes did not take place. The chairman said that shareholders representing £1,500,000 of stock wanted the company to hand over £13,000,000 of capital to the Yerkes Traction Company, with a capital of only £1,000,000. "The railways must work friendly," said the chairman, "but the District asked over much and gave over little." The Metropolitan calculated that it could supply its own electricity, thus saving £100,000 a year on the Yerkes proposition. The Metropolitan owns 65 miles of line in London underground roads; the Metropolitan District 13.

MARCONI MESSAGES.—When in this country Mr. Marconi was interviewed by Mr. Mildmay, who is a nephew of Gisbert Kapp and a representative of the *Corriere della Sera* of Milan. A cable dispatch from Milan of Fef. 7, says: The *Corriere della Sera* prints an interview with Mr. Marconi, had in London, in which the inventor is quoted as saying that he was prepared to pay £100 to any one who could interrupt or read one of his wireless messages. He said he intended to commence operation by cutting the transatlantic cable rates one-half, and would afterward reduce the rates for short distance land service. Marconi said he left Italy because he could not get the necessary financial support there. He could only find in England and America the capital required for his experiments, which would cost £200,000. The Marconi Company had made a contract with Great Britain, he said, for the installation of its wireless system on naval vessels for 15 years at £10,000 a year.

WIRELESS TELEGRAPH SCHOOL.—It is stated that the Marconi interests have opened at Frinton, on the English coast, a school for instruction in wireless telegraphy. Two houses on a bluff overlooking the sea have been hired, and in the yard between them has been erected a pole 160 ft. high for signaling purposes. The object of the school is not only to teach pupils how to send and receive messages by the Marconi system, but to instruct them in making and repairing the various parts of the Marconi apparatus. First, the pupil is taught to send and receive, and then takes a course in the mechanism and the theory of the apparatus he uses. He learns to take one apart and put it together again, and how to keep it in repair. The pupil is expected to become thoroughly familiar with the system in a month's time, though some pupils remain in the school for two months. The upper floors of the two houses are used as bedrooms. There is a spacious dining room, a parlor and a library of technical books, besides a workshop and laboratory. Heretofore the Marconi Company has trained its men at the company works in Chelmsford, but the demand for competent technical assistants became so great that they decided to open a school of instruction—the first and only one of its kind in the world. A unique feature of the school is that instead of the pupils paying they are given a small premium by the company while they are learning. This feature is, however, to be discontinued so far as the paying of the premium is concerned. The school has now six pupils.

STREET CARS FOR RURAL ENGLAND.—A charter has been taken out in New Jersey for the Great Britain Railways Development Corporation, an American company, to build and operate electric roads in rural England. It is said that the project is well financed.

HUTIN AND LEBLANC PATENTS.—The Westinghouse Company has purchased the American patents issued in the name of the French inventors, Hutin and Leblanc. These patents relate principally to single-phase and polyphase generators and motors and details thereof.

TELEPHONE MONEY ORDERS.—The Cumberland and East Tennessee (Bell) Telephone companies, with reference to our recent discussion of telephone money orders, report that they have had such a system for some years, and have experienced very little loss, although they do not undertake to transfer large sums. They send us the forms used. The public makes a liberal use of the system.

CENTRAL LONDON UNDERGROUND.—At the meeting of the Central London Underground Electric Railway on Feb. 5 the chairman stated that the working expenses for the year amounted to 54 per cent of the receipts. Of this amount 4 per cent was expended in the operation of the elevators at the various stations. The company intends to raise £3,000,000 on shares and a loan of £1,000,000 for a new route from Hammersmith to the city.

STREET RAILWAY MOTOR CUT-OUT.—A patent issued Feb. 4 to E. B. W. Reichel, of Steglitz, Germany, describes a cut-out, the object of which is to disconnect an electric railway heater when a car is starting or at any time when a very large current is being taken by the motor. The cut-out is actuated by a solenoid through which a current passes proportionate to that passing through the motor. When the motor is taking a large current the motion of the core of the solenoid breaks the circuit through the car electric heaters.

ELECTRICAL OPAQUE REFLECTOR.—At the Chicago Electrical Association meeting Feb. 7, Professor Charles Whitney Carman gave a demonstration of his new electrical opaque projector. This apparatus makes use of certain principles of reflection to project upon a screen in the same manner as a stereopticon engravings and common pictures of all kinds, as well as enlarged images of real objects. The advantage over the stereopticon is that it does not require specially prepared slides, as any picture or object within the limits of size of the apparatus can be projected on the screen

DISASTROUS PATERSON FIRE.—A fire that did damage to the extend of eight or ten million dollars occurred last Sunday at Paterson, N. J. It started from an overheated coal stove in an old car barn of the Paterson Street Railway Company, and the fierce west gale spread it rapidly. No lives were lost, but the trolley system was badly crippled, and the Western Union, Postal, Bell Telephone, American District and other services were wiped out. Very fortunately the fine power plant of the Paterson & Passaic Gas & Electric Company escaped, and light was available from it without delay.

A PATRIARCHAL PROJECT.—Mr. P. H. Patriarch, of Toronto, Ont., has in contemplation a project for supplying the city of Toronto with electricity developed on the Severn River, which is some 106 miles from the city. He calculates that sufficient power for the city for the next 50 years can be obtained from this source, and expresses his willingness to take a contract for a municipal plant with a capacity of 20,000 hp, and wire the whole city for distribution, for the sum of $2,000,000. This scheme, he estimates, would cost about one-half the sum required to bring power from Niagara Falls to Toronto, while the cost of electric lighting would be reduced by one-half to the consumer, and $50,000 saved in street lighting annually.

SURFACE CONTACT COLLECTOR.—A patent issued Jan. 28 to W. B. Potter relates to a device for collecting current from surface contact railways with button type of contact. It provides a movable shoe which can be readily renewed at slight expense, and also means for raising the shoe above the surface contacts whenever it is desired to run the car on the trolley system, which may often be the case in combination systems. A system of chain and equalizer bars and levers serves to lift the contact shoe clear of all obstructions when the car is traversing other parts of the road than those equipped with contact buttons. The collector is composed of a T-rail provided with flanges for the attaching of supporting means, the rib of which is secured in the groove of a collecting shoe which is removable when worn.

LONDON TROLLEYS.—A cable dispatch from London of Feb. 8 says: The formation of the Great Britain Railways Development Corporation under the laws of New Jersey for extensive operations in building and purchasing electric lines in London and elsewhere is commented upon by the press. A Conservative member of Parliament smiled blandly and remarked that "the Americans are coming on fast, and will soon be running everything in this tight little island." Parliament itself is the greatest drag upon the electric transit schemes of the metropolis, scores of projects being now hung up awaiting its sanction, with little probability that much legislation can be secured this year. The London County Council is greatly exercised over foreign interference with metropolitan transit, but the Progressive majority receives little encouragement from Westminster, for it has comprehensive plans of its own for electric lines and subways. American energy and reserves of capital offer the best hope for an early solution of the transit problem of the central belt of London.

MULTIPLE-UNIT SYSTEM.—The long list of patents pertaining to the General Electric multiple-unit system received another addition Jan. 28 in a patent granted to W. B. Potter. The patent relates particularly to the case of trains and short lines where the cars are not reversed, but move back and forth without turning. It comprises substantially the relay system of magnetic control applied to multiple unit work, and has particularly for its object to connect together cars so equipped by means of controlling train wires. There are three train wires, and in the patent the controllers are simply represented by two single-pole multiple-contact switches. The manipulation of these switches throws current into the electromagnets which actuate the cylinder controllers. One switch, for instance, will send current through the bobbin of one of the controller electromagnets by direct circuit, and through the train wires also to another controller electromagnet. Throwing the same switch to the other side of the circuit switches the current into another controller electromagnet, and also through the train wires to the bobbin of a fourth one, thus operating both controllers simultaneously. It is evident that by installing a controller at any point on the train and connecting the same to train wires, all the controllers on the train can be so operated, and the principle is capable of great extension. As shown, the principle is applied to those trains which have motor cars at each end of the train with unequipped motors between, but it can be extended to any system of cars desired.

EDISON STORAGE BATTERY.—A patent issued Feb. 4 to T. A. Edison relates to details of his cadmium-nickel-alkaline battery. In this battery finely divided cadmium is employed as the oxidizable element, and oxide of nickel or cobalt as the depolarizer, the electrolyte being a solution of potassium hydroxide varying from 10 to 25 per cent. When in a discharged condition the metallic cadmium will be oxidized and the oxide of nickel will be reduced to a low condition of oxidization. In charging, the oxide of cadmium is reduced to the metallic state and the oxide of nickel is raised to a higher state of oxidization than the peroxide state. The plates of the battery consist of sheet iron or steel grids carefully nickel-plated so as not to be affected by the alkaline solution. As shown, the grid has three tiers of openings, there being eight openings to each tier. Into each of these openings fits a pocket containing the active material. The pocket consists of very thin sheet steel of high carbon so as to be very elastic, and is carefully nickel-plated. The walls of the pocket are perforated in such a manner as to provide internally projecting burrs. The pocket consists of two parts, in one of which the active material is inserted in the form of blocks, the other section then being placed like a cover of a box, over this section, the whole being then inserted in one of the openings of the grid, where it is crimped into place. The plates carrying the oxidizable and depolarizable materials are, of course, in alternate order and are separated by perforated corrugated hard rubber partitions. The patent gives minute details of the process of obtaining finely-divided cadmium in desirable form, and also for obtaining the hydrated oxide of nickel in desirable form.

AN UP-TO-DATE YACHT.—The new steam yacht "Noma" for Mr. W. B. Leeds will have a wireless telegraph equipment and rooms for automobiles, electric windlasses, electric heaters and anything else electrically new that happens to offer, if worth while.

TROLLEYS AND RAILROAD EARNINGS.—A cable dispatch from London of Feb. 8 says: It will be a matter of surprise to learn that the extension of tramways in the suburban districts of London is seriously affecting the receipts of the railroad companies. In one case alone, that of the London & Southwestern, the chairman of the board of directors reported at the half yearly meeting the other day this extension has resulted in a loss of nearly 1,500,000 passengers. This result is not surprising to any one who has ridden in the suburban trains.

DEAD MAN'S HANDLE.—A patent issued Jan. 28 to W. B. Potter relates to a railway controller attachment sometimes-known as "the dead man's handle." The controller spindle carries two cylinders, the lower cylinder of which accomplishes the usual combination of contacts necessary to operate the motor. The upper cylinder carries two rings provided with appropriate breaks in them, and all the current passing to the controller must enter through the top ring, passing therefrom through a cross connection on the cylinder into the lower ring and thence to the controller proper. If this upper cylinder be returned to zero all current is cut off. If the controller handle is turned and the button contained in the handle is depressed at the same time, the top cylinder will move with the bottom one and allow current to pass into the controller and operate the motors. If the hand is taken from the controller handle, however, a spring throws the latch which releases the upper cylinder and a coil spring causes it to fly around to zero position, thereby cutting off current from the controller and motors. It is thus necessary for the motorman to have his hand on the controller handle at all times when power is being applied to the motors to drive the train, and should he drop dead or become disabled, the train will stop of itself, and will not run wild. Hence the popular name "dead man's handle." In one form shown in the patent, the device of the separately moving cylinder for cutting off power is utilized for a different purpose. The latch release or cylinder instead of being actuated by a button in the handle is worked by a magnet coil which carries the full controller current. If this current reaches more than a certain predetermined figure, the upper cylinder is released and snaps back to zero position, thus cutting off all current, and the motorman must return the handle to zero in order to pick up the current again. This will prevent the motorman from accelerating the train beyond a certain predetermined rate, and the device also takes the place of a fuse or circuit breaker with the advantage of being instantly resetable by the motorman without leaving his station. It is understood that both of these devices are to be used in the new Manhattan equipment.

LETTERS TO THE EDITORS.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I would like to say a few words in answer to Mr. Woolsey McA. Johnson's communication, published in your issue of Feb. 1. Regarding the reference to Mendeleeff, anybody who cares to look up the quoted page, will find that the term "tension" is used there without the slightest ambiguity, as the whole passage deals with the tension of vapors of boiling liquids. On the other hand, I am unable to understand how "a glance" at Mr. Johnson's original equation can show that in it p means vapor pressure; Nernst's formula of the potential difference at a reversible electrode as function of the solution tension and the osmotic pressure, has exactly the same mathematical form.

With regard to the hydrogen electrode, Mr. Johnson's statement that "its potential changes but little with the concentration changes of the alkaline solution," is an assumption based upon certain purely hypothetical conceptions, but not an experimentally proven fact. While such an assumption might be good enough for "theoretical academic discussions," it is a little singular that Mr. Johnson uses it like experimental evidence, while in the next paragraph he characterizes [illegible] as "theoretical and academic." It appears to me that in this somewhat discursive controversy Mr. Johnson has lost sight of what my theory of the Edison cell really is, and of the foundations upon which it is based. If he will be good enough to look up my original article, published in this journal, June 29, 1901, he will see that the conclusions drawn by me regarding the Edison cell are simply based upon measurements of transport numbers, i. e., upon experimental evidence.

True, my article was hypothetical in so far as I used the assumption that the active ions are K and OH. I did this because this is the ordinary current theory, and the transport numbers have been calculated from the experiments under this assumption. Granted also that this assumption is hypothetical, for it is not at all impossible that K and H are the positive ions and O the negative ion (see regarding this point the very interesting brief foot-note on page 95 of Kohlrausch and Holborn, Leitvermoegen der Elektrolyte). If the latter assumption should be right, the language of my article would have to be changed, but it can easily be seen that the numerical results obtained by me as to the concentration changes in the Edison cell, would not be changed. Therefore, I must insist that my theory is based "on a firm, experimental foundation," and I have not the slightest reason to modify any part of it.

The "theoretical, academic discussions" in this matter started from Mr. Johnson's article published in this journal, Nov. 2, 1901. At the end of my first article I had suggested that from analogy with the lead accumulator, one might suspect a relation between concentration changes and e. m. f. in the Edison battery, but I distinctly said that it seemed to me premature to attempt at present an answer to this question. Mr. Johnson endeavored to refute this suggestion, first, by means of his formula, later by some quite interesting experimental evidence. But for the reasons, given in my communication of Jan. 18, I cannot consider Mr. Johnson's arguments to be conclusive. I still consider the matter as an open question. I am unable to see how, under these circumstances, I can be accused of having been too theoretical.

I heartily agree with Mr. Johnson that any matter under discussion should be decided by experiment, and when he wishes his views to be placed before that court of appeal I would only like to add—and mine also.

PHILADELPHIA, PA. E. F. ROEBER.

Electric Traction in New York Central Tunnel.

To the Editors of Electrical World and Engineer:

Sirs.—There have appeared of late numerous communications and articles in both the lay and technical press regarding the dangers which would attend electrical operation in the tunnel of the New York Central Railroad; all to the effect that in case of a wreck fire would be inevitable, and escaping passengers who managed to get out of the flaming debris, would perish from contact with the conducting rails or devices that might be employed to convey current along the line of the road.

That these dangers exist to a small degree is admittedly true, but they are in nowise comparable to those that attend the wrecking of a locomotive with its steam, scalding water and an eighth of a ton of burning coal in its firebox. I do not take part, however, in this discussion of the pros and cons, but simply offer the following suggestion for an electrical system which would remove every element of danger in a wreck, obviate the possibility of collision and render the operation of trains at high speeds and under short headway safe.

The car equipment could be of any desired type, preferably the "multiple unit." It should take current from a rail which is "alive" only in that portion under the car and "dead" the rest of its length. The contacts to connect the rail with underground insulated feeders, should be so arranged that they can be opened or rendered inoperative by the controlling apparatus on the locomotive or controlling end of the train. The opening of the circuit between the feeders and conducting rail would leave the latter "dead." If the switch causing the contacts to operate be so arranged as to require holding in position continuously—either by the weight of the motorman on his seat or by foot pressure—the whole ssytem would automatically be open circuited in case of any accident, and there would be no electric current to burn or slay, as is alleged to be unavoidable.

The system could further be worked out to prevent collisions by dividing the conducting rail into blocks, and so arranging the con-

tact magnet circuits as to prevent the energizing of more than one section of each block simultaneously. A train following another onto the same block could then not obtain current wherewith to continue in motion until the preceding train had passed on to the next block.

Furthermore, the magnet currents could operate signals, and it would also be perfectly feasible to reproduce in each train dispatcher's office the actual positions of trains in his district at any time.

That skillful designing and some little experimental work would be necessary, and that the cost would be greater than with the ordinary form of conductors, is true; but the New York Central management has expressed itself as willing to spend money for a safe system and has employed an electrical engineer who is in every way capable of handling the problem.

NEW YORK. LAMAR LYNDON

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Sparkless Commutation with Fixed Brushes.—[illegible].—A mathematical article, illustrated by diagrams, in which he reviews the method of calculation which gave satisfactory results with the older forms of machine having copper brushes that required to be moved with each change of load, and then indicates the modification necessary to obtain satisfactory working with fixed carbon brushes and minimum air-gap excitation, by which means a minimum weight of machine may be obtained. After a brief discussion of what happens during the process of commutation, he gives the formula for the reactance voltage. To obtain sparkless collection, it is necessary with copper brushes to eliminate the reactance voltage, or with carbon brushes to reduce it to such an amount as will give sparkless collection. In the present carbon brush machine sparkless collection depends upon the voltage in the short-circuit coil being kept within a certain value. In a machine running continually in one direction, it is possible to give some lead to the brushes. The brush must here be set in such a position that at no load the voltage generated in the short-circuited coil by the fringe is insufficient to set up sparks, and that at full load the reactance voltage plus that due to the field created by adjacent armature coils does not exceed that due to the fringe by an amount sufficient to cause sparking. The simple mathematical formulas which represents the conditions of sparkless commutation are given. At the conclusion of his article, he remarks that for some outputs the requirements of his formulas can only be met either by an inconveniently large number of poles or a number of commutator bars so great that the individual bars become too thin for practical purposes. It then becomes a question whether a heavier design should be adopted or whether the light design shall be retained with a reasonable number of poles or commutator bars and sparkless commutation obtained by means of a special winding.—Lond. *Elec. Rev.*, Jan. 10.

Paralleling of Alternating-Current Transformers.—HANSARD.—The easiest method of ensuring an even distribution of load among a number of transformers is to put together in one sub-station nothing but transformers of the same make and output. Even where the same make of transformers is used, it is not advisable to attempt the running together of transformers of very great difference of output. When it is desired to parallel transformers of different designs, very serious difficulties are liable to arise even if the rated outputs are the same. The problem is discussed in a general way by means of diagrams. Another result of practical value is that while for regulation purposes it may be sufficient to specify the drop of transformers, for paralleling purposes it is absolutely necessary to specify also the "full load impedance volts." They are obtained by short circuiting one winding of the transformer through an ammeter and applying to the other winding such an e. m. f. at the working periodicity, as will cause the full-load current to be read on the ammeter.—Lond. *Elec. Times*, Jan. 16.

REFERENCES.

Properties of Collector Rings.—[illegible].—A mathematical article referring to the controversy, noticed at length in the Digest, between Leblanc, Latour and Heyland, on properties of collector rings (which are of importance for the construction of a certain type of induction motor with a power factor equal to unity). He analyzes mathematically the theoretical conclusions of Leblanc and shows where his theoretical error lies.—*L'Eclairage Elec.*, Jan. 18.

Converter.—VINCENT.—A brief theoretical description of a new converter designed by Leblanc and built by the Helios Company, a description of which, in German, has been noticed before in the Digest. *L'Eclairage Elec.*, Jan. 4, 11

LIGHTS AND LIGHTING.

Osmium Lamp.—GABRIEL.—An abstract of a paper read before the Elektro-technical Society of Vienna. The illuminating power and the watt consumption of the osmium lamp remain constant at a long life. The economy even increases for some time with an increasing number of hours of burning. The average life of a normal osmium lamp of "1.8 watt specific consumption" is 1400 to 1500 hours. By experimenting with a lamp built for 25 volts normal, he demonstrated that the osmium lamp stands a large overload very well. When 20 volts were applied to it it gave 22 Hefner candles and consumed 1.5 watts per candle. When the voltage was increased the following results were obtained: 25 volts, 26 candles, 0.995 watt per candle; 30 volts, 99 candles, 0.654 watt per candle; 35 volts, 171 candles, 0.478 watt per candle; 40 volts, 275 candles, 0.380 watt per candle; 46 volts, 460 candles, 0.322 watt per candle; at 50 volts the lamp burned through. The company which owns Welsbach's patents has so far succeeded in making practical osmium lamps up to 50 or 60 volts. Lamps have also been built for 100 volts, but they are not yet in a practical form. In order to introduce the lamps in the existing installations, the company will put on the market lamps of about 25, 33 and 50 volts, in order to be able to use these in series of four, three, or two in ordinary installations. The lowest illuminating power for which 50-volt lamps are made, is 16 to 17 Hefner candles, but the company intends to introduce the lamps, not so much in order to save energy but to increase the illumination. They intend to supply as a standard lamps of 40 candles. The first lamps will be put on the market in a few weeks. The introduction on a large scale is expected to be made during this year, but the lamps will not be sold outright at first, they will be rented. This method was found to be a success when the gas incandescent light was first introduced. The company owns enough osmium to make millions of lamps. Besides, the osmium of destroyed filaments can be again utilized with no great loss.—*Elek. Zeit.*, Jan. 23.

REFERENCES.

Train Lighting.—A note on train lighting by the Stone system in Germany. The Palatia railway authorities, after experimental trials of this system, are providing a large number of their railway cars with this system. The managers of the Bavarian, the Wuerttemberg, and the Baden State railways are also trying the system on the lines under their control, and the German Imperial Post Office has also used it for some of its rolling stock.—Lond. *Elec.*, Jan. 10.

Arc Lamps.—The first part of a descriptive article on the application and uses of arc lamps.—Lond. *Elec. Rev.*, Jan. 10.

Nernst Lamp.—An illustrated note stating that the General Electric Company, of Berlin, now makes new models of the Nernst lamp for all commercial voltages between 100 and 150, and between 200 and 250, and for currents of 0.25, 0.5 and 1 ampere.—*Elek. Anz.*, Jan. 2.

POWER

Electric Feed Pumps.—JOHNSTON.—An article illustrated by diagrams. Feed pumps can seldom be run at full load. One method of reducing the quantity of water delivered to the boiler by an electric feed pump, is by closing or partially closing the check valves. Another method is to insert resistance in series with the motor, and thus reducing its speed. Some results of tests of electric feed pumps

are given. It is an advantage if the motor is designed to run at the average speed required, without the introduction of external resistance, its speed being increased, when necessary, by weakening the field. A further advantage is gained by series parallel control of the motor, which gives it a fairly wide range without external resistance. This control is explained.—Lond. *Elec. Rev.*, Jan. 10.

REFERENCES.

Electricity in Mines.—PERKINS.—An illustrated article on the electric installation of a mine of the Thiederhall Company, near Brunswick, Germany. Electric power is used mainly for hoisting, direct-current shunt-wound motors being used. An extensive signaling apparatus and telephonic equipment is in use.—*West. Elec.*, Jan. 25.

Gas Engines and Steam Engines.—WITZ.—A very long paper in which he compares the efficiency of steam engines and gas engines, the results being much in favor of the latter.—*L'Eclairage Elec.*, Jan. 4, 11.

TRACTION.

[illegible].—LAVALARD.—An article by one of the managers of the General Omnibus Company, of Paris. The first commercial development of the omnibus system in Paris was in 1828. The lines were so successful that in 1854 there were 12 lines operating 3925 horses. In 1855 these were consolidated into one company, "The General Omnibus Co." In 1853 and 1855 franchises for tramway lines were awarded, and these two lines are now part of the system of the General Omnibus Co. He gives in a table some statistics as to the population of Paris in different years and the passengers carried by the General Omnibus Co. by its tram cars and omnibusses. In 1867 a boat service was established on the Seine, and by 1875 two independent tramway companies had been established in the outskirts of Paris, entering the city on the lines of the General Omnibus Co. In 1891 a cable line was built. Tables are given showing the lines of the tramway companies in Paris in 1901 with the length of line, motive power, etc.; the number of lines of the General Omnibus Co., their length, and motive power used.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

Brakes.—Some anonymous critical remarks on special points in a recent paper by Wigram on electric car equipments and maintenance. On the question of brakes, Wigram condemns air brakes for urban service, desires slipper brakes on grades steeper than 1 in 12 or 15, and insists on an emergency brake. The present author believes that Wigram condemns the rheostatic brake too freely. It is difficult to make motormen handle anything properly. But if the rheostatic brake is used with care in conjunction with another brake it is distinctly serviceable, and not too expensive. The other points concern the mechanical construction of the cars.—Lond. *Elec. Rev.*, Jan. 3.

Car Construction on the Indianapolis Street Railway.—An illustrated article. One of the special features of the cars used in Indianapolis is the employment of sheet steel panels in place of wood. In straight side cars the steel is placed on a wooden backing. On cars with curved panels, it is fastened directly to the posts. The vestibules and platforms on these cars are also of a novel type. There is a separate cab for the motorman, while access is provided to the cars for the passengers by the front platform. The rear platform is what is known as the Detroit type with standing room for passengers behind a railing.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

REFERENCES.

Glasgow.—ALLEN.—A long illustrated article on the Pinkston power station of the Glasgow municipal electric tramways.—*The Eng.*, Jan. 1.

Portsmouth.—An illustrated article on the Portsmouth electric tramway. The trolley system is used. The power plant contains two 400-kw and one 200-kw traction generators.—Lond. *Elec. Rev.*, Jan. 10.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Maximum Demand System.—A full account of the long discussion which folowed Wright's Brit. Inst. paper on "Some principles underlying the profitable sale of electricity." The main points of the discussion have already been noticed in the Digest.—Lond. *Elec.*, Jan. 10, 17. A long abstract of the discussion in Lond. *Elec. Rev.*, Jan. 10; *Elec. Eng.*, Jan. 17.

Several communications on Wright's paper and on Esson's article recently noticed in the Digest. Turner looks upon the maximum demand system as only a temporary expedient to benefit electricity supply companies during the introductory stages of the supply. He favors Esson's proposal that in cities with municipal plants all individual ratepayers should pay their quota towards its success, as in some cases as much as 33 per cent of the total quantity of electricity sold is supplied for public lighting, which is essentially for the benefit of the general public. He gives data to show that reduction of generating or of total costs is not a simple function of increase of load factor. He claims that the most economically worked installations charge on the flat rate system. "E. V. C." criticises Esson's proposal of a differential tariff based on units per lamp per year. He notices a case in which such a system caused a profitable customer to get rid of fittings already installed and revert in part to candle light. Goodchild favors Esson's plan of making the taxpayers in cities with municipal plants pay a special rate to cover the interest on capital charges and sinking fund for the plant.—Lond. *Elec.*, Jan. 10. Cottam criticises Esson's proposals, so does Baker, who appears to favor the Kapp system in which a time switch inserts resistance into the shunt circuit of the meter during, say, 23 hours per day, causing it to register the energy consumed during this period at a lower rate, while during the remaining hour of peak the normal rate is registered. Tapper defends the maximum demand system. He thinks a great deal too much has been made of the unpopularity of the system. It is simply a matter of how the tariff is put to the consumer. In his district, which contains many ignorant people, he uses the system with good success. His demand indicators are calibrated in 8-cp lamps of 33.3 watts. "This wattage is chosen so that the standard lamp may be said to consume 1 unit in 30 hours, and also because this is about the efficiency of the average lamp on the market, and consequently the number of lamps indicated agree fairly well with the number the consumer actually uses." He states his charges in the following simple form. Scale A: One unit per month at 16 cents for each 8-cp lamp demanded, as shown by the demand indicator, and 2 cents per unit for all further consumption in that month. Or scale B: A flat rate of 2 cents per unit for all consumption, and a monthly rental of 14 cents for each 8-cp lamp indicated by the demand indicator. To all consumers who use an average of one or more units per month per lamp the two scales are identical. All accounts are rendered monthly.—Lond. *Elec.*, Jan. 17.

Syracuse.—An illustrated description of the central station of Syracuse. There are two 600-kw, 2400-volt, three-phase alternators, one 600-kw. single-phase alternator, one 850-kw, direct-current generator, one 200-kw, 500-volt rotary converter, and 25 direct-current series arc machines, 23 of 50-light and 2 of 125-light capacity. There are no less than 1800 hp in motors connected to the station, mostly on the 500-volt, direct current. In general, lighting is accomplished from the different phases of the three-phase supply, the mains being operated at 2300 volts from the station and the current appropriately transformed by means of transformers located in manholes. Connected are the equivalent of 95,000 incandescent lamps of 16 cp.—*Elec. Rev.*, Jan. 25.

REFERENCES.

English Central Station.—An illustrated description of the Crystal Palace District electricity supply works. The station contains three 210-kw sets, two 90-kw sets and one 45-kw set. There are 10 substations, six of which have batteries.—Lond. *Elec.*, Jan. 10.

Chicago.—A long and well illustrated article on the lighting system of the Chicago Edison Company.—*Elec. Rev.*, Jan. 11.

ELECTRO-PHYSICS AND MAGNETISM.

P. D. Wave Forms in Three-Phase Systems.—RUSSELL.—A mathematical article, illustrated by diagrams, in which he proves that if the effective values of the p. d.'s between the mains of the three-phase system are not all equal the shapes of the waves of p. d. cannot be similar curves. The p. d. waves between the mains and earth can be similar curves only when the leakage currents to earth are all equal to one another. He then calculates the frequency of the alternating current in the fourth wire of a balanced three-phase system. If the frequency of the currents in the mains be f, the frequency of the current in the fourth wire is of the form $3(2n \pm 1)f$, where n is a positive integer; its lowest value is, therefore, $3f$. If the current waves in the mains be triangles or parabolas, then the current wave in the fourth wire is a triangle or a parabola, and since its frequency is three times as rapid, its effective value is one-third that of the currents in the mains. If the currents in the mains were sine curves its value would be zero. Since a sine curve and a parabola differ very lit-

tle in shape from one another, this shows how important a small modification in the shape of the wave may be. In the general case, the shape of the resultant wave is quite different from the shape of the component waves. These results prove that in practical three-phase working slight causes may considerably alter the shape of the e. m. f. and current waves. For example, a slight variation in the resistance, or a fortiori, in the inductance of the fourth wire, will alter the shapes of the current waves in the other three.—Lond. *Elec.*, Jan. 17.

Magnetic Effect of Electric Convection.—RIGHI.—An attempt to decide between the contradictory results of Rowland and Cremieu. He distinguishes four closely related phenomena, the existence of any one of which would imply the existence of the other three. These four phenomena are the following: A moving electric charge produces a magnetic field. The creation, destruction or variation of a magnetic field produces an electric field; a moving magnetic pole produces an electric field; the creation, destruction or variation of an electric field produces a magnetic field. Only the first of these three phenomena has been subjected to careful experiment. He points out that the verification of the third phenomenon—i. e., the production of an electric field by the motion of a magnet—offers the smallest number of practical difficulties. He has prepared the apparatus necessary for the experiments. He believes that Cremieu's experiments are not conclusive, as in them certain electromagnetic forces are neglected whose presence would suffice to counterbalance the phenomenon looked for.—*Nuovo Cimento*, Oct.; abstracted in Lond. *Elec.*, Jan. 10.

Gravitational Matter.—LORD KELVIN.—A paper read at the Glasgow meeting of the Brit. Ass'n. He first distinguished between gravitational matter and ether. Ether is matter, but outside of the law of gravitation. In this paper he deals with "the clustering of gravitational matter in any part of the universe." The paper, which contains much mathematics, is concluded as follows: Suppose many millions of years ago all the matter in the universe to have been atoms very nearly at rest, more densely distributed in some places than in others, of infinitely small average density through the whole of infinite space. In regions where the density was then greater than in neighboring regions, the density would become greater still. In places of less density, the density would become less, and large regions would quickly become void or nearly void of atoms. These large void regions would extend so as to completely surround regions of greater density. In some part or parts of each cluster of atoms thus isolated, condensation would go on by motions in all directions not generally convergent to points, and with no perceptible mutual influence between the atoms until the density becomes something like 0.000001 of our ordinary atmospheric density, when mutual influence by collisions would begin to become practically effective. Each collision would give rise to a train of waves in ether. These waves would carry away energy, spreading it out through the void ether of infinite space. The loss of energy, thus taken away from the atoms, would reduce large condensing clusters to the condition of gas in equilibrium under the influence of its own gravity only, or rotating like our sun or moving at moderate speeds as in spiral nebulas, etc. Gravitational condensation would at first produce rise of temperature, followed later by cooling and ultimately freezing, giving solid bodies, collisions between which will produce meteoric stones such as we see them. It cannot be regarded as probable that these lumps of broken-looking solid matter are primitive forms in which matter was created. "Hence we are forced in this twentieth century to views regarding the atomic origin of all things closely resembling those presented by Democritus, Epicurus, and their majestic Roman poetic expositor, Lucretius."—*Phil. Mag.*, Jan.

Electromagnetic Theory.—CARVALLO.—An article in which he formulates the following three "laws of electric inertia": First, a non-magnetic conducting element with a current p in a magnetic field a undergoes an electrodynamic force represented by the vector $p\ a$; second, a non-magnetic conducting element moving through a magnetic field a with a velocity x carries an induced e. m. f. represented by the vector $x\ a$; third, the induced e. m. f. within a closed curve is the sum of two terms, one of which is the integral of the vector $x\ a$ along the curve, and the other the derivative of the magnetic flux traversing the curve, but reversed in sign. Among the experimental proofs suggested by him, one consists in replacing Barlow's wheel by a wheel of soft iron, when the electrodynamic force applied to the wheel will be increased on account of the magnetic induction in the soft iron. At the same time the e. m. f. induced by the rotation is also increased. No theory of Barlow's wheel is complete unless it explains the fact that the vertical spoke of the wheel behaves exactly like conducting wire.—*Comptes Rendus*, Dec. 23; abstracted in Lond. *Elec.*, Jan. 10.

New Vacuum Phenomena.—PELLAT.—A description of some novel phenomena presented by vacuum tubes 3 ft. long and ½ inch wide when brought into a magnetic field. The tube is long enough for the electrodes to be beyond the influence of a magnet placed at the center of the tube. The stratifications are observed to crowd together into the magnetic field, and new strata leave the anode to fill up the vacancies. At the same time the strata undergo a tilting about an axis parallel to the lines of force. Another phenomenon is observed when the tube is passed through perforations in the poles of an electromagnet. If the portion between the poles is entirely filled with positive light, then, on exciting the magnet, the beam of positive light is reduced to a narrow pencil passing along the axis of the tube. No change is produced by reversing the current or the field. He attributes these phenomena to the magnetic properties of the gases concerned, which were alcohol, oxygen or hydrogen mixed with nitrogen.—*Comptes Rendus*, Dec. 3; abstracted in Lond. *Elec.*, Jan. 10.

REFERENCE.

Radium.—A review and summary of the experimental work done with radium.—*Zeit. f. Elek.*, Jan. 5.

ELECTRO-CHEMISTRY AND BATTERIES.

Industrial Electro-Chemistry.—J. B. C. KERSHAW.—A long article on the electro-chemical and electro-metallurgical industries of the world in 1901. The electrolytic alkali industry during 1901 has not shown any marked growth or expansion, there being about 30 factories with 52,000 hp; the Castner-Kellner mercury process, and the secret process of the "Elektron" Company appear to be the most successful of those worked on a large scale, and these two processes together account for quite two-thirds of the electrolytic soda at present produced in Europe and America. Interesting details have been given out concerning the gravity or "bell" process developed by a company at Aussig, Austria. It is the result of work and experiments commenced early in the nineties, and the process is now in operation in four works, three of these being situated in Germany. The process is very simple, and if all the claims made for it can be substantiated, it will undoubtedly displace some of the more complicated diaphragm processes. In the four plants 24,000 bells are said to be already operating, and this number will be increased early this year. Anodes of ordinary lamp carbon are said to last 1¾ to 2 years when working this process. Diaphragms are entirely dispensed with, while a current efficiency of 85 to 90 per cent is obtained in the cells. Aluminum is made in 9 plants with an available aggregate power of 62,000 hp, although not all this power is used for this purpose, but probably only 30,000 hp. The consumption of aluminum and its alloys in practice for various purposes is growing. For the calcium carbide industry the year 1901 has not been a prosperous one. The fall in prices which set in towards the end of 1900 has not been counterbalanced by a corresponding rise during 1901. A more satisfactory relationship between the annual supply and demand in this industry can only be instituted by the permanent closing of some of the European carbide works. Other processes are now worked in several such plants, which were built for the production of carbide. The acetylene industry has been profited by the low price of carbide, and acetylene central lighting stations for small towns and villages continue to grow in number both in Great Britain and Continental Europe. In the electrolytic chlorate industry there has been little change in 1901. The fall of prices of chlorates has caused the manufacture to be less remunerative than a few years ago. The tendency is for chlorate plants, to devote some portion of their power to the manufacture of perchlorates and similar compounds of high oxygen value, since these products, though the market for them is somewhat restricted, command better prices than chlorate of potash or soda. The number of chlorate plants is 11, with an available power of 40,000 hp. There has been only one important addition to the knowledge of the theory of the electrolytic chlorate process during 1901. Brochet has found that in all cases hypochlorite is the primary product in the electrolytic formation of chlorates, and that the addition of chromates to the electrolyte, in some unexplained way, facilitates the secondary reaction by which this hypochlorite is converted into chlorate: his experiments showed that when chromate was used the formation of chlorate was accelerated seven-fold. The production of raw cop-

per in 1900 amounted to 486,000 tons, as compared with 470,000 tons in 1899. It is estimated that of this total between 220.000 and 240,000 tons were refined by the 37 electrolytic refineries situated in Europe and America. It is probable that the figures for the past year will show a slight reduction on the above totals. "Electrolytic processes for the extraction of copper from its ores are being worked at Papenburg in Germany, and at a mine in New Jersey." Electrolytic bleaching plants are most widely distributed in Germany and Austria, and in these two countries the advantages of using solutions of hypochlorites of soda in place of hypochlorite of lime, are most fully recognized. Some information is given about various nickel plants. The interest in ozone as an agent for sterilizing water, has been renewed. One of the London water companies is now trying this method of sterilization on its own account. The question of the use of the process on a large scale hinges entirely upon the cost factor. The ordinary sand filtration is a necessary preliminary to the ozone treatment. The cost of sterilizing water by ozone must, therefore, always prove an addition to the present costs and increase the charge to the consumer. The cost of the process at Moscow in Russia is reported to be $6.50 per 1,000,000 gallons, but this statement lacks confirmation. Chassy, experimenting with pure oxygen and a Berthelot ozonizer, has found that "the quantity of ozone produced per ehp-hour tends toward a limit determined by the temperature. To obtain a concentration of 7 per cent requires 90 times as much electrical energy as to obtain one of 0.5 per cent." The Hoepfner zinc process is in use in two places. The Swineburne and Ashcroft zinc process will be used at a plant in course of erection. A new method of treating zinc ores is reported from Italy, where Casaretti and Bertani are said to have obtained 1 kg. Zn per 2 hp-hours by smelting the ores in an electric arc furnace. The zinc under such treatment is volatilized. The writer says he has reason to believe that a somewhat similar process is in actual use by the Sulphide Corporation at one of their smelting plants in New South Wales, but in this case "zinc concentrates" are used in place of the crude ore. At Bockenheim, near Frankfort, a new electrolytic zinc extraction process is said to be at work, depending upon the use of a zinc sulphate electrolyte and insoluble anodes. It is patented by Strzoda. Carborundum and artificial graphite are produced in increasing quantities. The output of carborundum amounted to 1300 tons in 1900, as compared with 807 tons in 1899. The Groth system of electrolytic tanning is in use at two places, one of which has a capacity of 750 hides per week. The Moebius and other electrolytic processes of silver refining are in operation at a large number of bullion refineries in America and Europe; "and the Wohlwill process of parting gold from silver and platinum is worked at Hamburg, at a French refinery and at Philadelphia. The value of the output of the refineries at Frankfort and Hamburg alone, in 1900, is estimated to have been over $12,500,000." Sodium and sodium peroxide are produced at numerous places by an electrolytic method which has completely supplemented the older chemical methods of manufacturing these products. Magnesium is also produced by a similar process. Trials are made with the use of the electric furnace for reducing iron ores and making glass; but the writer believes that these attempts (presumably meaning that the source of energy is water power or some cheap fuel) can only succeed in countries where the price of fuel is abnormally high.—Lond. *Elec.*, Jan. 3, 10.

Manufacture of Aluminum.—HABER and GEIPERT.—An account of an experimental investigation of the manufacture of aluminum by electrolysis of a molten solution of alumina in cryolite. Pure aluminum can be easily obtained at a pressure of 7 to 10 volts with a cathode current density of about 3 amperes per square centimeter in a carbon crucible with carbon anodes. Regarding the properties of the aluminum obtained, it is very important to use pure materials. The electrolysis takes place in an easy and uniform way, like an electro-analytic deposition of a metal, if the dimensions of the bath and of the electrodes are properly chosen, and if the anode is so adjusted that during electrolysis it can be easily raised in a systematic way. The electrolyte from which the pure metal was obtained consisted of about one-third sodium fluoride, one-third aluminum fluoride, and one-third alumina. The high percentage of aluminum fluoride is favorable because it lowers the melting point. The temperature of the bath is that of a light red heat. They believe that the progress which has taken place in the last 10 years in the industrial manufacture of aluminum is not due to secret-modifications of the electrolytic process, but to the use of pure materials.—*Zeit. f. Elektrochemie*, Jan. 2, 9.

Hypochlorites and Chlorates of Alkalies.—FOERSTER and MUELLER.—An account of an experimental investigation concerning the ampere-hour and watt-hour efficiencies which can be obtained in the electrolytic preparation of hypochlorites and chlorites of alkalies. They find that by proper arrangement nearly the theoretical efficiencies can be obtained in the manufacture of the chlorates so that this process may be called ideal. On the other hand, in the electrolytic manufacture of hypochlorites there exist inherent limits, which cannot be overcome, although not regarding the ampere-hour efficiency, but regarding the concentration which can be obtained.—*Zeit. f. Elektrochemie*, Jan. 2.

REFERENCES.

Liquid Resistance.—ABEGG.—A brief illustrated description of a simple liquid resistance for laboratory purposes. The electrodes are in the two arms of a U-tube. The resistance is changed by pushing a glass rod into the one arm and thereby changing the cross section of the electrolyte.—*Zeit. f. Elektrochemie*, Jan. 16.

Theory of the Lead Storage Battery.—Some critical remarks, by two anonymous writers and by Abegg and Abel, on Abel's mathematical representation of Leblanc's theory of the lead accumulator.—*Zeit. f. Elektrochemie*, Jan. 2, 9, 16, 23.

Carbons for Electrodes.—HARDEN.—An illustrated article on the manufacture of carbons for electrodes and on the construction of dry cells.—*Elek. Anz.*, Jan. 2.

Transport Numbers.—HITTORF.—An abstract of an experimental investigation of the influence of animal membranes in the determination of transport numbers.—*Zeit. f. Elektrochemie*, Jan. 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Fault Testing.—An illustrated description of a new fault-testing set, made by Elliott Bros., London. The apparatus consists of a small portable battery, a standard resistance of 1 ohm, and a very accurate voltmeter of high resistance, the method used for localizing the faults being based on a fall of potential; an adjustable resistance is used for keeping the current constant. Fig. 1 shows the application when

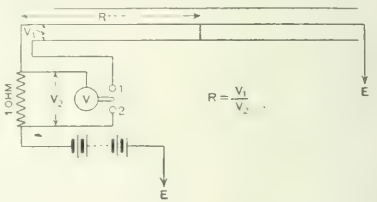


FIG. 1.—TESTING FOR FAULTS.

there is a short circuit insulated from earth, between the two conductors of the three-core cable; the first, reading V^1, is taken with the switch in position 1, and the second, reading V_2 with the switch in position 2. Then R, which is the resistance from the testing point to the fault, is equal to $V_1 \div V_2$. If the resistance of the fault is low compared with that of the voltmeter, one reading may be sufficient

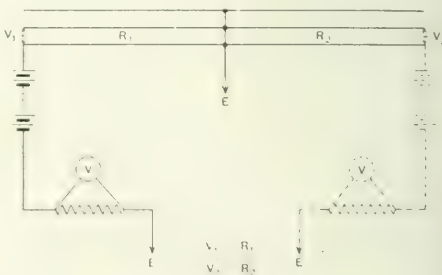


FIG. 2.—TESTING FOR FAULTS.

for an accurate result; if not, tests from the two ends should be compared and the average result taken. In the second diagram, it is assumed that all three conductors of the cable have become earthed, a fault that might occur through continuity of the short circuit or a mechanical injury. The voltage V_1 and V_2 are taken as shown in the

diagram, and the equation [illegible] fault. Although this result may be checked by the use of another core, it seems that the determination can only be deemed accurate if the resistance of the fault is so small as to be inconsiderable when compared with the resistance of the cables. In an actual case a fault in a 3000-yard length of concentric cable was localized, first, to between two junctions 300 yards apart, and when these were opened a further test gave the result within 3 yards of the actual spot.—Lond. *Elec.*, Jan. 17.

Water Resistance.—An illustrated description of an improved testing tank devised by Lindley. It consists of an ordinary wooden tank which is made longer than required by the length of the electrodes. Horizontal electrodes of cast iron are used, with a large number of holes through them, in order to permit a free circulation of the electrolyte and to permit also of the upper plate which is adjusted by means of a screw, being moved easily up or down. These electrodes occupy about one-third of the length of the tank; the remaining two-thirds is occupied by a cooling device. This arrangement is identical in construction with that of a water heater, and consists of a number of copper tubes connected in series with each other. Cold water is forced through these tubes, and the quantity so flowing is regulated by means of a valve, or a pump may be added if it is necessary to greatly increase the flow. In practical trials it has been found that the temperature of the electrolyte can well be kept constant.—Lond. *Elec. Rev.*, Jan. 17.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy versus Submarine Cables.—The first part of an article, in which numerous scientists and engineers are quoted as saying that the property of the submarine cable companies will not be in the slightest degree injured by Marconi's achievement. The slow speed of operation, the delicacy of the apparatus, and the insufficient reliability of synchronizing are believed to be unsurmountable difficulties to wireless telegraphy across the ocean on a commercial scale. The only field for wireless telegraphy is as "a feeder for ocean and land telegraphy," not as an opponent.—Lond. *Elec. Rev.*, Jan. 17.

MISCELLANEOUS.

Stassano Process.—CHIARAVIGLIO.—A note stating that the Italian Company, which introduced the Stassano process (for making steel in the electric furnace) in one of its plants, has not used it commercially, as it is now in liquidation.—*Zeit. f. Elektrochemie*, Jan. 16.

Pan-American Exposition.—HRHSCHKA.—The first part of a long, illustrated description of the exhibits of electric machinery on the Pan-American Exposition in Buffalo.—*Zeit. f. Elek.*, Jan. 5.

New Books.

KALENDER FUR ELEKTROCHEMIKER. Sowie Technische Chemiker und Physiker fur das jahr 1902. VI jahrgang. Mit einer Beilage. Von Dr. A. Neuberger. Berlin: M. Krayn. 555 pages, 21 illustrations. Beilage, 448 pages. Price, 4 marks.

The 1901 issue of this annual edition of a German pocketbook for electro-chemists was reviewed at some length in these columns last year. The new issue for 1902 has been enlarged, the additions being more especially in the chapters on galvanic cells and storage batteries, on solubility, electro-plating and quantitative analysis by electric methods. We are glad to note that the index in the front of the book has been revised. These additions and revisions certainly enhance the usefulness of the pocketbook, but many parts, especially the older ones, still need a very careful overhauling. The many tables which the book contains are certainly very useful, but very often the accompanying description lacks exactness and clearness. For instance, on page 335 and 376 the internal resistance of various cells is given, without any data concerning the size of the cells. On page 333 the author gives ionization heats in Ostwald's heat unit K, which is defined as follows: "$K = 100$ average calories (approximately)." The reader who does not know Ostwald's notation will find this definition very ambiguous. The author should clearly state that K represents a centuple gram calorie, i. e., the heat required to raise a gram of water from 0 deg. to 100 degs. C.; or that $K = 100$ gram calories, in which gram calorie is defined as one-hundredth of the heat required to raise a gram of water from 0 deg. to 100 degs.

There should be more uniformity throughout the book. In the atomic weights on pages 164 to 168 the new value of the ratio between [illegible] 289 he uses the old value $O = 15.96$ for $H = 1$. It would be preferable to have all the conductivities (page 297 to 324) in one and the same unit, instead of sometimes giving the conductivity in relation to mercury, sometimes the resistance in relation to mercury, sometimes the resistance of 1 cc. in ohms and at other times the resistance of 1 cu. ft. in ohm; this may, however, be excused, as the author has evidently copied his table directly from the papers of the original investigators; but he should under all circumstances in every table say in which unit the numbers are given. More thermo-chemical data besides those given on page 478 to 481 (in the chapter on technical electrolysis, where, by the way, nobody would look for them) would certainly be appreciated. On the whole, the book contains much useful and valuable matter, but the compilation is sometimes poor. An alphabetical index at the end of the book would be very useful.

BOOKS RECEIVED.

POWER AND POWER TRANSMISSION. By E. W. Kerr. New York: John Wiley & Sons. 356 pages, 264 illustrations. Price, $2.00.

"THE ELECTRICIAN" WIREMAN'S POCKETBOOK. A Manual for the Wiring Contractor, the Mains Superintendent and the Wireman. Edited by F. Charles Raphael. London: The *Electrician* Printing & Publishing Company, Limited. 330 pages, 174 illustrations. Price, 5 shillings.

MANUAL OF ELECTRICAL UNDERTAKINGS AND DIRECTORY OF OFFICIALS. 1901-1902. London: Garcke. 976 pages. Price, 12½ shillings.

PRIMARY BATTERIES: Their Theory, Construction and Use. By W. R. Cooper. London: The *Electrician* Printing & Publishing Company, Limited. 324 pages, 131 illustrations. Price, 10½ shillings.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Twenty-fourth Convention, Niagara Falls, N. Y., May, 1901. New York: National Electric Light Association. 451 pages, illustrated.

DIZIONARIO TECHNICO. Hoepli Manual. By E. Webber. Milan: Ulrico Hoepli. Second Edition. 553 pages. Price, 4 lire.

Combination Electric Automobile.

The idea of a combination street car, or of a combination automobile, in which some prime mover shall be associated on the vehicle with a generator and batteries driving the motor, is not broadly a new one, but while not hitherto worked out successfully finds attractions for ingenious minds. The most striking work in this direction was that of Heilmann with his combination electric locomotive on the steam railroads of France. It would seem that in the automobile field, an opportunity of this kind for practical work might well exist.

The Fischer Motor Vehicle Company, of Hoboken, has for the past five years been perfecting such a combination system. Fig. 1 is a diagram illustrating this system, which consists of a combined

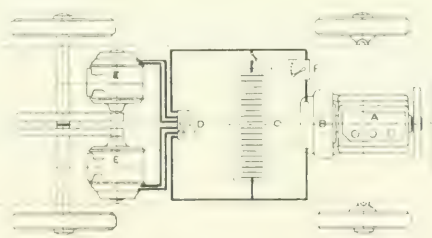


FIG. 1.—DIAGRAM OF THE SYSTEM.

Starting Switch.

gasoline engine and dynamo, one motor for each rear drive wheel, a small storage battery and a controller. It will be noticed that there is no mechanical connection between the engine shaft and vehicle drive wheels, hence the dynamo is free to run at a practically even speed, furnishing a constant and steady supply of electricity. The electric circuit is so arranged that when running the vehicle under

normal conditions (loaded on the level) the current goes directly from the dynamo (through the controller) to the motors, but when coasting down grade slowing up or in general when less power is needed than that furnished by the engine, the current is automatically taken up by the battery which is connected to the wiring at a point between the dynamo and controller. Again, when extra power is needed, as in ascending steep grades or starting heavy loads, the battery promptly furnishes the deficiency. This action, carrying the peak of the load, does not have to be watched by the operator, being entirely automatic. As the output of the engine does not vary, no governor is required and the gas and air mixtures can be set permanently for perfect combustion. This should insure great saving in fuel and prevent the usual bad odor. As the speed of the engine is almost constant the balance will be practically perfect, obviating vibrations. Another very important and convenient feature is the starting of the engine, which is accomplished by simply throwing in a switch controlled by the driver. Patents covering the fundamental principle and a number of patents on separate parts, such as steering gear, axles, motor suspension, controller, engine, oiling device, heating system, etc., are controlled by the Fischer Company. Fig. 3 shows an 18-passenger omnibus recently completed. The vehicle and its full equipment, excepting the batteries, was designed by their chief engineer, L. G. Nilson, and built at the company's Hoboken shops.

Fig. 2 is a photograph of one of their standard running gears, which consists of an angle steel under frame, to which various parts of the machine are attached. The front portion carries the gasoline engine, dynamo, controller and steering gear. The front axle, instead of the usual heavy forging, is trussed somewhat on the principle of a bridge, and carries extra long and flexible platform springs bolted to the brackets on the frame. The rear axle and the wheels, springs, two motors and reduction gears form a complete driving unit. All parts subject to wear are entirely incased so as to be properly lubricated, and at the same time protected against dust and moisture. No reach is used, the half elliptic springs conveying the power from the rear axle to the frame. The water cooler is suspended under the frame between the front and rear axle. The illustration (Fig. 2) shows the

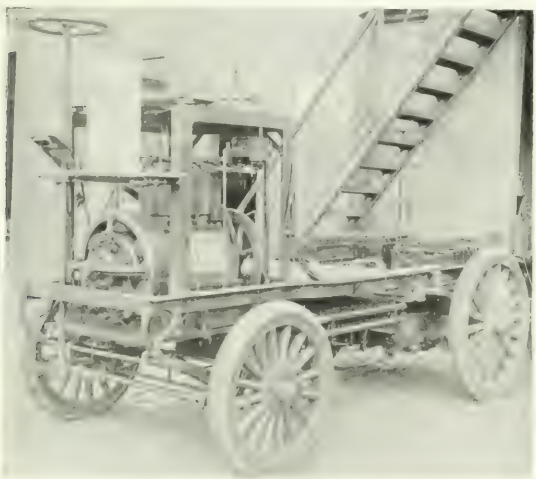


FIG. 2.—STANDARD RUNNING GEAR.

running gear complete in every respect, and Fig. 3 the body in place, making a finished bus.

The power equipment consists of a 10-hp, 3-cylinder, 4-cycle gasoline engine running 600 r. p. m. All wearing parts are extra large, provision is made for taking up wear, lubrication is entirely automatic and the general construction designed for constant work with a minimum amount of care. Directly on the engine shaft is placed the armature of a 5-kw, 110-volt dynamo. The motors are of a special "twin" type, built together, 5 hp each, and will stand an overload of 100 per cent for a half hour, or 200 per cent for 5 minutes without sparking at brushes. The controller is of the series parallel type of five forward speeds from 2½ to 10 m. p. h., and two reverse speeds from 2½ to 5 m. p. h., all controlled from one lever. The batteries consist of 50 cells of 90 a. h. capacity. The front wheels are 38 inches and the rear 46 inches, equipped with 4-inch Calumet solid rubber tires.

In a test recently made of this bus it developed, we are informed, that the bus not only made its scheduled time during a snowstorm, but that the heating apparatus kept the inside comfortable while the



FIG. 3.—COMBINATION AUTOMOBILE.

weather was below freezing point. The total mileage made by the bus on this day was 54, the engine using 12½ gallons of gasoline, same costing 9 cents per gallon, making the cost of fuel a fraction over 2 cents per mile, and this under the very worst conditions that an automobile could be asked to work under—snow.

Protective Fuses.

We show herewith several types of S. K. C. fuses, two of which are for high-tension circuits, and the third for circuits of medium and low tension.

The mechanism of the high-tension or bail fuse, which is designed for circuits up to 30,000 volts, is shown in Figs. 1 and 2. As the fuse appears on the board it is merely a cylinder with two clips which are inserted in spring contacts in porcelain bases—the whole thus very much resembling exteriorly the enclosed fuse, shown in Fig. 4. This fuse operates successfully at 30,000 volts and 50 amperes; for voltages below 10,000 the porcelain bases are not necessary.

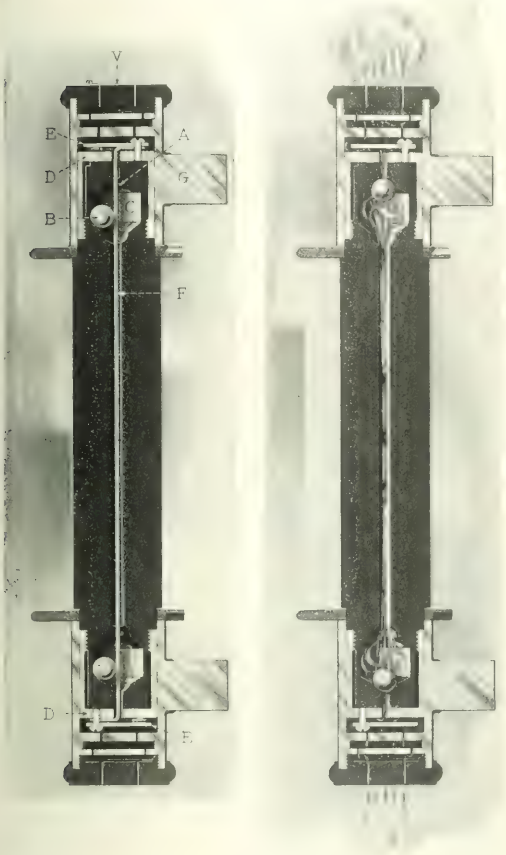
Referring to Figs. 1 and 2, at each end of the tube which encloses the fuse proper (*F*, Fig. 1) is a chamber, *C*, which contains a small carbon ball. These chambers are large enough to contain the balls without interfering with the proper passage of the fuse wire. When fusing takes place the vapors resulting from the combustion of the metal blow the carbon balls into the cavities, *A*, effectively cutting off the arc.

At the top of the tube hinged on its upper cap is a small aluminum tell-tale *V*, which covers a circle of perforations. The out-rush of gases incident to fusing throws this little vane over and into view of the attendant, indicating that that fuse has gone. The cap, including the contact jaw *J* makes a snug fit over the fuse terminal *D*. The latter carries the machine screw holding the eccentric washer *E*. Around the screw and under the washer is clamped the fuse wire. The cap carrying the jaw is released by a slight twist, slips off the barrel and exposes washer and screw. Re-fusing is the work of but a minute; ordinary fuse wire is used.

Exactly what happens at the instant the "Ball" fuse operates is clearly shown in Fig. 2. Perforations are provided at both ends of the barrel for the exit of combustion vapors, but the path is a devious one, and by the time the vapors reach the atmosphere they are harmless. An extra barrel on hand, kept fused, makes feasible the re-establishing of a circuit almost instantly.

Another type of fuse for large currents and voltages of 20,000 and

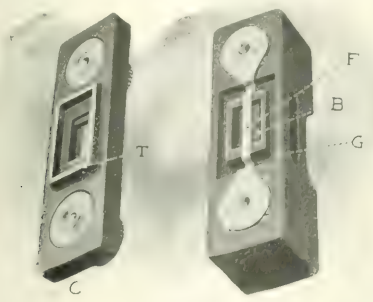
below, is shown in Fig. 3. The fuse proper, *F*, is of aluminum and is mounted in a lignum vitæ case. Extensive experimenting with large currents at high voltages has demonstrated this wood to give the best service of any material available for enclosing fuses carrying large



FIGS. 1 AND 2.—BALL FUSE.

currents, porcelain having been found wanting as a base to carry such fuses.

The construction of this type of fuse is such that when the combination is assembled, the portion of the aluminum strip of smallest cross-



section is virtually enclosed in a "blowing chamber," *B*. The only opening from this chamber is at the back, and the discharge of volatile metal finds outlet through this and is discharged against a piece of micanite on the base, to which the fuse is connected by spring clips. Therefore, even if fusing should take place while the attendant was in the very act of handling the fuse no harm would result.

The cap *C* is secured by the thumb nuts, and when in place the tongue *T* fits snugly into the groove, *G* bounding the discharge chamber effectively, confining the exit of molten fuse to the rear as explained. A dowel pin, invisible, keeps the nuts permanently secured in place in the cap and a spring washer is so inserted as to

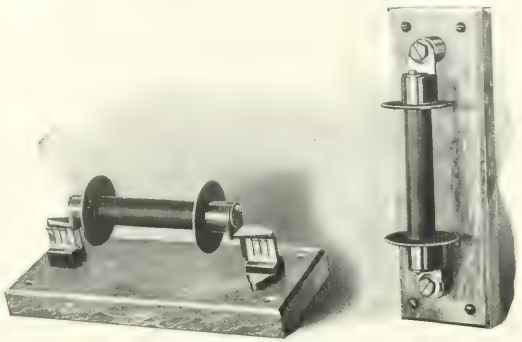


FIG. 4.—ENCLOSED FUSE.

maintain the contact under tension. The opening for the discharge (not shown, but beneath *F*) is covered with a piece of mica and provides means for observing whether the fuse is intact or not.

Fig. 4 shows the S. K. C. type of enclosed fuse for circuits carrying up to 150 amperes and for voltages not exceeding 2400. The "Ball" fuse was evolved from this type, and the latter possesses the same general characteristics of a fiber barrel enclosing the fuse wire, excepting, of course, the ball arc-rupturing feature.

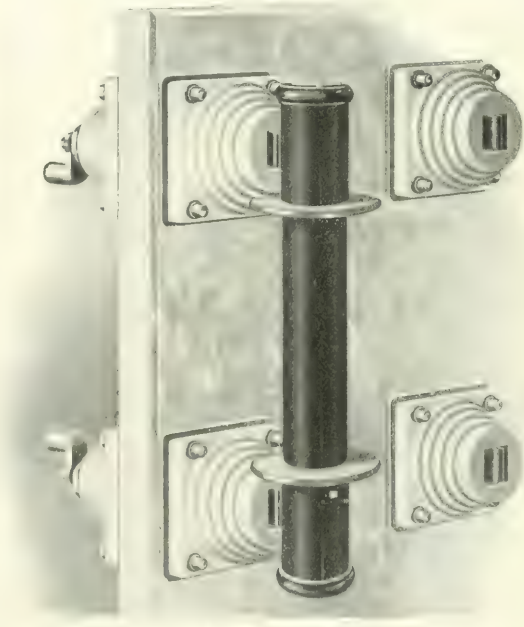


FIG. 5.—ENCLOSED FUSE.

Another form of this fuse is illustrated in perspective in Fig. 5. It is distinguished as having bolt or jaw contacts. The latter provides for most expeditious re-establishing of a circuit. An extra barrel on hand with fuse wire in place can be quickly inserted between the contact jaws without aid of tools, replacing one in which the fuse was blown. Eccentric washers, under which the wire is clamped at the ends of the barrel, cover up the opening, and at the time of "fusing" confine the volatile metal.

NEWS OF THE WEEK.

Financial Intelligence.

MONEY IN WALL STREET.—[illegible] closed at 4 per cent for 30 to 90 days, and 4@4½ per cent for four to six months. Greater activity characterized the stock market during the week and investment demands for bonds and dividend-paying stocks were well sustained. Amalgamated Copper was irregular on the uncertainty of the copper market and the management's policy. Steel stocks were steady but dull. Although there was considerable activity and business done in tractions, these stock failed to respond to the Metropolitan's plan for financing the contemplated improvements. The sales of Brooklyn Rapid Transit for the week aggregated 416,650 shares, the closing price being 66⅞, which is a net gain of 1⅛ points. Metropolitan Street Railway made a net gain of 1½ points, the closing price being 173¼—¾ point below the highest figure of the week. The stock sales amounted to 159,560 shares. Manhattan was an exception, closing with a net loss of 1⅝, the last quotation being 133⅞. In the electric stocks, General Electric reached the remarkably high figure of 292, which, we believe, is the highest figure recorded for this stock, closing at 290¾. This represents a net gain of 10¾ points, the sales aggregating 700,020 shares. It is stated that the sharp rise was due to talk again about the early readjustment of capital, which, if carried through, will restore to the common shareholders at least a portion of the 40 per cent reduction for their quota which was made several years ago. Western Union was weak, closing at 91, a net loss of ⅜ points. The sales of Westinghouse Electric were 1300 shares, the closing figure being 175¼, a net gain of 1¼ points. American District Telegraph advanced 2½ points, closing at 36. Following are the closing quotations of Monday, Feb. 10:

NEW YORK

	Feb. 4.	Feb. 10.		Feb. 4.	Feb.
[illegible]			[illegible]		
[illegible]			[illegible]		
Brooklyn Rapid Transit.			Hudson River Tel.....	—	—
[illegible]			[illegible]		
[illegible]			N. E. Elec. Veh. Tran...	½	—
Electric Boat.....	26		N. Y. Elec. Veh. Tran...	14½	14
Electric Boat pfd.....	48		N. Y. & [illegible]		
[illegible]			[illegible]		
Electric Vehicle.....	2½		Western Union Tel.....	91	91
Electric Vehicle pfd.....	4¾		West. E. & M. Co.....	174	176
			West. E. & M. Co., pfd..	175	176

BOSTON.

	Feb. 4.	Feb. 10.		Feb. 4.	Feb.
Am. Tel. & Tel....			[illegible]		
Cumberland Telephone			[illegible]		
Edison Elec. Illum.			[illegible]		
[illegible]			[illegible]		
[illegible] pfd..			[illegible]		

PHILADELPHIA.

	Feb. 4.	Feb. 10.		Feb. 4.	Feb.
[illegible]			[illegible]		
Electric Storage Battery.	58	62	Philadelphia Electric.		
Elec. Storage Batt'y pfd.	58	62	Pa. Electric Vehicle..		
Elec. Co. of America....	6	8	Pa. Elec. Veh. pfd...		

CHICAGO.

	Feb. 4.	Feb. 10.		Feb. 4.	Feb. 10.
Central Union Telephone.	86	—	National Carbon pfd....	83	83½
[illegible]			[illegible]		
[illegible]			[illegible]		
Chicago Telep. Co.....	—	—	Union Traction pfd.....	47	49½
[illegible]			[illegible]		

EVERETT-MOORE SYNDICATE.—The bankers' committee has given out a statement of the earnings of the Everett-Moore syndicate for the fiscal year ending Dec. 31, 1901. The statement shows that the gross earnings of the eight subsidiary companies were $8,004,733, a gain of $989,011 over 1900. The net earnings were $3,607,352, a gain of $533,574 over 1900. Deducting fixed charges, the surplus is $1,886,083, a gain of $466,891. The partly completed plant of the People's Telephone Company will be purchased for $400,000. Preliminary arrangements for a perpetual lease of the Big Consolidated Street Railway property have been made and a memorandum of the terms has been drawn up. Before the lease can become operative it must be approved by the bankers' committee in charge of Everett-Moore affairs and ratified by two-thirds of the stockholders of the company. The plan to lease is cordially approved by President Everett, who, with his friends, control about 60 per cent of the stock. They do not anticipate trouble in securing the consent of two-thirds of the stockholders. The prospective lessee is the Elkins-Widener-Dolan syndicate, of Philadelphia. This syndicate has been after the Cleveland line ever since the embarrassment of the Everett-Moore syndicate was announced.

TELEPHONE YAWP.—The Boston News Bureau is responsible for the following: "We understand that the American Telephone & Telegraph Company is making an exhaustive research into wireless telegraphy. Some telephony students believe that the heretofore impregnable position of the American Bell Telephone Company and its successor, the American Telephone & Telegraph Company, is more seriously threatened by wireless telegraphy than by the independent telephone movement. It is said that the telephone company has offered a Boston man $500,000 for a coherer that will take a wireless message without any interference from other electrical disturbances, not that the Telephone Company could make use of the invention, but it is realized that its acquirement by the wireless telephone people might in time prove an interference with the telephone company."

NATIONAL CARBON COMMON.—News from Chicago states that James S. Humbird, one of the largest stockholders of the National Carbon Company, and some of the high officials of that concern were in the city last week and said positively that it would be the policy of the company to declare no dividends on the common stock this year. This statement was brought out by the rumor on the Chicago Stock Exchange that Carbon common would be placed on a dividend basis this month. The report was accompanied by a rise of 3 in the price of the stock. Trading was lighter last Saturday, but the stock declined to 21 and closed at 21⅛, a net loss of 1⅝.

PHILADELPHIA TROLLEYS.—Mr. John B. Parsons, president of the Union Traction Company, states that the plan to lease the trolley lines of the company to a syndicate represented by John M. Mack, and Congressman Foerderer has received definite official sanction. This company has secured the right to lay tracks on all unoccupied streets, and it is the intention to merge this company with the Union Traction Company, which controls all the street railway lines of the city. It is reported that the lease would become operative on April 1.

DIVIDENDS.—The directors of the Metropolitan West Side Elevated have declared a semi-annual dividend of 1 per cent, payable Feb. 28. Six months ago 2 per cent was declared. Niles-Bement-Pond Company have declared a dividend of 1¼ on the preferred stock and 1½ on the common. Pratt & Whitney Company have declared a dividend of 1½ per cent on the preferred stock.

INTERNATIONAL TELEPHONE.—Parties interested in the Telephone Company of America are said to be interested in the organization of the International Telephone Company of America, which, it is claimed, will soon be incorporated under the laws of Delaware, with $250,000,000 capital, of which $50,000,000 will be preferred and $200,000,000 common stock.

WATERFORD (N. Y.) TELEPHONE MORTGAGE.—In the Saratoga County Clerk's office there has been filed a mortgage for $150,000, made by the Waterford Telephone Company, in favor of the Knickerbocker Trust Company, of New York City. It covers an issue of 6 per cent gold bonds on franchises and property in Saratoga and Albany counties.

NEW ORLEANS RAILWAY COMPANY.—The New Orleans Railway Company, capital $5,000,000, to operate and construct street railways, was incorporated at Trenton, N. J., on Jan. 28. Incorporators: Walter R. H. Hardingham, Charles F. Gehrman, Malcolm N. Butler and Henry B. Pogfon, all of Jersey City.

MEXICAN EASTERN.—The Mexican Eastern Railway Company has been incorporated at Dover, Del., with a capital of $5,000,000 to build and operate a railroad from Merida, Yucatan, to Zacoalco, Vera Cruz, Mexico, and to construct and operate telegraph, telephone and express lines over the same route.

YOUNGSTOWN BOND ISSUE.—To provide for the issue of 5 per cent bonds not to exceed $1,000,000 the Youngstown & Sharon Railway & Light Company, Youngstown, Ohio, has given a second mortgage in that amount to the New York Security & Trust Company, New York.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade developments during the week were largely favorable, although there was some interruption to railway traffic and outdoor work by severe storms and cold weather. A slight but general strengthening of values in staple goods and in tin, copper and lead among the metals, are among the favorable ruling conditions. The demand for building materials was quiet on account of the snow and cold weather. According to *Bradstreet's*, all the measures of legitimate trade point to January equaling in most respects, and exceeding in many the records of a year ago. At the close of the week a confident feeling prevails in nearly all lines of distribu-

tive trade. In iron and [illegible] and there is a virtual famine [illegible] products of steel, the extremely cold weather and snows having hampered work among the furnaces. In the metal market, copper was the subject of a speculative boom, which, however, collapsed. Prices were steadily raised until 13½ cents was reached for Lake early in the week, but a sharp break followed, and at the close of the week, February and March casting was offered in large amounts at 12½ cents. The closing quotations are as follows: Lake, 12½c. to 13c.; electrolytic, 12½c. to 12¾c.; casting, 12¼c. to 12½c. The exports for the month of January were very heavy, but about two-thirds of the stock shipped went to England, where it appears in the visible supplies. The business failures for the week, as reported by *Bradstreet's*, numbered 247, against 303 the previous week, and 250 the corresponding week of last year.

THE CROCKER WHEELER COMPANY, of Ampere, N. J., has just issued a bulletin describing the electrical equipment of the Joseph Dixon Crucible Company, of Jersey City, which formerly operated four separate steam plants and has now combined them into one electrical power plant. A 100-kw generator and 24 motors, all of Crocker-Wheeler manufacture, have already been installed, and future equipment is contemplated. The Crocker-Wheeler Company reports that the outlook at the end of the first month of the New Year is most promising, both as to orders coming in and as to the indications for a heavy spring business. Among the January shipments may be noted the following: De Lamar Copper Ref. Co., Carteret, N. J., one 520-kw generator, one 100-kw generator, one 50-kw generator; Iron City Engineering Company, Uniontown, Pa., four 100-kw generators; Anglo-American Prov. Co., Chicago, Ill., seven motors ranging from 10 to 75 hp; Pennsylvania Steel Casting Company, Chester, Pa., one 350-kw generator; Quintard Iron Works, New York City, one 65-kw generator; Marine Engine & Machine Company, Harrison, N. J., two 50-kw generators, one 60-hp motor, two 35-hp motors; U. S. Electric Lighting Company, Washington, D. C., one 90-kw generator, one 130-hp motor; National Tube Company, Pittsburg, Pa., one 110-kw generator; Niles Tool Works, Hannibal, Ohio, a consignment of motors; Erie Rapid Transit Railway, Harbor Creek, Pa., one 200-kw generator; L. S. & M. S. Railway Shops, Collinwood, Ohio, one 400-kw generator, one 75-kw generator; Mechanical Laboratory, Lehigh University, South Bethlehem, Pa., one 30-kw generator; American Car & Foundry Company, Madison, Ill., one 110-kw generator; Armour Fertilizer Works, Atlanta, Ga., one 150-kw generator, two 50-hp motors, one 90-hp motor; Park Steel Company, Pittsburg, Pa., one 200-kw generator; J. K. Farley Manufacturing Company, Chicago, Ill., one 150-kw generator; Ft. Hill Chemical Company, Rumford Falls, Me., four 140-kw generators.

ELECTRICITY IN SIAM.—Mr. Hamilton King, United States Consul General at Bangkok, in calling attention to the various opportunities in Siam, says: "The electrical development of the city of Bangkok during the last 10 years has been wonderful. The Siam Electricity Company, Limited, has a capital of £150,000, plus 200,000 ticals ($100,000); it has 17,000 lamps installed at 16 cp; a tramway track of 7½ miles in operation, and a track of 3½ miles under construction, which will be in operation before the end of this year; it has 26 cars in use and 14 under construction; it is advertising and supplying electric power for various industries throughout the city, and is now considering a line of automobiles to be run in connection with its tram line. Besides this company, there is being pushed a request for another concession on the other side of the river, and there are 26 private plants in the various mills, forts, dock companies and the navy yard of the city. The United States has almost the entire market in this line now, and, with interested and intelligent management, this trade should be greatly increased."

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a number of large contracts for batteries of the Chloride accumulator to be installed in electric railway power houses and sub-stations for the purpose of regulation and peak work. Among these are three installations recently contracted for by the Twin City Rapid Transit Company, of Minneapolis, Minn.; two of which consist of 288 cells each, installed in Minneapolis, Minn., and St. Paul, respectively. These have a nominal capacity of 1000 kw, and are operated in conjunction with motor-driven boosters for regulating and peak work. The third battery for this company is to be installed in a sub-station at Stillwater, 7½ miles distant from the power house. This battery consists of 315 cells, having a capacity for one hour of 400 kw, and is to be used with shunt booster entirely for regulating the line voltage. These three batteries have tanks sufficiently large to allow of an ultimate increase of 50 per cent greater capacity.

ELECTRIC POWER FOR COPPER MINES.—The Copper Belt Railway & Power Company, which was recently incorporated with a capital stock of $2,000,000, will construct during the present year a temporary water power electric plant. The head of water utilized will be 56 ft., and 6000 hp will be generated for the use of the mines and the electric railway, which will be built from the De la Mar Mine in Copper City to the Shasta King Mine near Kennett, Calif. The railway will be 21 miles in length, and will be taxed to its full capacity to transport copper and supplies to and from the mines. By lengthening the water ditch 6 miles the available head will be increased to 145 ft., and it is estimated that 16,000 hp can be developed at the site of the permanent electric generating station. The Copper Belt Mining Company is controlled by the same capitalists, and will consume most of the output of the electric plant. Sidney Sprout will be the consulting engineer on construction.

TWIN CITY RAPID TRANSIT.—The Twin City Rapid Transit Company, Minneapolis, Minn., will build a steam plant at the St. Anthony Falls dam for use when the water is low. The plant will have a capacity of 3000 hp, and will cost about $700,000. Bids for its construction have been received. It is stated that three sub-stations will be established, one in Minneapolis, one in St. Paul and the third for the Stillwater line. The company will spend $1,350,000 in betterments during the year. It has been found that the power plant by the St. Anthony dam is no longer sufficient to supply the fast-growing needs of the street railway system, hence the erection of the steam plant. In the city the feed wires will be carried underground through the business districts.

CLEVELAND FIRE ALARM SYSTEM.—For the sixth time the city has opened bids for a fire-alarm system. The figures were considerably lower than had been previously offered. For apparatus alone the Municipal Signal Company bid $8,675, Cleveland Electric Manufacturing Company for 20 registers $600, Gamewell Fire Alarm Telegraph Company $23,700. For apparatus complete and installed the Gamewell Company bid $43,650, the Municipal Company $14,700, the Star Electric Company $15,500. On boxes the Gamewell Company's prices ranged from $35 to $125, the Municipal's from $68 to $74, and the American Watchman's Time Detector Company's $60. The contract will probably be divided.

PITTSBURG REDUCTION COMPANY.—It is stated that the Pittsburg Reduction Company has decided to largely increase its plant at Shawinigan Falls, Que. The company now uses 5000 hp for the manufacture of aluminum, but has acquired a new process for the extraction of the alumina from bauxite. Hitherto this was done by a chemical process, but the company has decided to do this work itself, and has contracted with the Shawinigan Water & Power Company for 1300 ehp in adition to the water it already uses. It will also go into the manufacture of wires and cables.

NEW ELECTRIC RAILWAY IN MEXICO.—United States Consul General Hanna, of Monterey, Jan. 14, 1902, says it is understood that an American company has obtained a concession to build and operate an electric street car line on several of the streets of that city, with extensions to Topo Chico, to the new steel plant, and to the smelters. It is also understood, the consul general adds, that Mackin & Dillon, of Monterey, are the principal promoters, and that the greater part of the equipment will probably be purchased in the United States.

WINNIPEG TRANSMISSION.—Mr. Charles Chamberlain announces that he has completed arrangements with New York capitalists to start immediately the carrying out of the great enterprise of erecting gigantic pulp and paper mills, and developing some 100,000 hp on the Winnipeg River, about 65 miles from the city of Winnipeg. The mills are to be in operation within two years, and the intention is declared of transmitting power to Winnipeg next fall.

STILWELL FEED WATER HEATERS have just been furnished by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, to the following electric light companies: Consolidated Light & Power Company, Evansville, Ind.; Arnold Electric Power Company, Chicago; Jacksonville, Fla., Gas Light & Coke Company; Duncan Electric Manufacturing Company, Lafayette, Ind.; Vinita Electric Light & Power Company, Vinita, I. T.

AUTOMATIC TELEPHONES IN BERLIN.—A recent issue of the *Illustrirte Zeitung* has a well written popular account of the Strowger automatic telephone exchanges in that city, with illustrations. There are 200 banks and financial houses, and 200 instruments in government bureaus connected on the Strowger automatic exchange system.

GERMAN IMPORTS of electrical machinery from the United States of America from Jan. 1 to Oct. 31, 1901, are given as 267 tons, as compared with 274 tons for the same period in 1900. German electrical industries are now reported to be recovering slowly but surely from the extreme depression of last year.

THE LACHINE RAPIDS HYDRAULIC & LAND COMPANY, LIMITED, R. S. Kelsch, chief engineer, 160 McCord Street, Montreal, Canada, is about to begin plans on a large sub-station, including an auxiliary steam plant of 6000 to 8000 hp capacity.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has recently installed an electric power plant. The Ball Engine Company, Erie, Pa., furnish the engine.

WESTINGHOUSE STEAM EQUIPMENTS.—In the list of sales by Westinghouse, Church, Kerr & Co. during the last month there are included several interesting stoker, mechanical draft and economizer equipments. The New York office reports an order for two 100-inch 24-grate stokers to Obermeyer & Liebman, of Brooklyn; a complete stoker and economizer plant with stack and mechanical draft to the Union Bag & Paper Company, of Sandy Hill, New York; two 138-inch, 24-grate and four 132-inch, 22-grate stokers to the British Westinghouse Electric & Manufacturing Company at Manchester, England. The Boston office reported the sale of an equipment of dampers and actuating mechanism for economizers to Sanderson & Porter, for the Rockingham County Light & Power Company at Portsmouth, N. H.; and the Detroit office three 54-inch, 20-grate stokers to Frank J. Hecker, for the Washington Arcade Building plant in Detroit. The Chicago office added a list of four plants, comprising 12 stokers, and including a 48-inch, 20-grate stoker to Sligar & Holloway, Indianapolis; one 84-inch, 22-grate stoker to the United States Board & Paper Company, of Carthage, Ind.; eight 54-inch, 22-grate stokers to the United States Mining Company at Salt Lake City, Utah, and two 93-inch, 22-grate stokers to Deere & Co., of Moline, Ill.

NIAGARA POWER FOR TORONTO.—With regard to the steps for getting Niagara power in Toronto, some 80 miles distant, Alderman Spence, of that city, has introduced the following resolution which has been approved by the legislation committee: "That the City Solicitor be instructed to immediately make application to the provincial Legislature for the enactment of legislation empowering the municipal corporation of the city of Toronto to purchase electric energy at any place not more than 150 miles distant from the said city, and to secure any right of way and establish any poles, wires or other plant or appliances necessary to bring such energy to Toronto, and there distribute it. And to raise loans and borrow moneys on debentures issued on the credit of the city for the purpose of carrying out the said undertaking, and any other powers necessary to enable the corporation of the city of Toronto to acquire, bring to Toronto and distribute electric energy from any point within the distance aforesaid."

MANUFACTURING STATISTICS.—The statistics of the manufacturing industries for the United States, as shown by the official returns of the twelfth census, were announced in a preliminary report issued last week. These figures do not include establishments with a product of less than $500, Governmental establishments, or penal, eleemosynary and educational institutions which were not reported at the eleventh census. The summary, as compared with the figures for 1890, follows: Number of establishments, 512,585; increase, 44 per cent. Capital, $9,853,630,789; increase, 51 per cent. Wage earners (average number), 5,310,598; increase, 25 per cent. Total wages, $2,322,407,257; increase, 23 per cent. Miscellaneous expenses, $1,028,550,653; increase, 63 per cent. Cost of materials used, $7,349,916,030; increase, 42 per cent. Value of products (including custom work and repairing), $13,019,251,614; increase, 39 per cent.

NEW CALIFORNIA POWER COMPANY.—The Valley Counties Power Company has been incorporated in San Francisco for the purpose of constructing an electric power plant on French Creek in the eastern part of Butte County, Calif. Directors: R. A. Colgate, E. de Sable, Jr., John Martin, R. M. Hotaling, John C. Coleman, William M. Pierson and C. A. Grow. Capital stock, $2,500,000; subscribed, $70,000. The organizers of the corporation are the men who have carried the Bay Counties Power Company to a dividend-paying point, and who are preparing to rebuild the North Pacific Coast Railroad, and operate parts of it as electric lines, at an expense of several millions of dollars. The new generating plant will furnish an additional supply of current for the numerous electric lighting, power and railway lines owned by these capitalists.

THE SPRAGUE ELECTRIC COMPANY has closed an order with the Atlas Portland Cement Company for three 400-kw engine type split pole generators at speed of 156 r. p. m. for their plant in Hannibal, Mo.; another order is from the De Laval Steam Turbine Company for ten 20-kw and ten 75-kw turbine generators. The Pennsylvania Steel Company has ordered for its new bridge shop at Steelton, Pa., 15 wall crane trolley hoists, the electric hoisting equipment of which is built by the Sprague Company. The Lima Locomotive & Machine Company, Lima, Ohio, has let contracts for its new shops to the Sprague Electric Company for electrical appliances, power plant, etc.

CONSOLIDATED RAILWAY LIGHTING.—The directors antagonistic to the presidency of Isaac L. Rice in the Consolidated Railway Lighting & Refrigerating Company, who were requested at the recent special meeting of shareholders to resign, have issued a circular, in which they stated that they declined to do so. The directors signing the circular were George W. Knowlton, J. B. Clement, Irving Cadmus, Robert Dixon, S. Marsh Young and John H. Thompson, Jr. The reason given for their action was that the legitimate shareholders in the company have not had a chance to vote upon the question after a full knowledge of the facts.

TO IMPROVE PITTSBURG RAILWAYS.—The Pittsburg Railways Company, which is the new corporation recently formed and including all the electric street railways of that city, and Allegheny, as well as the various suburban towns, is about to begin a large number of improvements for the betterment of the system. The board of directors of the company has authorized President James D. Callery to make an expenditure of $2,000,000, which sum is to be used in the erection and equipment of a new power house, the purchasing of 200 new cars, renewal of tracks and the extension of some of the lines.

THE MARION LIGHT & HEATING COMPANY, a new corporation of Marion, Ind., with a capital stock of $300,000, with B. F. Burk, president; R. E. Breed, vice-president; G. A. H. Shidler, treasurer; R. T. Burk, secretary; William H. Anderson, manager; Harry F. Reynolds, chief electrician; has purchased the property of the Marion Electric Company, and that of the M. C. Mead Electric Company, and has installed a complete hot-water heating system. This company has now control of the heating and lighting interests of the city and will make extensive improvements which will convert these properties into a thoroughly modern system.

SNOQUALMIE TRANSMISSION.—Charles H. Baker, president of the Snoqualmie Falls Power Company, which transmits electricity to Seattle and Tacoma, Wash., has applied for a franchise for supplying electric light and power throughout the city of Portland. The distance of transmission from Snoqualmie Falls would be about 200 miles, with a cable span of one mile across the Columbia River. A greater distance of transmission and similar conditions have been successfully engineered in California. It is reported that machinery has already been ordered for an extension of the Snoqualmie plant.

BOILERS FOR ST. LOUIS FAIR.—A meeting of St. Louis boiler manufacturers was held last week to inquire into the letting of the contract for boilers for the World's Fair power plant. It is claimed that the contract was let unfairly to the Westinghouse Electric & Manufacturing Company, of Pittsburg, and that local manufacturers were not even allowed to bid on the work. Among those present at the meeting were John O'Brien, Joseph F. Wengler, Joseph J. Rohan and H. C. Memhotz.

ELECTRIC LIGHT IN YOSEMITE PARK.—The General Electric Company has been awarded the contract for two 2300-volt alternators, having a capacity of 75 kw each, by the Yosemite Valley Commission. The generators will be operated by waterwheels, the hydraulic contract having been awarded to Henshaw, Bulkley & Co., San Francisco. The plant will be used to illuminate the hotel and other buildings in the Yosemite Park.

BROOKLYN EDISON EXTENSION PLANT.—The Brooklyn Edison Company is at present placing some substantial contracts for equipment to be installed in an extension of its Bay Ridge station. The contract for the 3300-hp boiler plant, comprising six high-pressure horizontal water-tube boilers of 550 hp each, has been allotted to Thayer & Co., whose New York offices are in the Taylor Building, 39-41 Cortlandt Street.

NILES-BEMENT-POND COMPANY.—The annual report of the Niles-Bement-Pond Company for the year ended Dec. 31, 1901, shows the net earnings of the constituent companies to be $1,468,570. After dividends and the setting aside of $196,600 for depreciation a surplus was left of $668,470. The previous reserve fund was $1,617,370, making the present reserve fund $2,285,540.

ELECTRIC PLANT FOR BLAST FURNACE.—A large power house and electrically-driven conveyers will constitute part of the blast furnace plant to be erected at Toledo by Pickands, Mather & Co., Cleveland. Julian Kennedy, Pittsburg, Pa., is the engineer in charge. Plans are being prepared and contracts will be closed in the near future.

THE SHELBY STEEL TUBE COMPANY, of Shelby, Ohio, has equipped its plant with Burt exhaust heads, manufactured by the Burt Manufacturing Company, of Akron, Ohio, which also makes the Cross oil filter, which is now reclaiming waste oil for manufacturers in 28 different countries.

LIGHTING PLANT EQUIPMENT.—The village of South Brooklyn, Ohio, will receive bids up to March 1 for the building and equipping of an electric light plant. Plans and specifications are in the hands of C. N. Smith, E. E., South Brooklyn.

OIL FILTERS FOR ANACONDA.—Two 120-gallon Cross oil filters, manufactured by the Burt Manufacturing Company, of Akron, Ohio, were recently ordered by the Anaconda Copper Mining Company, of Butte, Mont.

HOLBROOK, CABOT & DAILY, a firm of contractors, are to build a large coal pocket at Lincoln's Wharf for the Boston Elevated Company.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Jan. 29: Antwerp—70 pkgs. material, $1,088; 2 pkgs. machinery, $22. Aberdeen—26 pkgs. machinery, $300. Bremen—3 pkgs. material, $66. British East Indies—40 pkgs. material, $1,535. British Guiana—20 pkgs. material, $310. Berlin—4 pkgs. material, $875. Brazil—226 pkgs. material, $6,737; 20 pkgs. machinery, $6,408. British Australia—1 pkg. material, $128. British West Indies—16 pkgs. material, $269. Central America—1 pkg. material, $153; 2 pkgs. manufactures of copper, $110. Cuba—69 pkgs. material, $1,537. Ecuador—1 pkg. material, $17. Genoa—2 pkgs. material, $100. Hong Kong—5 pkgs. material, $689. Huddersfield—1 pkg. material, $50. Hamburg—1 pkg. machinery, $40; 101 pkgs. material, $2,802. Havre—3 pkgs. material, $300; 2 pkgs. machinery, $84. Ipswich—8 pkgs. wire, $347. London—213 pkgs. machinery, $9,082; 95 pkgs. material, $8,635; 30 pkgs. electric cable, $8,989; 63 pkgs. copper wire, $4,505. Liverpool—64 pkgs. machinery, $5,264; 55 pkgs. material, $2,560. Leghorn—2 pkgs. material, $100. Lyme—6 pkgs. wire, $2,900. Mexico—82 pkgs. material, $1,246; 351 pkgs. wire, $832; 5 pkgs. machinery, $288. Manchester—4 pkgs. machinery, $3,125; 250 pkgs. material, $2,125; 60 pkgs. machinery, $13,724. Milan—24 pkgs. material, $540. Naples—8 pkgs. material, $200. Peru—10 pkgs. material, $878. San Domingo—5 pkgs. machinery, $500. Southampton—47 pkgs. machinery, $4,995. Siam—1 pkg. material, $25. Venezuela—5 pkgs. material, $145; 4 pkgs. wire, $76. Vienna—3 pkgs. material, $1,391. Zurich—1 pkg. material, $30. Exports for the week ended Feb. 5: Antwerp—1 pkg. material, $30. Argentine Republic—1 pkg. machinery, $77; 116 pkgs. material, $3,913. Amsterdam—1 pkg. material, $94. Berlin—7 pkgs. material, $769. British Australia—9 pkgs. material, $454. British West Indies—44 pkgs. material, $928; 4 pkgs. machinery, $156. British Guiana—8 pkgs. material, $281. British East Indies—6 pkgs. material, $160. Bremen—2 pkgs. material, $110. Chili—4 pkgs. material, $56. Central America—19 pkgs. material, $1,440; 1 pkg. manufactures of copper, $24. Cuba—34 pkgs. material, $652; 1 pkg. manufactures of copper, $33. Dutch West Indies—3 pkgs. material, $57. Doncaster—29 pkgs. copper wire, $7,100. Danish West Indies—1 pkg. material, $15. Genoa—7 pkgs. material, $127; 4 pkgs. wire, $65. Havre—2 pkgs. machinery, $225; 26 pkgs. material, $576. Huddersfield—2 pkgs. material, $100. Hamburg—6 pkgs. material, $99. Japan—18 pkgs. material, $1,070; 34 pkgs. machinery, $6,885. London—114 pkgs. machinery, $9,631; 73 pkgs. material, $2,741; 44 pkgs. copper wire, $3,481. Liverpool—53 pkgs. material, $2,864; 1,029 pkgs. copper material, $53,640; 5 pkgs. copper wire, $147. Mexico—35 pkgs. material, $951; 3 pkgs. machinery, $809; 13 pkgs. manufactures of copper, $185; 3 pkgs. motor parts, $118. Newcastle—33 pkgs. machinery, $3,545. Philippine Islands—19 pkgs. material, $838. Peru—15 pkgs. material, $32. Rotterdam—8 pkgs. manufactures of copper, $50; 3 pkgs. material, $30. Southampton—1 pkg. wire, $18; 4 pkgs. manufactures of copper, $275; 9 pkgs. material, $258; 42 pkgs. copper wire, $2,550. Stockholm—3 pkgs. material, $650. Sheffield—1 pkg. material, $50. U. S. Colombia—349 pkgs. wire, $7,196; 3 pkgs. material, $78; 12 pkgs. wire, $30; 1 pkg. manufactures of copper, $14. Uruguay—1 pkg. material, $12. Venezuela—29 pkgs. material, $226; 20 pkgs. copper wire, $330.

MOTORS AT PENCOYD WORKS.—In a souvenir issued on the occasion of a reception given to Mr. Percival Roberts, Jr., in commemoration of 25 years' active share in the business, the Pencoyd Iron Works say: "In 1891 a 20-ton overhead electric traveling crane was placed in the blooming mill. This was the first crane of this character put in service at Pencoyd. A 30-kw generator was also added to the plant, and motors distributed in the mills for driving machinery. In 1892 a 6-ton overhead traveling crane was installed to cover the space between the 12 and 20-in. mill building and the machine shop, and used for loading material on cars for shipment. During the succeeding years there was a gradual displacement of shafting, belting, engines, etc., and the substitution of electric motors connected direct to individual machines; power being obtained from a central plant in which the generating units were added to, until at date, in place of one 30-kw unit, there are now installed five 220-volt generators of 1100 kw capacity, furnishing power for 67 cranes equipped with 159 motors, six charging machine—20 motors, in addition to 387 motors distributed throughout the works, 300 arc lights and 2000 16-cp incandescent lamps, aggregating 4645 hp of motors, ranging in size from 1-6 to 125 hp." It is believed that the power motors are virtually all Crocker-Wheeler.

WESTINGHOUSE ELECTRICAL WORKS IN RUSSIA.—An extensive plant for the manufacture of Westinghouse electrical machinery is now under construction in St. Petersburg. A company styled the Westinghouse Electrical Works has been incorporated under the Russian laws for the purpose of carrying on the enterprise. Most of the capital ($3,000,000) of the new concern has been subscribed by Moscow parties. The company, which has been subsidized by the Russian Government to the extent of $1,500,000, will devote its attention principally to turning out electrical machinery for the Government. The works will embrace an area of 28 acres, and will employ some 1500 men. This is expected to be one of the most modern equipped shops of their description in Europe. Everything other than the castings, which are to be imported from the United States, will be manufactured in the new plant.

ELECTRICAL MACHINERY FOR SPAIN.—Mr. J. F. Villalta, of the American machinery concern of J. F. Villalta, Barcelona, Spain, who is at present on a visit to this country, states that he is in the market for some 2000 fans to be used for ventilating purposes. He also says that there is an important consumption for electrical-covered wires in Spain. Mr. Villalta has placed orders with the New England Butt Company, of Providence, R. I., for several machines to be utilized in the manufacture of covered electric wire, and John Royle & Son, of Paterson, N. J., have obtained an order from him for insulating machines. Mr. Villalta, who will be in this city for about a week, is stopping at the Hotel American, Irving Place. He can be found downtown at the offices in the Produce Exchange of Alfred H. Post & Co.

POWER HOUSE CONTRACT.—L. E. Myers, general manager of the Akron-Canton Railway Company, is authority for the statement that a contract for a power house has been placed with J. J. Jobst, of Chicago, and that work on the buildings will start as soon as possible. The station will have a capacity of 2000 hp. It is planned to open a coal mine within 1000 ft. of the power house, a considerable tract of coal land having been secured. Coal cars will be run directly from the mine into the power house. The boilers will be fed by automatic stokers.

THE AMERICAN FOUNDRY & MACHINE COMPANY recently organized in Cleveland, with $200,000 capital stock, is preparing to build a large foundry and machine shop at Ravenna, Ohio. There will be a separate power house and all machinery will be electrically driven. The foundry and machine shop will be covered by cranes. Contracts for equipment are to be closed at once. W. W. Wallace, formerly with the American Clay Working Company, is general manager and superintendent.

LIGHT AND POWER PLANT.—The Bradley Heat, Light & Power Company has recently been organized in Cleveland, Ohio, to furnish light, heat and power to the Bradley buildings as well as others in the downtown section of the city. The company has just placed contracts to increase the capacity of its plant. The new equipment will include a Sterling boiler, a 375-hp Bates Corliss engine and a 200-kw Triumph generator for lighting purposes.

ELECTRIC LOCOMOTIVES.—The General Electric Company's Salt Lake City agency will fill a contract for three electric locomotives for the United States Company's new smelter. A number of 34-foot electric cars equipped with 80-hp motors have been ordered by the Consolidated Railway & Power Company, Salt Lake, through District Manager Benson.

BIDS FOR CUYAHOGA FALLS.—Bids will be received until Feb. 19, by T. A. Steel, president of the board of trustees of Cuyahoga Falls, Ohio, for furnishing and installing an alternating-current generator for incandescent lighting, of from 90 to 120 kw capacity; also bids on a horizontal medium or high-speed engine of not less than 200 ihp.

G. I. ENCLOSED ARCS.—The Cincinnati Gas & Electric Company has just placed with the General Incandescent Arc Light Company, of New York, an order for several thousand enclosed arc lamps—in fact, it is said and believed to be the largest contract ever given out for enclosed arcs at one time; and probably for arcs of any kind.

THE HUDSON RIVER TELEPHONE COMPANY, in a circular to its stockholders, announces that the board of directors has voted to issue at par to stockholders of record at the close of business on Feb. 8, 4000 shares of new stock. The proceeds will go to pay for new construction work.

POWER PLANT FOR RAILWAY SHOPS.—The Wheeling & Lake Erie Railway will make extensive additions to its machine shops at Norwalk, Ohio. A large amount of new machinery will be installed and a power plant will be erected.

EXPORTS OF ELECTRICAL MATERIAL FROM SAN FRANCISCO.—During the month of December the exports of electrical material from the port of San Francisco amounted to a valuation of $11,365.

INCREASE OF CAPITAL.—The Abbott Electric Manufacturing Company, formerly of Cleveland and now of Warren, Ohio, has increased its capital stock from $40,000 to $60,000. H. H. Hammond is president.

BOILERS, ENGINES AND GENERATORS WANTED.—Two boilers, 250-hp engine and generator will be required for a new plant to be erected at Coshocton, Ohio, by the H. D. Beach Company.

General News.

THE TELEPHONE.

TUSCALOOSA, ALA. The reported purchase of the Home Telephone Company by the Southern Bell is confirmed. A number of cables will be substituted for overhead wires.

LOS ANGELES, CALIF.—The Pacific States Telephone & Telegraph Company has applied for permission to extend its underground conduits in Los An-

SAN FRANCISCO, CALIF.—The Mountain Automatic Telephone Company has been granted a franchise for the construction of its lines along the public roads in Tuolumne County, Calif.

SAN FRANCISCO, CALIF.—The Arizona State Telephone Company, which was recently incorporated by F. D. Wright and associates, of Prescott, Ariz., will extend its lines to Congress, Crown Point and other towns.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company recently gave a banquet to its underground cablemen, instrument assemblers and branch office troublemen at the California Hotel, San Francisco. Mr. Thomas Trebell presided and addresses and songs heard from a number of employees and officials.

PEORIA, ILL.—The Northwestern Telephone Company has been granted a franchise in Peoria.

SENECA, ILL.—The Graves & Hayer Telephone Company has increased its

MIDDLETOWN, ILL.—The Middletown Telephone Company may extend its line north connecting with New Holland.

DAHLGREN, ILL.—The Dahlgren People's Telephone Company, capital stock $2,500, has been incorporated by J. W. Gavin, L. C. Morgan and J. T. Hunt.

CALEDONIA, ILL.—The Boone County Co-operative Telephone Company, capital stock $7,500, has been incorporated by George A. Brown, John C. Ralston and John A. Picken.

TOCSIN, IND.—Arrangements are being made to connect Tocsin with Ossian by telephone.

LAGRANGE, IND.—The telephone company of Lagrange has issued bonds for $18,000 in order to improve its system.

ROSSVILLE, IND.—The Rossville Home Telephone Company has increased its capital stock from $2,500 to $6,000. The company will extend its lines.

SALEM, IA.—A rural telephone company, the first one in West Township, is to be organized.

HUDSON, IA.—At a special election franchises were granted to J. E. Strayer for a lighting plant and telephone system.

SHANNON CITY, IA.—The Shannon City Telephone Company, capital stock $11,000, has been incorporated. P. W. Miller is president.

IVESTOR, IA.—The farmers in the vicinity of Ivestor have organized the Ivestor Mutual Telephone Company. Adam Messner is president.

PRAIRIE CITY, IA.—The Farmers' & Merchants' Telephone Company, capital stock $1,000, has been incorporated by J. H. Little, president; C. W. Bryan, vice-president.

FAIRFIELD, IA.—Articles of incorporation of the Southeastern Iowa Telephone Company have been filed. It is a Packwood organization, with a capital stock of $5,000. The officers are J. L. Everett, president; R. K. Baker, vice-president; J. W. Watson, secretary, and G. L. Everett, treasurer.

LOUISVILLE, KY.—The Cumberland Telephone & Telegraph Company has entered suit for an injunction to prevent the Louisville Home Telephone Company from placing cross arms and stringing wires on certain streets, alleging that such would be destructive to plaintiffs' line already located there.

LAWRENCEBURG, KY.—The plant of the Anderson County Telephone Company has been purchased under foreclosure proceedings instituted by the United States Mutual Investment Company, of Lexington. The purchasers were the independent telephone companies of Frankfort, Lexington and Louisville, the amount paid being $5,700. The purchasers will at once reorganize the company, improve and increase the plant, extend the toll lines and instal new telephones.

BROOKS, ME.—The Waldo and Penobscot Telephone Company, capital stock $10,000, has been incorporated for the purpose of operating a telephone line from Brooks to Dixmont and Jackson. A. E. Kilgore is president and H. R. Pelley, treasurer.

MARSHALL, MICH.—A movement is on foot at Marshall to install a local telephone exchange and subscribers are being solicited.

WINONA, MINN.—A new telephone line is to be run from Yucatan to Houston.

BYRON, MINN.—The Byron Telephone Company, capital stock $5,000, has been incorporated by R. C. Cutting, president; Samuel H. Brooks, vice-president; Charles Watts, treasurer; Myron E. Hicks, secretary.

HOLDEN, MO.—The Farmers' Independent Telephone Company, capital $5,000, has been incorporated by Edwood Andrews, J. T. Hughes, Geo. Sellers and others.

NORFOLK, NEB.—The Madison County Telephone Company, capital stock $50,000, has been incorporated by Thomas E. Parmele, J. A. Lulkhart and Oliver O'Neil.

WILMINGTON, N. C.—It is stated that the Southern Bell Telephone Company will soon build a long-distance line from Wilmington to Goldsboro.

ELIZABETH CITY, N. C.—The Camden Telephone Company has completed a line reaching Norfolk, Va., where connection has been made with the Bell

FAYETTEVILLE, N. C.—Agents of the North and South Carolina Telephone Company have visited this city securing right of way and arranging for construction of lines.

WILMINGTON, N. C.—This city will be given a long-distance connection by the Bell Telephone Company. The proposed line is from Charlotte via Hamlet

HENDERSON, N. C.—The Henderson Telephone Company now has long-distance lines reaching to twenty towns in Central and Eastern North Carolina. The company has 1200 miles of toll lines, 26 exchanges, with nearly 3000 subscribers.

MOREHEAD CITY, N. C.—The City Telephone Company has been incorporated with a capital stock of $1,000. The Henderson Telephone Company has also completed a long distance telephone line to Beaufort, N. C. It will be extended to Morehead City.

ELIDA, OHIO.—The Elida Mutual Telephone Company is building eight farmers' lines to towns in this vicinity.

OXFORD, OHIO.—The Oxford Telephone Company has been reorganized and the exchange is to be practically rebuilt.

CINCINNATI, OHIO.—The Central Union Telephone Company is building a new line which will connect with Blanchester and intermediate towns.

CANTON, OHIO.—The Wheeling & Lake Erie Railway is building a private telephone system connecting the terminal at Columbus with the general offices at Canton.

OTTAWA, OHIO.—The directors of the Putnam County Telephone Company have ordered a large quantity of copper wire and expect to have the system in operation by May 1.

YOUNGSTOWN, OHIO.—The Beaver Telephone Company has been incorporated with a capital stock of $10,000, and will connect up some 200 farmers in Beaver Township.

COLUMBUS, OHIO.—The Columbus Citizens' Telephone Company has paid to the city the sum of $2,459.97, representing the franchise tax agreed upon when the company commenced operations.

ATHENS, OHIO.—The Guysville Telephone Company, recently incorporated, is preparing to build a farmers' system at Guysville and will build toll lines to connect with all other exchanges in the county.

FREMONT, OHIO.—The Fremont Home Telephone Company has declared a regular quarterly dividend of 1½ per cent. The company has about 650 subscribers on its books at present, and the exchange is growing rapidly.

ASHLEY, DELAWARE COUNTY, OHIO.—The New Ashley Telephone Company, capital stock $20,000, has been incorporated. Incorporators are Mary Heseltine, W. Guy Jones, W. F. Mitchell, George H. Carter and W. M. Heseltine.

CONVOY, OHIO.—The Convoy Home Telephone Company has been organized to build an exchange and farmers' system in this township. L. W. Larber is president; W. C. Long, vice-president; E. M. Leslie, secretary, and A. Mollenkopf, treasurer.

MENTOR, OHIO.—The Mentor Telephone Company has elected officers as follows: President, Dr. J. W. Lowe; vice-president, C. A. Norton; W. A. Cadle, treasurer; N. C. Frost, secretary. The company has decided to make a number of improvements.

FINDLAY, OHIO.—The Trades and Labor Assembly are maintaining a boycott on the Bell Telephone Company's business at this place. The company refuses to discharge its non-union foreman and claims to have felt no unpleasant effects from the Assembly's action.

LORAIN, OHIO.—The Black River Telephone Company has decided to issue $10,000 worth of new stock to increase the capacity of the system. The main exchange will be increased by 200 telephones and the South Lorain exchange by 100. The company is in excellent condition.

PLEASANTON, OHIO.—The Pleasanton Telephone Company has been organized. The incorporators are C. M. Pierce, Wm. Pierce, B. F. Shamel, W. W. Henry, F. M. McPherson and Wm. Gilkey. A line will be built from this town to Shade, a distance of four miles, there to connect with the county seat line.

CLEVELAND, OHIO.—The United States Telephone Company has recently closed several contracts for leasing its toll lines for telegraph service. The company is adding to its revenue materially by leasing its wires to brokers, etc., for telegraph service, the wires being used at the same time for telephone service.

GENEVA, OHIO.—Business men of Geneva have submitted a petition to the Council asking that a new company be given a franchise to build an exchange in the town. It is claimed that the service being given by the Madison Telephone Company is very unsatisfactory. The Madison company has promised to make improvements.

STEUBENVILLE, OHIO.—The independent telephone companies at East Springfield and Annapolis have completed a line between the two towns, each company building half interest. The Steubenville company will shortly make extensive improvements on the Richmond line and will equip the central exchange with a new and improved switchboard.

FREMONT, OHIO.—The annual meeting of the Fremont Home Telephone Company was held Feb. 4. Officers were elected as follows: S. K. Brinkerhoff, president; C. M. Russell, vice-president; Russ J. Christy, secretary; John M. Sherman, treasurer. The company has about 700 telephones in operation, and last year was a very successful one financially.

CINCINNATI, OHIO.—Two new switchboards are being installed in the central exchange of the City & Suburban Telegraph Association. There is a genuine boom on with this company, the inhabitants apparently having become reconciled to the belief that independent competition is now dead and that the rates are sufficiently equitable for good service.

SANDUSKY, OHIO.—The Sandusky Telephone Company held its annual meeting Feb. 4. Officers were elected as follows: Louis Duennisch, president; Jacob Kuebeler, vice-president; Sidney Kilbourne, secretary; John C. Hauser, treasurer, and Carl C. Curtis, general manager. The company is in a flourishing condition, having over 1000 telephones in operation.

COLUMBUS, OHIO.—The [illegible] Company has abandoned the idea of building sub-stations and has decided to enlarge the present building and to increase the capacity of the switchboards to 12,000 lines. Leading stockholders of the company are making an effort to buy up the interest in the company held by the Federal Telephone Company, and a syndicate has been formed for the purpose.

CINCINNATI, OHIO.—The American Directory Telephone Company, of Reading, Pa., represented here by a gentleman named Browning, will not operate in conjunction with the City & Suburban Telegraph Association, which controls the local telephone field. The company has opened offices in the Union Trust Building, and has announced it's intention of doing business here notwithstanding. Agent Browning says that he will organize a local company and will be ready to begin operations about March 1.

CLEVELAND, OHIO.—The Bankers' Committee in charge of Everett-Moore affairs has completed arrangements for a loan of $50,000 to complete the plants of the Mansfield Telephone Company, the Zanesville Telephone & Telegraph Company, and the Stark County Telephone Company, which were nearly completed when the syndicate became embarrassed. The opening of these three systems will materially increase the earnings of the United States Telephone Company, which has long-distance lines connecting them.

AKRON, OHIO.—In its annual statement to stockholders the Akron People's Telephone Company announces that it has nearly 2800 telephones in operation in Summit County. The exchanges are divided as follows: Akron, 1900; Barberton, 400; Cuyahoga Falls, 300, all of which have free connection with one another, and lines to Hudson, Tallmadge and Twinsburg numbering over 200. The company is installing new aerial and underground cables with a capacity of 800 pairs of lines, and has over 100 contracts for telephones, which will be installed as soon as the new cables are completed. The company commenced operations less than eighteen months ago.

LUCAS, OHIO.—The Monroe Telephone Company has perfected a traffic arrangement with the Central Union Telephone Company, and its lines are being connected with the Central Union exchange at Mansfield. The Monroe Telephone Company was organized as an independent local and long-distance telephone company for the benefit of farmers, and its exchange is located at Lucas. Each subscriber is a stockholder and has free use of all lines connected. Under the new arrangement they will have free connection with all Central Union telephones in Mansfield. They also have a similar traffic arrangement with the Mifflin & Widowville Telephone Company, a farmers' company organized on a similar basis. George W. Mowers has been elected superintendent of the company's lines.

WAKITA, OKLA.—The Wakita Telephone Company, capital stock $5,000, has been incorporated by A. H. McMahan, C. L. Bickendike, of Sand Creek; F. W. Hipple, P. H. Loomis and Chas. Simpson, of Wakita.

HARRISBURG, PA.—The United Telegraph & Telephone Company will make improvements to its system in Delaware County to cost $30,000.

UNION, S. C.—The Union Telephone Company has sold its system to J. F. Floyd, of Newberry. Mr. Floyd owns a number of telephone systems in the upper part of South Carolina.

McMINNVILLE, TENN.—The Citizens' Telephone Company will be ready for service in about ten days. The company was formed in opposition to the Cumberland company.

BRYAN, TEX.—The Bryan Telephone Company, capital stock $5,000, has been incorporated by J. S. Ford, Spencer Ford and H. M. Aubrey.

FORT WORTH, TEX.—The Texas Telephone Supply Company, capital stock $10,000, has been incorporated by W. D. Lasswell, L. J. Taylor and M. E. Martin.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has put in thirty new telephones at St. Anthony, Idaho, and there is a good prospect of some 50 more being installed.

SALT LAKE CITY, UTAH.—The Montana & Wyoming Telephone Company has announced that its line will be extended from Basin to Themopolis this summer. The company is the successor of the Red Lodge Telephone Company, the pioneer company of northern Wyoming. The extension announced is thought to be part of the scheme of the Rocky Mountain Bell Company to build a line through central Wyoming from north to south.

SMITHFIELD, VA.—The Home Telephone Company, composed of two previous concerns, has opened a telephone exchange at this place. J. W. Holladay is president.

BERRYVILLE, VA.—A telephone line from Bluemont to this place may be established. This would afford connection with Winchester, Martinsburg and Charlestown.

RICHMOND, VA.—The Constitutional Convention has defeated an amendment allowing telephone companies rights in cities without the consent of the municipalities.

SPOKANE, WASH.—Dr. Emil Dorn, of Chicago, wants the city of Spokane to grant him a franchise to operate a new and independent telephone system. Mr. Dorn promises to save subscribers 25 per cent on the present price; also to put all wires under ground.

EVERETT, WASH.—The franchise granted to J. E. Bell last April for the construction of a telephone and telegraph system in Everett has been transferred to the Northwest Telephone & Telegraph Company. The new company will put in a complete local and long-distance plant, with all late improvements. Six wires are to be strung between Everett and Seattle, and four between Everett and Whatcom. All the towns in the Northwest are to be reached by the new system.

BARABOO, WIS.—The [illegible] Telephone Company has been increased from $15,000 to $30,000.

OSHKOSH, WIS.—The Wisconsin Telephone Company will this year spend $90,000 on improvements here, including a new exchange.

ELECTRIC LIGHT AND POWER.

FOWLER, CALIF.—There is a proposition on foot to install an electric lighting and water works plant here, provided the people of the town will sign contracts for service.

SAN FRANCISCO, CALIF.—Plans are being prepared for a modern lightship for the guidance of vessels entering and leaving San Francisco. Powerful electric beacons will be provided for the vessel.

SAN BERNARDINO, CALIF.—The Edison Electric Company, of San Bernardino has secured from Judge J. L. Campbell an option of thirty days for the purchase of the franchise he secured about a year ago, for putting up poles and wires throughout the city.

ONTARIO, CALIF.—The Ontario Electric Light Company has received two new dynamos, which, when installed, will enable it to furnish 3500 to 5000 additional lights. It is said that this company has sold its entire plant to the San Gabriel Electric Company.

SAN FRANCISCO, CALIF.—The San Joaquin Electric Company of Fresno, California, will not attempt to redeem its property, which was recently ordered sold by the United States Circuit Court. It is said that when the bondholders take charge of the property, eight months hence, the plant will be greatly improved.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company recently transmitted electric power to San Rafael, Calif., where a lighting service will soon be in operation. Electric power from the same company's transmission lines will be used to operate electric motors for the extensive jute-bag works in San Quentin prison.

DIXON, CALIF.—This town is now lighted by current from the transmission lines of the Bay Counties Power Company. The local distributing system is handled by Mr. E. D. N. Lehe, the purchaser of the Dixon Light & Water Works. The citizens indulged in a public demonstration on the night when the new service was inaugurated.

SAN FRANCISCO, CALIF.—Mr. A. Sbarboro, the promoter of the new electric light and power system to be operated by the water power of Sulphur Creek, recently offered to purchase the old Albertz electric plant. He would remove the apparatus to Cloverdale, Calif., and operate it as an auxiliary steam plant in connection with the new water power plant that is to light Cloverdale and Asti.

SAN FRANCISCO, CALIF.—The San Francisco Gas & Electric Company recently held an eventful annual meeting resulting in numerous changes among the officials. William B. Bourn was elected president, A. H. Payson, vice-president, and A. D. Grimwood secretary. The election was considered a triumph for the faction led by Mr. Spreckels, and there is much speculation as to the future of the company in view of the tendency towards consolidation.

SAN FRANCISCO, CALIF.—According to the annual report of the San Francisco Gas & Electric Company, it has ordered an additional 1000-kw generating unit for its new electric power station. The engine, which will be direct connected, is being constructed at the Union Iron Works. The contract under which the company took a large amount of current from the Central Light & Power Company, will expire in February next. The profits for the year were $409,777. There was expended on improvements on the electric system $258,316. Gas rates were cut on account of the competition, but electric rates not to any extent. The sales of electric current amounted to 1,361,309 kilowatts. There was an increase of ten per cent in gas consumption. Oil fuel, at the present rates, effects a great saving in generating electricity.

SPRINGFIELD, ILL.—The Sattley Manufacturing Company has contracted with the Fort Wayne Electric Works for a plant to operate all its machinery and light the building. The plant will cost $7,000.

LAWRENCEBURG, IND.—The City Council has voted to lease the newly erected electric light plant for ten years at an annual rental of $3,800. At the expiration of that time the plant is to be deeded to the city for a consideration of $1.

INDIANAPOLIS, IND.—The Citizens' Heat & Light Company, of Indianapolis, has filed articles of incorporation. The company proposes to secure a franchise and put in a hot water heating and electric lighting plant. The capital is $10,000, and G. W. Eicholtz heads the board of directors.

HARTFORD CITY, IND.—The City Council has voted to accept the proposition of the American Light Company to purchase the electric lighting system of this city. The company is to reconstruct the plant and the city is to pay the company $9,600 a year for ten years, at the end of which time the city will become the owner of the property.

NEW ORLEANS, LA.—It has developed that a faulty municipal electric light ordinance which has been advertised for a month will have to be submitted to the proper committee and then published. The ordinance was for a ten-year franchise.

ST. LOUIS, MO.—As a result of complaints filed with the board of public improvements that certain electric companies are grounding one wire in their three-wire system, the board recently adopted a rule which provides that in three-wire systems all three wires must be cased in lead, and prohibiting companies from insulating two wires and grounding the return wire.

MOORESVILLE, N. C.—M. W. White desires to establish a local electric light plant here.

RALEIGH, N. C.—Work of stringing wires from here to Milburnie, where large water power is being developed, will begin soon. Machinery is now being placed at Milburnie and in all probability the plant will be in operation early in March.

FAYETTEVILLE, N. C.—John A. Oates, chairman of the Light Committee, has been instructed to get bids for all necessary material for constructing a line and putting in a municipal lighting system. The power will be brought from the falls of the Cape Fear River.

MIAMISBURG, OHIO.—The Miamisburg Water, Light & Power Company has been incorporated, with $100,000 capital stock.

[illegible], formerly of Xenia, Ohio, has purchased a controlling interest in the Delphos Electric Light & Power Company.

CIRCLEVILLE, OHIO.—After three years of differences, the Circleville Light & Power Company and the Town Council have agreed on a five years' contract. The company agrees to furnish 127 arc lamps at the rate of $62 per lamp per year.

FOSTORIA, OHIO.—The City Council is considering a proposition to buy the plant of the City Light & Heat Company. Theodore Wentz, of the Toledo, Fostoria & Findlay Railway, has applied for a franchise to furnish light for the city from the company's franchise.

GENEVA, OHIO.—The Geneva Illuminating Company has been organized by officials of the Cleveland, Painesville & Eastern Railway, to do lighting in Geneva. Charles W. Wason is president of the company. The company is building a new power-house at Geneva.

BARBERTON, OHIO.—Ohio C. Barber has submitted to the Council his proposed plan for supplying the town with water, electric light, gas for fuel and lighting purposes, steam heat and artificial ice. He proposes that the Council issue bonds in the sum of $300,000 to guarantee the building of a plant to have 3000 horse-power. Of this 1000 horse-power is to go for the production of the utilities mentioned and the balance to be sold to manufacturers at actual cost to induce new industries to locate here.

ORILLIA, ONT.—The town of Orillia has gone into the business of supplying electric light and power. It has developed a water power on the Severn River, about nineteen miles from the town, and has established a plant at a cost of $125,000. The town will be supplied with 750 horse-power from two turbine wheels and generators, and will furnish light and power at very low rates. The entire plant is owned and will be operated by the municipality.

CHATTANOOGA, TENN.—The Bristol Gas & Electric Company's plant and the Bristol Belt Line Railway Company have passed into the hands of a new company, and both are now under one management, with the following officers: Benjamin L. Dulaney, president; W. M. B. Emmert, general manager.

SEATTLE, WASH.—The Washington Water Power Company, of Seattle, is arranging to furnish electricity for lighting and power to Hillyard, Wash.

BALLARD, WASH.—An ordinance has been introduced in the City Council of Ballard granting a light and water franchise to W. W. De Long, S. E. Sanders and W. H. Peter.

COLVILLE, WASH.—W. L. Bowen, of Colville, has been granted a thirty-year franchise to maintain an electric light line between Colville and the falls of the Little Pend d'Oreille River, a distance of seventeen miles.

CHIPPEWA FALLS, WIS.—The Common Council and the Chippewa Falls Water Works & Lighting Company cannot arrive at an agreement on the contract price for lighting the streets of the city, and the Council is taking steps to either purchase the plant or build a new one. The company wants a ten-[illegible] to furnish estimates on the cost of erecting a new lighting plant.

THE ELECTRIC RAILWAY.

FT. WAYNE, IND.—The directors of the new Southwestern Interurban railway have elected the following officers: W. B. McKinley, president; G. E. Macomber, treasurer, and S. L. Nelson, vice-president and general manager.

DETROIT, MICH.—Prominent citizens of Windsor, Ont., are agitating the purchase by the city of the lines of the Windsor Street Railway. It is understood that the property is held as collateral security by two Detroit banks which furnished cash to the Everett-Moore people at the time the road was purchased last fall. The property has been paying 6 per cent dividends for the past ten years.

CLYDE, OHIO.—The Council has passed an ordinance giving franchise through town to J. C. Parker, promoter of the Sandusky, Clyde, Tiffin & Southern Railway.

CINCINNATI, OHIO.—Stockholders of the Ft. Wayne, Dayton & Cincinnati Traction Company have organized a company for the purpose of building and equipping the road.

CLEVELAND, OHIO.—The annual meeting of the Tuscarawas Traction Company was held a few days ago. F. T. Pomeroy is president; J. A. Rutherford, vice-president; William Aikins, secretary-treasurer.

CONNEAUT, OHIO.—The Erie & Eastern Traction Company has applied for a franchise in Conneaut. If granted, it is stated that the line will be built in the spring. It will complete a line from Erie to Cleveland.

COLUMBUS, OHIO.—The Wooster & Mansfield Electric Railway Company, with headquarters at Shreve, has been incorporated with $30,000 capital stock by David Collier, Wm. A. Craig, Jas. D. Keys, John Cheesrown and Brown T. Craig.

CLEVELAND, OHIO.—Directors of the Aurora, Elgin & Chicago met in Chicago a few days ago and elected L. J. Wolf, president; Myron H. Wilson, vice-president; Edward Dickinson, secretary, and M. J. Mandelbaum, treasurer, all of Cleveland.

HAMILTON, OHIO.—Stockholders of the Hamilton & Lindenwald Electric Transit Company and the Miamisburg & Germantown Traction Company will meet to vote on a proposition for the absorption of the lines by the Southern Ohio Traction Company.

CLEVELAND, OHIO.—At the annual meeting of the Cleveland, Painesville & Eastern Railway Charles A. Post succeeded W. W. Moore as treasurer of the company, his selection being made on the advice of the bankers' committee now in charge of Everett-Moore affairs.

TOLEDO, OHIO.—Directors of the Toledo & Indiana Railway have placed a contract with the Toledo & Indiana Construction Company, the terms of which call for the completion of the road to Wauseon by Oct. 1, 1902, and to Bryan by Sept. 1, 1903.

TOLEDO, OHIO.—Directors of the Toledo & Western Railway have elected officers as follows: Luther Allen, president and treasurer; F. R. Seagrave, secretary, and C. B. French, auditor. The directors decided to buy several more freight and passenger cars and to extend the road from Morenci, Mich., to Fayette, Ohio, early in the spring.

BUCYRUS, OHIO.—The Bucyrus, Upper Sandusky & Lima Railway Company has incorporated with $10,000 capital stock to construct an electric railway from Bucyrus to Lima, by way of Upper Sandusky, which will be the headquarters. Incorporators are George D. Whipple, Charles L. Schaber, Allen Smalley, C. D. Hare, George Kennan, Jesse Stephens and A. S. Stevenson.

JOHNSON CITY, TENN.—A charter has been granted the Johnson City Traction Company. The capital of the company is $45,000. J. H. Bowman, Adam B. Couch and others are interested.

WILLIAMSBURG, VA.—The Yorktown, Hampton and Poquoson and the Yorktown, Williamsburg & Jamestown Electric Railway have been organized, with H. N. Phillips, of Williamsburg, treasurer. It is reported that plans for building the proposed roads will be carried out.

pany reports for the year 1901 gross earnings of $171,172, as against $140,685 in 1900. Net earnings over operating expenses were $96,157, against $81,169 last year.

MILWAUKEE, WIS.—The Chicago & Milwaukee Electric Railway Com-

MADISON, WIS.—The people of Milton Junction are anxious to have the proposed Madison-Janesville interurban electric road run through their town and have requested P. T. Spooner, the promoter, to look into the feasibility of the plan.

KENOSHA, WIS.—It is reported that negotiations have been opened for the purchase of the Kenosha Street Railway Company's franchise in Kenosha. The deal is supposed to be made by a Cleveland firm seeking a road between Chicago and Milwaukee.

THE AUTOMOBILE.

THE MOBILE COMPANY OF AMERICA, of Tarrytown-on-the-Hudson, of which John Brisbin Walker is president, is contemplating an automobile service in St. Louis between the Union Station, the principal hotels and the World's Fair grounds.

ENDURANCE TEST.—The second annual 100-mile endurance test of the Long Island Automobile Club will take place on April 26, starting from Jamaica. It will be preceded by a "smoker" at the club rooms on the evening previous—Friday. Entries close April 21.

AUTOMOBILE OF AMERICA.—Henry C. Cryer, Jersey City, has been appointed receiver for the Automobile Company of America, which had capital of $5,000,000 and is now said by V. Everett Macy and other stockholders to owe [illegible] with no tangible assets. It has been building pleasure vehicles exclusively.

LEGAL.

AGAINST EXCESSIVE TAXES.—The Supreme Court of Ohio has decided against Tom Johnson's claim that the State Board of Equalization should raise appraisement of street railroad property for taxation purposes. The court holds that the Board has no such power, and dismisses Johnson's mandamus suit to compel the Board to act.

OBITUARY.

MR. FRANCIS A. PRATT.—We regret to note that Mr. Francis Ashbury Pratt, one of New England's best known manufacturers, fell dead from apoplexy while dressing one morning this week. He had been in poor health for some time. He was seventy-five years old, and in 1861, with Amos Whitney, founded the Pratt & Whitney Company. He retired from the presidency of the concern two years ago. He leaves a widow, a daughter, Mrs. Carrie L. Spaulding, and a son, Francis C. Pratt.

MR. E. M. PIERSON.—We regret to note the recent death at Newark, N. J., of Mr. Edward M. Pierson, father of Mr. H. G. Pierson, of Foote, Pierson & Company, New York City. The deceased was one of the pioneers in the electrical field, particularly in the manufacture of telegraph and telephone apparatus. He entered the service of the Western Union Telegraph Company in 1863 at Cleveland, Ohio, remaining with it two or three years, when he came to New York at the request of the late Mr. L. G. Tillotson to organize the manufacturing department of the well known concern of L. G. Tillotson & Company. He was associated with this concern and its successors, The E. S. Greeley & Company up to 1894, at which time, owing to ill-health, he was compelled to give up active business.

MR. D. W. BAKER, JR.—It is with deep regret that we note that Mr. Daniel W. Baker, Jr., son of the late Controller Baker of Newark, was instantly killed on Saturday afternoon, Feb. 8, by a trolley car of the Elizabeth line at Green and Broad streets, Newark. He was crossing the street with a setter at his heels, and had his head lowered on account of the wind, when he walked in front of the car, which was going at high speed, and went under the fender. He was engaged with his brother, Cyrus O. Baker, (master of transportation of the National Electric Light Association), in platinum refining, under the firm name of Baker & Company, in Newark. He leaves a widow. The motorman of the car was held on a charge of manslaughter. He could not explain the circumstances of the accident. The police have been unable to find any witnesses. A host of electrical friends proffer their sympathy with the family in this sad and sudden bereavement.

PERSONAL.

MR. WALLACE C. JOHNSON, [illegible] in connection with the Shawinigan power transmission [illegible] Canada [illegible] last week, is a native of Granville, Western Massachusetts. He spent two years at Williams College and graduated from the Worcester Polytechnic Institute in [illegible]. He was for two years an assistant at the Holyoke Water Power Company, of Holyoke, Mass., under Clemens Herschel, the well known hydraulic engineer. He then [illegible] Falls Hydraulic Power & Manufacturing Company, of Niagara Falls, which position he still holds. In the spring of 1898 he became consulting engineer for the Shawinigan Water & Power Company, and later chief engineer. He has had entire charge of the design and construction of the power-house for that company, as its chief engineer. As consulting engineer he outlined the general plan of its works. At present Mr. Johnson is consulting engineer for the Hannawa Falls Water Power Company, and for the Pittsburg Reduction Company. At all times during the past twelve years he has been in the general business of a consulting engineer for water-power work and has built a number of small installations, in addition to the above referred to. He is also at present general manager of the Albion Power Company, of Albion, N. Y., the Middleport Gas & Electric Light Company, of Middleport, N. Y., and of the Shawinigan Falls Electric Light Company, Shawinigan Falls, P. Q.



MR. WALLACE C. JOHNSON.

MR. LEON M. HALL, consulting engineer, San Francisco, has removed his offices from 331 Pine Street to Hayward Building, that city.

PROF. A. C. KELSEY has taken charge of the new telephone engineering department of Purdue University. He is a gentleman of extended experience in this line of work.

MR. MALCOLM W. FORD, the well known sporting writer, automobilist, etc., is now editor of the sport club, and technical departments of the *New Centaur Magazine* of New York City.

MR. C. W. MORSE, the controlling factor in the Telephone, Telegraph & Cable Company of America, denies that he has any intention of selling that company to the Bell Company.

LORD KELVIN was a member of the dinner party at the House of Commons on Feb. 6, at which Mr. and Mrs. C. M. Schwab were entertained. Mr. Joseph Chamberlain was also present.

MR. C. E. DONNATIN has been appointed superintendent of the mechanical department of the Los Angeles, Calif., Railway Company. He will have charge of the rolling stock, car shops, machine shops and storeroom.

MR. F. O. RUNYON is resigning on March 1 his position as engineer of the New York & New Jersey Telephone Company, to take up the work of consulting electrical engineer. His offices will be at 122 Market Street, Newark, N. J.

MR. AUGUST BELMONT, the president of the Rapid Transit Subway Company of New York, announces that it is not in any way interested or likely to be in the new Securities Company's plan for taking over the Metropolitan Street Railway system.

MR. HERMAN A. STRAUSS has resigned the post of assistant engineer of the Manhattan Elevated Railway Company, which he has held during the past two years, to engage in consulting electrical engineering work, with office in the Park Row Building, New York City.

MR. BRET HARTER, who has been associated as superintendent, electrical engineer, etc., of various electric railways in Michigan and New York State, has joined the engineering force of E. P. Roberts & Company, of Cleveland, Ohio. Mr. Harter is a graduate of Purdue University.

MR. E. D. LEAVITT, the well known engineer of the Calumet & Hecla Company, has designed for that concern a huge "sand wheel," operating 550 buckets at ten revolutions per minute. It will be driven by a 700-hp General Electric induction motor now being built for it at Schenectady.

MR. THOMAS L. TOWNSEND has severed his connection with Partrick, Carter & Wilkins to accept a position with the Vallee Bros. Electrical Company of Philadelphia, as general manager. It is with great reluctance and best wishes that the old concern parts with Mr. Townsend's services.

PROF. W. L. ROBB, of Trinity College, Hartford, Conn., has accepted the offer from the Troy, N. Y., Polytechnic Institute to organize an electrical department. Mr. H. A. Perkins, instructor in the Sloan Laboratory at Yale, is spoken of as his likely successor. He is a Columbia man.

MR. GEORGE A. WADDELL has been appointed chief electrician of the Merchants and Miners' Transportation Company, Baltimore, Md. Mr. Waddell is a student of the American School of Correspondence, of Boston, Mass., and adds another to the list of those who, coming from such institutions, are able to make a good place for themselves.

MR. C. P. BRUCH, the assistant general manager of the Postal Telegraph-Cable Company, is to be heartily congratulated on the latest publications he has prepared in regard to the old-time telegraphers. His official illustrated report of the Montreal meeting is one of the most interesting things of the kind we have seen and likely to be prized by all recipients.

MR. HENRY RUSTIN, mechanical and electrical engineer of the department of works of the Louisiana Purchase Exposition, addressed the members of the Engineer's Club of St. Louis, Mo., on the evening of Feb. 5 on the subject of the mechanical and electrical problems of the Exposition. Mr. Rustin's paper elicited a lively discussion among those present.

MR. R. LANCASTER WILLIAMS, of the firm of J. L. Williams & Sons, of Richmond, Va., will leave New York at the end of the month for England. He will study the trolley situation in that country, and on his report will depend the future investments of the Great Britain Railway Development Company, incorporated at Trenton, N. J. Mr. Williams is interested in many roads in the South and Southwest, and is a brother of John Skelton Williams, president of the Seaboard Air Line, and one of the directors of the new company.

EDUCATIONAL.

UNIVERSITY OF VERMONT.—The catalogue of the University of Vermont and State Agricultural College at Burlington, for the current year, gives the usual information of the different courses of instruction. At this institution there is an electrical engineering course which is quite comprehensive. The engineering laboratories have been well equipped with many standard electrical instruments and machines. Instruction is also given in photometry.

CARNEGIE LABORATORY FOR STEVENS.—Last week the new laboratory which Mr. Andrew Carnegie has presented to the Stevens Institute of Technology, Hoboken, N. J., was opened with considerable éclat. It is known as the Carnegie Laboratory of Engineering, and is devoted more particularly to electrical work. Mr. Carnegie has now sent a check for $100,000 to President Morton for endowment purposes. In his remarks at the dedication Mr. Carnegie said he owed his success in life to his ability to get around him men cleverer than himself.

Trade Notes.

REMOVAL.—The New York office of the Cutter Company, of Philadelphia, has been removed to 15 Cortlandt Street. Mr. G. A. Annable is the company's New York representative.

BUCKEYE LAMPS.—Mr. Bailey Whipple, of the Buckeye Electric Company, Cleveland, Ohio, reports a very prosperous business in the new type Buckeye lamps. He is at present devoting his attention to the larger trade.

OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York City, reports a growing demand and increased inquiry for its "Flexduct" tube for interior wiring. Mr. C. E. Corrigan is very much pleased with the outlook and states that the factory capacity is being increased.

THE HAYNES & NOYES COMPANY, of Chicago, which makes telephone apparatus for private exchanges and intercommunicating systems exclusively, has just issued a handsome catalogue of that apparatus. This company employs no traveling salesmen, and is so free from a heavy item of expense, but is well represented over the country by its advertising matter and its excellent catalogue.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt Street, New York, has recently secured the entire building running through to Dey Street, and in rear of its present quarters. This will about double its present store space and in addition to the recent large increase in its factory building in Jersey City will relieve much congested business which has recently grown beyond all expectations.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, it is said, is having a large demand for its new patented switchboard ringing and listening key, which it recently put on the market. The compact and durable construction of the "International" key meets the need for a short and narrow key for central energy multiple and toll line switchboards, with its contact springs of a proper length to avoid breaking under heavy use.

FOSTORIA LAMPS.—The Fostoria Incandescent Lamp Company, Cleveland, Ohio, reports a large increase of business in extra quality Fostoria inner globes. It has given particular attention to this product and brought it to a high state of perfection. Mr. Wm. Rothschild, of the Fostoria Company, has just returned from an extended Southern trip and reports electrical business in general and Fostoria lamps in particular as being on a flourishing basis.

HART & HEGEMAN SWITCHES.—In a note printed recently in this column, it was stated that the Hart & Hegeman Manufacturing Company, of Hartford, Conn., has announced that all Hart rotary switches will hereafter be supplied, should the purchaser so desire, with a new type of "on" and "off" indicator free of charge. It should have been further explained that the indicator consists of a dial which turns under the cover, the words "on" or "off" coming opposite an opening in the cover.

SELF-INDICATING FUSES.—In the description of the D. & W. self-indicating fuses which appeared in the issue of last week, an error of the engraver rendered one of the cuts meaningless. One of the cuts shows the fuse after it has blown, as indicated by a black mark within a circle. The second cut was intended to represent the fuse before it was blown, and should have shown the circle of the first cut lacking the enclosed black mark. By an error of the engraver, this circle was routed out.

REMOVAL.—The office of the secretary and general manager of the Sills-Eddy Mica Company was moved on Feb. 1 from the company's factory at Newark to the Broad Exchange Building, New York. This company reports good prospects for the year 1902 and a good year's business just closed. In addition to a large mica trade, it manufactures the well known brands of Micabeston and Imperial insulation. It is believed by many that compressed mica insulation is equal in every respect to solid mica. Its use is rapidly growing.

EMERSON FAN MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., is among the first concerns to bring out a fan motor catalogue for the season of 1902, a copy of which has just reached us. It contains 64 pages and is artistically illustrated with views of many styles of motors and ceiling fans for alternating current. The information given about these machines is very complete and concise, and is well arranged for reference. The catalogue is handsomely gotten up, and is printed in three colors, making a very attractive piece of work. Among other recent literature of the Emerson Company is a telegraph code and terms of sale (bulletin No. 3000) and a bulletin on automatic start induction motors for low frequency single-phase current.

Record of Electrical Patents

[illegible] PATENTS ISSUED FEBRUARY 4, 1902, [illegible] New York.

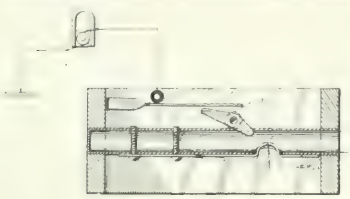
692,236. ELECTROMECHANICAL DEVICE FOR ELECTRIC TRACTION; E. Cantono, Rome, Italy. App. filed Aug. 2, 1899. A device for steering vehicles whereby the speed of the motors on each side of the vehicle is altered relative to each other at the same time that the vehicle is turned.

692,260. INCANDESCENT LAMP; H. Garwood, Ottawa, Ohio. App. filed Sept. 9, 1901. A lamp having a number of filaments of different candle-power, one end of each connected with successively arranged contact pieces in the neck, and a sliding plug adapted to be moved to engage with any one of the contact pieces, and thus throw a desired filament into circuit.

692,[illegible]. [illegible] LAMP; H. [illegible], New York, N. Y. App. filed May 2, 1900. A glass rod or handle is made in one piece with the lamp bulb, the leading-in wires extending through the full length of the handle, thus providing a lamp which can be used readily for surgical explorations and at the same time be thoroughly cleansed and sterilized without injury to the lamp or fixture.

692,298. POSITIVE ELECTRODE FOR ACCUMULATORS WITH CONSTANT ELECTROLYTE; E. V. Gungner, Stockholm, Sweden. App. filed March 16, 1900. A positive grid composed of a metal not acted on by the electrolyte (alkali-metal hydrate solution, of which the metal may be nickel) is coated with a mass of finely reduced silver and silver chloride. Mixed with the silver is any of its salts, such as the sulphate or nitrate. The mixture is pressed and dried, after which the electrode is heated up to or beyond the fusing point of silver chloride and then immersed as a cathode in an electrolyte composed of a solution of alkali-metal hydrate, whereby the chlorine is removed and pure silver remains in a coherent mass. The electrode is then placed as the anode into a new bath of alkali-metal hydrate, whereby the silver is converted partly into oxide of silver and partly into peroxide.

692,318. COIN OR METAL DETECTOR; F. E. J. Litot and A. Mayer, Pittsburg, Pa. App. filed July 5, 1895. The inductive effect of primary coils upon secondary coils is varied by the insertion of coin or different metals between them which have different specific inductive effects; the variation [illegible] and [illegible]



692,471. Electric Annunciator.

current in a relay which closes the circuit of a mechanism to automatically separate the good coin from the bad or the different kinds of metal.

692,348. SYSTEM OF ELECTRICAL DISTRIBUTION; E. B. W. Reichel, Steglitz, Germany. App. filed Oct. 2, 1899. (See Current News and Notes.)

692,352. CONTROLLING APPARATUS FOR ELECTRIC MOTORS; W. J. Richards, Milwaukee, Wis. App. filed April 27, 1901. Details of construction devised for the purpose of preventing arcing between the contact pieces to automatically stop and start a compressor motor at predetermined maximum and minimum limits of pressure, to govern the operation of a number of motors by a single primary switch, as well as to perform other functions.

692,395. RAIL BOND; M. F. Whiton, Hingham, Mass. App. filed June 27, 1901. The bond is composed of a laminated strip having flat feet and an intermediate extensible portion, the layers being soldered together and embraced by a sleeve to close the side openings between the layers. The sleeve prevents the escape of the solder when heat is developed for any reason in the bond.

692,[illegible]. ELECTRIC HEATER; [illegible] Bachmann and A. von Vicmetz, Austria-Hungary. App. filed Dec. 12, 1899. The heating resistance is placed in circular grooves in a plate, the grooves being inclined or undercut to hold the wires in place, and after the wires are deposited therein, are filled with a material of the same nature as that of which the plate is made.

692,421. TAKE-UP DEVICE FOR TROLLEY CORDS; S. J. Buckland, Springfield, Mass. App. filed March 6, 1901. The device normally takes up the ordinary slack of the cord, but when the trolley leaves the wire, a take-up device becomes effective in putting into operation a winding mechanism to draw the trolley down.

692,422. WATER SHED OR DEFLECTOR FOR TROLLEY POLES AND ROPES; S. J. Buckland, Springfield, Mass. App. filed Sept. 30, 1901. A water shed consisting of a looped piece of metal inserted in the cord near the pole to prevent water from running down the cord.

692,423. ELECTRIC SIGNAL; C. Budke, Jr., St. Louis, Mo. App. filed Oct. 7, 1901. Details.

692,[illegible]. [illegible] FOR SIGNS, ALPHABET AND PRINTING TELEGRAPHY; L. Cerebotani, Munich, Germany. App. filed March 8, 1900. The arrangement is such that on depressing the necessary key the latter remains in position until it has caused the sign to be transmitted. This is effected by a cylinder commencing to rotate on the key being depressed and by contacts being made during the rotations corresponding to the letters to be transmitted. The key then springs up again and the cylin[illegible]

692,[illegible]. ELECTRIC SWITCH; J. D. Clay and F. A. La Roche, New York, N. Y. App. filed Aug. 22, 1900. An overhead switch operated by a cord passing over a drum having a crank pin connected with the movable part of the switch.

692,429. ELECTRIC SWITCH; H. J. Cogswell, Hartford, Conn. App. filed March 2, 1901. A pair of blades connected to the opposite sides of the center of a disk by links, so that on rotating the disk a half turn the blades will be simultaneously thrown into or out of connection with the contacts.

692,[illegible]. APPARATUS FOR THE PREVENTION OF SPARKING AND ARCING IN ELECTRIC CIRCUITS; H. H. Dow, Midland, Mich. App. filed March 13, 1899. A device capable of generating a counter electromotive force is switched into the circuit across the break the moment the circuit is opened.

692,433. ELECTROLYTIC ACCUMULATOR; C. P. Elieson and V. De Bobinsky, Paris, France. App. filed May 15, 1901. Very thin bands or strips of lead, alternately corrugated and straight, are united together by a central core of lead, being similar in appearance to a bird's feather. This construction is strengthened by a frame, which is, however, completely insulated from the electrode and may itself be of insulating material.

692,458. ELECTRIC LAMP SOCKET; S. A. Koltonski, Boston, Mass. App. filed Dec. 1, 1899. The binding screws which hold the end of the wires are so placed in the socket that they can be reached with a screw driver through the open end of the socket, without the necessity of removing the metal casing.

692,471. ELECTRIC ANNUNCIATOR; E. B. Overshiner, Chicago, Ill. App. filed Nov. 9, 1900. The jack is constructed to automatically restore the drop when the plug is withdrawn.

692,475. AUTOMATIC CIRCUIT BREAKER; C. Reynolds, Columbus, Ohio. App. filed Oct. 10, 1901. A circuit breaker for air compressors embodying a cylinder and piston which compresses a spring attached to the armature of a magnet; when the air pressure reaches a maximum point the tension of the spring overcomes the attraction of the magnet and breaks the circuit.

692,507. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed June 20, 1901. (See Current News and Notes.)

692,509. ELECTRIC CLOCK; M. Fischer, Zurich, Switzerland. App. filed Sept. 3, 1901. The clock is regulated by an armature which is moved out of the field of a permanent magnet by the train and drawn back again by the attraction of a magnet to thus provide the necessary movement for the escapement.

692,519. TROLLEY HARP; A. Johnson, Quincy, Ill. App. filed Oct. 10, 1901. Contact springs which bear upon the opposite sides of the wheel are held in place by a tapered plug at the base of the harp.

692,529. HANGER FOR AERIAL CABLES; G. J. Knittle, Wheeling, W. Va. App. filed Sept. 10, 1901. A sheet metal strip adapted to embrace the cable and the suspending wire.

692,531. ELECTROLYTIC CELL; E. A. Le Sueur, Rumford Falls, Me. App. filed March 8, 1898. An alkaline metal as it is set free by electrolytic action is absorbed by one side a mass of mercury and continuously separated from the other side of the mercury, so that as fast as the alkali metal enters the mercury it is removed therefrom and converted into the required hydrate.

692,533. ELECTRIC SIGNALING DEVICE FOR PREVENTING RAILWAY COLLISIONS; G. Del Monaco, Triest, Austria-Hungary. App. filed Sept. 4, 1900. Details.

692,554. CHAIR FOR THERAPEUTIC PURPOSES; J. J. Stanger, Ulm, Germany. App. filed June 26, 1900. The chair is fitted with tubes through which electrically charged liquids can be directed to the various parts of the body of a person occupying the chair.

692,579. ELECTRIC GONG; J. A. Wotton, Atlanta, Ga. App. filed June 8, 1901. A pivoted electromagnet carrying the hammer vibrates between the poles of a permanent magnet. The electromagnet carries two windings through which the current is alternately directed.

692,580. ANNUNCIATOR; J. A. Wotton, Atlanta, Ga. App. filed June 10, 1901. Details.

692,688. APPARATUS FOR PRODUCING FLUORINE; M. Meslans, Paris, France. App. filed Nov. 10, 1900. A copper partition separates the anode and cathode cells, the partition being electrically connected with the anode and having openings below the normal level of the electrolyte. The partition is immersed in a refrigerating tank whereby any vapor of hydrofluoric acid is condensed and returned to the electrolyte. The partition becomes coated from the commencement of the electrolysis, with a layer of fluoride of copper, which protects the same.

692,690. MOTOR FOR RAILWAY DEVICES; H. D. Miles, Detroit, Mich. App. filed March 12, 1901. A motor for operating railway signals, switches, etc., is provided with air-tight inclosures to shield it from moisture, ice and dust.

692,[illegible]. COMBINED ELECTRIC SWITCH AND SPARK BLOW OUT MECHANISM; [illegible] Portland, Oreg. App. filed June 17, 1901. Details.

692,[illegible]. STATIC ELECTRIC MACHINE; H. B. [illegible], Meriden, Conn. App. filed May 11, 1901. A supplemental plate mounted in close relation to the main generator plate and turning with the latter, is used in connection with the ordinary driving, supporting and collecting devices.

692,[illegible]. CONTROLLING APPARATUS FOR ELECTRIC MOTORS; F. E. Brush, New York, N. Y. App. filed April 27, 1901. A modification of [illegible]

692,[illegible]. TROLLEY STAND; O. F. [illegible], Ypsilanti, Mich. App. filed Aug. [illegible]. [illegible] the other, the trolley pole being under spring tension when in any position except the vertical.

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TELEPHONE JOKES.

The admirable little address by Mr. J. J. Carty before the New York Electrical Society on the occasion of its visit last week to the new Cortlandt Street telephone exchange brought out very clearly the enormous expense and the great amount of work necessary in keeping the system up in efficiency and on a scale commensurate with the growth of the population and the needs of the community. It has always seemed to us that the New York telephone service aimed consistently at a high standard, and succeeded in attaining it, while the adoption of the measured basis put that service within the reach of everybody who would rather telephone than travel. In the course of his interesting remarks Mr. Carty touched indirectly upon the share of the public in getting good results, when he referred to the foolish practical joking with which the lines were often burdened. As he said, last year the calls for Mr. Fish at the Aquarium were so numerous while the joke was fresh and victims were plenty, that they had to put on extra operators to intercept the messages. We happen to know of cases where Mr. Stiff has been asked for at the Morgue, and during the present wintry week Messrs. Snow and Frost have been residuary legatees for kindred tomfoolery at the telephone number of the Street Cleaning Bureau and other similar addresses. It is all very funny, of course, but it is just that joking and loading the lines and operators with unnecessary work that militates against satisfactory service. Fortunately, the measured system of payment for each call stops much of this wretched foolery, but there are still lots of telephone users willing to pay 5 or 10 cents to "make fools" of other people, and to block business. Quite unfairly the reproach for it all falls upon the system that suffers from it.

THE EFFECT OF ELECTRIC WAVES ON THE HUMAN BRAIN.

The article of Mr. A. F. Collins on page 335 contains a number of interesting suggestions. It opens avenues by which the obscure subject of telepathy may be logically reached, as well as the possibilities in the horizon of electro-therapy. The only danger lies in drawing conclusions too hastily. Electric waves permeate all matter, except the best electric conductors. In permeating and traversing matter, these waves must produce some effect, however small it may be. The brain of an animal, regarded as a mass of material, is capable of being traversed to some extent by electric waves, and such waves as may traverse it must produce some effect in transit, however small the effect may be. The only question is to what extent do the waves permeate it, and how much influence can they produce. The influence might be very considerable, and yet be of such a nature as not to become manifested, either objectively or subjectively. Or the influence produced by the electromagnetic waves passing through the substance of the brain upon that substance, might be so infinitesimally small as to produce no significant effect.

Mr. Collins adduces certain experiments upon the living head of a cat to show that electric waves, produced in the neighborhood of the animal, brought about observed electric changes in the head. Granting that the experimental results are correctly described, it does not necessarily follow that those changes would have occurred in the said head if the testing apparatus or electric detecting apparatus had not been applied to them. In other words, the application of the electric apparatus to the head may have so modified the conditions, that the electric waves obtained access to the interior of the head in a manner which would otherwise have been impossible. Holes were drilled in the skull of the animal and wires introduced

into the holes. Wires are the things which catch, entangle and lead electric waves, and it is, therefore, unsafe to conclude that because with such wires applied to the lining membranes of the skull electric effects were found to follow each set of waves produced by the oscillator, therefore the same waves without any wires would have produced the same results.

The brain is invested by highly vascular tissues and is a highly vascular substance. The external vascular tissues contain blood which is a fairly good conductor, and consequently the brain is shielded to a certain extent, although perhaps only to a limited extent, from external electromagnetic wave action. If this shield be virtually removed, by leading wires into the brain for the purpose of detecting coherer changes, it is immediately open to question how far those changes are *propter hoc* instead of *post hoc*. We think, therefore, that broadly speaking, electromagnetic waves must produce some effect on the brain, and that possibly these effects may be very appreciable under certain favorable conditions; also that Mr. Collins may have observed some of these effects. Such experiments should be made with the greatest care. The more such experiments are made, and the greater care that is taken in making them, the more interesting and valuable the results will be. Meanwhile, if any persons are found to be in real danger of their lives from electric waves in thunderstorms, as Mr. Collins believes is sometimes the case, the right thing to do is to shut them up during the storms in a tightly closed metal box, with a grating ventilator, just as we shut up the receiving coherer in the neighborhood of wireless telegraph sending apparatus. We fear, however, that the demand for such thunderstorm electric shelters is not likely to be sufficient to render the business of their manufacture profitable.

The Light of the Enclosed Arc.

The interesting note on a spectro-photometric study of the enclosed arc which we print this week forms an appropriate complement to Dr. Bell's preliminary study published Feb. 1. Mr. Smith's comparisons show in a most striking manner the remarkable differences in light distribution between the light of the sky and that from the enclosed arc on one hand and the Nernst lamp on the other. It must be remembered, of course, that skylight is wonderfully different from sunlight in color value. The selective absorption and reflection from small particles that give to the sunset its crimson and to the sky its blue, indicate a very wide departure from the normal light distribution of the solar spectrum. This is very conspicuous in the comparison between the Nernst lamp and the sky. On the showing there made, if the skylight were white the Nernst lamp ought to show a deep orange. On the contrary, the latter, weak as it apparently is in the blue, is really fairly near to white as compared with ordinary average sunlight, while the enclosed arc is strikingly bluish white.

One of the curious and interesting features of color photometry is the absence of any practical color standard. Sunlight may be anything from a rather bluish white to orange or orange red, and a spectro-photometric comparison made with sunlight depends on the altitude of the sun and the clearness of the air. It would be of no small value to science if in the list of necessary photometric work the constitution of a normal color standard could be placed [illegible] the photometric experts have a plentitude of troubles already, but we really need their help. The word white, for instance, ought to mean, by general convention at least, one definite and reproducible thing. At present we not only lack a satisfactory standard of intensity, but one of color as well, and there is plenty of work cut out for investigators who, like Mr. Smith, have the skill and the ap[illegible]

The Jubilee of a Great University.

As we go to press there is being held at Baltimore a notable cel[illegible] bration at the Johns Hopkins University, marking a full quarter cen[illegible] tury of notable work, and, unhappily for the institution, the retir[illegible] ment of its distinguished president, Daniel Coit Gilman. Dr. Gi[illegible] man has been an unique figure in the progress of American educ[illegible] tion. He assumed the initiation and development of Johns Hopkin[illegible] University at a time when American universities were a bywor[illegible] and with few exceptions American colleges were strangled by hid[illegible] bound conservatism. University, to the ordinary American layma[illegible] meant merely the addition of a law school, a theological school ar[illegible] a school of pharmacy or dentistry to a narrow sectarian foundatio[illegible] where the trustees insisted on having a good sectarian before a goo[illegible] instructor. Every student who hoped for better things and longed [illegible] pursue his studies after taking his baccalaureate degree head[illegible] straightway for Germany, there to unlearn what he had been taug[illegible] here. Dr. Gilman took up his great work with different and high[illegible] ideals, and thanks to a far-sighted and liberal board of trustees, he ca[illegible] ried them out with the strong courage of his convictions. He took h[illegible] stand for academic freedom and learning for its own sake and steadil[illegible] tactfully, if need be stubbornly, maintained it through sunshine ar[illegible] storm. If public opinion hampered him he held his ground and wo[illegible] it over. Through every difficulty he persisted, always keeping th[illegible] one strong ideal before him, and now, after a quarter of a centur[illegible] in laying down his task to assume the direction of an even great[illegible] one, in large measure made possible by the stimulus he had given [illegible] scientific education, he may well look back with pride on his achiev[illegible] ments.

Johns Hopkins University occupies an unique place in Americ[illegible] education. It represents perhaps more fully than any German un[illegible] versity, because of fewer trammelling traditions, the Germanic co[illegible] ception of academic freedom. It stands apart from all other Amer[illegible] can institutions in the dominant influence of the purely post-gradua[illegible] work over the university and its whole environment. There are, [illegible] course, some few institutions in which there is no undergradua[illegible] work, but no one of them has carried so strong a general influen[illegible] for university ideals. Perhaps the strongest evidence of the fund[illegible] mental character of the institution is the fact that the one criticis[illegible] which could fairly be passed upon the post-graduate student body [illegible] an excess of feverish activity, of over haste, in plunging into wor[illegible] The present celebration sees a gathering of graduates that represen[illegible] the influence of the university on American education to an exte[illegible] that could hardly be paralleled. The new president, Dr. Ira Remse[illegible] has the universal indorsement of the alumni, and is amply fitted [illegible] take up the work where Dr. Gilman lays it down. Of late years th[illegible] Johns Hopkins University has suffered severely from lack of fun[illegible] due to the depreciation of its investments, but Baltimore has sto[illegible] staunchly behind it, and if we mistake not generous friends will [illegible] this time see to it that its valiant work in the cause of science sha[illegible] not go unrewarded. The work of Rowland alone has been enou[illegible] to justify the whole foundation, and others no less distinguished [illegible] their respective fields of research have joined in giving the Unive[illegible] sity a reputation of which the country at large may well be proud.

Static Strains in High-Tension Circuits.

The paper read at the recent meeting of the American Institu[illegible] of Electrical Engineers upon the subject of the static strains to whi[illegible] high-tension circuits are subjected, is interesting, as showing th[illegible] growing tendency to raise the pressure of long-distance electric tran[illegible] mission circuits, and to introduce resemblances between such circu[illegible] and frictional electric appartus, or high-tension electric apparat[illegible] generally. At the present time, the insulators and modes of insul[illegible] tion of wires and transformers on long-distance transmission lin[illegible]

suggest a partial return to frictional electric apparatus, as developed by Franklin and others in the eighteenth century before the advent of the voltaic cell and voltaic circuit. It is evident that there are two difficulties to be dealt with in high-tension circuits, so far as static strains are concerned. One is the static effect of lightning or of disturbance from without, and the other is the static effect of sudden changes of load, or of disturbance from within. The surges due to lightning are not confined to high-tension circuits, but the higher the normal pressure of the circuit the more difficult becomes discrimination between abnormal stresses due to lightning, and the normal stresses due to the working machinery. It becomes difficult to educate lightning arresters to operate properly on high-tension circuits. These effects of lightning are always a source of difficulty in all transmission circuits.

The surges due to internal causes are, of course, more readily capable of control than those due to lightning. As regards underground lines, there seems to be but little danger from surges, at pressures hitherto employed in practice. In overhead lines the surges are more serious, and more likely to occasion a breakdown of the system. The protective devices recommended in the paper are condensers and choking coils. Of these it would seem that the condensers are the better safeguards against short circuit or accidental current change, because they absorb the electrostatic energy, and reactance coils are the better safeguards against sudden potential changes because they absorb the electro-magnetic energy. Consequently, as the sudden current changes appear to be the more formidable of the two dangers in practice, it would seem that the condensers are the more important adjunct. An interesting fact alluded to in Mr. Thomas' paper was the rapid increase of the leakage current and energy loss in condensers attending a rise of temperature. It is known that the condenser may be made the most efficient of all known apparatus for a given activity or energy storage capacity. The loss of energy in them is partly hysteretic and partly due to conductance. It would be interesting to ascertain how elevation of temperature affects these two components.

Magnetic Clutches and Induction Motors

In one of the discussions before the recent Northwestern Electrical Convention, it was suggested that the magnetic clutch offers a satisfactory solution of the problem of how to run electric elevators and apparatus of a similar nature with induction motors. Indeed, Mr. Rau spoke quite confidently to the effect that the elevator problem is solved by the use of the magnetic clutch. Aside from its use in the Arnold central station arrangement, the magnetic clutch has been little applied in larger work, but we understand that at least gratifying progress has lately been made in the development of such devices for use with large motors. The idea, of course, in employing a magnetic clutch in elevator work is to allow the motor to run constantly, and connect it with the elevator machine through the medium of the clutch. The motor would in such case start its full load while running at full speed, and while working with a better power factor than when exerting full torque from a state of rest, thereby obviating the extreme current and voltage fluctuations which are the horror of the central station man, and have caused him to consider the induction motor as it has been applied in the past out of the question for electric elevator work if run from mains used to distribute both light and power. In rough-and-tumble mine work where regulation is a secondary matter, the induction motor is commonly geared directly to a hoist and is started and stopped by means of a controller, which inserts resistance in the armature or rotor circuit at starting. This appears to be the method which offers the least interference with the line voltage of any that has been devised if the motor itself is geared directly to, and starts with, the load. The scheme is, however, hardly applicable to modern elevator service, and the same may be said of the plan of belting an induction motor to the old-fashioned elevator machine formerly used to operate freight elevators from constantly driven line shafts through friction clutches.

If the development of magnetic clutches can really bring about the placing of the induction motor, either polyphase or single-phase, on an equality with the direct-current motor for operating electric elevators and for intermittent work of a similar character, it would mean much to the art of electric light and power distribution for all purposes by one uniform system of alternating current. Aside from intermittent work of the electric elevator character, present alternating-current systems of light and power distribution, either by polyphase or single-phase currents, have demonstrated themselves to be entirely applicable to general distribution of light and power upon a uniform plan suited to all common uses, without the use of rotary converters. The present existence of large direct-current networks in many large cities with a great number of direct-curent motors connected thereto, is claimed to make any but the direct-current distribution system out of the question in such cities. There are, however, plenty of other smaller cities and towns where the chief present objection to the use of polyphase current distribution for all purposes, both light and power, is the difficulty in starting loaded induction motors without destroying the regulation of voltage over the system. Central stations will, therefore, be apt to maintain their 500 and 220-volt power circuits to take care of elevators and similar service until some method of running them by induction motors can be devised which will be as satisfactory as the operation of elevator motors off the direct-current three-wire network in large cities. If the direct-current service is maintained for the elevator work, many other motors will probably be connected on the same circuit to give the generator a load, but even this does not overcome the many objections to having two classes of generators and circuits. Again, in some of the smaller towns there is sometimes enough business in sight to warrant running 24 hours, and give a day service for light and power, provided all the service can be supplied from one generator, but not otherwise. In such cases there is not likely to be any electric elevator load, but there is apt to be, in the aggregation of local industries to which power can be supplied, some intermittent business of a similar nature which the development of a magnetic clutch would make easily handled, and in many cases determining whether the power service could be undertaken with profit.

From the standpoint of the designer and inventor, the magnetic clutch would seem to offer many advantages over the purely mechanical clutch, not only in simplicity of control from a distance, without the intervention of rods and levers, but in ease of regulation. All who have had to operate mechanical clutches know how hard it is without close attention to apply the mechanical force necessary to operate the clutch steadily and without jerk. Not only is the human hand likely to be unsteady in applying the pressure, but no matter how steady the man, the unevenness in the working of the clutch mechanism makes it difficult to apply the clutch so as to obtain an even torque. With a magnetic clutch there would be a definite current supply for each position of the controlling handle and means to regulate the torque afforded by the motor in starting the machine to whatever maximum might seem desirable without leaving it to the judgment of the operator. This feature would prevent the use, through carelessness, of the excessive current it is so desired to avoid in starting, and perhaps would be fully as valuable in reducing the starting current from the fact that the motor would run at full speed and best power factor when exerting its greatest torque.

New York Central Railroad Plans for Electricity.

It was doubtless to offset certain rumors that Senator Chauncey M. Depew and J. Pierpont Morgan, directors of the New York Central, called upon Mayor Low on Feb. 18 and were with him nearly an hour. Corporation Counsel Rives took part in the conference. The Mayor gave out the following memorandum, which he said contained all that was of public interest in connection with the conference:

Mr. Depew and Mr. Morgan called to-day to say that the New York Central Railroad desires to co-operate with the city in every proper way in improving the conditions in the tunnel, and it will give to the Mayor any formal assurance that may be required of its intention to substitute electricity for steam as rapidly as practicable. In the meanwhile it proposes to submit its present plans and to confer with the Corporation Counsel as to the legislation required to permit it to substitute electricity for steam.

Reports have been given wide circulation that the elaborate plans for the adoption of electricity with which the New York Central Railroad had been filling the columns of the daily papers were merely a "bluff." It was said that the company had no serious intention of using electricity at all, and wished merely to save time by satisfying popular clamor on the subject. In support of these assertions, various schemes have been attributed to the management, all based upon the rejection of electricity. It will now be noted that the company has made its promise as to electric traction as formal and definite as possible. Meantime, Mr. Bion J. Arnold has been actively engaged by the company as its consulting electrical engineer, and no small amount of work has already been done in investigating the data connected with the subject.

In this connection, other rumors have recently been in circulation as to what the Central would do if it adopted electricity, and its name has been mentioned in connection with proposed Manhattan and Metropolitan deals. It is asserted that the Central could obtain from one or both of these without difficulty all the current needed for the operation of the tunnel, and upon this hypothesis has been built up a scheme crediting the Central with an underlying intention to control the local transportation system of New York City. In recent movements of the stock of the Manhattan and Metropolitan companies, the names of the Vanderbilts, Mr. Morgan and the New York Central have been freely used.

Electrical Engineers of the Day—XXXIV.

A. M. HUNT.

Andrew Murray Hunt was born at Sioux City, Iowa, in 1859. His early education was received in the common schools of Sioux City and Indianapolis. In 1875 he was appointed to the Naval Academy as cadet engineer from the State of Indiana, and was graduated near the head of his class four years later. During his naval career he served at sea as engineer officer on the warships "Powhattan," "Tennessee," "Richmond" and "Atlanta," and the Fish Commission steamer "Albatross." During his service ashore, he spent one year as instructor in mechanical engineering at the Orchard Lake Military Academy, Mich., two years as steel inspector in Pittsburg, and one year as member of the Naval Steel Inspection Board. The appointment of an officer so young on the latter board at a period when its functions were of unusual importance, was a well-deserved recognition of the thorough mastery Mr. Hunt had made of the subject of his duties during his previous service on steel inspection. While inspector of steel, Mr. Hunt had charge of the chemical work in this line, and was frequently called on to report on the composition of special metals procured by representatives of the Navy Department abroad.

While attached to the "Albatross," he was called on to investigate an obscure case of disintegration and pitting of the condenser tubes on the United States steamer "Baltimore," to carry out which he started the chemical laboratory at the Mare Island Navy Yard, which since that time has been regularly used in testing materials furnished to the Navy Department on the Pacific Coast.

In the Fall of 1893, while chief engineer of the "Albatross," Mr. Hunt was detailed as chief of the department of mechanical arts for the Midwinter Fair in San Francisco, at the expiration of which duty in July, 1894, he resigned his commission and entered into partnership with Mr. W. F. C. Hasson as consulting engineers in San Francisco, Calif. While connected with this firm, he was identified with much of the early transmission work on the Pacific Coast, including the pioneer Sacramento-Folsom transmission plant, the high voltage transmission plants of the Nevada County Electric Power Company and the San Gabriel Electric Company, and the transmission plant for Victoria, B. C. He also installed a number of steam-driven isolated plants, and had direct charge of the important work connected with the conversion of the cable roads of Los Angeles to electricity.

The winter of 1897 and 1898 was spent in Alaska, where he built four steamers for service on the Yukon River. Mr. Hunt's resource and ability to carry out work under difficulties were particularly displayed in this undertaking. These four boats, 225 ft. long and 40 ft. beam, were built in five months' time, in a country where there were no shops, and where lumber and other materials had to be rafted ashore, and in a climate where snow and cold were a serious handicap.

In January, 1899, Mr. Hunt resumed consulting engineering work in association with Mr. E. H. Benjamin and Mr. Wynn Meredith. In April of that year, he was appointed consulting engineer for Mr. Claus Spreckels in the erection of the plant of the Independent Electric Light & Power Company in San Francisco, which is one of the model city lighting and power plants of the world. This plant is located at a distance from the center of the city, and has installed about 20 miles of underground cable, transmitting current at 11,000 volts to sub-stations. Subsequently, he became general manager of the Independent Company, which now has an installed capacity of 6500 kw, and later also general manager of the Independent Gas & Power Company, which is just completing a new plant.



Mr. Hunt still retains his connection with the "Engineering Offices," on the staff of which he has also associated Professor C. L. Cory, dean of the College of Mechanics at the University of California. The combination of men associated under the name of "Engineering Offices" is thus particularly strong, including engineers of large experience in all the lines of engineering work carried on in the Pacific territory. In the past three years, the above-named offics have installed complete the plant of the Truckee River General Electric Company, a transmission plant of 1500 kw capacity; that of the Keswick Electric Power Company, a plant of 2250 kw capacity, and supervised the first year's work of the Yuba Electric Company, from which the well-known Bay Counties Power Company has grown. Much minor work has also been done by the firm. While the greater portion of Mr. Hunt's time is absorbed by the two companies, of which he is general manager, he takes an active part in the work of the "Engineering Offices," the success of which is in no small degree due to his advice and supervision.

Mr. Hunt is essentially an engineer in all that the word implies, uniting sound judgment and technical knowledge with great capacity for detail and conscientious regard for the interests placed in his care. In addition, he is possessed of executive ability of a high order, as has been particularly demonstrated in his construction work at Los Angeles and San Francisco, and his work in Alaska. Mr. Hunt is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Society of Naval Engineers.

The Dalles, Oregon, Transmission Plant.

By Arthur Seufert.

THE beginning of the corporation which recently completed The Dalles 20,000-volt transmission plant goes back to Sept. 11, 1883, when the Wasco Warehouse Company was formed for the purpose of engaging in the wool business and in forwarding and storing general merchandise. In 1890 another corporation known as The Dalles Electric Light & Power Company, was formed for the purpose of furnishing light and power. In 1901 the above corporations were consolidated into the Wasco Warehouse Milling Company, having a capital stock of $300,000, and composed of leading business men and bankers. It having been decided to build a flouring mill at The Dalles of a capacity of 700 barrels a day, the question arose as to what to use for power. It was quickly decided that electric power was the most feasible, as within a few miles there are many undeveloped waterfalls, among which may be mentioned one at Hood River, 22 miles west; another at Klickatat River in Washington, 20 miles west; the Celilo Falls in the Columbia River, with a fall of 34 ft., about 12 miles east; the Des Chutes River, 18 miles east, and the White River, a branch of Des Chutes River, 27 miles south. After careful examination of all, the latter was decided to offer the most advantages, including lowest cost for development, and in 1901 a contract was let to the Pacific Bridge Company, of Portland, to develop the power and build the generating plant. Work was started in August, 1901, and the plant was to be completed before Nov. 15, 1901, but through unforeseen delays it was not ready for operation until Jan. 5, 1902.

The plant is situated as a bird flies, 27 miles south of The Dalles at White River Falls in Wasco County, Oregon. There are two falls in the river at the head of the works, and the power station, which is of stone, 30 by 60 ft., is at the bottom of the second fall. The plant is placed 10 ft. above the level of the river, and utilizes a head of 131 ft., the 10 ft. insuring there will be no interference through freshets in the river. At the head of the falls there is a concrete dam 8 ft. high, from which the water is carried in a wooden flume 54 inches in diameter and 1200 ft. long laid with one foot fall to a hundred, and delivering a head of 119 ft. at the waterwheel pit. There are at present three waterwheels, two of which are direct connected to two three-phase 500-kw, 2300-volt generators, operating at 60 cycles, and of a current capacity of 126 amperes each. The other wheel is direct connected to a 30-kw exciter. This wheel is also in reserve for another generating machine in case business requires its output. The waterwheels were made by the Knight Waterwheel Company, of Sudder Creek, Calif., and the electrical apparatus by the General Electric Company. The current passes through three 400-kw step-up transformers of the air-blast type, in which its voltage is raised to 22,000. The transformers are connected in delta, and are cooled by air furnished by a blower, a second blower being held in reserve. There are three oil switches.

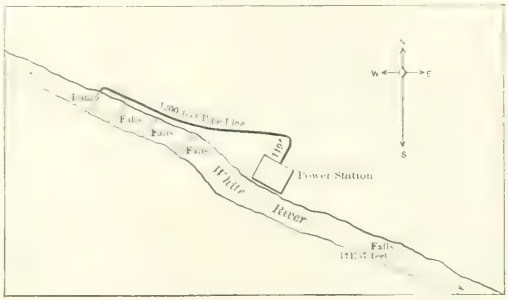


FIG. 2.—MAP SHOWING LOCATION OF PLANT.



FIG. 1.—WHITE RIVER FALLS.

The line is 27 miles long, and of No. 6 B. & S., bare copper wire on glass insulators. The conductors are transposed every mile. The main line poles are 35 ft. high, and those in The Dalles 60 ft. high, all being of cedar with 8-inch tops. There is a telephone line 6 ft. below the high-potential line, transposed every five poles. No inductive effect whatever has been noticed in telephone transmission.

The sub-station at The Dalles is built of brick, the dimensions being 27 by 45 ft. It contains three transformers, each of 375 kw, air-cooled under a pressure of ⅝ ounce by a blower, a second blower being held in reserve. The voltage is here reduced to 1100 for distribution. There is also one 35-light constant-current 6.6-ampere transformer. The high-potential switches are of the oil-break type, mounted in a brick vault. There are also two oil-break switches on the low-potential circuit.



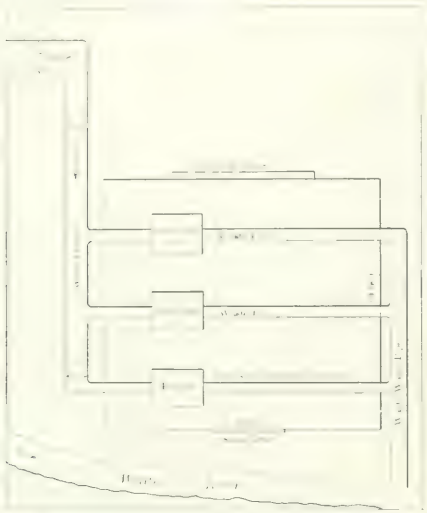
FIG. 3.—SUB STATION, THE DALLES.

The 35-light transformer is for street lighting, the arc lamps used being of the enclosed type and of 1200 cp, all connected in series. The lamp takes about 72 volts at the arc.

The flouring mill has two induction motors, one of 200 hp and one of 50 hp, operating at 1040 volts. The larger motor runs the mill, and the smaller one operates the elevator. The city lighting circuit

has a voltage 1040 volts, which is stepped down to 104 volts for incandescent lighting.

The plant so far has given perfect satisfaction, and from all appearances will continue doing so. There is at present a surplus of 700 hp. Fig. 1 shows the White River Falls. The generating station is on the left side of the view, but does not show in the picture,



as it is situated considerably below. Fig. 3 shows the sub-station at The Dalles. The chimney of the old steam plant which had to give way to the new one, is shown to the left.

Note on the Spectrum of the Enclosed Arc.

By Wm. Lincoln Smith.

On page 195 of Electrical World and Engineer for Feb. 1, 1902, appears a brief article by Dr. Louis Bell upon the spectrum of the enclosed arc. Dr. Bell called my attention to this spectrum on the evening of the day upon which he observed it, and the brilliant character of the carbon bands interested me greatly. Being engaged upon a considerable piece of research work and having ready at hand a Konig spectrophotometer, it occurred to me that it would be interesting to examine the arc with that instrument, and see how the results would fit in with Dr. Bell's Knowing, however, of his intention to print his observation, I did not feel justified in printing an account of my measurements until his article had appeared.

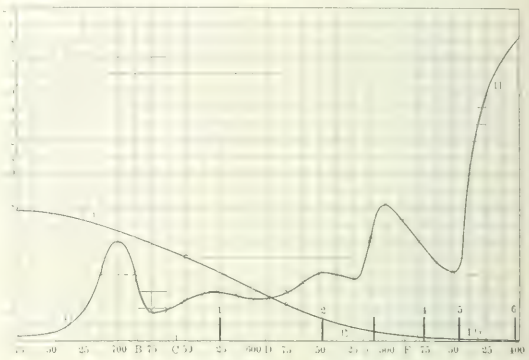
In the electrical laboratory of the Massachusetts Institute of Technology, where I was at work, were set up a number of enclosed arcs of various types convenient for the purpose at hand, and of these I selected a General Electric constant-current alternating lamp adjusted for 6.6 amperes, 70 volts at the arc and a frequency of 55. It was fitted with a light opal enclosing globe 3 inches by 6.5 inches, and a clear outer globe 11.5 inches by 12 inches; the carbons were ½ inch Electra, the upper solid and the lower cored. The lamp was running with several others on a constant-current transformer of the same company, fed from a large Mordey alternator carrying no other load, and the steadiness was excellent. As a comparison lamp, I used a 220-volt, three-glower Nernst lamp, sent me by Mr. A. J. Wurts. I had fitted this with a screen having a little window of the same opal glass as was used on the arc.

The accompanying chart will show the results obtained with clearness. Abscissæ are wave lengths and ordinates ratios of lamp under test to standard. The locations of several of the more important of the lines in the solar spectrum are indicated, and the heavy black lines indicate approximately the centers of the bands shown in the cut in Dr. Bell's article and are numbered to correspond.

Curve I. gives the ratios of the Nernst lamp to the clear overhead sky as determined on Jan. 27 at about 2.15 P. M. It had rained the lamp with its screen was at a distance of 1 ft. from the slit of the instrument. It will be seen that under these conditions the intensity of the Nernst is about 0.8 that of the sky in the lower red and falls to about 0.01 in the region of the *G* line. I used the sky for reference because it seemed to me that it was a less variable thing than the sun itself, provided that it was not veiled with clouds and the sun was a reasonable distance above the horizon, especially when it had just cleared off after a rain.

Curve II. gives the ratios of the arc to the Nernst. The latter was again 1 ft. from the slit and the arc at 4 ft. delivering its light horizontally. Under these conditions the ratio of the arc to the Nernst at the *B* line is 0.4, and at the *G* line it is 1.3.

There are distinct maxima at abscissæ 700, 625, 550, 500 and 400. Of



SPECTRUM OF THE ENCLOSED ARC.

these the second, third and fifth coincide with Dr. Bell's first, second and sixth bands; the first lies wholly below his limit of the *B* line; the fourth is apparently due to the joint effect of his third and fourth bands, and there is none corresponding to his fifth band.

I was careful in taking readings to do so only when the arc was playing between the same points on the carbons, as nearly as one could judge, but some variation, of course, occurred, and may account for exception at band No. 5. At any rate, the curves are not without interest and show clearly enough why these arcs are so good photographically.

I would say in closing that the curves obtained from a 220-volt enclosed arc are something fearful and wonderful to see. They are not plotted here because of the widely different scale of ordinates required, the ratio at the *G* line being in this case 6.9, while at the *B* line it is only about 0.6, not very different from the one here shown.

Telephony in Arizona.

Great telephone development has been made in Arizona in the past year. There are now in the Territory 36 exchanges and public offices, with 1476 telephone connections. All of these stations are connected by toll lines. In the same time the Pacific States Telephone & Telegraph Company has erected 108 miles of copper toll lines, and has put in 712 new telephones. During the past 22 months the company has built 418 of long-distance toll lines in Arizona. A large gang of men is engaged at Tucson installing a new plant.

The Arizona system is as yet isolated to a degree, having no through connection outside of the Territory. As soon as material is available the company proposes to extend its line eastward from Redlands, Calif., to Phœnix, Arizona, via Yuma, thereby connecting the Arizona and the Pacific Coast systems. This will give patrons in the Territory through communication with Los Angeles, San Francisco and all the cities and towns of California, as well as opening to them Oregon and Washington as far north as the Canadian lines, and portions of Idaho, Utah and Nevada.

The company also proposes, within the coming year, to extend its main lines north from Jerome to Flagstaff, north from Florence to Globe, and east from Nogales to Bisbee, taking in intermediate points of importance. It is expected that on the completion of these extensions the Rocky Mountain Telephone Company will reach out to some point in Northern Arizona—probably Flagstaff—and establish a connection with its service.

The Effect of Electric Waves on the Human Brain.

BY A. FREDERICK COLLINS.

DURING the month of September I made a series of experiments, demonstrating that the brain cells of man and animals exhibit a marked "coherer" effect under the action of electric waves of the Hertzian order.

The encephalons employed ranged from those of mammals of the lower type represented in the feline family to the highest, typified in man. The purpose of arranging these tests was to verify, if possible, the casual observations long since made that approaching electrical storms manifested their presence in persons afflicted with certain forms of nervousness and other pathological conditions, though the storm influencing them might be many miles beyond, or even below, the horizon.

To accomplish this task it was necessary, of course, to decide conclusively that electric waves exercised some behavior or produced a change, molecular or otherwise, on the brain cells, and finding this premise true to then inquire into the nature of the phenomenon resulting from such action, and, finally, to ascertain the physiological consequences proceeding therefrom.

There are other maladies besides nervousness that are extremely susceptible to the disturbing atmospheric electrical agencies, and the two most common ones are gout and rheumatism.

Upon the barometric readings of an old gentleman I once know, who foretold approaching storms with an accuracy equal to the best meteriological apparatus by means of his "bad leg," as he called it, I formulated the opinion that the connection between the storms and his bodily self was real, in fact, as real as though he and his enemy were connected by a metallic conductor, though many seemed to believe, like Boscovitch and his followers, that the storm acted at a distance on his offending nether member without the aid of intervening matter to convey the impressions, or as Lord Kelvin tersely puts it, "that matter can act where it is not." This solution was as widely divergent from the truth as that confessed by the most ignorant who attributed his prophesies to some supernatural agency.

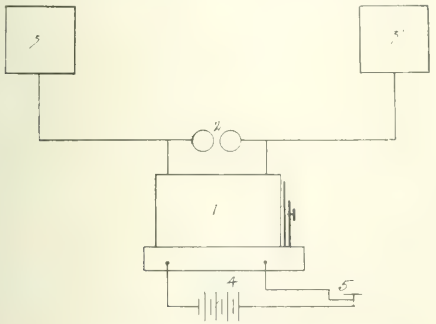


FIG. 1.—DIAGRAM OF WAVE-EMITTING APPARATUS.

After observing the case just cited, I studied many similar ones, some less marked, others more serious, and finally one came under my notice that had a tragic ending.

A little girl of eight years, residing in Germantown, a suburb of Philadelphia, during the month of August became *apparently* frightened as the heavy disruptive discharges of an electrical storm approached, and as the terrific crashes sounded simultaneously with the flashes she was thrown into convulsions, and when a moment later the lightning struck a house a quarter of a mile distant, the child expired. Now see: it was not the lightning that killed the child, and, in my opinion, it was not fright, but a deeper, far more subtle agency, and in this there is food for thought. The coroner did his duty in returning the verdict that her death was caused by "shock and convulsions, due to fright." On the surface of the post-mortem and in view of the fact that at the time nothing was known absolutely concerning the action of electric waves on brain matter, his statement was perfectly justifiable. The daily papers said the child was suffering from heart trouble, but this I ascertained was incorrect. I then formed the hypothesis that, not only in this, but in every case the waves acted on the brain cells first and the other physiological effects followed as a natural sequence, and I believed then, before I made the tests, as I do now, that the fright exhibited by this little girl was only an outward physical expression of the change registered by the cells, and that the real cause could be logically attributed to the preculiarly strained tension of the brain matter, and that death was the secondary product of this result.

The experiments of Herr Heinrich Hertz, which lead to his discovery of stationary electrical waves as are those of M. Edward Branly on the effects of the Hertzian waves acting on the variable contacts formed by filings of metals so well known that they need not be repeated here. Suffice it for me to say that I merely carried out the theory and practice of Hertz and extended the researches of Branly on the action of electric waves to the realm of physiological matter.



FIG. 2. APPARATUS EMPLOYED TO SEND OUT WAVES.

The apparatus I employed for emitting the waves was similar to that designed and used by Hertz in his later experiments wherein he used a coil of small proportions. Mine was somewhat smaller, giving a 2-cm. spark, and was constructed by Queen & Co., of Philadelphia. Fig. 1 shows the general arrangement of the oscillator, spark-gap, battery and key: 1 is a Ruhmkorff coil with the ordinary mechanical interrupter, 2 the spark-gap formed of two brass balls 12 mm. in diameter, and connected with the terminals of the secondary, as shown, and directly joined to the terminals of the secondary are the capacity areas 3 and 3′, made of sheet zinc 1 mm. in thickness, and its other dimensions measuring 14 cm. each. This arrangement gave, when the waves were reflected by metal mirrors to effect interference, wave lengths of approximately 30 cm.

To the primary coil a storage battery 4 supplied the energy and the current from this could be arbitrarily made and broken by means of the key 5.

The photograph (Fig. 2) shows the apparatus in operation, in which *A* is the coil, *B* the battery, *C* the key, *D* the spark-gap and *E*, *E′* the capacity areas forming the oscillating system of the disruptive discharge. By means of the detector apparatus shown in the diagrammatic drawing (Fig. 3), I was enabled to determine that the brain matter, when subjected to the radiations of the emitting apparatus produced a "coherer" effect, i. e., a change in the normal resistance. This apparatus consisted simply of two dry cells *A* connected in series with a telephone receiver *D*, although this was occasionally substituted for a galvanometer of the d'Arsonval type, the

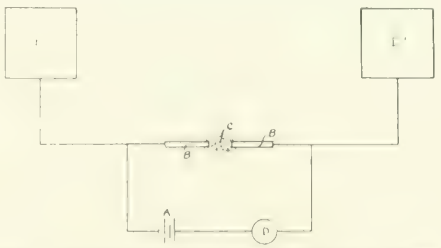


FIG. 3.—DIAGRAM OF LITTLE WAVE RECEIVING APPARATUS.

coherer plugs *B* and *B'*, the brain cells are, in the drawing represented by the dots *C*. While no attempt at "tuning" was made, the zinc plates *E, E'* forming capacities, of the same shape and size as those of the emitter system, were employed in nearly all the experiments, although sometimes they were omitted.

In the first test I obtained from my butcher the brain of a freshly killed mammal. Into this mass, so unlike the human brain, I inserted two glass armored needles at a distance one from the other of 4 cm, and found that the inert assemblage of dead cells offered a tremendous resistance to the current from the two-cell battery, and I also noted that the effect of electric radiation was *nil*. While the test was disappointing, still the outlook was encouraging, since the results coincided with the action of the waves on loose metal filings, as in the early experiences of Calzecchi. I bethought me to cut down the distance between the needles, and these were then inserted into the brain, devoid of form or convolution at a distance of 1 mm. apart, and crudely adjusted until the telephone told me the resistance was not too great. Now, the key was pressed again, and as the disruptive discharge oscillated to and fro, emitting electric waves of great frequency, the characteristic sounds of cohesion could be distinctly heard in the receiver, almost exactly as when the standard [illegible] Fig. 4A was inserted instead of the brain.

Here the keynote had been struck, and the results obtained offered something more than a mere incidental phenomenon to be wondered at and forgotten. In the above statement I mentioned that the sound audible in the telephone receiver caused by the cohering brain cells and that produced by granular carbon were similar, and that both are characteristic. Now, carbon granules, be it known, when sub-

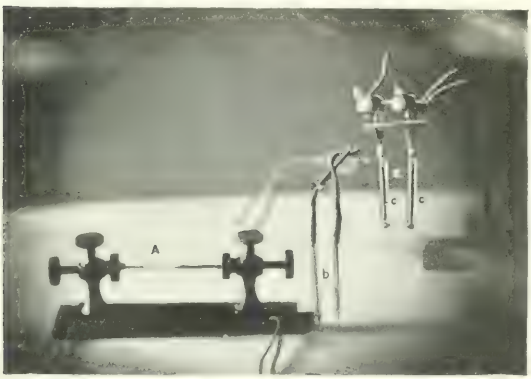


FIG. 4.—COHERER AND EMITTER SYSTEMS.

jected to the radiation of electric waves, cohere only while the waves are acting upon it, but immediately the influence is removed or even weakened, the particles de-cohere, or in the terminology adopted by those engaged in wireless telegraphy it is self-restoring or "self-righting," which means that without tapping or other extraneous means the particles de-cohere. For this reason I chose the type of coherer shown in Fig. 4A as the standard, with which to compare the subsequent results obtained with the brain matter.

The brains from the abattoir, though fresh in the sense that decomposition had not set in, were two or three hours old, and it seemed to me that the experiment should be tried upon a brain immediately it was removed from the cranium.

With this idea in view, I laid the results obtained as well as the object of the tests, together with my plans and hopes, before Dr. Rotzell, lecturer on zoology and anthropology of the Hahnemann Medical College, of Philadelphia, and who resides near me in Narberth, and with his approval and co-operation I was able, the following morning, to operate on the brain of a feline in my laboratory within 30 minutes after respiration had ceased and the heart had stopped beating. In these experiments I was assisted by Mr. Warner, a third-year medical student. The brain was removed from the cat's skull at the doctor's place and transferred to mine in a vessel containing water. The tests were not as satisfactory as the previous ones, but this was probably due to the surface moisture short circuiting the local battery current.

However, the sounds of cohesion were distinct enough to warrant varying the tests, and we decided upon some control experiments. These were performed within a few days, and there were present Dr. Rotzell, Mr. Charles B. E. Taylor, of Germantown, and myself.

Another cat, under the influence of an anæsthetic, willingly lent itself to the subject for the investigations to be made on brain matter in the living state. The doctor made an incision with his scalpel extending the length of the frontal bone and at right angles to it. Laying the skin back the cranium was exposed; two holes, 1 mm. apart, were carefully drilled through the frontal. These were 5-10 mm. in diameter, and the depth so gauged that even the *dura mater*, or outer membranous lining separating the brain from the bone, was not disturbed. The needles were now inserted—these representing the coherer plugs—and the key of the wave emitting apparatus was closed at intervals of one-half second. The sounds of cohesion were decisive, especially after the serum was dried away with absorbent cotton. When the key was opened the brain regained its normally high resistance like the carbon granules of the standard coherer.

Varying distances between the dissecting table on which the cat lay and the wave-emitting apparatus was arranged and tried, but within the small confines of the laboratory no position could be obtained where the brain was not subject to the waves.

While the table was being moved about, the key of the emitter apparatus became accidentally closed and a flood of electric radiations went forth, which, had they been of the visible instead of the invisible spectrum, they would have filled the room with light. Mr. Taylor was at this moment administering more ether to the cat, for it showed evidence of awakening. Grasping its spinal column just below the *medulla* with his left hand he held in his right the cone containing the etherized cotton. Anæsthesia was quickly accomplished. Mr. Taylor then called my attention to a vibrating movement at the base of the brain, when both Dr. Rotzell and myself noted in turn the phenomenon. There was a spasmodic twitching of the muscles just as a Du Bois-Reymond or "shocking" coil would produce. When the electric waves were intercepted or cut off the muscles regained their normal tension. After consultation, in which Dr. Rotzell represented the case in its physiological aspect, Mr. Taylor as arbiter and myself in the capacity of electrician, we came to the conclusion that the manifestation was the result of the following causes:

It is well known that there is no apparent physiological effect from a direct current of small amperage and low voltage, except, as Du Bois-Reymond has shown, when the current begins to flow and when it ceases to flow, or upon the make-and-break of a very feeble current an excitability of the nerves produce results analogous if not exactly identical to those which took place. In a carbon coherer, where the granules are under pressure, the resistivity and conductivity will increase alternately, while the waves may be emitted constantly. This increase and decrease in effectiveness of the waves is, very likely, due to the oscillations of the discharge, the first swings producing waves of much greater energy than the final swings which are damped down until they reach zero.

In the phenomenon under investigation this is what evidently took place. The brain cells cohere with the waves emitted by the first few oscillations, and then de-cohere to a certain appreciable extent, when the waves were enfeebled by the last few oscillations, as the discharge was restoring the potential between the secondary terminals of the induction coil. This process, it seemed to me, acted as a make-and-break of very great rapidity, and so gave rise to the electro-nervous excitability and its attendant muscular action. This seems much more reasonable than the theory that the direct action of the waves themselves exerted this influence, although it would be easier to reconcile this latter hypothesis with the one offered in advocating the cause and effect of the waves on living brain matter advanced in the beginning of this argument. The solution of the problem is to be found in assuming that the e. m. f. of the battery is replaced in life by nerve force, with which it is often compared. It is true the cat was alive, but there is no doubt that the nerve force is greatly nullified by the administered anæsthetic. While these are yet theories to be sifted by further experiment, the fact is clearly established that electric waves act on and cohere brain matter not only after the change in it by death, but also *while it is in the living state*.

Having demonstrated this, it follows in logical sequence that the same effects would be apparent in the human brain, though there is considerable difference in the formation of the cells as well as in mass of the brain of man when compared with the lower animals.

To experiment with a living human brain under the conditions ob-

tained with the cat is, of course, impossible, or nearly so, but it is not impossible, however difficult to procure a human brain immediately after the death of its physical affinity—the body.

Upon the advice of Dr. H. L. Prince, the well-known pathologist of Philadelphia, I designed a coherer especially for the purpose of obtaining accuracy of adjustment, which was not possible with the armored needles previously used.

It is shown in detail in the drawing (Fig. 5), and in perspective in the photograph (Fig. 4*c*). As the illustrations show it is formed with parallel legs of sufficient length to permit the contact points *a*, *a'* to be sunk into any portion of the brain. The points are 5-10 mm. in diameter and 2 mm. long, hard soldered at right angles to the brass legs *d*, *d'*, and these in turn are securely attached to the brass levers *j*, *j'*, which are fitted with binding posts 6, 6'. Through the orifices of the binding posts slides the wire *K*, having a thread cut on the right-hand end. A milled screw thereon gives a micrometer adjustment between the two platinum terminals *a* and *a'*. The last

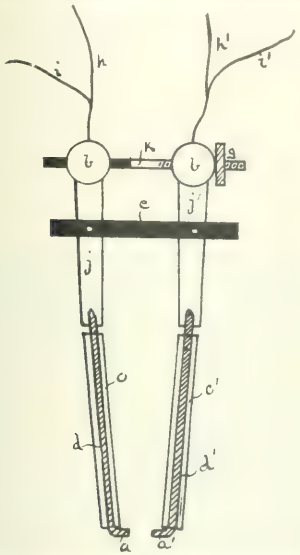


FIG. 5.—SPECIAL DESIGN OF COHERER FOR BRAIN EXPERIMENTS.

is a piece of hard rubber. The brass legs *d*, *d'* are protected with armors of glass tubing sealed at the top and bottom. The wires *h*, *h'* lead to the resonator plates when they were used, and the sub-terminals *j* and *j'* to the telephone receiver or galvanometer and to the battery, as shown in the diagram (Fig. 3). With the details of these simple apparatii in mind, let us turn to the human brain. A brain, when death has eliminated its spiritual affinity from the grosser physical form, is of little worth to any one, except the anatomist. The beautiful psychological functions of the brain can be better studied when it and the body it represents are endowed with that indescribable life principle. Yet, clay though this wonderful organ is in death, it is a most difficult object to obtain. A brain prepared for the anatomist could not, it is indisputable, be employed in the succeeding tests, for if treated with formalin or any other preservative it would represent no longer its original elementary parts, but a combination of extraneous chemicals with it, and our tests with electric waves would be valueless. None but a fresh brain could be used if accuracy is aimed at. That the nature of the experiments may be the better understood, it may be well to say something of the anatomy of the brain itself.

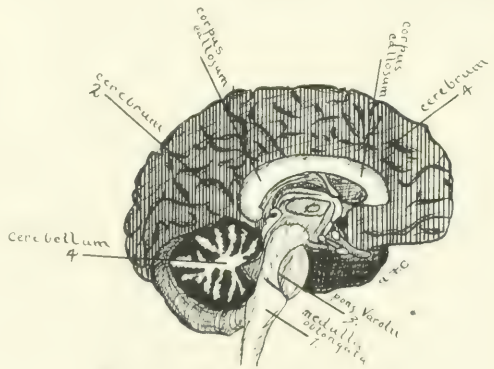
The human brain or encephalon is the central axis of the nervous system, and through it the physiological machinery responds. The spinal cord is connected with the brain at its base, and from these two great centers branch the nerves in every direction. Fig. 6 shows a cross section of the brain. The *medulla*, 1, is an uninterrupted portion of the spinal column; the *cerebellum*, 2, lies directly behind the *medulla* and a little above, and is continuous with it. The *pons*, 3, lies above and in front of the *medulla*, and likewise continuous with it; the *cerebrum*, 4, is the larger mass above the *pons* and *cerebellum*, with both of which it is directly connected. Without entering into a detailed anatomical description of the various parts it will be necessary to describe them broadly inasmuch as the phenomenon forming the subject matter of this statement, and the brain are closely allied.

The brain and other portions of the nervous system are composed of two kinds of homogeneous tissue known as gray and white matter. There are occasionally minute masses of gray matter in isolated places, and this is called *ganglia*. This is the active element, and apparently the source of nervous force, or if the analogy is permissible, the battery supplying the vital principle. The white matter composes the fibers or nerve tracts for transmitting the impressions, the conductors by which the nerve force sends and receives its messages.

The *medulla* is made up of two parts, and these are subdivided into elongated fibers composed chiefly of nerves. The gray matter of the *medulla* contains many nerve cells, and in it originate several important brain nerves. The *pons varolii*, or bridge, like the other portions, consists of gray cellular matter, and the fibrous white matter, the latter passing through the *pons*, both transversely and longitudinally. These cross directional nerves connects the hemispheres of the *cerebellum*, so that they are virtually continuous with each other. Those parallel with the length of the *pons* arise from the *medulla*, and those entering the *pons*, emerge from it at the surface nearest the *cerbrum*. The *cerebellum*, or little brain, is divided into two hemispheres and a central lobe. On cross section the *cerebellum* presents a tree-like appearance. It is connected to the *cerebrum* above and to the *medulla* below by nerve fibers. The external surface of the *cerebellum* is apparently sub-divided into numerous thin plates caused by fissures, thus giving it the appearance of laminæ. Both white and gray matter are present, the first forming the cortex of the laminations and the latter branching off from a common center to the exterior. *Ganglia* are also found in the interior of the organ. It is claimed that the auditory nerve as well as the sensory roots of the fifth cranial nerve are of *cerebellar* origin.

The gray matter of the exterior surface of the *cerebellum* is separated into two layers, the outward of gray and the inner of a rust color containing granules and invested by protoplasm or microscopic cells.

The *cerebrum*, or great brain, is marked in the human anatomy with prominent convolutions upon its surface and comprises six-sevenths of the entire brain. From the *pons* two white fibrous bands enter the hemispheres on either side. The optic nerves find their origin in the nervous tracts of matter which converge in front. The cortex of the *cerebrum* is of gray matter, and upon horizontal dissection the gray matter of each convolution is found to have a core of white matter. Lateral cross-section shows five or more strata,



CROSS-SECTION OF HUMAN BRAIN.

and these in turn are composed of pyramidal nerve cells, of nerve fibers, of matrix and blood vessels.

Closely allied with the nerve cells are minute nerve corpuscles and fusiform cells are found imbedded in the lower layers of the gray matter. These general notes on the brain will suffice to make clear the following observations of electric wave action upon it.

On a certain afternoon a magnificent specimen of a human brain came into my possession immediately after its removal from the cranium, and within a few hours after the death of the physical body. It weighed 1250 grams. Here the individual convolutions were

in marked contrast with those of the lower animals, and every part was developed to a high degree. Upon reaching my laboratory the brain was placed on a glass insulating slab, and its electrical resistance measured. The needles were inserted in either hemisphere of the *cerebrum* at a distance 8 cm., and to a depth sufficient to obtain good contact without reaching the white matter. With a Wheatstone bridge it was ascertained that the resistance was normally over 5000 ohms, which, when Ohm's law is taken into consideration, is a very high value. The coherer was then adjusted as well as the emitter apparatus, and I made a number of tests to determine what special portion, if any, was most sensitive to the effects of the radiation. First the coherer was inserted into one hemisphere of the *cerebrum* to a depth of 2 or 3 mm., so that contact was made with the gray matter only. Fig. 6 shows the arrangement of the coherer relative to the brain in the test just mentioned. The result was similar to those previously obtained in the lower animals. Slicing a horizontal portion from the upper part of the hemisphere, the coherer was next inserted in the mass of white matter forming the core. The sound of cohesion was less marked than in the previous test with the gray matter. Different portions of the white and gray matter were tried, but with similar results. The *medulla oblongata* did not yield results as satisfactory as the gray matter of the convolutions of the *cerebrum*. There was little difference between the calculations of the *cerebrum*, and the white and gray matter of the *pons*. The different layers of the *cerebellum* were next tried, but the rust-colored layer containing the granules produced the greatest coherer effect, while in the *medulla*, where the nerves center, the effect of the electric waves was less marked than in the other portions of the brain. All the above tests were made with the brain intact, except where it was necessary to operate on an interior portion, when dissection was resorted to. The calculations thus obtained were made on the day the brain came into my possession. On concluding, I immersed the inert mass in a 6-10 of 1 per cent solution of chloride of sodium, this representing very closely the natural alkaline solution, not only of the cerebral cavities, but the physiological body as well; surrounding the first vessel was a second containing ice. The purpose of this solution was to preserve the brain with as little recourse to artifice as possible. The following day there was no appreciable deterioration. Now, instead of employing the special coherer I used the standard coherer shown at *A* (Fig. 4). After removing the carbon I then inserted in the glass tube minute masses of the gray and white matter of the *cerebrum*, of the *cerebellum*, *pons*, and the *medulla*, as well as the granules of the rust-colored layer of the *cerebellum*, and then the coherer plugs were oppositely adjusted by means of screws, the brain matter taking the place of the ordinary carbon powder in the coherer. The action was more marked when a slight pressure was brought to bear on the brain matter, but as in metal filings it was *nil* when too much pressure was applied, and if considerable pressure was applied the cellular matter became semi-liquid. As in the preceding trials with the brain in its entirety the granules of the rust colored layer proved the most sensitive. In the brain, when examined under the microscope, these granules consist of well defined nucleus invested by delicately branched protoplasms.

The cross sections of the brain matter used in the coherer tube were accurately measured, and were 1 mm. in diameter and 1 mm. in length, and the resistance of varying portions was from 5000 to 11,000 ohms, although this divergence was, very likely, due to the difference in pressure applied by the coherer plugs, and not to the structural difference of the parts compared.

In conclusion, I intended to once more measure the resistance of the brain as a whole to ascertain if possible the relative differences in electrical resistivity the deterioration 24 hours would produce. The needles were inserted in the opposite hemispheres of the brain, as previously described, and connected with the terminals of a Queen testing set. It was with some astonishment I found I could not balance the bridge arms. After an approximate balance the needle suddenly swung to + without apparent cause, showing hundreds of ohms too much, and an immediate second deflection to the — showing hundreds of ohms too little, without the removal or insertion of a plug. This state continued a few minutes, when a peal of thunder awakened me to the actual cause. A storm was approaching. The battery and galvanometer key was held in contact every alternate second at one second intervals, and as the storm approached the deflections grew more and more pronounced, the needle quivering at either end of the scale alternately, as though endowed with life. The very phenomenon I sought to verify with a 2 cm. spark coil was here produced by the lightning itself. I placed the needles closer together in the *cerebrum*, and the deflections of the needle gave an absolute demonstration of the energy transmitted by the electric waves from the lightning.

To exclude the probability of the waves acting on the galvanometer system I measured a 1-ohm coil, and in this no difficulty was encountered. When the storm was at its height I substituted a telephone receiver for the testing set (Fig. 7), and through it and the medium of the brain came three sounds like the cooling of a piece of red-hot metal quickly submerged in water. Lightning had struck a house a quarter of a mile away, down in the valley of Narberth, ripping the slate roofing from the cupola. In these tests I was favored with circumstances, which, with me, might never occur again, for the reason that a fresh human brain was necessary, and that an electrical storm should be in progress when all was in readiness was quite remarkable.

The summation of the results showed that the gray matter, which is the source of active force, is more susceptible than the white tracts consisting of the nerves or conductors of the impressions, and that the granules of the rust-colored layer is the most sensitive of any portion examined. Just why this should be so is hard to state, since the gray matter of the *cerebrum* evidently performs the functions of the mind and by its offices we are conscious of sensations; it would seem, then, that the electric waves acting on this part would be transmitted to the diseased portions of the anatomy. Oppositely, the functions of the *cerebellum* appear to act as a kind of governor in steadying the movements of the muscles and electric waves in cohering the cellular tissue, must certainly aggravate any previously existing disorders. Then, again, the waves may, and probably do, affect not only each individual differently, but also in individuals different portions of the brain. In the realm of theory let us suppose,



FIG. 7.—LISTENING TO COHESION OF HUMAN BRAIN UNDER ACTION OF ELECTRIC WAVES.

as, for instance, where the waves caused the death of the child, that the *medulla oblongata* was the most susceptible, it is not difficult to understand how death could ensue if cohesion was great enough or why the outward physical expression took on the aspect of fear, for in the *medulla* originate nerves that are absolutely essential to life and affect directly the face, throat, neck, heart, lungs and stomach.

From the foregoing results, I have tried to establish these facts (1) that electric waves emitted by lightning produce cohesion of the brain cells; (2) that cohesion takes place in brain matter when in the living state as well as immediately succeeding death; (3) that cohesion of the brain is manifested physiologically through the nervous system and not by direct action; (4) that which is often defined as fear is due to the action of electric waves on the brain; (5) that the brain cells are more violently affected than the brain fibers; (6) that this condition prevails when the brain cells or the nervous system or both are in a state of disorder, and, finally, (7) that the long electrical waves propagated by the disruptive discharge of lightning may produce distinct symptoms, and which may, under certain conditions result in death.

It is my intention to test the effect of the waves on the brain and auxiliary nervous system in its physiological aspect; in the tests just cited I have only attempted the primary anatomical ones. These may serve as stepping stones to psychological, physiological and pathological investigations of a similar character which it is to be hoped experts in these various specialized lines will be encouraged to take up.

The Debt of Electrical Engineering to C. E. L. Brown—X.

BY [illegible]

200-HP SLOW-SPEED MOTOR.

FIGS. 62 and 63 are [illegible] of a 200-hp three-phase motor for 50 cycles and 125 r. p. m. The motor is wound in delta for 4000 volts. The diameter of the rotor is 2700 mm., the bore of the stator being 2704 mm. It was necessary to keep the diameter small on account of lack of space. The magnetic circuit of the motor is very carefully proportioned, and thus a maximum power factor of 83.5 per cent has been obtained. Anybody who knows something about induction motor design will consider this result very good indeed. Fig. 64 shows the performance curve of the motor.

The short-circuit mechanism of this motor is novel and interesting. The annular spiral springs are moved parallel to the shaft and produce a contact all around the rings. This construction was devised by Mr. Aichele in charge of Mr. Brown's testing room.

SINGLE-PHASE INDUCTION MOTORS.

In 1892 Mr. Brown devoted his energies to the development of the single-phase induction motor, and he was the first to create a commercial type. We show a curve of a small early single-phase motor in Fig. 65, and it is not to be wondered at that after such success he enthusiastically advocated single-phase currents for the City of Frankfort. He who makes good polyphase motors is apt to know something about single-phase motors.

Mr. Brown started his motors as split-phase motors, using a water condenser as illustrated by Fig. 66 in the auxiliary phase. This condenser is generally in parallel to the auxiliary phase, which latter has twice as many turns as the main phase, and is in series to it. With this arrangement fairly good results for starting under load are obtained, but, of course, no single-phase motor is very satisfactory in this respect.

POLYPHASE RAILWAYS.

In 1894 Mr. Brown proposed to build, and soon afterwards did build in Lugano, Switzerland, the first three-phase surface railroad ever made. Then followed his railway upon the Gorner Grat near Zermatt, his locomotives for the Jungfrau Railway, and finally his trunk railway between Burgdorf and Thun. Pioneer as Mr. Brown had been in the design of alternating-current machinery, so he has been pioneer in its applications. The Lugano street railway has been a complete success. The Gorner Grat enterprise and its unquestionable success gave rise to the largest undertaking, the Burgdorf-Thun Railway. We have already given in Fig. 38 a view of the Kander station in which four 900-hp direct-connected generators supply by means of step-up transformers 16,000 volts to the lines. The line pressure is between 600 and 800 volts. We give in Fig. 67 an outline sketch of the 60-hp motors, four of which are mounted on a car, two on each swivel truck. A heavy freight locomotive is equipped with two 150-hp motors, which are shown in Fig. 68.

Mr. Brown writes about the 60-hp motors: "After seven months working we were told by the railway company's officials that none of the motors had ever been opened. On hearing this we sent a man to inspect the motors, as we wished to ascertain the state of the motors inside. The man reported that the interior of the motors showed absolutely no signs of wear and looked altogether as though the motors had done no work at all. Just compare this result with continuous current practice. This is also confirmed by the fact that since the opening of the line in July, 1899, we have never had to re-

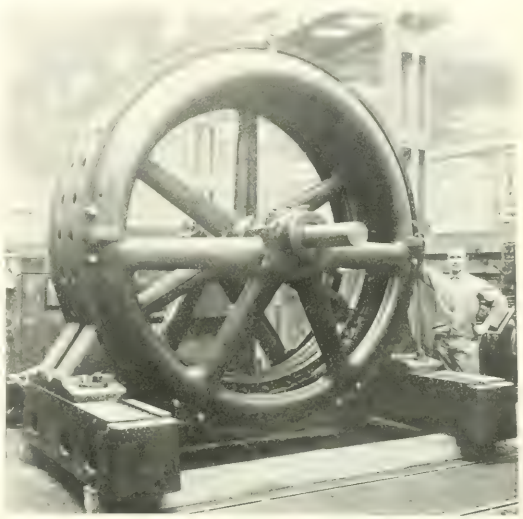


FIG. 62.—200 HP INDUCTION MOTOR, 125 R. P. M., 50 CYCLES.

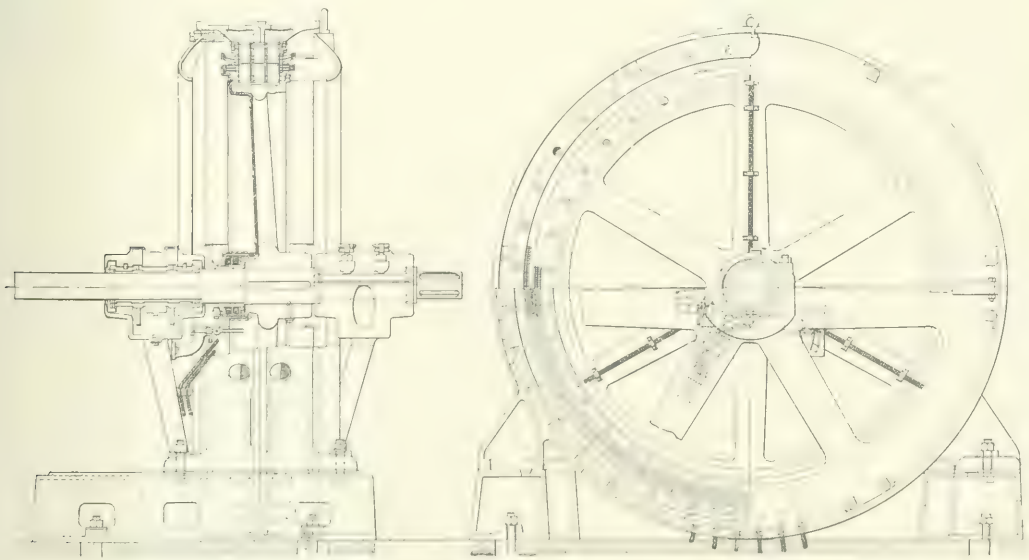
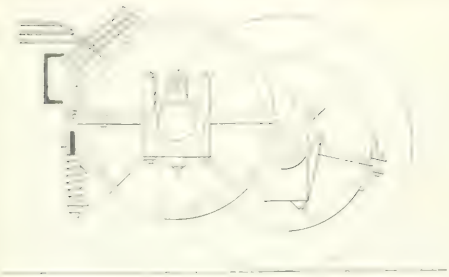
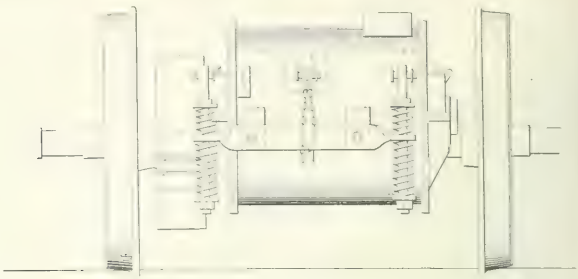


FIG. 63.—200-HP INDUCTION MOTOR, 125 R. P. M., 50 CYCLES.





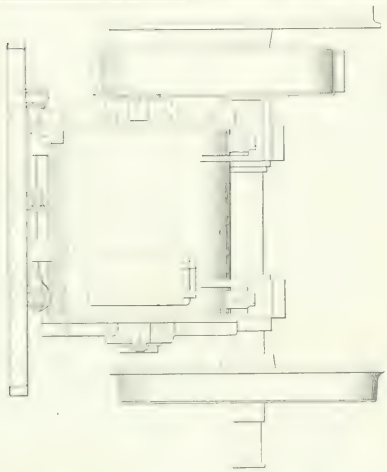


FIG. 67.—60-HP INDUCTION MOTORS FOR BURGDORF-THUN RAILWAY.

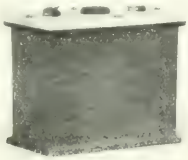


FIG. 70.—AIR CONDENSER FOR STARTING SINGLE PHASE MOTORS.

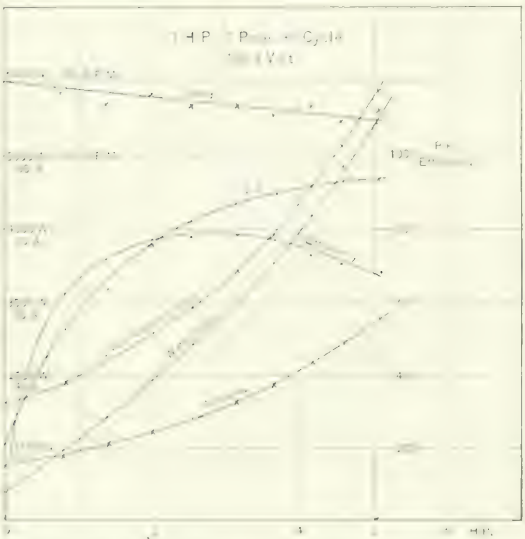


FIG. 64.—PERFORMANCE CURVES OF 200 HP INDUCTION MOTOR.

FIG. 65.—PERFORMANCE CURVES OF 3-HP SINGLE-PHASE MOTOR.

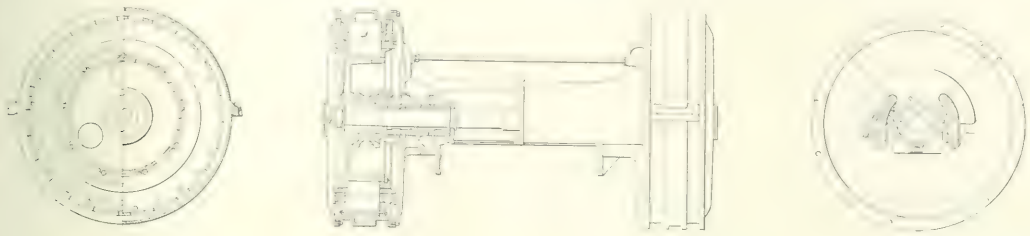


FIG. 69.—BROWN'S LOCOMOTIVE FOR JUNGFRAU RAILWAY.

pair any of the motors. Now, after two years' service with 24 motors the following results can be reported:

"Not a single fault occurred in either stator or rotor windings of any of the motors. The contact rings showed practically no wear. The same carbon brushes are in use as at the start. The ring lubrication has given perfect satisfaction, and no bearing bushings have had to be replaced. The only interruption to speak of was caused by the failure of a split ring, which locked a nut on the large sprocket-wheel of the gearing. This nut worked loose and fell into the gearing."

Fig. 69 shows one of the first two locomotives as built by Brown for the Jungfrau Railway. The rumor had been spread that, as the later locomotives had been built by the Oerlikon Company, the first locomotives had not given satisfaction. Though the Oerlikon locomotives contain some novel features and improvements, it must be borne in mind that Mr. Brown's locomotives had been the first in the field, and had become typical when the Oerlikon locomotives were constructed. Both companies' locomotives have given entire satisfaction.



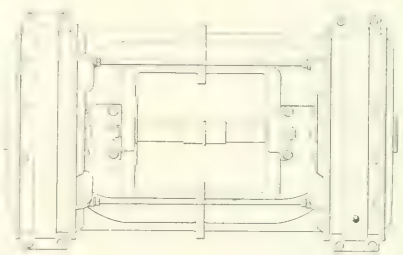


FIG. 68.—OUTLINE OF 150-HP INDUCTION MOTORS FOR FREIGHT LOCOMOTIVE.

Mr. V. Hegner, president of the Jungfrau Railway, writes that the "locomotives I. and II. built by Brown, Boveri & Co., have been in operation since 1898. They weigh about 30,000 lbs., and they take 230 to 250 amperes at 500 volts on a gradient of 25 per cent. They are very simple in construction, and they have proved reliable and safe."

Features of Modern Telephone Work.

The New York Electrical Society held a most successful and interesting meeting on Feb. 13 at the new Cortlandt Street exchange of the New York Telephone Company. Some 250 members were present. Before inspecting the exchange the society held a brief meeting, when Secretary Guy announced the name of 32 candidates, who were duly elected, and President Williams reported the society to be in excellent shape. It was a pleasant coincidence that the meeting was held on the same day of the month when the first circular in regard to it was issued in 1881. In the enforced absence of Mr. U. N. Bethell, the general manager, the society was welcomed by Mr. J. J. Carty, chief engineer, who said:

During the history of the New York Electrical Society, this is the second time which it has been my privilege to receive the society at this building and to exhibit and describe to it the central office telephone apparatus which it contains. It is almost exactly 10 years ago that the society met in this building for the purpose of inspecting its telephone installation. Ten years ago, as well as to-night, the Cortlandt Street plant was of sufficient novelty, magnitude and merit to warrant a visit from such a distinguished society as yours. But within these 10 years radical improvements have been made, changes have taken place, and an almost complete transformation has been effected. Therefore, before undertaking to sketch for your information an outline of the main features of the plant which it is my pleasure to exhibit to you to-night, it will be interesting and possibly instructive if I should first call your attention to some of the important advances in telephony which have been made in this country, and in this city during the last 10 years, all of which are embodied in what you are to see to-night, and when you view with the critical eye of experts that which is to be exhibited I am sure that your feeling will be that in the phenomenal advance in industrial affairs which has been made by Americans, that electrical developments are in the front rank, and that among these electrical developments the art of telephony has not lagged.

The opening of the present Cortlandt Street central office was but the culmination of a series of works planned a number of years ago and but recently completed. The common battery system, of which the Cortlandt Street office represents the highest type, was in New York first installed at Harlem more than three years ago. After a rigid demonstration of the system in that district, a great many improvements were decided upon, and the switchboards of all of our offices transformed from the old magneto system to the now standard common battery plan, and to show how rapidly improvements follow one upon another I may say that before we had installed Cortlandt Street on the common battery system the Harlem office, in which it was first installed only three years ago, had outgrown its equipment, and a new building had been started for a greatly enlarged central office with improvements not known at the time the Harlem office of three years ago was installed.

At the time of its installation the first Cortlandt Street switchboard represented all that was best in the telephonic art. The switchboard was large enough to accommodate 5000 subscribers' lines and 600 trunk lines. It was inspected and studied by engineers from at home and abroad, and was regarded as so great an improvement over what had gone before that this society met to visit and inspect it in a body. But to-day there are those young in the business who laugh at our boasted improvements of 10 years ago, and we, who were responsible for its installation, find it hard to justify to-day those plans about which we then boasted so much.

It is my hope and wish that we shall all live to again visit the Cortlandt Street exchange at a time when the apparatus to be inspected to-night will be as antiquated as that which was the occasion of our first meeting in this building.

I shall say a word or two about some of the significant changes which have taken place during the last 10 years in this building.

Ten years ago, to operate each subscriber's transmitter, it was necessary that two cells of Fuller battery be provided at each telephone station. To-day, in the new switchboard, we are operating on the common battery plan, no battery being required at the subscribers' station, all of the battery being concentrated at the central office and taking the form of large storage cells.

Ten years ago, in order to signal the central office, each station was provided with a small alternating-current generator operated by hand. To-day the generator is dispensed with at the subscribers' station, and the signaling is automatically performed when the subscriber takes the telephone from the hook.

Ten years ago, when the subscriber had finished talking, it was not only necessary that he should hang the telephone on the hook, but it was also necessary that he should give a brisk turn to the crank in order to send a clearing-out signal to the central office. To-day this is unnecessary; the act of the subscriber in hanging his telephone on

the hook automatically lights a signal in the keyboard which notifies the operator to clear out.

Ten years ago, notwithstanding our numerous instructions in the telephone book and requests to subscribers that they should notify the operator to clear out by turning the generator crank when through talking, it was necessary for the operator, owing to the failure of the subscriber to remember these instructions, to listen-in to see whether the subscribers had finished talking, and it was not only necessary to listen-in, but it was necessary for the operator to ask, "Are you through?" Unfortunately, owing to the strenuous conditions under which the then operator worked, she almost invariably reversed the order in which she conducted these operations, too often breaking in on the subscriber in the midst of his conversation, asking, "Are you through?" and then listening afterwards.

It will not be necessary to enter into details on this point in order to bring vividly to your mind the conditions which I have attempted to describe. At the present time, when two subscribers have finished talking, two lamps are lighted in the connecting cords in front of the operator in control of the connection. The lighting of these lamps means that both subscribers have hung their telephones on the hooks and have relinquished control of the line. Seeing the lamps lighted, the operator is not obliged to connect herself into the line, and is not obliged to ask whether the subscribers are through, but knows of necessity that both subscribers have hung up, and that the only thing for her to do is to disconnect both lines.

It is owing to this fact that one of the greatest advantages of the common battery system is realized. A substantial improvement in the service arises from relieving the operator of the duty of supervising the connections by listening in. She can now supervise visually by glancing at the condition of the lamps to see whether they are lighted or not. The operator, thus relieved of the old-time supervision, can handle a much larger number of lines than formerly. Consequently, fewer operators are required and, furthermore, what is also important, fewer sections of switchboard are required. In the system of 10 years ago, there were 44 sections of switchboard installed upon the eighth story of this building. A new story has been added, but the floor space is identical in amount with that contained in the old story. At the present time 9000 lines are placed in a room of the same area which formerly contained the 5000-line switchboard, and the number of operators employed is not much greater than before. These constitute two of the important advantages of the common battery switchboard: The simplifying of the labor of the central office and the vast improvement in the character of the service rendered to the subscriber.

In addition to these, another improvement, by no means to be neglected, has been obtained. While formerly it was necessary to maintain two cells of Fuller battery at each subscribers' station, at the present time no battery at the subscribers' station is required, all of the current being provided from a few cells, although very much larger cells, at the central office. This relieves the subscriber from the annoyance formerly occasioned by the visits of the telephone battery men to make periodical renewals of the Fuller cells, which in the case of busy subscribers took place sometimes as often as once in two months.

The idea of a common battery switchboard was not new 10 years ago. Many attempts to attain such an end were made, the principal idea being, however, to avoid the necessity of renewing batteries at subscribers' stations, no thought being given to the advantages accruing in the way of operating at the central office. When finally the result was obtained it was found to the surprise of many that, while the doing away with the battery renewal at the subscribers' station was accomplished, and while this was by no means an unimportant factor, nevertheless, when considered with reference to the improvement in the quality of the service rendered, it was found to be of subordinate value.

When to-night you view this modern installation you will no doubt, having in mind the Cortlandt Street of 10 years ago, be impressed with the fact that a vast amount of complication has been added to the system, and I think you will find it difficult to resist the idea that the tendency to complexity, which will be perceived, is, to some extent, unfortunate. But to this I can only say that the requirements of the modern telephone exchange have become more and more exacting, and that a telephone exchange located, as Cortlandt Street is, in the financial and business center of this country, has to be constructed with reference to the various complexities which there arise. There have to be considered those waves of excitement, those rushes of business, those financial panics, those concentrations of calls resulting from national celebrations, from explosions, accidents, etc., which unfortunately are so increasingly frequent in our modern civilization. To all of these influences the telephone exchange in general, and the New York telephone exchange in particular, is peculiarly subjected, and it is at these very times that the telephone is at its best. We should be derelict in our duty, therefore, if we did not plan our vast and complicated system so as to stand these sudden demands which no human foresight can avoid.

Even a harmless practical joke started on its way by some wag would, unless we provided sufficient reserve power, seriously embarrass the working of our system. Not long ago, a joke akin to the Tom Collins joke of old was started in New York. A practical joker would tell his friend to call up Mr. Fish at — Broad on a matter of importance. The friend so informed would call up the number, only to be asked which Mr. Fish he wanted to talk to, because that number was at the Aquarium. For about a week this joke raged, and it took the services of a number of special operators to intercept calls for the Aquarium and flash the joke in the pan, as it were, at the central office. Afterwards some minor jokers started a similar lot of calls for the menagerie at Central Park and for the zoo in the Bronx, sending their victims to the telephone to call up Mr. Wolf, Mr. Fox, etc.

Thousands of calls a day are received from subscribers who wish to know who is the nearest subscriber to a given number on a street named. It would be more troublesome to refuse these calls than to attend to them, so that provision for handling such contingencies must be made. In New York, the Saturday half-holiday has resulted in crowding into a very small space of time an enormous amount of business on Saturdays, and when Saturday half-holiday precedes a legal holiday the rush of business is intense.

In consequence of these conditions, our plans must be made on such a liberal scale that we can handle the business at the busiest periods even when they occur at infrequent intervals. To meet these contingencies we have, in addition to installing a large amount of additional apparatus, provided a large number of special operators called monitors, whose sole duty it is to relieve the subscribers' operators of the necessity of holding conversations with the subscribers and to take the request of the subscriber, whatever it may be, and see that adequate and polite attention is given to it. All of these conditions have been taken into account in making the plans for the installation which you will inspect to-night, and to some extent account for the complexities you will observe which were not present in the Cortlandt Street of 10 years ago.

But in making the comparison between the old system and the new, I wish to call your attention to other conditions which, when rightly viewed, will establish the fact that after all there has been a successful movement in the direction of simplicity. It should be borne in mind that in the old system there were required at each subscribers' station two cells of Fuller battery, which would in an installation of the present magnitude amount to 18,000 cells. All of these Fuller cells have been displaced by 11 cells of storage battery of the chloride type located at the central office and occupying only 110 sq. ft. If the 18,000 cells of Fuller battery were assembled at the central office and arranged on racks in the most economical way, it would occupy a very large space. In the old system a small alternating-current generator was required at each station. If these generators and batteries were massed at the central office, they would together occupy a space almost equal to that occupied by the entire common battery switchboard itself. The total weight of the present storage cells is only about 11,000 lbs., and that of the local batteries would amount to over 216,000 lbs.

During the last 10 years many improvements have been made in underground telephone cables, but the main ideas of their original construction have been adhered to. Dry cables have taken the place of filled cables, paper has entirely displaced cotton, and the improvement has been in the direction of placing a larger number of pairs of wires in a given lead sheath. Cables of 200 pairs are now the rule where formerly only 50 pairs were used.

A vast amount of detail in construction and engineering has been worked out, and Mr. J. C. Rennard, our assistant chief engineer, who has carried on the practical engineering work of the New York installations, will describe to us many features of interest.

The installation in all of its parts has been constructed by the Western Electric Company, which was the concern which installed the old Cortland Street board, and which as much as any other single

agency has contributed to the forward condition which the art of telephony has attained not only in this country but abroad.

Nearly all branches of electrical engineering have been drawn upon in making this telephone installation, and to deal exhaustively with even one of the important details of the work would take up the entire time of the meeting.

Mr. Carty was followed by Mr. J. C. Rennard, assistant chief engineer, who, with the aid of large diagrams, explained the common battery exchange circuits. After outlining in a general way the various features of interest which were to be shortly viewed by the members, Mr. Rennard gave an outline sketch which was of the greatest interest to the large number of engineers present. Among other things, he stated that the Cortlandt Street installation required for its operation 13,875 miniature incandescent lamps which, so far as numbers are concerned, would represent a fair-sized central station. When considered from the standpoint of energy consumed, of course, the comparison did not hold good, the total amount of capacity available and needed for the operation of the central office for all purposes being 75 kw. In the switchboard itself over 469,000 spring jacks are installed, being connected together and to the other parts of the apparatus by over 400,000 ft. of cable containing more than 25,000,000 ft. of wire. The switchboard itself has a capacity for 9600 subscribers' lines and more than 15,000 stations.

After Mr. Rennard's interesting remarks were concluded, the members of the society were taken through the central office in groups, guided by details from the chief engineer's staff. So interested were the members in viewing the installation that they remained until a late hour, and it was the opinion of all that they had spent an enjoyable and profitable evening. The exchange was illustrated in ELECTRICAL WORLD AND ENGINEER, Nov. 9 and Dec. 7, 1901.

Static Strains on High-Tension Circuits and the Protection of Apparatus.

MR. PERCY H. THOMAS, at a special meeting of the American Institute of Electrical Engineers on Feb. 14, read a paper with the above title, discussing the so-called static effects in high-tension circuits, especial attention being given to the disturbances produced by lightning, switching, grounding and the like. As the paper is quite voluminous—covering 44 pages of the Institute *Transactions*—but a brief resume can be given in the space here available. The paper is divided into two parts, one of which is on the nature, causes and effects of static disturbances; and the other on the protection of apparatus and on a new type of appliance called "static interrupter."

The author coins the word "undic" to designate those changes of potential and waves of current of an abrupt nature, which result from the transfer of electrostatic discharges of a system from point to point. The elementary principles underlying the phenomena considered are presented, and with particular reference to their occurrence in transmission lines and connected apparatus. The case of a long-transmission line is considered at some length, accompanying curves illustrating the charging waves of such a line, and the case of cables is similarly treated. Following is a summary of the conclusions reached in the first part of the paper:

1. When a "dead" transformer is connected to a live line a strain may be produced on the layers of the coil next to the terminal which may be as great as the line voltage.

2. When a short line is charged suddenly from live bus-bars, a momentary voltage rise may be produced which will be not more than double voltage.

3. When a long line is charged a strain similar to that in the short line is produced, doubling the potential first at the end of the line and afterward along the whole length. This result assumes that the terminal of the line is abruptly raised to full normal potential and rigidly maintained there until the wave is fully formed; also that the losses are zero.

4. The fundamental principles governing the charging of a cable are the same as those of a transmission line.

5. Opening a light high-tension circuit is nearly the equivalent of charging the circuit, since before the line is completely freed from the bus-bars it is often momentarily recharged several times.

6. When a branch line of small e. s. capacity is supplied from a main line, the rise of potential at the farther end may be twice as great as at the end of the main line.

7. In addition to switching, other causes of static strains are grounding, short circuit, lightning, etc., when these cause abrupt changes of potential.

8. A rise of potential due to resonance is always possible, but generally improbable. It requires that there be an oscillating circuit and an exciting cause which must be of very nearly the same frequency as the oscillating circuit. When an alternating e. m. f. of high frequency is applied to a long line the danger that resonance will occur is usually greater.

The second part of the paper—on the protection of apparatus and on the "static interrupter"—is developed under the following heads: Tracing of damage caused by static, protection from static, protection against short circuits, static interrupter, protective power of static interrupter, location in circuit of static interrupters, features of the commercial static interrupters, protection against grounds, lightning arresters, series resistance, location of arresters.

The static interrupter, to which a great part of this section of the paper is devoted, is shown in the accompanying illustration. The apparatus is a combination of a choke coil and a condenser connected in such a way as to magnify the effect of the choke coil as regards static waves, without causing a sensible derangement of the normal operation of the circuit. It is stated that by the use of this device a comparatively small coil can be made to afford the same protection as a coil of much larger dimensions, without entailing either excessive cost or excessive loss of energy, or heating. The choke coil of the interrupter is connected in series with the line, and the condenser is connected by one terminal between the choke coil and the winding to be protected, and by the other terminal to such parts of the apparatus as have electrostatic capacity with respect to this high-tension winding. In the case of a transformer this would be the low-tension winding in the core. As the parts designated are always at ground potential, the second condenser terminal may be connected directly to ground.

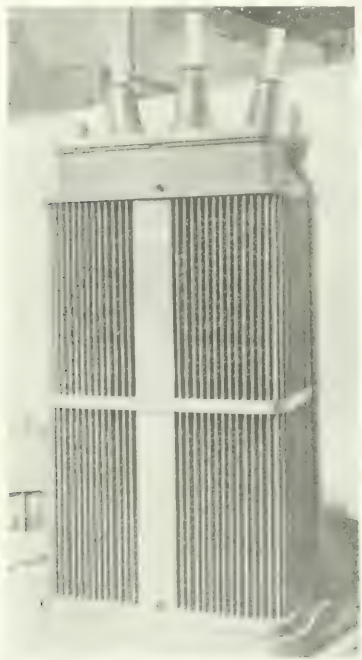


FIG. I.—STATIC INTERRUPTER OPEN.

As to the location in circuit of such interrupters, one may be placed in each lead wire of a transformer or other apparatus connected with the source of static disturbance, such as a line or a high-tension switch. As switching is a frequent cause of static strains, the interrupter should in general be placed between the apparatus and the

switches, thus making the interrupter virtually a part of the generator or transformer to be protected, and not a part of the line. In case of a bank of transformers, if there is no switching of individual transformers, it will be satisfactory to arrange the apparatus so that several transformers are protected by the same interrupters. For example, in polyphase systems a group may be protected as a unit, instead of giving individual protection to each transformer.

As to the construction of interrupters, they are usually single pole, one coil and one condenser being placed in the containing case surrounded by oil. The actual capacity of condensers for static interrupters is much larger than the electrostatic capacity of the windings they are to protect, but is still very small—some not exceeding a few hundredths of a microfarad. Fig. 4 represents diagrammatically a static



interrupter protecting a transformer and a high-tension generator. Following is a summary of the second portion of the paper:

1. Damage resulting from static strains is of two sorts: short circuits and grounds. It is the function of the static interrupter to protect apparatus against such short circuit strains; it is the function of the lightning arrester to discharge the line of excessive static charge and thus prevent grounds.

2. The static interrupter consists of a choke coil and condenser, the latter being connected between line and ground on the apparatus side of the choke coil. The interrupter delays and smoothes out static waves which attempt to pass it. The condenser by absorbing a large part of the static charge which passes the choke coil very much increases the effectiveness of the coil.

3. The choke coil and condenser of the interrupter must be adapted to the circuit upon which it is to be run, and must be proportioned with regard to the design of the apparatus it is to protect. The interrupter should, as a rule, be placed nearer the apparatus than any switches which are to be operated with potential on the line. The interrupter is thus essentially a part of the apparatus to be protected and not a part of the line or the arrester.

4. Lightning arresters must be able to discharge electricity from the line as fast as it actually appears there, and must also be non-arcing under all conditions. Any resistance or inductance used in series with the arrester should be low enough to allow the passage of all actual discharges without causing excessive potential on the arrester.

5. On the systems where the apparatus is distributed the arresters should also be distributed.

On systems with apparatus concentrated at a few points arresters should be placed on each line wire where it leaves a station.

6. Well designed static interrupters and lightning arresters, properly arranged, furnish a complete system of protection against the static disturbances found on high-tension lines.

The author concludes that it is quite evident that the protection of the apparatus of a large high-tension system, with its numerous

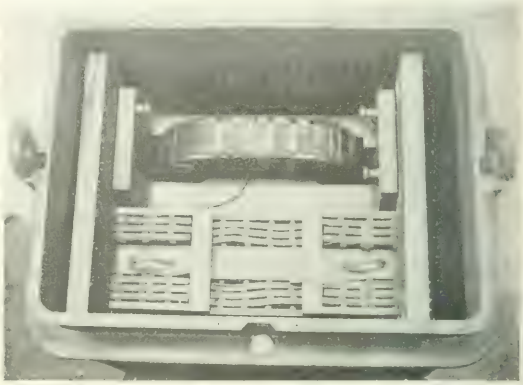


FIG. 3.—VIEW OF STATIC INTERRUPTER FROM TOP.

opportunities for static disturbances and its widely spread apparatus, is by no means a simple problem, to be solved off-hand by the use of a few lightning arresters of any available style. The type and location of the protective devices must be adapted to the actual conditions of the plant; the severity of the lightning in the neighborhood, the voltage of the system, the type of apparatus to be protected and perhaps the actual constants of the circuits. The determination of the most

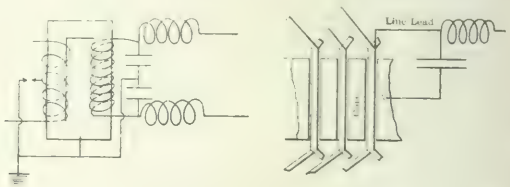


FIG. 4.—STATIC INTERRUPTER PROTECTING A TRANSFORMER AND HIGH TENSION GENERATOR.

satisfactory protection is a matter to be arrived at from a combination of theory, experience and experiment, and any protective system should be modified when actual trial shows a better arrangement.

Monorail Road in Scotland.

Plans have been submitted to the Government Board of Trade, according to a recent dispatch from London, for the construction of a monorail system between Edinburgh and Glasgow. The distance between the two cities is 49 miles.

Pacific Cable Report.

Congressman Corliss has prepared the majority report of the House Committee in regard to his bill providing for government ownership of the Pacific cable. The report rehearses the evidence, and the familiar facts already noted. The vote authorizing a favorable report on the bill stood 8 for and 7 against. Two members, Mann (Rep., Ill.) and Davis (Dem., Fla.), who are favorable to the bill, were absent, and since the meeting two of the members, Lovering (Rep., Mass.) and Wagner (Rep., Penn.), who voted against the bill in the committee, have signed the favorable report, suggesting an amendment authorizing the purchase of the cable contracted for between California and Hawaii. The minority of the committee opposes Government ownership and favors the proposal of the Commercial Cable Company to lay a private cable.

Opening the New Carnegie Laboratory at Stevens.

As most of our readers no doubt know from the daily papers there was held at the Carnegie Laboratory of Engineering, recently erected on the grounds of the Stevens Institute of Technology in Hoboken, a series of dedicatory ceremonies, etc., of a character involving many items of interest to the mechanical engineer. The occasion was in form the mid-winter meeting of the Alumni Association of the Stevens Institute, but the special business consisted in the presentation of the Carnegie Laboratory of Engineering by Mr. Carnegie to the trustees of the Institute, and the presentation to Mr. Carnegie by President Morton on behalf of the Alumni of a solid silver box containing a piece of the first T-rail ever made, which was the design of Mr. R. L. Stevens, and made under his personal supervision in 1830. These ceremonies were followed by a collation involving many novel features.

The meeting having been called to order about 8.30 P. M., and a little formal business disposed of, a temporary adjournment or intermission was taken, awaiting the arrival of Mr. and Mrs. Carnegie, who, with some members of the Stevens family, had been dining with President Morton at his home near by. As soon as this delegation arrived, at the request of Mr. C. H. Page, the chairman of the meeting, Mr. William S. Ackerman, of Ackerman and Ross, the architects of the building, presented the keys of the same to Mr. Carnegie, who then made one of the most brilliant speeches of his life, at the conclusion of which he presented the keys (as typifying the building) to Mr. S. Bayard Dod, the president of the board of trustees.



OPENING OF CARNEGIE LABORATORY.

In the course of his speech, which was sparkling with wit and good humor throughout, Mr. Carnegie proposed as an appropriate epitaph for himself, "Here lies a man who knew how to get around him men cleverer than himself." This speech was followed by the presentation of the rail in its silver receptacle, an admirable piece of artistic work, doing great credit to the Tiffanys, who made it, and to the artist, Mr. A. D. Turner, who designed it.

In his speech on the reception of this box, which had on one end a medallion likeness of himself and on the other one of Robert L. Stevens, Mr. Carnegie passed from humor to serious words of appreciation of the honor done him by thus uniting him with Mr. Stevens, who had been described by Abram S. Hewitt as "the greatest mechanical engineer, the greatest naval engineer, the greatest railroad engineer which the nineteenth century has produced."

In the course of his first speech Mr. Carnegie made some appreciative references to President Morton in response to whose request he had agreed to erect the Carnegie Laboratory building, and in explaining to the Alumni the commercial value of a good name, said humorously: "Call it Morton, and you can get anything for it you choose to ask." To this sentiment Mr. Carnegie gave a further concrete meaning the next day when he directed his banker, Mr. Franko, to send a check for $100,000 to President Morton for the endowment of the same building.

After the ceremonies, the meeting adjourned to the second floor, where was in readiness a collation such as has never been seen before. The accompanying photographic picture shows one of the many tables. On the center of this one was set a completely equipped model of a modern blast furnace, which, however, delivered not melted iron, but punch when "tapped" in the usual manner into "ladles" mounted on trucks running on tracks laid along the table. One of these "ladles" is shown in the picture in the act of being filled. On another table was an "open-hearth" furnace so illuminated as to look red-hot inside, but yielding fried oysters when explored with a long spoon. On another table was a Bessemer converter which from time to time ejected flames and showers of sparks, but also yielded on demand fancy cakes. At various points were set kegs filled with railroad spikes of the regular size and shape (these were invented by Mr. Stevens), but made of bread and cake. The ice cream was served in the form of T-rails and steel ingots, and numerous ingot moulds on trucks were filled with chicken and lobster salads, etc.

Mr. Carnegie was much interested in many of these novelties; made the Bessemer converter eject flames and sparks, remarking, "This is the first time I have operated a Bessemer converter myself." He also personally attended to the distribution of punch to the ladies, and gave many toasts.

A good deal of this ingenious work or play depended upon electricity. The decorations shown in our picture were done by the National Improvement Company, with its "Elblight" system, which it will be remembered was installed with such surprising expedition and success at the Institute annual dinner. At Stevens the company installed 1000 decorative lamps, complete, between 8 A. M. and 6 P. M., the same day, using white and red lamps spiked into green cable spiralled with smilax. The effect was admirable. Current was available from the Allis-Corliss-Edison bipolar direct-current unit, and from the regular city circuit two-phase supply.

This spring the Institute will see the beginning of the new chemical laboratory, named on account of its donors, the Morton-Alumni Building. Stevens has plenty of use for these new accommodations, there being now about 300 students, or more than ever before, while the entries are rapidly growing in number. The success of Stevens men in engineering work is familiar to all our readers, and it is believed by the trustees that the new facilities will keep the old Institute fully abreast of the times. We are indebted to Professor Albert F. Ganz, of the Institute, for the photograph and above data.

Meeting of the Institute at Columbia University.

At the extra meeting held in Havemeyer Hall, Columbia University, Friday evening, Feb. 14, Mr. Percy H. Thomas, of the Westinghouse Electric & Manufacturing Company, lectured on "Static Strains in High-Tension Circuits and the Protection of Apparatus." About 400 members and guests were present, with President Steinmetz in the chair. Mr. Thomas made many experiments, showing the concentration of potential in the outer portions of transformer or generator windings resulting from the operations of switching, grounding, short-circuits, lightning, etc. Also the protection of windings by choke coils and the "static interrupter." A mechanical model of a transmission line showing the formation of waves in the charging of a line was also exhibited.

This model received high and well merited praise for its ingenuity in clearly showing the wave forms due to the varying conditions in the operation of a transmission line. But little time remained for discussion, in which Messrs. Steinmetz, Scott, Fisher, Blackwell and Torchio participated. A hearty vote of thanks to the speaker of the evening preceded the motion for adjournment. The paper is abstracted elsewhere in this issue.

Chairman Rice, of the committee on papers, and Chairman Mullin, of the committee on transportation and accomodation, after a visit to Great Barrington, Mass., recommended, and it has been decided, that the date of the annual convention to be held in that town be changed to June 17, 18, 19, 20, a special train to leave New York on June 16. This was deemed necessary in order to assure ample accommodation, as it is believed that the preparations being made will lead to a much larger attendance than was originally anticipated. All the available space in the "Berkshire Inn" and all the rooms in the "Barrington" will be reserved for the occasion. The famous Berkshire Hills are in their early summer glory in June, and a better season for visiting them could not be selected.

Dr. Sheldon on the Storage Battery.

A very interesting experimental lecture was given on the storage battery by Dr. S. Sheldon on Feb. 11, before the Automobile Club of America. In the course of his remarks, Dr. Sheldon called attention to an interesting phenomenon he had noticed, and of which he had not been able to find previous mention. If an alternating current be sent through a dilute solution of sulphuric acid, by means of lead electrodes, there will be formed lead sulphate at both electrodes, pro-

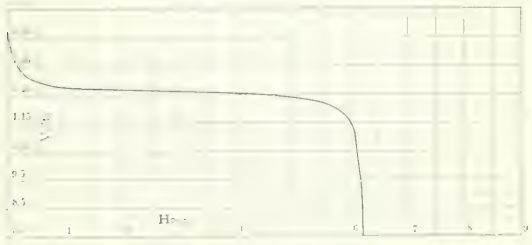


FIG. 1.—CURVE OF EDISON AUTOMOBILE BATTERY.

viding the current density and the frequency be properly adjusted, and the electrodes will be attacked and dissolved. If the frequency be lowered, a limit will be reached, and if it be exceeded the formation of lead sulphate will cease and each electrode will become alternately peroxidized and reduced.

If a direct current be sent through concentrated sulphuric acid by means of lead electrodes, both electrodes will be attacked and lead sulphate will be formed. Hydrogen in a gaseous form is developed at the cathode in addition to the lead sulphate and a gas, and what appears to be free sulphate is developed additionally at the anode.

These phenomena are probably in some way related to the variation in solubility of lead sulphate with the concentration and temperature

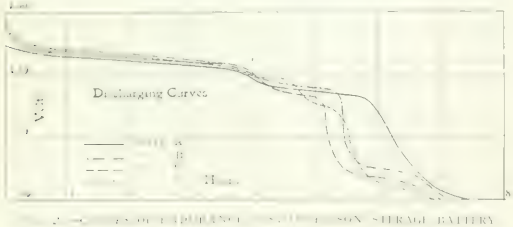


FIG. 2.—CURVES OF ENDURANCE TEST OF EDISON STORAGE BATTERY.

of the electrolyte. Differences in the rapidity of the chemical reactions are also involved.

Dr. Sheldon gave a description of the Edison storage battery, and illustrated his remarks by two sheets of curves, which, he said, had been received from Mr. Edison earlier in the day. Both sheets of curves are reproduced herewith. In Fig. 1 are plotted the data of the first test of a full-size automobile 18-plate cell, entirely machine made. The curves of Fig. 2 were plotted from the data of an endurance test. The full line curve corresponds to the first discharge of a cell, and the other curves, *B*, *C*, *D*, to, respectively, the 137th, 157th and 313th discharges of the same cell. This cell had up to the date of the lecture been discharged and charged more than 500 times, and without beginning to show any indications of fatigue. Moreover, since it was desired to make the test a drastic one, that rate of discharge has been twice the normal rate.

Electrical Literature for Chinamen.

It is stated that Gong Hee, a Chinaman, who is a practical electrician, graduated from the Portland (Ore.) Technical School, is writing a book on electricity in the Chinese language. The book, which will be a complete treatise in simple electricity and electrical application, is an extended translation of American text-books, with exhaustive original explanatory addenda, made necessary by the difficulty in translating electrical terms into a language which knows nothing of them.

New Telephone Patents.

Telephony contributes but two patents to the issue of Feb. 11, and neither scores any striking advance in the art. One is an addition to the noble army of receivers, and merely goes to show that all the possible shapes in which receiver magnets may be assembled have not yet been exhaustd. The other emanates from Sweden, and re-

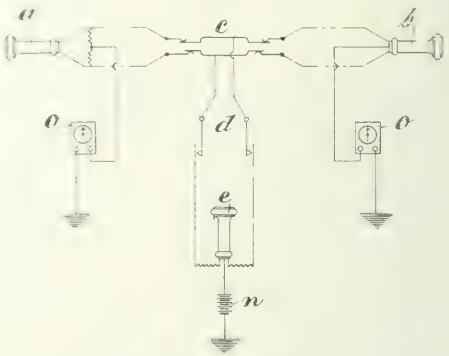


FIG. 1.—STAFSING AND EGNERS TELEPHONE SYSTEM.

lates to a detector device for the purpose of showing the subscriber if the operator is listening in or not—a device which stands little chance of adoption in such a practical telephone land as Sweden, and less in this country.

The latter device is the invention of Messrs. Frans Stafsing, of Stockholm, and Carl Egner, of Klippan, who have drawn up a specification of such delightful quaintness that it would be a pity to con-

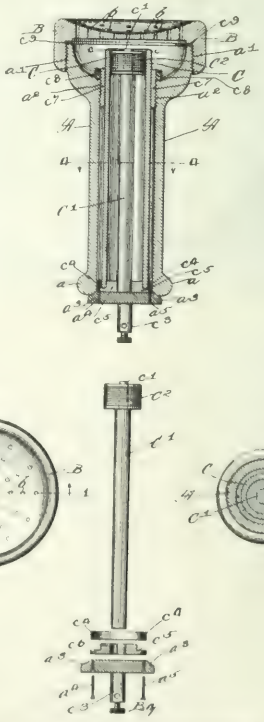


FIG. 2.—NOLIN'S TELEPHONE RECEIVER.

sign it all to oblivion. For example, they say: "It is well known that the operators of a telephone exchange are often obliged to connect their receiving apparatus to the subscribers' circuits in order to ascertain whether a discourse has begun or has been finished. This listening, however, is not seldom, to the detriment of the clearness

of the sound transmitted, and to the displeasure of the subscribers, prolonged for too long a time.

"The object of the present invention is improvements in telephone systems by means of which the persons using the telephones are enabled to observe whether any undue listening takes place or not. By this means the great advantage is also gained that the operators may be spared being unjustly accused of listening.

"The invention consists, briefly, in connecting to the circuit of the operator's receiver of a usual telephone system an extra source of electric current, in such a manner that extra electric currents are sent out in the subscribers' circuits as soon and as long as the receiving apparatus of the operator at the exchange is coupled to the said circuits, and in connecting to the subscribers' circuit some suitable signaling apparatus which will give visible or audible signs when the listening is taking place."

The diagram shows clearly the nature and simplicity of the invention. Connected to the neutral point of the operator's set is a grounded battery *n* and connected similarly at each sub-station is a grounded detector *O*. "As soon and as long as" the operator depresses listening key *d* current flows through the detectors and the subscriber is thereby notified that the operator is listening in.

Mr. James G. Nolen, of Chicago, patents a telephone receiver, in which the principal novelties are an arrangement of magnets consisting of a cylindrical magnet surrounding the usual bar magnet and coil, and an ear-piece having a number of small perforations instead of a single large one. This novelty in design causes it to become "a matter of indifference as to the exact position of the telephone cap with reference to the ear of the operator, as it is hardly possible to hold the cap of the receiver to the ear without the interior of the ear covering one or more perforations in the said cap." That the "interior of the ear" covered anything except its own contents is something new in anatomy, and it would also be news to know that telephone users in general have hitherto had much difficulty in covering with their ears—even though they do use the exterior ear for the purpose—the standard telephone ear piece with its single perforation. The patent also covers an arrangement of parts whereby all the electrical portion of the instrument may be removed from the case without disturbing the connections. The drawings show clearly the construction of the instrument, including the perforated ear piece. The cylindrical magnet *C*, having a rounded polar end *c*, surrounds the coil C^2 and bar magnet C^1 to which it is connected magnetically by the washer c^5 and ring c^4, which is firmly fixed to C^1, c^5 being made fast to c^4 and ring a^4 a^5 passing through the cap a^3 and washer c^5. The cylindrical magnet *C* is made fast to the case by a tightly fitting thimble C^7, threaded to screw into the case, and held by a check-nut c^8 when in place.

CURRENT NEWS AND NOTES.

INSURING MR. MARCONI'S LIFE.—A dispatch from London states that the directors of the Marconi Wireless Telegraph Company have insured the life of Mr. Marconi for $750,000.

PROFESSOR ROWLAND CREMATED.—It may not be generally known that the remains of Professor H. A. Rowland were cremated and that the ashes have been deposited in a niche in the walls of his laboratory at Johns Hopkins University.

WIRELESS TELEGRAPHY FOR THE PRINCE.—It is stated that the "Kronprinz Wilhelm," of the North German Lloyd line, bringing Prince Henry of Germany, will have on board a Marconi ship wireless telegraph set of the latest kind, and that she will probably signal with it anywhere for 200 up to 1000 miles. This set can "duplex" or talk at once with two shore instruments differently tuned.

DOUSING LIBERTY'S GLIM.—The notice of the Lighthouse Board, published last week, that the light in the torch of the Statue of Liberty in New York Harbor would be discontinued on or about March 1, was taken by many to mean that after the date named there would be no lights held aloft in Liberty's hand. The notice meant, however, that the statue will cease to be an official lighthouse in New York Harbor, but the War Department will henceforth provide for the lighting of the torch. Assistant Adjutant General M. V. Sheridan, stationed on Governor's Island, states that the President had transferred that part of Bedlow's Island back to the War Department, where it belonged several years ago.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The committee charged with the arrangements for the inaugural meeting of the American Electro-Chemical Society announces that it is the present intention to hold a meeting at Philadelphia, Pa., beginning on the evening of April 3, which will be devoted to organizing the society, and continuing during the days of April 4 and 5, which will be devoted to the reading and discussion of papers, experimental demonstrations, visits to installations, social functions, etc. The preliminary programme will be issued as soon after March 1 as practicable. Up to the present, 294 names are on the rolls of the society.

MEETING OF A. I. E. E.—The 162d meeting of the Institute will be held at the house of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Friday evening, Feb. 28, at 8.15 o'clock. The general subject of the meeting will be "Electro-Chemistry and Electro-Metallurgy." The following papers will be presented: 1. "The Electro-Chemical Industries," by Dr. Samuel Sheldon, of Brooklyn; 2. "The Electric Furnace in Industrial Chemistry," by Charles B. Jacobs," of New York; 3. "Electrolytic Recovery of Copper from Low Grade Ores," by Dr. Nathaniel S. Keith, of New York; 4. "Colloids," by W. R. Whitney, of Boston; 5. "Liquid Potentiometer; Determining Electrolytic Resistance with Direct Current Instruments"; 6. "Point of Cut-off in a Battery Discharge"; 7. "Electrolytic Conduction without Electrodes," by Dr. Carl Hering, of Philadelphia.

NEW TYPE OF DRY CELL.—A new type of dry cell forms the subject of a patent issued Feb. 11 to W. McA. Johnson. The receptacle of the cell is of glass or porcelain, and the exciter is a double salt of zinc, the electrodes being zinc and oxidized copper gauze, respectively, surrounded by an absorbent material such as sawdust. The inventor states that heretofore it has been common to use in batteries having electrodes of zinc and copper oxide an alkaline solution such as potassium hydrate. When, however, such a cell works on a closed circuit, the zinc goes into solution, displacing the hydrogen of the hydrate and forming potassium zincate. The hydrogen thus displaced reduces the copper oxide, and such action causes the depletion of the alkali. By the use of potassium cyanide, or an equivalent substance, which is capable of increasing the ability of the solution to dissolve zinc without increasing its corrosive action, this depletion of the alkali can be largely prevented. This desirable result is due to the fact that potassium cyanide forms with zinc a soluble double salt, thus freeing the solution of zincate and thereby preventing the clogging of the cell.

PRODUCTION OF FLUORINE.—M. Maurice Meslans, of Paris, has patented under date of Feb. 11 a compact and ingenious cell for the commercial production of fluorine, according to the method developed many years ago by Moissan. The method itself involves merely the electrolysis of fluoride of potassium dissolved in hydrofluoric acid, but the chemical activities of the element and the acid are such that the choice of materials for the electrodes, the joints and insulating parts, and particularly for the cell, becomes of vital importance. Moissan has already pointed out the availability of copper for the latter purpose, the metal becoming quickly coated with an insoluble layer of fluoride, which acts as an efficient protector. The Meslans device is constructed somewhat on the lines of the apparatus used by Garuti and Pompili for the electrolytic production of hydrogen and oxygen, and comprises anodes and cathodes of platinum separated by an apertured diaphragm of sheet copper, which, for its more complete protection from the electrolyte, is electrically connected with the anode. Under these conditions the diaphragm is soon covered by the protecting fluoride layer, which arrests further action. Both anode and cathode are water-cooled, and the evolved hydrogen and fluorine are conducted through refrigerated coils to condense and return any hydrofluoric acid. The plan of shunting a portion of the electrolyzing current through a metallic diaphragm to protect it has been heretofore adopted by Darling in an apparatus for the decomposition of fused nitrates. The device of Meslans presents, therefore, little novelty.

NORTH CAROLINA WATER POWERS.—The Division of Hydrography of the United States Geological Survey has issued a bulletin dealing with the measurement of North Carolina water powers.

INTERNATIONAL EXHIBITION OF MOTOR-BOATS.—A circular, signed by the Count A. de Talleyrand-Perigord, informs us, that an exposition and competition of motor-boats and equipments with motor power for sailing boats, will be opened in June, 1902. This undertaking is of great practical interest for the coast and inland navigation of all nations, and it is expected that the participation of the public interested in the matter will be a general one. The exhibition will take place near Berlin on the lake Wannsee, a most lovely and charming place in the Royal Forest named "The Grunewald." The address of the secretary is Berlin, Universitats str. 1.

SUBMARINE CABLE BREAKS.—The Commercial Cable Company had to repair five breaks to various sections of its cables last year, due to fouling by ships' anchors. The companies are always willing to pay a captain to slip his anchor if fouled, and most cases are on the Newfoundland Banks in the shoal water. One case is mentioned, however, where a captain let go 1600 fathoms, and was given $1,200 for his chain and anchor. The companies are glad to encourage this consideration on the part of sea captains, and, so far as they know, there has been no attempt to take fraudulent advantage of it. The men of the sea are more apt to be impetuous and high-handed than dishonest, and while they will not report fictitious losses, there is frequent evidence that they release their fouled anchors by cutting the cable that holds them. There is but one case on record where this offense was brought home and proved. On Dec. 29, 1898, the schooner "William H. Bailey" was fouled off Sandy Hook and the cable cut. The deed was proved, and, after four years of litigation, an award of $2,500 has just been granted the cable company.

MERCURY DIAPHRAGM.—An electrolytic cell for the decomposition of brine recently patented to Ernest A. Le Sueur, of Rumford Falls, Me., returns to the principle of the stationary mercury diaphragm, familiar in the early constructions of Vautin and Kellner, and in the more recent cell of Langguth. Le Sueur's cell comprises an anode bell, closed at the bottom by a horizontal sheet of wire gauze, the meshes of which are filled with mercury. A layer of gravel rests upon this gauze and supports the anodes, of the filamentary platinum type heretofore described by the same inventor. Each anode comprises a number of ribbons or filaments of platinum or a platinum-iridium alloy, resting upon the gravel and radiating from a central vertical glass tube which carries their common conductor. This anode bell is suspended in an iron tank which constitutes the cathode; the mercury diaphragm operates, therefore, as a bipolar electrode, to transfer the sodium from the brine solution in the anode bell to the water in the containing vessel. The very small amount of mercury used rapidly deteriorates under the influence of magnesium separated from the brine, and it is found necessary to continuously flood the amalgamated gauze with fresh mercury, displacing that which has lost its fluidity. The patentable novelty of the construction lies in the provision of these means.

CHLORATES AND PERCHLORATES.—Since the first announcement by Imhoff of the remarkable effect upon the yield of chlorates and perchlorates of the addition to the electrolyte of small amounts of chromic acid in the form of chromate or bichromate, the conditions most favorable to a high yield have been carefully worked out on a laboratory scale by Muller and Brochet. In seeking to apply these results on a commercial basis, Lederlin has encountered certain unlooked-for difficulties. Chief among these are the oxidizing action of the solution on the cathodes, and the gradual falling off in yield which at the beginning was 90 per cent of that indicated by theory, but which decreases to 50 per cent or less after some days continuance. The changes in the solution which correspond to these effects are marked by color variations, the solution turning from a clear red orange to yellow. Lederlin finds the solution of these difficulties in the addition to the electrolyte of a small quantity of very dilute hydrochloric acid, the effect of which seems to be the maintenance of the chromic acid in the form of bichromate, and, curiously enough, secures a sustained yield of about 90 per cent of the theory, or .70 grams of potassium chlorate per ampere-hour. Another effect not hitherto obtained is the production of electrolytes saturated with sodium chlorate, and capable of yielding crystals of this very soluble salt by refrigeration. Lederlin's patent is issued under date of Feb. 11.

Letter to the Editors.

Testing Three-Phase Induction Motors.

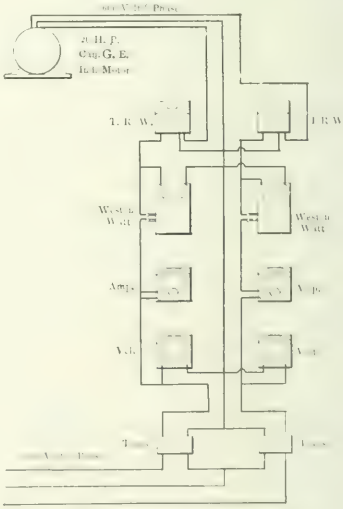
To the Editors of Electrical World and Engineer:

Sirs.—In testing some three-phase induction motors, I have obtained results that seem odd to me, and I ask the courtesy of your columns to get an explanation.

The motor tested was a three-phase 20-hp, 60-cycle C. G. E. induction motor, operating a large blower which runs constantly with no variations of load. The method of testing was as follows: A Weston wattmeter was connected on each leg as shown in the accompanying sketch; that is, the current coil of one wattmeter was put in one leg, and the potential coil was connected from this leg to the middle leg of the circuit. The other wattmeter was connected in a similar manner to the other outside leg.

The watts indicated by the right-hand wattmeter were 8000, and by the left-hand wattmeter, 3600. To determine the power factor of each leg, an ammeter was put in series with the current coil of the wattmeter in each leg, and a voltmeter was put in multiple with the potential circuit of each wattmeter. The readings for the right-hand leg were 15 amperes, and for the left-hand leg 15 amperes. The voltage readings of each leg were 600. This would give the apparent watts of the right-hand leg 9000, and that of the left-hand leg 9000. The power factor of the right-hand leg would thus be 88.8 and that of the left-hand leg 40.

This circuit was metered with two Thomson recording wattmeters



TESTING THREE PHASE INDUCTION MOTORS

of the two-wire, single-phase, 500-volt type. One meter was connected on either side of the system, the same as the Weston wattmeters. A check test of these two meters showed the right-hand meter to be correct, and the left-hand meter 11 per cent fast. This left-hand meter was removed and tested on a single-phase circuit with the same load that it had on the three-phase circuit, and showed the same per cent of error, or 11 per cent fast.

As is well known, a recording wattmeter of the single-phase type connected to a circuit with an inductive load will run backwards when the power factor is below 50, but with this meter the load on it showed a power factor of only 40, and still it does not go backwards. To make sure that no error existed in the readings, the instruments were shifted, those on the left-hand leg being placed on the right

hand, and those on the right-hand on the left-hand, and the results were the same.

What seems odd is that this being a motor circuit, supplying one motor, it is supposed to be balanced. A voltage test of each of the three legs shows that there is no variation—each leg being 600.

I do not see how this can be accounted for, unless one leg is working at a higher inductive load than the other, and in this case it would seem that one set of fields is stronger than the other. If this were the case, I should think that the motor would have an eccentric motion, but this is not true.

I have found the same state of affairs in a number of three-phase induction motors and cannot account for it. The motor is running at about half its rated capacity.

I should be glad to have an explanation offered by some one who has had more experience in this class of work than I have had.

MONTREAL, CAN. M. G. SLEATON.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Voltage Drop of Alternators.—ROTHERT.—A reply to the article of Fischer-Hinnen, recently abstracted in the Digest. He claims that Fischer-Hinnen has not applied correctly his (Rothert's) method, in which, he says, the simple diagram cannot be directly used for machines with great stray field and great saturation of the poles. In such cases the excitation required for no-load cannot be simply combined with that for short circuit, but the first must be connected in order to take into account the increased saturation in the field system, due to greater field straying. He shows how this may be done. He claims that his method, if properly and judiciously applied, gives as good results as may be desired. Regarding Potier's method, he says that "any method which does not take into account the variation of the field straying between no load and full load, is wrong, for the modern highly saturated generators, and must be wrong, even if it gives good results for many machines."—*Elek. Zeit.*, Jan. 16.

RESELMAN.—Another communication, referring to Fischer-Hinnen's article, in which he discusses the reason why the method of Behn-Eschenburg gives too low values of the voltage at the terminals at saturation in the poles.—*Elek. Zeit.*, Jan. 16.

Induction Motors Used as Synchronous Motors.—EICHBERG.—A communication referring to the article of Danielson, abstracted recently in the Digest. He tried the same method independently, and believes that it may be used to advantage, especially with large motors, on account of the increase of the power factor and the increase of the efficiency, but only in such cases where no capacity of overloading is required. He discusses the problem with the aid of diagrams.—*Elek. Zeit.*, Jan. 16.

REFERENCES.

Heyland Induction Motor.—HEYLAND.—A translation in full with the illustrations of the German article, which was abstracted at length in the Digest, Jan. 25.—Lond. *Elec.*, Jan. 24.

Induction Motor.—WIENER.—An illustrated article with several tables, in which he discusses in a popular way the principle of the rotary magnetic field, the general design of the induction motor, and the construction of its field winding and its armature winding.—*Elec. Age*, Jan.

Measuring the Armature Resistance of Direct-Current Dynamos.—WETTLER.—A mathematical article illustrated by diagrams, on the measurement of the armature resistance by means of the Thomson double bridge. One way of using it is to apply the current at only two certain points, to which at the same time the voltage wires are connected. He gives a general formula which holds good for all kinds of windings, and which enables one to determine easily the two segments to which the current wires and voltage wires of the double bridge are to be connected.—*Elek. Zeit.*, Jan. 2.

Direct-Current Dynamos.—An illustrated description and account of tests of the 500-volt, 1100-kw dynamos for the Bolton lighting and traction plant.—Lond. *Elec. Eng.*, Jan. 24; *Elec. Times*, Jan. 23.

Tramway Generator.—NIETHAMMER.—An illustrated description of a 1000-kw tramway generator, built by the Union Electric Company, of Berlin, for a British plant.—*Elek. Zeit.*, Jan. 16.

British Dynamos.—An illustrated description of direct-current dynamos and controllers for crane work, made by Royce, Manchester.—Lond. *Elec. Rev.*, Jan. 17.

LIGHTS AND LIGHTING.

Osmium Lamp.—GABRIEL.—His Vienna Elec. Soc. paper in full, an abstract of which was recently noticed in the Digest. Gabriel is the chief engineer of the company, which owns the patents of Welsbach. Osmium has a specific gravity of 22.5, and is, therefore, the heaviest metal (sp. gr. of gold 19, platinum 21) Osmium is also the most refractory metal, the melting point being far above that of platinum, at about 2500 degs. C., or above. Osmium is very hard, much harder than glass. A normally burning osmium lamp gives 2.3 times as much light as a normally burning carbon filament incandescent lamp, for the same life and the same consumption of current (he evidently means energy). For the same illumination and at the same life the osmium lamp saves 55 to 60 per cent of current (evidently meaning energy). Fig. 1 gives a comparison of the osmium lamp with two

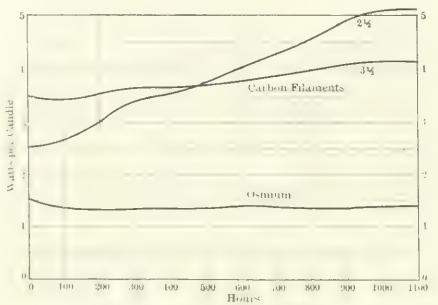


FIG. 1.—CURVES OF OSMIUM AND FILAMENT LAMPS.

carbon filament incandescent lamps, showing the economy as a function of the hours of burning. The curves are the average of a great number of tests. One of the two carbon filament lamps starts with a consumption of 2.5 watts per candle, which rapidly increases up to more than 5 watts per candle after 1000 hours. The other carbon filament lamp starts from 3.5 watts per candle; its economy is much more nearly constant. After 1000 hours it consumes 4.2 watts per candle. The average watts per candle of both carbon filament lamps, especially of that with 2½ watts initial, are considerably greater than at the start. The osmium lamp starts with 1.5 watts per candle, which decrease to 1.32 watts per candle, and then remain nearly constant. After 1000 hours 1.4 watts per candle are consumed. The average during 1000 hours is, therefore, at most 1.4 watts per candle. Fig. 2 gives a comparison of the same three lamps, showing the illumination as a function of the hours of burning. The "2½-watt per candle" carbon filament lamp gives at the start 20 candles, and at 1000 hours only 8.5 candles. The "3½-watt per candle" carbon filament lamp gives at the start about 17 candles, and after 1000 hours about 13 candles. The osmium lamp starts with 14.8 candles, then comes an increase with a maximum of 16.8 candles after 250 hours. After 1000 hours it gives 15 candles, which is still more than at the start. If the two curves of the osmium lamp in the two diagrams are considered together, it will be seen that at decreasing watts per candle,

the illumination increases or at least remains constant. He gives a table, of which the following is an abstract:

Hours	0	24	528	624	672	1000	1090	1032
Ampere ...	1.02	1.02	[illegible]	[illegible]	1.00	0.98	0.98	0.95
Candle ...	[illegible]	[illegible]	16.53	16.80	16.39	15.23	15.35	14.08
Watts cand.	1.51	1.40	[illegible]	[illegible]	[illegible]	1.42	1.40	1.40
Per cent....	0	7.9	11.2	[illegible]	9.6	2.4	3.2	0.7

The figures of this table are in agreement with the diagrams. The last line gives in per cent the increase of the candles over the candles at the beginning. (From the figures in this table it follows that the

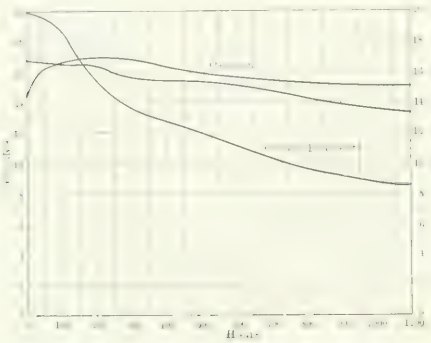


FIG. 2.—ILLUMINATION CURVES OF THREE LAMPS.

lamp tested was used on a 22-volt circuit, although this is not stated in the article). Regarding the life of the osmium lamp he says that at 1.5 watts per candle it is "scarcely shorter" than that of a good 3-watt-per-candle carbon filament lamp; at 1.5 watts per candle it has "at least the same life" as the latter; at 1.8 watts per candle the life is 1400 hours or more. It is hoped that this can be improved upon, as the development of the osmium lamp as an industrial apparatus is really only in its infancy. A disadvantage of the osmium lamp is its low voltage, they have so far only succeeded in making practical lamps up to 50 or 60 volts, due to the nature of the osmium filament which has a low resistance. One hundred-volt lamps can be made, but they are still too delicate to be used in practice. It is expected that several lamps in series will be used in existing installations. He argues that a consumer who has 10 carbon filament lamps of 16 cp always burning in his shop would not object to 10 osmium lamps of 40 cp in series, if the cost of energy is the same. In alternating-current systems the transformation to a convenient voltage is, of course, easy. He thinks that the osmium lamp will be of the greatest value for new installations, as the total plant to give a certain amount of illumination, will have to have only half the capacity required for carbon filament lamps. The osmium raw material is made into a paste by a special process and pressed into filaments under high pressure. These filaments look like ordinary threads and are soft. They are dried, and are then electrically reduced to pure metal. In the discussion which followed he said that a limited number of osmium lamps will be put on the market in the next few weeks, not for sale, but only for an annual rental fee. While in the paper itself he called the osmium lamp a "vacuum incandescent lamp," he refused to answer a question put to him in the discussion regarding the conditions of the vacuum.—*Zeit. f. Elek.*, Feb. 2.

Nernst Lamps.—ADAMS.—An article on the practical value of Nernst lamps. He reaches the following conclusions: "For street lighting the Nernst lamp is not generally suited, because it is impracticable to operate it on series circuits, and because its efficiency is materially below that of series arcs. For divided indoor lighting, Nernst lamps are less suitable than incandescent lamps, because of the larger first cost, fixed charges and energy consumption of the former in the smallest units. Where large interior spaces are to have general illumination, the Nernst lamp has some advantage over the incandescent in the quality of its light and over the arc in the weight of conductors necessary. This advantage over arcs seems to be fully offset by the lower Nernst efficiency."—*Sc. Amer.*, Feb. 8.

POWER

REFERENCES.

Electric Gear for Operating Gates.—In a continuation of an article on the North Sea Canal, the Ymuiden locks and the port of Amsterdam, an illustrated description is given of the electrical gear for operating gates of the Ymuiden locks. They are operated by series wound motors.—Lond. *Eng'ing*, Jan. 24.

Hoisting Machinery.—HORNER.—An illustrated article on hydraulic wharf cranes, steam and electric jib cranes, locomotive cranes and general hoisting machinery.—*Cassier's Mag.*, Feb.

TRACTION.

Negative Boosters.—KAPP.—A paper, read before the Elektrotechnical Society, of Berlin, "On a new method for diminishing the drop of voltage in the rail in electric tramways with the rails used for the return current." He first refers to his older method which has been used in practice in many cases in England. This older method consists in inserting negative boosters in return feeders connected to various points of the rails. These boosters "suck" the current back from the rails. They are excited by current in the positive feeders, so that the sucking effect of the return feeders is at any moment proportional to the load at that place. The most extensive application of this method has been made at Glasgow, where in several substations more than a dozen such boosters are in use, each for 1000 amperes. The difference of voltage between the various feeding points of the rails there is not more than one volt. Such an exact regulation is, however, required only in cities with a large subdivided network of gas and water pipes, and, as in such cases, the railway network also has many branches, the cost of the special return feeders for the rails and of the boosters is not very great compared with the total first cost of installation. It is different with a straight line of considerable length, like an interurban railway, which is to be supplied with current from one terminal. In this case the cost of the special return feeders for the rails would be prohibitive. For such cases he now recommends inserting boosters directly into the rails at different points. An important point which determines the danger of stray currents escaping from the rails into the earth is the "theoretical potential of the rails," i. e., that potential which would exist at any point of the rails if no current would es-

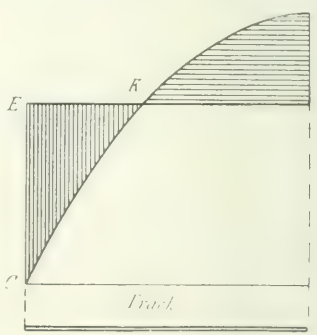


FIG. 1.—NEGATIVE BOOSTER.

cape from the rails. The curve of this theoretical potential of the rails is the curve CKP in Fig. 1, which is a parabola. If now the point K is determined in such a way, that when a horizontal line is drawn through it parallel to the axis of abscissas, the two cross-hatched areas are equal, then the straight line through E represents the earth potential. The point K is at a distance $0.42 \times l$ kilometer from the central station at C, in which l is the length of the road. If a gas or water pipe is parallel to the road, then at points at the left

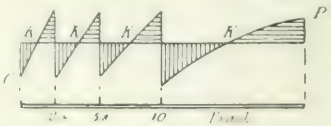


FIG. 2.—NEGATIVE BOOSTER.

hand of K the pipe is liable to corrode by electrolytic action of the stray currents, while at points at the right hand of K the rails are liable to corrosion. He remarks that "there is the same danger for

pipe and rail. One generally speaks only of the danger of the stray currents for the pipes of the gas and water companies, but one forgets that this danger cannot exist, without the same danger for the railroad company itself. If at one point a pipe is destroyed, there must be another point at which the rail is destroyed." In the present case there is such a danger. He suggests leaving out the rail joints at one or several places, and to bridge the opening by inserting a small booster with series excitation. The result is that the curve *C P* of Fig. 1 is changed into the form of Fig. 2, and the potential differences as well as the length of the dangerous zones are greatly reduced. The arrangement of such a booster is represented in Fig. 3. *G*

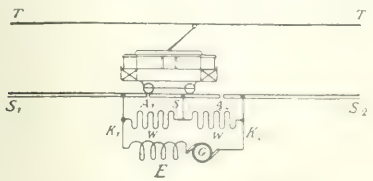


FIG. 3.—ARRANGEMENT OF BOOSTER.

is the armature, *F* the exciter winding, and *W W* are permanent resistances. The rails are electrically disconnected at A_1 and A_2, and the length $A_1 A_2$ is greater than the distance between the first and last wheel of the car. The rail *S*, between A_1 and A_2, is connected to the central point of the permanent resistance. The booster is driven by a motor connected to the overhead wire and the rails. The purpose of the resistance *W* is to enable the car to start, when by chance it has stopped on the part *S*. If that happens only occasionally, and if the ground conducts well, *W* may be omitted. The booster is placed in a small cabin near the road and does not need continuous attendance. A booster arrangement for alternating currents is also given, but in the discussion which followed Dolivo-Dobrowolski showed that Kapp's arrangement for alternating currents would not work. In a communication of Dobrowolski, published in the same issue, this criticism is dealt with in greater detail.—*Elek. Zeit.*, Jan. 2.

British Tramway Statistics.—The large annual table of statistics for 1901, of electric railways and tramways in the United Kingdom, in operation and "in progress," giving a large amount of valuable statistical information. There is also an editorial summary. In addition to large extensions made to the networks of electric tramways previously existing, 27 new electric lines have been opened to the public in various parts of the United Kingdom, bringing the total number of these undertakings up to 85. There are 45 more being constructed or are undergoing conversion from horse service to electricity, the corresponding figure of last year having been 29. The tramway branch of the "heavy" electrical industry is now regarded as the most promising one for the moment in Great Britain. A large proportion of the new electric tramways are municipal undertakings. —Lond. *Elec.*, Jan. 24.

REFERENCES.

Trials of Electric Operation on German Main Railroads.—SPAENGLER.—The first part of a long illustrated paper in which he discusses several trials made in Germany. This part deals with Siemens & Halske's experiments on their trial road, and with the trials of the Wannsee railroad, which have been mentioned before at length in the Digest.—*Zeit. Oest. Ing. and Arch. Ver.*, Jan. 17.

Guard Wires in Electric Traction Installations.—A reprint of the new rules proposed by the Brit. Board of Trade.—Lond. *Elec.*, Jan. 17.

Multiple Unit System.—BLACKSTONE.—The first part of a long, well illustrated article on the different systems of multiple unit control of trains.—*L'Eclairage Elec.*, Jan. 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

German Combined Traction and Lighting Plant.—LEISSE.—An illustrated article on the electric plants in Rheydt and Gladbach. Between both cities there had been a horse car service. When it was decided to change over to electric opration, the purpose was to combine it with electric light and power service in both cities. In order to be able to use the three-wire direct-current system at 2×220 volts, each city put in its own plant. The plant in Rheydt is described. It contains the steam-driven generators. When running at 102 revolutions, each gives 360 amperes at 480 volts, for light and power purposes; when running at 100 revolutions, each gives 300 amperes at 550 volts for traction. There are two storage batteries—the one for the light and power service has a capacity of 648 ampere-hours if discharged in 3 hours, the other, for the traction system, gives 200 ampere-hours if discharged in 1 hour.—*Elek. Zeit.*, Jan. 2.

REFERENCE.

Supply Regulations.—A reprint of the regulations drafted by Wordingham on the regulations for the supply of electrical energy in the area of the Stretford District Council.—Lond. *Elec. Eng.*, Jan. 17.

WIRES, WIRING AND CONDUITS.

Three-Phase Circuits.—TEICHMUELLER.—A long mathematical article, illustrated by many diagrams, on the calculation of "elastic three-phase circuits." He first gives some general notes on vector-diagrams, and then discusses three-phase circuits with delta connection of the receiving apparatus, and also with star connection, with a neutral wire. He calculates the wires for uniform load on the phases for a certain loss in the line, and discusses the influence of differences of load in the different phases. He finally gives a comparison of the copper required in different systems under different conditions. What he considers to be the fairest comparison, relates to the case of unequal load of the phases or halves of the system, the load different in one phase in percentage of the total load being the same in all cases; then if the copper required by the two-wire system is 100, the copper required by the threee-phase system with star-connected and with neutral wire of a cross-section equal to one-half the cross-section of the other wires, is 58.33; the copper required by the three-phase system with delta connection, is 75; the copper required by the "three-wire" system, with a middle wire of half the cross-section of the outer wires, is 41.67.—*Elek. Zeit.*, Jan. 2, 9.

Cable Industry in Germany.—O'GORMAN.—Some notes comparing the cable industry in Germany with that in Great Britain. He regrets that most cable factories resort to secret compounds and processes. The universal prevalence of the lead covering shows that no water-proof substance has yet been found. The essentially technical improvement in which the German cable industry is slightly ahead of the British, is the adoption of vacuum drying, and vacuum impregnating tanks. In order to reduce the very large stocks of copper wire which cable makers have to carry owing to the large number of difficult sizes and styles of cable required, the Germans have installed wire-drawing mills and purchase only one or two stock sizes of copper wire, so that the variety of demand may be met without the delay of waiting for the wire drawers' delivery, and yet without carrying a multiplicity of different sizes in large quantity. Furthermore, there is an incidental economy in the operations of winding and measuring. In general, the German cable industry is not ahead of the British, but is making important advance.—Lond. *Elec. Rev.*, Jan. 17.

REFERENCE.

India Rubber.—WICKHAM.—An illustrated article on the Hoevia, "Para," Indian rubber, and on the origin of the introduction and cultivation of the tree.—Lond. *Elec. Eng.*, Jan. 10.

ELECTRO-PHYSICS AND MAGNETISM.

Hysteresis.—DINA.—An account of an experimental investigation in which he compared the three different kinds of magnetic hysteresis in iron. In the static hysteresis and the alternating-current hysteresis, the magnetizing force has a constant direction but a variable value, but a cycle in the former takes place slowly step by step (ballistic and magnetometric method), while in the latter it occurs quickly and continually (in the transformers). On the other hand, in the "rotating hysteresis" the magnetizing force has a constant value and variable direction, and a cycle is completed in a short time (in dynamos). He determined the rotating hysteresis as follows: A coil made of thin insulated wire was revolved in a magnetic field, and from measurements of the resistance of the wire, the increase of temperature and the hysteresis energy were determined. He afterward also used the ballistic method and also determined the alternating-current hysteresis. The general result is that rotation diminishes the hysteresis loss, while an increase of the speed at which a cycle is completed, increases these losses. At relatively low inductions, the second influence is the more important one, at higher inductions, it is the first. In the iron investigated by him up to $B = 10{,}000$, the rotating hysteresis is greater than the static, but smaller than the alternating-current hysteresis. Above this induction it is smaller than the other two.—*Elek. Zeit.*, Jan. 18.

REFERENCES

Absorption of Röntgen Rays.—McCHUNG and McINTOSH.—An account of an experimental investigation of the absorption of Röntgen rays by aqueous solutions. An increase in the amount of salt in solution produces an increase in the absorption; but there is no proportionality. The relation appears to be a logarithmic one. The absorption depends upon two factors, the cation and the anion.—*Phil. Mag.*, Jan.

Hydrogen Peroxide.—D'ARCY.—An account of an experimental investigation of the decomposition of hydrogen peroxide by light, and the electrical discharging action of this decomposition.—*Phil. Mag.*, Jan.

Magnetic Induction and Magnetic Force.—MUELLENDORF.—A mathematical article with several tables. As has been noticed in the Digest, he has formerly developed from theoretical considerations two different formulas for the relations between magnetic induction and magnetizing forces. In this article he examines both formulas with reference to the degree to which they agree with magnetizing curves determined by Kapp. As neither agrees entirely with these curves, he modifies one of his formulas by introducing another constant.—*Elek. Zeit.*, Jan. 9.

ELECTRO-CHEMISTRY AND BATTERIES.

Spongy Tin and Tin Crystals by Electrolysis of Aqueous Solutions.—PFAMHAUSER.—An account of an investigation of the conditions under which spongy tin or tin crystals are deposited from aqueous solutions. When electrolyzing highly concentrated solutions of stannic chloride and stannous chloride, he found that for higher concentrations than a normal solution, the formation of spongy tin ceases entirely only at smaller current densities, while at current densities above 1 ampere per square decimeter formation of crystallized tin took place. When the electrolyte contains sodium ions or potassium ions or generally cations which form strongly dissociated solutions at the cathodes these ions accumulate at the cathode, but cannot be deposited, as the voltage is not sufficient. The tin ions must then pass through the solution of potassium hydroxide, etc., and can reach the cathode only at isolated points, so that the formation of a tin tree sets in and this is the beginning of the formation of spongy tin. The formation of spongy tin is, therefore, evidently avoided by proper stirring or circulation. The deposition of tin in thick layers is only possible with highly concentrated solutions of tin salts containing no cations (like K, Na), which can form strongly dissociated solutions around the cathode. It is also necessary that there are always enough tin ions at the cathode, and for this reason a small current density and stirring are necessary.—*Zeit. f. Elektrochemie*, Jan. 16.

Nitric Acid.—VELEY and MANLEY.—A brief summary of an experimental investigation of the ionic and thermal coefficients of nitric acid, for greatly changing concentrations. Nitric acid is like other electrolytes in possessing a positive temperature-coefficient for concentrations up to 96 per cent, yet beyond this point it behaves as a metallic conductor in possessing a negative temperature-coefficient. This phenomenon cannot be explained by the aid of the ionic dissociation theory. They have observed a similar abnormality in other physical properties, and especially in the contractions. Kohlrausch and Hallwachs have pointed out that there is an undoubted relation between the contraction, produced even in very dilute solutions of electrolytes and ionic dissociations, since non-electrolytes do not show this phenomenon. In the present instance, though the points of alteration of direction of curvature are the same, both for the contractions and the quotient of ionic dissociation, if expressed in terms of percentages, yet the correlation of the two phenomena does not appear to be of a simple character.—*Phil. Mag.*, Jan.

Internal Resistance of Galvanic Cells.—AYRES.—An illustrated account of measurements of the true internal resistance of galvanic cells by means of a "capacity bridge" method, which is a new modification of Kohlrausch's method. The method gives not only the resistance but also the capacity of the cell. A complete mathematical theory of the bridge is given. Experiments were made with Daniell cells, "Excello" cells and Leclanche cells. The results show that the resistance was the same whether the cell was on open or closed circuit, within high limits of accuracy. However, it is to be noted that the condition of a cell, of course, depends upon its previous history, among other things upon any prolonged current that may have been flowing, in so far as this actually alters the cell. What his results show is that the resistance of a cell is not a function of the current at the time.—*Phys. Rev.*, Jan.

Polarization of Magnesium.—CAMPETTI.—An account of experiments in which he used a magnesium anode in the same way in which the aluminum anode has been used at repeated times for rectifying alternating currents. He used a magnesium anode, a platinum cathode, and a solution of caustic soda. He found that the current passing through the cell is very small until a potential difference of 75 volts is reached when there is a rapid evolution of gas and a strong current. "When the platinum is made anode the current is about 30 times as strong. It appears that 10 or 15 per cent of the energy transmitted through the cell is used up in overcoming the resistance of the boundary between the electrodes and the liquid."—*Nuovo Cimento*, Oct.; abstracted in Lond. *Elec.*, Jan. 10.

REFERENCES.

Scrap Tin.—An illustrated summary of numerous recent improvements and modifications of electrolytic methods for obtaining tin from scrap tin.—*Zeit. f. Elektrochemie*, Jan. 9.

Electro-Chemistry in 1901.—KRUEGER.—The first part of a very condensed summary. This part gives a brief review of articles on theoretical chemistry.—*Electrochem. Zeit.*, Jan.

Dielectric Constant of Solutions.—DE FOREST PALMER.—A long illustrated account of an experimental investigation of the dependency of the dielectric constant of dilute electrolytic solutions, upon the concentration.—*Phys. Rev.*, Jan.

Electrolytic Production of Chlorates.—J. B. C. KERSHAW.—An illustrated description of the Corbin process and cell for the electrolytic production of chlorates, as used in Chedde in Savoy, since 1896. Water power is utilized, the mean annual power being from 8000 to 9000. The construction of the cell is described and illustrated. A current efficiency of 85 per cent is attained. The output of chlorate and perchlorate has increased from 2200 tons in 1899 to 4000 tons in 1900.—Lond. *Elec. Rev.*, Jan. 17.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Frequency Measurements.—K. E. F. SCHMIDT.—A description of several methods of measuring the frequencies of alternating currents. In one of these a telephone is made to produce stationary sound waves in a glass tube, and two positions of minimum resonance are determined by means of a piston. The telephone is excited by the current to be studied, and the position of the piston together with the known velocity of the sound in the air, suffice to determine the frequency sought. He has also successfully used Kundt's dust figures for the same purpose. Both methods are suitable only for frequencies which are considerably higher than those ordinarily used. For ordinary frequencies he uses an incandescent lamp fed by the current under investigation. This is photographed by a camera attached to a pendulum and the negatives show alternate bright and dull stripes in accordance with the maxima and minima of the current traversing the lamp. He also simultaneously photographed two lamps in this manner, one of which had a difference of phase with respect to the other. This phase difference then expresses itself in a displacement of the stripes with respect to each other.—*Ann. der Physik*, No. 1; abstracted in Lond. *Elec.*, Jan. 17.

REFERENCES.

Registering Instruments on Tramways and Railways.—JACQUIS.—A long illustrated description of various registering instruments for use on tramways and railways. The results of tests of two French railway companies are also given at some length, in which the e. m. f. at the lamps was registered, the lighting current being furnished from dynamos connected to the wheels in parallel with a battery.—*L'Eclairage Elec.*, Jan. 4, 18.

Voltameter.—LEHFELDT.—His Phys. Soc. paper on a voltameter for small currents, an abstract of which has been noticed before in the Digest.—*Phil. Mag.*, Jan.

Wattmeters.—ARMAGNAT.—The first part of an article, illustrated by many diagrams, on the theory and construction of wattmeters. In this part he deals with electrodynamic wattmeters and discusses the effects of mutual induction and of self-induction.—*L'Ind. Elec.*, Jan. 10.

Electrograph.—An illustrated description of the electrograph devised by Lancetta, in which the property of imperfect contacts is applied to the registration of disturbances of atmospheric electricity and especially to the observation of the progress of distant storms.—Lond. *Elec. Rev.*, Jan. 17.

Cable Testing.—SAVAGE.—The first part of an article illustrated by diagrams in which he discusses the methods used in practice for eliminating corrections for the leads, etc., in cable testing.—Lond. *Elec. Rev.*, Jan. 17.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—FERRIE.—A long abstract of a paper read before the Internat. Soc. of Elec. in Paris. After a review of the development of wireless telegraphy he discusses the part which the vertical wires play, and also the earth. He has found that the Hertzian field is concentrated immediately above the ground, so that the earth plays a part in the transmission as it prevents the field from being dissipated into all the space. He also discusses the methods of syntonizing, and the action of the coherer. The disadvantages of wireles telegraphy are uncertainty, depending upon atmospheric disturbances, lack of secrecy, and low speed of transmission. Nevertheless, wireless telegraphy has great advantages for transmission from ship to ship and from ship to coast, especially in war times, when it may also be used by the army. He does not believe that in other ways wireless telegraphy will ever be able to compete commercially with ordinary telegraphy.—*L'Eclairage Elec.*, Jan. 18.

REFERENCE.

Submarine Cable.—MASCART.—An illustrated article on the submarine cable between Tourane, Annam, and Amoy, China, which is the first French cable in the Orient. The construction of the cable and the installation of the cable ship are described.—*Rev. Gen. des Sc.*, Jan. 15.

MISCELLANEOUS.

Physiological Effect of High-Frequency Currents.—BORDIER and LECOMTE.—An account of experiments on the probable reason why high frequency currents, as used in Tesla's experiments, are under certain conditions harmless when applied to the human body. The prevailing idea has been that the currents pass over the surface of the body without affecting the vital organs. This is contradicted by the present authors who tried the effects of an induction coil worked by a continuous current of 120 volts and a Wehnelt interrupter upon a guinea pig, a rabbit and a rat. The rat died immediately, the guinea pig died in seven minutes and the rabbit after 13 minutes. Under the same conditions a human subject did not experience the slightest sensation. D'Arsonval in reviewing these results points out that the physiological effect is entirely due to heating, which leads to a coagulation of the blood. This heating is small in the case of the human body, and, therefore, harmless.—*Comptes Rendus*, Dec. 30; abstracted in Lond. *Elec.*, Jan. 17.

Earth Plates.—TANAKADATE.—An article on earth plates which are used for diminishing the resistance of telegraph circuits, lightning conductors, etc. While it is often assumed that the efficiency of such plates is measured by their area, he shows mathematically that great economy of material may be effected by using elongated strips instead of square or round plates. Roughly speaking, a strip of 1 cm.² by 5 meters will be enough to replace a plate of 1 square meter, i. e., one-twentieth of the material will suffice. As regards corrosion, more damage may be done by a long, narrow fault than by a round one of the same area.—*Denkigakkwai Zassi*, No. 159; abstracted in Lond. *Elec.*, Jan. 10

REFERENCES.

British Engineers in Germany.—The reports to the Brit. Inst. Elec. Eng. on last year's visit to Germany, by the committee on manufacturing, dealing with the financial conditions of the electrical industry in Germany, the works, management, and the design, etc., also the report of the committee on telegraphs and telephones, also a full record of the discussion of the reports before the Institute.—Lond. *Elec.*, Jan. 17.

Glasgow Exhibition.—BATHURST.—A continuation of his illustrated description of machine tools at the Glasgow Exposition with special reference to needs of electrical manufacturers. This part deals with new hexagon turret lathes.—Lond. *Elec Rev.*, Jan. 17.

Marconi's Return to America.

A special cable dispatch from London, Feb. 14, states that Mr. Marconi will return to the United States in 10 days to resume his transatlantic experiments.

New Books.

VELOCITY DIAGRAMS. Their Construction and Their Uses. By Chas. W. MacCord, A. M., Sc. D. New York: John Wiley & Sons. 116 pages, 83 illustrations. Price, cloth, $1.50.

The author says in his preface, "This treatise is in effect an abstract of a series of lectures forming a part of the course of instruction of the Stevens Institute of Technology." It is written in a manner, however, that is satisfactory to the student who is studying without an instructor.

In the operation of any piece of mechanism each part goes through a complete series or cycle of motions, and then returns to its initial position. The graphical deliniation of such a cycle is called a velocity diagram. The book takes up the subject at the beginning and extends it to a sufficient number of practical cases, so that the student can become familiar with the method and be able to apply it to new cases as they occur in his work.

In expounding the method of Roberval for drawing tangents the author becomes somewhat polemical, and devotes two or three pages to demolishing the statements of Mr. J. F. Heather in his descriptive geometry. He proves his case, but it is scarcely necessary in a work of this class to bring in incorrect statements for the purpose of disproving them. A demonstration of the correct method is sufficient. We can recommend the book to students of machine design and others interested in mechanical movements.

THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson. Second Edition, rewritten and enlarged. New York: The Macmillan Company. 333 pages, 238 illustrations. Price, $1.75.

The first edition of Professor Franklin's book was issued in September, 1899, and that a second edition is now called for is an indication of the reception that has been given this text-book. This second edition is in effect a new book, for, besides containing 50 per cent more matter, much of the original text has been rewritten. The authors evidently concluded that as first issued the book partook too greatly of class exercises, for the matter which they have added is rather of a general and descriptive character. The added topics deal with the discussion of the relative advantages and disadvantages of alternating currents, and the characteristic features of the problems involved in such current working, though, as stated here, many of the claims are not convincing, and the entire discussion is far from satisfactory.

A very clear and simple statement of the nature and specific problems of electrical resonance has been added, and supplementing the more theoretical discussions is a new section devoted to the description of alternating-current machinery. In these latter five chapters are given excellent selections from standard catalogue matter, with illustrations and diagrams whose originality has emanated from the draughting rooms of the several large electrical companies. This is one of the constantly recurring complaints of reviewers, and authors seem to be as industriously continuing in the path of least resistance, which, in this case, is the binding of catalogue matter between boards and offering it as a book. Under the circumstances an author is dependent upon the voluminous catalogue literature for many of the essential details of the commercial apparatus which he must describe; but it is the privilege of the reader to demand a vital and individual presentation of such details in a work of authority.

The publisher, too, is to be criticized for numerous typographical defects. The table of contents is a surprise, as it is set up in "display." Both the paper and letter press are excellent, though the latter is frequently marred by the unusually large diagrams, as on page 122, and by the excessive size of the half-tone illustrations of apparatus, and the failure of the printer to bring these out with clearness. On page 278 a section of an armature is shown which would have been equally effective in a much smaller cut. These are pronounced defects which have spoiled the appearance of an otherwise typographically excellent book.

For the general reader, as well as the student, Professor Franklin's Elements of Alternating Currents is decidedly the best book available in English, both in respect to the scope of the subject matter treated, and the general development of the discussions. Its superiority over the excellent work of Messrs. Jackson is due to its clearness of treatment and grasp of essential physical relations. The writer here is in full and trained command of the mathematical

tool, and it does not dominate him to the detriment of the work. American readers will no doubt find more of interest and real value in it than in the works of Fleming and Thompson.

The book is distinctly inferior in mathematical method when compared with the treatment given alternating currents by Bedell and Crehore and Blakesley. On the other hand, aside from the logical treatment of the subject matter, the work of Bedell and Crehore is so destitute of physical significance and value that it should not be compared with this more matured and masterful work of Professor Franklin.

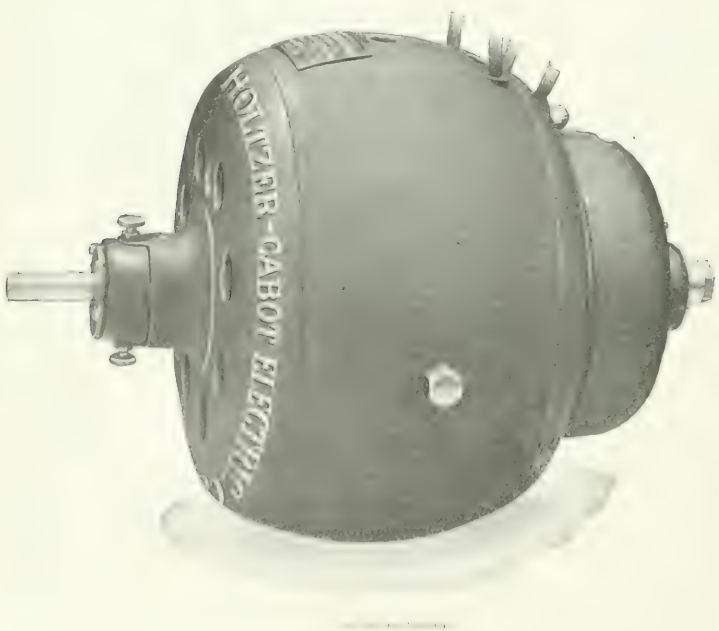
In Chapter LII. one feels disappointed that the authors have adhered to a geometrical method of discussion, when the only satisfactory one to pursue is the purely analytical. This same stricture may be applied nearly to all the purely theoretical portions of the text. The work is also lacking in physical explanation of electromagnetic phenomena of a periodic character. This is especially noticeable in the discussions of capacitance, reactance and inductance, as these concepts occur from time to time. As a whole, the style of the book is clear and forceful, though it often suffers from the personal emphasis of the writer and the frequent use of inconsequential headings, such as "remark" and "note," while in not a few cases iteration has been mistaken for explanation.

The text is copiously illustrated with problems. Doubtless this will yield a secret joy to those readers who are addicted to the ciphering habit; but to others it has the gruesome suggestion of the examination room. The matter of problems might have been left to works on electrical calculations.

The most impressive portions of the book are the three chapters which deal with the synchronous and induction motors, and the rotary transformer. No author has yet given these subjects such a clear and satisfactory treatment. As a whole, Professor Franklin is to be congratulated on the great excellence of this new edition of his book, and it is a conspicuous addition to the list of the few really good electrical books which American scholarship has produced.

The Development of Launch Motors.

In the accompanying illustration is shown a ½-hp motor, which is



one of a line constructed especially for launch work by the Holtzer-Cabot Electric Company, of Boston. As will be observed, the motor is entirely enclosed, being practically moisture proof. If the motor is well protected or is to be used in fresh water, the weight is materially decreased by the use of aluminum in parts where other metals are not necessary for electrical or magnetic purposes, although if the motor is likely to be exposed to the salt water, brass or iron fittings are recommended because of the corrosive action of the salt water upon the aluminum. In the latter case, the finished parts of the machine are copper plated for the same reason. The shape of the frame is such that two equal paths are provided for the magnetic flux, one on either side of the armature, a design which allows of great compactness.

The brush holder used with these motors is of the box type with parallel feed, making it impossible to run the motor for a long period of time without any attention to the brushes. A special form is used, consisting of stratifications of woven copper gauze and carbon, the outside layers being of the latter substance with a heavy copper plate. In this way are secured the advantages of the high conductivity of the copper and the wearing qualities of the carbon, the latter also preventing the copper gauze from spreading out and sticking in the holder.

The machines are economical in operation. The speed is low, 1000 r. p. m., and as they are series wound, they use field energy only in proportion to the load. The voltage is usually low, from 20 to 40 being ample in most cases. The motor is usually supported in the stern of the boat by means of heavy braces which are bolted to the body of the motor.

An Improved Theater Dimmer.

The increasing demand for more and better stage lighting effects has brought into prominence a type of theater dimmer manufactured by the Wirt Electric Company, of Philadelphia. The usual disadvantage accompanying dimmer operation is lack of space for installing the apparatus. To circumvent this difficulty it is customary to curtail the dimmer outfit and accommodate it to the available space. As a result, the apparatus generally lacks in some essential points.

The desirability of placing the stage dimmer at the first entrance implies small space, and recommends that dimmer which is the most compact while at the same time most complete.

The present method of furnishing three colors throughout all stage circuits demands a dimmer outfit of great flexibility. The operator wishes to combine the various colors and the various circuits in every possible way, and to accomplish this the only satisfactory method is to furnish for each color an individual dimmer. By this arrangement the operation of the board may be greatly simplified, and the possible combinations for producing light effects considerably increased. For example, if a sunset effect is desired, the usual method to accomplish this heretofore has been to first raise the red lights while the white lights are bright, and then dim the white lights by throwing the red light dimmer on the white light circuit. This is undesirable, since the stage is momentarily illuminated to an unusual brightness, owing to the superposition of the red lights on the white. Then, when the white lights are thrown out there remains a disagreeable impression of darkness, and this is particularly intensified, owing to the fact that there are usually a less number of colored lights in the circuit than there are white lights.

Another disadvantage arising from this method is the likelihood of mistakes in operation, owing to the complication of switches to enable the proper combinations to be made with a limited number of dimmers; in fact, an experienced operator is needed to manipulate such a board with certainty. To avoid this, a dimmer should be placed on each circuit and means provided for gradually dimming one set of

circuits at the same time that another set is being raised. Reference to the illustrations will show in what manner this is accomplished with the Wirt dimmer. Fig. 1 illustrates a bank of 24 stage dimmers arranged on three horizontal shafts, each shaft for a color; the white lights on the top shaft, red lights on the middle shaft, and blue lights on the bottom shaft. Each one of these 24 operating levers may be independently adjusted, or any combination of levers on a single shaft may be simultaneously controlled by means of one of the master levers shown at the right.

This board is intended to go on the left side of the stage, and, consequently, the arrangement of dimmer circuits from right to left is as follows: On the top shaft, white lights, proscenium, foots, first border, second border, third border, fourth border, fifth border,

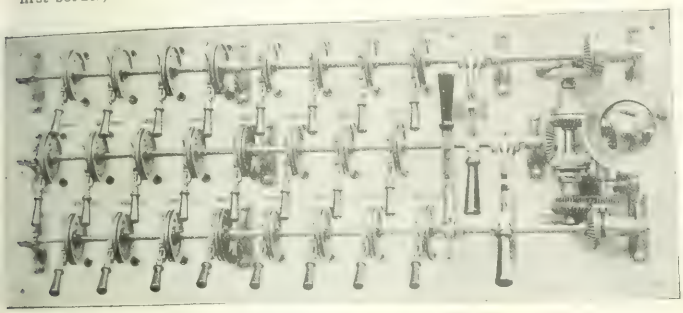


FIG. 1.—24 STAGE DIMMERS.

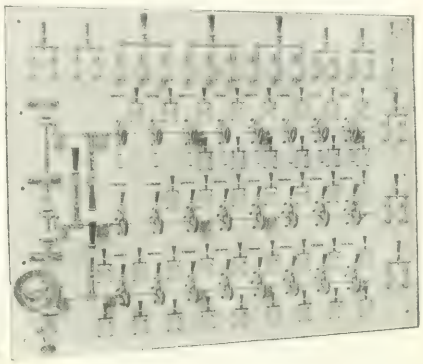


FIG. 2.—ANOTHER FORM OF DIMMER.

auditorium. On the middle shaft, white lights and auditorium are displaced by red lights and bunch lights, and on the bottom shaft blue lights displace red lights, the other lights being the same on the several shafts.

With the individual dimmers operated by the levers, as above noted, it is a very simple matter to secure any combinations of light on any one shaft, and to operate any pair of shafts in the same or opposite direction at the same time.

To aid in securing a gradual light variation in dimming one color or dissolving two colors, a vertical gang shaft with worm gear is supplied that may be engaged or disengaged with one or all of the horizontal shafts. In the improved form, the horizontal shafts are engaged or disengaged by means of friction clutches which may be thrown in or out while the vertical shaft is in motion. This accomplishes a most important function. It enables one color to be thrown on the gang shaft at any time after another color has been thrown on and in the reverse direction, and this is accomplished without stopping the motion of the gang shaft or of the lights that are being raised. If, now, it is desired to produce a sunset effect, the first operation is to engage the horizontal interlocking shaft controlling the red lights with the vertical gang shaft and start the worm wheel. This will gradually raise the red lights. When they have been raised a small amount, the horizontal shaft controlling the white lights is engaged with the vertical shaft by means of its friction clutch, and the dimming of the white lights is begun. When the red lights have been raised to their full candle-power, they are thrown off of the gang shaft, and the dimming of the white lights is completed.

If now it is desired to secure a moonlight effect, a similar operation is performed with the red and blue lights. Owing to the easy operation of these levers and shafts, dark changes may be made by means of the master levers, as the bank of dimmers can be almost as easily operated as a knife switch. In fact, this method of interlocking dimmers and arrangement of independent horizontal shafts removes entirely the necessity for ganging switches, a method which was almost exclusively adopted before the dimmer was perfected, and as a makeshift has outlived its usefulness.

This same type of dimmer is also made in another form wherein the branch circuit switches and main switches are also on the same panel. This is illustrated by Fig. 2. In this arrangement each dimmer lever has a corresponding switch adjacent thereto, so that the two are for controlling the same circuit.

At the extreme right of each horizontal shaft is a bull switch or break-down switch for controlling all of the stage lights on one color. This is very convenient in some instances in dark changes where it is not desired to operate the dimmers.

Another modification of this type of dimmer was made this year for the Garrick Theater, of Philadelphia. At the suggestion of Mr. Beerwald, electrician of the Garrick, the switches were placed back of the main panel and operated by levers on the front of the board. By placing these levers on the same horizontal shafts supporting the dimmer levers the control of each circuit was secured by two levers adjacent to each other, one supporting the switch and one the dimmer. The particular advantage of this form is the removal of all live parts from the face of the switchboard.

This operating board may be placed quite close to the proscenium

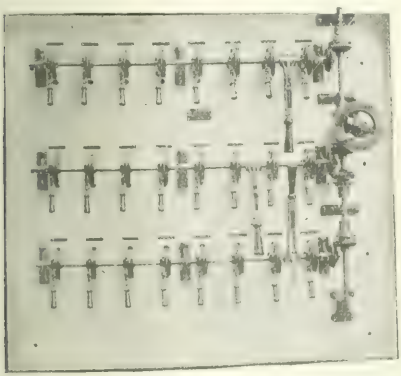


FIG. 3.

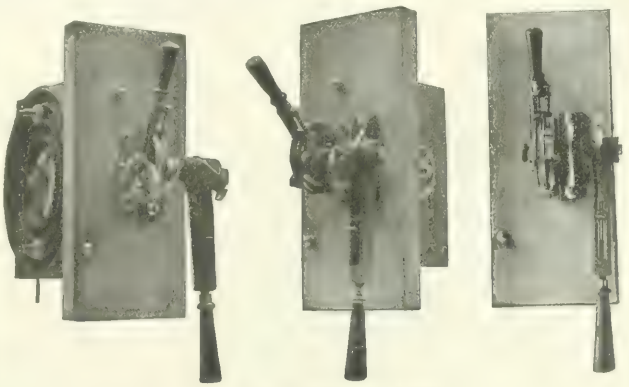


FIG. 4.

wall, and the dimmers proper may be situated either above the operating board, beneath the stage floor, or directly behind the board. The arrangement of dimmers beneath the stage floor is preferable, as there is always plenty of room for installing dimmers in that position, and they are easily accessible for examination or repairs.

Steel cables passing over pulleys on the operating board and through grommets in the panel turn over idlers, and pass down beneath the stage floor, where they are connected to the proper dimmers and control them. There is provided a take-up for any slack that may occur in these flexible steel cables, but it has been found after two years' use that the cables stretch very little, and the take-up device is an unnecessary refinement.

The whole operating board is preferably contained in a cabinet with sliding or rolling front, which may be closed when the board is not in use. The small size of the board enables a single operator to control every circuit and dimmer without the necessity of moving from one point to another.

Fig. 1 illustrates a board measuring approximately 2 ft. by 4 ft. 6 inches, and, as before stated, with 24 dimmer circuits. The dimmers themselves are attached to the proscenium wall above the operating board. Fig. 2 illustrates a board with dimmer plates beneath the stage floor. In the case of Fig. 3 the dimmers were directly back of the operating board. Fig. 4 represents three views of a single unit, showing the operating lever together with a portion of the interlocking shaft and master lever on the face of the board, and the dimmer plate directly back of it. As will be seen from an examination of these cuts a simple rotation of the handle of the lever is sufficient to engage it with or disengage it from the interlocking shaft. It may be set so that the interlocking shaft when rotated will pick it up at any point at which it has been left.

G. E. Fan Motors for 1902.

The fan motors manufactured by the General Electric Company for 1902 embody but slight modifications. The standard sizes this year for alternating-curent motors include 12-inch desk motors with swivel frames and with swivel and trunnion frames; 12-inch wall bracket motors; 16-inch solid frame desk motors and 16-inch wall bracket motors. The direct-current motors are made in the same sizes and styles excepting the 12-inch desk motor which is made with the solid frame and with swivel and trunnion frame. These motors are all fitted with variable speed switches. They are finished in black enamel; the fans, guards and trimmings being of polished brass. Attention is called to the fact that the guards are all fitted with two outer rings, which, besides protecting the fan, increases the stiffness of the guard, a precaution made necessary by the rough handling to which motors are often subjected.

Beside the standard line of desk and wall bracket fan motors, this company presents a special spring supported bracket motor of ornamental design using a 10-inch fan. On account of its noiseless operation and attractive appearance, this motor is intended specially for private residences and sleeping apartments, particularly when the motor must be placed on walls or partitions where the vibration tends to make the operation of solidly supported motors noisy and unsatisfactory. These motors are made for both direct and alternating-current circuits.

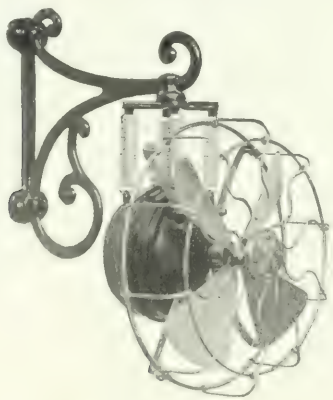


FIG. 1.—BRACKET FAN.

The 1902 ceiling fan is a four-blade fan, with 58-inch sweep of blade, furnished with black enamel or oxidized copper casing. A decidedly novel and attractive type is the radial fan motor made for 115-volt direct-current circuits, and intended for such places as dining and reading rooms, where a gentle horizontal breeze in all directions is especially desirable. This device is 24 inches high; a six-blade fan 8 inches in diameter being used and protected by a suitable guard. A three-speed switch is provided in the base of the motor, which is connected to the circuit in the usual way by means of a flexible cord. It is furnished with an artistic casing finished in streaked oxidized silver.



FIG. 2.—RADIAL FAN.

There is another line which the General Electric Company includes with its fan motors this year, and known as ventilating fan motors. They consist of 12 or 16-inch fans, mounted on a tripod intended for use in openings in walls or partitions or in any place where it is desirable to remove more than about 3500 cu. feet of free air per minute. These are made for 115 volts and 230 volts direct current, and 100 to 115 volts alternating current, 60 and 125 to 140 cycles.

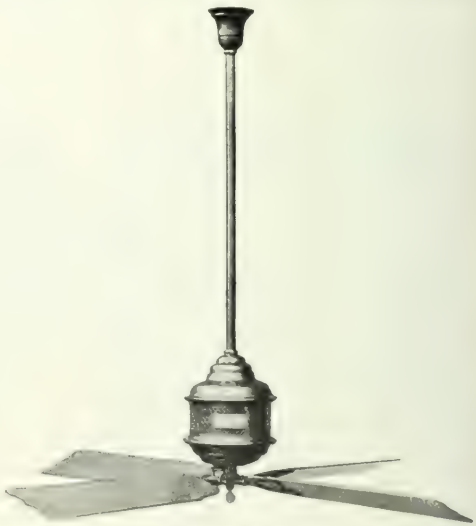


FIG. [illegible] CEILING FAN.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4 per cent for 30 to 60 days, and 4@4½ per cent for three, four and five months. Early in the week the stock market showed a broadening tendency but the threatened enforcement of the recent rulings of the Internal Revenue Department regarding the war tax in connection with securities deposited as collateral for loans, somewhat checked the market and brought on hesitation in dealings. United States Steel securities responded more or less to favorable accounts of the steel trade conditions. Amalgamated Copper was heavy throughout on the reports of a further dividend reduction, and traction securities were unfavorably affected by the news of the $150,000,000 blanket bond mortgage on the Brooklyn Rapid Transit system. The latter stock closed at 62⅞, a net loss of 4 points. Metropolitan Street Railway showed some weakness, closing at 171¼, which is a net loss of 2 points, the sales being 104,900 shares. Electric stocks held their own throughout the week, General Electric closing at 291, a net gain of ¼ point. The highest point reached by this stock during the week was 295. Western Union remains unchanged at 91; Westinghouse common made a net gain of 1¾ points, closing at 177, and Westinghouse first preferred is unchanged at 180. Other closing quotations are: American District Telegraph, 34½, a net loss of 1½ points; American Telegraph & Cable, 90¾, a net gain of 2 points, and Manhattan Elevated, 134, a net gain of ⅛ point. Following are the closing quotations of Tuesday, Feb. 18:

NEW YORK.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
American Tel. & Cable...	91	91	General Electric.....	292	290
American Dist. Tel.....	34	30	General Carriage.....	1	78
Brooklyn Rapid Transit..	66⅝	62¾	Hudson River Tel.....	—	—
Ches & Pot. Telephone.	—	—	Metropolitan Street Ry..	171⅝	171⅛
Commercial Cable.....	162	155	N. E. Elec. Veh. Tran...	—	—
Electric Boat.....	26	26½	N. Y. Elec. Veh. Tran....	14½	13¼
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	—	1¾	Tel. & Tel. Co. America.	—	4½
Electric Vehicle.....	2½	2	Western Union Tel.....	91⅛	90⅞
Electric Vehicle pfd.....	4¾	4¼	West. E. & M. Co.....	176½	174
			West. E. & M. Co., pfd..	179	175

BOSTON.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
Am. Tel. & Tel.....	158	158	Mexican Telephone.....	2	—
Cumberland Telephone...	—	—	New England Telephone.	140	*140½
Edison Elec. Illum.....	—	257	Westinghouse Elec.....	88	*90
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	—	90
General Electric pfd.....	—	202			

PHILADELPHIA.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
American Railways.....	—	—	Phila. Traction.....	99½	—
Electric Storage Battery.	62	—	Philadelphia Electric....	4½	—
Elec. Storage Batt'y pfd.	62	—	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	8	—	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
Central Union Telephone.	—	—	National Carbon pfd....	83½	83
Chicago Edison.....	164	—	Northwest Elev. com....	38¼	—
Chicago City Ry.....	219	210	Union Traction.....	15	15¼
Chicago Telep. Co.....	—	—	Union Traction pfd....	49½	48½
National Carbon.....	20¼	20½			

*Asked.

EVERETT-MOORE AFFAIRS.—Creditors of the Everett-Moore syndicate, officials of the Federal Telephone Company and a subcommittee representing the bankers' committee in charge of the syndicate's affairs are considering a plan for refinancing the Federal Telephone Company. It is stated that if the plan is successful, it will not only obviate the necessity of selling or leasing any of the traction properties, but will place the syndicate on its feet to resume operations. The plan is to float a bond issue on all the properties of the Federal Company, the issue to be on the collateral trust plan under which the stocks and bonds of the subsidiary companies are to be deposited with some local trust company, and a bond to the amount of $5,000,000 to be issued against them. The bond would be divided into three issues, the first to cover a loan of $1,000,000 for development purposes, the second of $2,000,000 to go to the secured creditors who at present hold Federal securities on claims, and the third of $2,000,000 to go to the unsecured creditors. A considerable sum of money other than that required for completing several of the plants which has already been arranged for is required to place the system at its maximum earnings basis. For instance, the Cuyahoga Telephone Company, Cleveland, requires an outlay of about $125,000 for additional apparatus to place the exchange in first-class shape. The Columbus Citizens' Company has reached the limit of its capacity, and it will require $300,000 to make needed improvements. The bond issue would be secured by the treasury assets of the Federal Telephone Company to the amount of $1,200,000, but which have a face value of $5,000,000. The remainder would be made up of other securities of the subsidiary companies that at present are hypothecated.

LIGHTING DEAL IN SAN FRANCISCO.—An effort is being made to get the control of the San Francisco Gas & Electric Company as a preliminary to a combination of a half dozen concerns supplying light and power in that city. To accomplish this end an offer has been made of $60 a share for 66,000 out of 130,301 shares of capital stock, payable on or before Feb. 1, 1904. This offer holds good till April 1 next. Pending the taking up of the option, the shareholders will be paid $2 yearly on shares placed to fulfill this condition. Fifty thousand dollars has been deposited with the Bank of California for the first quarterly payment. The identity of those back of this deal is kept a profound secret. One report has it that the $30,000,000 Colgate syndicate is promoting the deal. Others say Claus Spreckels is the moving spirit. The most plausible theory is that Rudolph Spreckels, head of the San Francisco Gas & Electric Company, is the chief spirit in the plan. The report of the scheme sent Gas and Electric stock up. The seven gas and electric companies represent a capital of nearly $19,000,000, while the net return is only 3.44 per cent.

PHILADELPHIA KEYSTONE TELEPHONE.—President Robert H. Foederer, of the Keystone Telephone Company, says that the reports that the Keystone Telephone Company is not meeting with success, and that he or the company or both have lost a large sum of money in the enterprise are absolutely without foundation. The Keystone Telephone Company is steadily progressing with its plans. Telephones are being installed at the rate of 300 a week, and by May 1 it is expected to have 5000 in operation. The number of contracts signed with the company already aggregate 8200, that is to say, business aggregating about $500,000 a year, is already contracted for. Connections have been arranged for covering the territory between Philadelphia and St. Louis and other lines have been arranged for, which practically assure to the company all the long-distance connections necessary or desirable. Contrary to report the Keystone Telephone Company is not negotiating for the use in Philadelphia of the system of the Telephone Company of America.

BONDS FOR $150,000,000.—The board of directors of the Brooklyn Rapid Transit Company, at a meeting Feb. 10, unanimously decided to submit for the approval of the stockholders at a special meeting to be called for March 20, 1902, a mortgage to secure bonds to the amount of not exceeding $150,000,000. The proposed mortgage is to be called "general consolidated and collateral trust mortgage," and the bonds are to bear interest at the rate of not exceeding 4 per cent per annum. Out of the $150,000,000 of bonds authorized, provision is made for the practical retirement at maturity, or sooner, if advisable, of all the various issues of bonds of the companies of the Brooklyn Rapid Transit System, amounting in the aggregate to $61,065,000, including $7,000,000 of Brooklyn Rapid Transit bonds. The exact use of the large portion of bonds not accounted for above does not yet appear.

SYNDICATE BUYS CONNECTICUT TROLLEY.—The Meriden, Southington & Compounce Tramway Company will soon be turned over to the United Gas Improvement Company, of Philadelphia, thus adding about 30 miles of paying electric lines to the already important holdings of the Connecticut Railway & Lighting Company. The price paid for the road is not given, but it is large, as the Consolidated Road's intention to connect New Haven and Waterbury through Cheshire added greatly to the value of the property and gave the syndicate the desired entry to Waterbury from the east. The charter of the Southington Company permits extension to Waterbury, and in this way a through line will be established from Waterbury to New Haven, to Meriden and north to Springfield, Mass. Mr. A. M. Young has the matter in hand.

PITTSBURG TELEPHONES.—The report of President Wilson, of the Central District & Printing Telegraph Company, (Bell telephone), shows that the increase in capital stock from $7,500,000 to $10,000,000 is absolutely necessary to meet the extension of the business of the company. The number of miles of wire operated is now 96,145, an increase of 18,497, or nearly 20 per cent during 1901. The number of subscribers is now 40,136, an increase of 4625 since January, 1901. The board elected at the stockholders' meeting is as follows: D. Wilson, president; D. F. Henry, George I. Whitney, Charles E. Speer, J. G. Stevenson, Daniel H. Wallace, F. P. Fish, P. Jay French and Joseph P. Davis. One-half of the new stock is to be issued this year and half in 1903.

DIVIDEND.—The directors of the Kings County Electric Light & Power Company have declared the regular quarterly dividend of 1½ per cent, payable March 1, to stockholders of record Feb. 19. American Railways directors have declared the regular quarterly

dividend of 1¾ per cent, payable March 15. The net earnings for six months ending Dec. 31 were $159,190, an increase of $80,646, and surplus after dividends of $74,791.

ELECTRIC COMPANY OF AMERICA.—An advance statement of the Electric Company of America for the year ended Dec. 31, 1901, issued by President Snowden, says: "It has been thought advisable to submit at this time a brief statement as to the condition of the company in advance of the report to be submitted at the annual meeting of the stockholders. Briefly, the company owns and operates the following plants: Atlantic Electric Light & Power Company, Atlantic City, N. J.; Electric Light Company, of Atlantic City, Atlantic City, N. J.; Scranton Electric Light & Heat Company, Scranton, Pa.; Suburban Electric Light Company, Scranton, Pa.; Scranton Illuminating, Heat & Power Company, Scranton, Pa.; Columbus Colliery, Scranton, Pa.; Dunmore Electric Light, Heat & Power Company, Dunmore, Pa.; Wheeling Electrical Company, Wheeling, W. Va.; Bridgeport Electric Light & Power Company, Bridgeport, Ohio; Rockford Edison Company, Rockford, Ill.; Edison Electric Illuminating Company (controlling interest), Altoona, Pa.; Canton Light, Heat & Power Company, Canton, Ohio; Auburn Light, Heat & Power Company, Auburn, N. Y.; Conshohocken Gas Light Company, Conshohocken, Pa.; Conshohocken Electric Light & Power Company, Conshohocken, Pa., and the Atlantic City Gas & Water Company (large interest), Atlantic City, N. J. The net earnings from operating these companies for the year ending Dec. 31, 1901, will exceed $327,000, which, after deducting the interest on the bonds of the subsidiary companies, will leave a total of over $275,000 applicable to dividends, or more than 9 per cent on our paid in capital. In this statement two plants—Canton and Auburn—have been owned and operated for only five months of the year. It will be seen from the above that the dividend we are paying, 6 2-3 per cent on the paid-in capital ($7.50 per share), leaves a large surplus to profit and loss. We confidently expect our net earnings from operating the above-named plants will exceed $300,000 in the year 1902. This estimate, based upon the actual earnings for 1901, with Canton and Auburn on a full year's earnings, is very conservative; it does not take into consideration any increase in earnings, although the plants show an average net increase of 15 per cent in 1901 over the previous year. The company is without floating debt of any kind, with the exception of bills for current expenses, which are paid every month. It has no bonded indebtedness whatever, and has largely reduced that of its subsidiary companies. The books of the company show a very large surplus of undivided profits. All the plants have been equipped with modern appliances and are now in first-class condition.

GENERAL ELECTRIC FIGURES.—Boston is still a headquarters for General Electric gossip and the following is published in that city: Although but 10 days have elapsed since the close of the fiscal year of the General Electric Company, Jan. 31, the books of the company are so closely up to date that the result of the year's operations have been determined. In round figures the General Electric Company did business the past year aggregating $36,000,000, or at the rate of $3,000,000 per month. This compares with $27,969,541 the previous year, $26,323,636 for the year ended Jan. 31, 1900, and $11,170,319 for the year ended Jan. 31, 1899. The directors may decide to charge off a portion of these net earnings to depreciation, but it is difficult to determine what to charge off, as the plant account now stands on the books for but $3,400,000, although the plants with their expensive machinery could probably not be duplicated for $15,000,000, while remaining assets of the company are now inventoried on a rock-bottom basis and are worth millions more than the price at which they are carried on the books. Net earnings of $12,000,000 on the outstanding $25,000,000 common stock (there remains but $500,000 debenture bonds and $10,000 preferred stock not converted into common stock) are equivalent to 48 per cent. It is the expectation of the management, having in view the fact that the output for 1902 is already largely contracted for, that it will transact a business of $3,500,000 per month during 1902, 33 1-3 per cent of which should be net. It is not unlikely that in view of the remarkable showing of earnings which the company will be able to present, covering the operations of the past year, that the question of capital readjustment will be taken up in the early spring, upon the return of President Coffin from abroad. After the restoration of the capital reduction of 1898 the capital stock of the General Electric Company will stand at $40,000,000, and net earnings of $12,000,000 would mean 30 per cent upon such a capitalization.

CONNELLSVILLE (PA.) TROLLEYS.—The Connellsville Suburban Street Railway Company has taken over the stock of all the other traction companies in Connellsville, and has issued $175,000 of 30-year 5 per cent gold bonds in payment for the same.

TO LIST AMERICAN TELEPHONE BONDS.—Application has been made to the New York Stock Exchange to list for the American Telephone & Telegraph Company $13,000,000 additional 4 per cent collateral trust bonds.

INCREASE OF CAPITAL.—The Western Electric Company proposes to increase its capital stock from $8,000,000 to $15,000,000, and the number of directors from 9 to 11.

Commercial Intelligence.

THE WEEK IN TRADE.—Advices received by the mercantile agencies indicate hardening of prices, due to the expansion of sales on spring account, demand for manufactures and industrial operations generally. Especially good reports come from the West and Northwest, and the leading Eastern markets also showed a growth of sales for spring. The demand for and consumption of iron and steel are alike in advance of all past records. Scarcity of pig iron, steel billets and other crude materials is still a feature, and high premiums are being paid for prompt deliveries. It is stated that there never were so many orders on iron manufacturers' books for future delivery as now, and that the bar mills are sold ahead for five months. Re-orders of agricultural implement manufacturers are a feature. *Bradstreet* calls attention to the large and growing loss by fire as a serious menace and tax upon the community. General compilations show that the aggregate fire loss for the three prosperous years, 1899, 1900 and 1901, exceeds the loss from all business failures by $87,000,000, or 25 per cent. The railway earnings are still in excess of a year ago, the aggregate for January being $60,370,661, a gain of 7.6 per cent over January last year. Far Western and Northwestern roads returned the heaviest percentage, 23.7 per cent and 18.6 per cent, respectively. Central West roads report a gain of 6 per cent, and those of the South, 5.2 per cent. The business failures for the week, as reported by *Bradstreet's*, numbered 265, as against 247 the week previous, and 226 the same week last year. The consumptive demand for copper seems to be indifferent, and it is weaker here and abroad. The market ruled dull in spite of the fact that business in all branches seems to be very brisk. Exports continue on a large scale. The closing quotations are 12¼@12⅜c. for Lake, 12@12¼c. for electrolytic, 11¾@12c. for cathodes, and 12⅛c. for casting stock.

PITTSBURG RAILWAY EQUIPMENT.—The Philadelphia Company, of Pittsburg, which controls all the street railways of Pittsburg and Allegheny City as well as the suburbs, gave out contracts on Feb. 14 for additional equipment to its lines as well as for improvements in the power generating plant which aggregate upwards of $2,000,000. A new central power station is to be built at Brunots Island in the Ohio River, about 3 miles below Pittsburg, where the company intends to generate all the power to be used on its network of street railways as well as in the various lighting plants controlled by it. Contracts were given to the Providence Engineering Company for six steam engines, aggregating 20,000 hp capacity. The boiler plant will be equipped with Babcock-Wilcox boilers. Contract was also let for 100 cars.

BOOK TYPEWRITERS FOR ABROAD.—The Elliott & Hatch Book Typewriter Company, of 256 Broadway, reports a number of orders recently received for foreign governments, etc. The Russian representative of the company, M. Sekerinsky, of St. Petersburg, has forwarded an order for 100 machines which are to be used in several of the government departments. M. Kurosawa, of Tokio, the agent in Japan, has requisitioned for 25 of the largest machines for the Department of Communication and Record Office of the Japanese Government. Substantial contracts have also been lately received from the London offices of the Elliott-Hatch people for book typewriters to be utilized in various municipal record and railroad offices throughout the United Kingdom, where it is said nearly 2000 of these machines are already in use.

TO EXHIBIT MACHINERY BY BIOGRAPH.—The General Electric Company has taken the largest area of space—3000 ft.—so far applied for by an individual firm at the exclusively American exposition, which is to be held at the London Crystal Palace from May to October, this year. The company will exhibit machinery in motion by means of the biograph, thus being able to illustrate the operation of the most intricate movements of machines free from noise.

ELECTRIC RAILWAY FOR ITALY.—A special cablegram from Rome, Italy, dated Feb. 15, states that the American Westinghouse Company has promoted a bill for the construction of an electric railway between Rome and Naples. It is added that the distance (118 miles) will be covered in 2¼ hours. The journey now occupies six hours.

ORDER FOR ELECTROLYTIC COPPER.—The *Detroit Journal* says that the American Copper Mining Company, of Detroit, has entered into a contract to deliver to the American Metal Company, Limited, of New York, 150 tons of electrolytic copper in ingots monthly, at a uniform cost of 11 cents per pound.

THE PITTSBURG CONDUIT COMPANY is reported to be contemplating the erection in East St. Louis of a plant that will employ 500 men to manufacture aluminum wire.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Feb. 12: Antwerp—16 pkgs. electrical material, $703; 1 pkg. electrical machinery, $862. Argentine Republic—141 pkgs. material, $1,162; 41 pkgs. machinery, $2,694. Brussels—1 pkg. material, $131. British West Indies—11 pkgs. material, $161. British East Indies—92 pkgs. machinery, $31,165; 166 pkgs. material, $5,133. Barcelona—33 pkgs. machinery, $1,348. British Australia—70 pkgs. wire, $1,614; 52 pkgs. machinery, $8,097. Brazil—201 pkgs. material, $4,879. Bristol—2 pkgs. machinery, $282. British Possessions in Africa—2 pkgs. material, $134; 35 pkgs. material, $2,041; 2 pkgs. cables, $800. Bath—1 pkgs. wire, $200. British Guiana—4 pkgs. material, $145. Cuba—15 pkgs. machinery, $4,870; 90 pkgs. material, $1,663; 172 pkgs. wire, $821; 1 pkg. manufactures of copper, $68. Corruna—16 pkgs. wire, $347. Carlisle—1 pkg. machinery, $45. Chili—23 pkgs. material, $1,299. Christiania—8 pkgs. wire, $207. Central America—66 pkgs. material, $844; 100 pkgs. wire, $225. Copenhagen—8 pkgs. material, $125. Dusseldorf—9 pkgs. machinery, $100. Danish West Indies—8 pkgs. material, $129; 2 pkgs. machinery, $43. Ecuador—1 pkg. material, $15. Glasgow—11 pkgs. machinery, $1,103; 35 pkgs. material, $395; 25 pkgs. cables, $7,010. Genoa—21 pkgs. material, $235; 10 pkgs. machinery, $9,000; 112,000 lbs. copper, $12,320. Hull—5 pkgs. wire, $195. Halifax (Eng.)—1 pkg. material, $50. Huddersfield—5 pkgs. material, $150. Havre—51 pkgs. material, $2,295; 4 pkgs. machinery, $170. Hamburg—13 pkgs. machinery, $1,195; 8 pkgs. material, $323. London—8 pkgs. manufactures of copper, $375; 37 pkgs. electric cables, $11,514; 164 pkgs. machinery, $7,142; 89 pkgs. material, $4,126. Liverpool—29 pkgs. machinery, $2,351; 126 pkgs. material, $5,002; 24 pkgs. copper material, $131,160; 4 pkgs. manufactures of copper, $225; 224 pkgs. copper wire, $4,622. Mexico—4 pkgs. manufactures of copper, $66; 126 pkgs. material, $2,727; 154 pkgs. machinery, $19,391; 319 pkgs. wire, $1,368. Manchester—1 pkg. material, $50; 12 pkgs. machinery, $3,250; 128 pkgs. machinery, $49,460. New Foundland—2 pkgs. material, $82. Newcastle—6 pkgs. machinery, $2,600. Nova Scotia—32 pkgs. material, $314. Preston—4 pkgs. material, $118. Peru—17 pkgs. material, $596. Reval—7 pkgs. material, $250. Rotherham—3 pkgs. material, $100. Santo Domingo—5 pkgs. material, $29; 1 pkg. manufactures of copper, $40. Southampton—6 pkgs. manufactures of copper, $40; 123 pkgs. machinery, $17,608; 10 pkgs. material, $300. Tasmania—1 pkg. wire, $18. U. S. Colombia—20 pkgs. material, $119. Vienna—1 pkg. material, $15; 5 pkgs. machinery, $200. Vladivostock—4 pkgs. material, $198.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, is actively engaged in preparing and installing a great number of railway and lighting batteries that are to be put into operation within the next few months. In addition to the three large batteries for the Twin City Rapid Transit Company, which were mentioned recently, the West Hampton Park Railway, at Richmond, Va., has contracted for a battery of 250 cells of 480 ampere-hours capacity; the St. Albans St. Railway Company is to be equipped with 216 cells; the Indianapolis & Eastern Traction Company, Indianapolis, has contracted for 230 cells for regulation and emergency work; the San Juan & Santa Clara Railroad Company, at San Jose, Calif., is having a battery of 264 cells installed for the purpose of regulating the fluctuation in their railway power station. This plant is operated by a Westinghouse gas engine and generator, and the battery is intended to furnish power during the period of light load when the generator will be shut down. The Trenton Street Railway Company, Trenton, N. J., is having installed 264 cells with a capacity of 200 amperes for regulation on their Princeton Division. The Chippewa Valley Electric Railroad Company is having installed at Eau Claire, Wis., a battery of 264 cells with a discharge rate for regulation of 200 amperes. The Virginia Electric Railway & Development Company has recently installed at Richmond, Va., a battery of 1440 ampere-hours capacity. The 280 cells comprising this battery are in containing tanks of sufficient size to allow of an increase of 25 per cent in capacity. The battery is to be divided—140 cells to operate on each side of a three-wire lighting system. The company has under construction a battery of 134 elements for the Washington Arcade office building in Detroit, Mich., to be used as a regulator to absorb the fluctuations caused by elevator service and to furnish power for night lighting. A battery is also being installed for the Pennsylvania Epileptic Hospital and Colony Farm, at Oakbourne, Pa., for lighting purposes. A battery of 160 ampere-hours is being placed on the private yacht "Helenita," owned by Mr. Frank J. Gould, and there are five yachts being built by Messrs. Tams, Lemoine & Crane, each of which is to be equipped with batteries of Chloride accumulators.

PELTON WHEEL CONTRACTS.—Among the orders which the Pelton Waterwheel Company is filling from its San Francisco works are: Wheels for driving four 500-kw units for the Pike's Peak Power Company, Victor, Colo.; a 1200-hp wheel plant for the Morning Mine, Mullan, Idaho; wheels, etc., for pumping station for the city of Seattle, Wash.; two 600-hp units for the Central California Electric Company, of Auburn, Calif.; one 500-hp unit for electric lighting plant of the Crystal Lake Gold Mining Company, Lundy, Calif.; three 300-hp units for electric transmission of the Hilo Electric Power & Refrigerator Company, Hilo, H. I.; one 300-hp wheel for a silk factory in Japan; one 200-hp air compressor wheel for a plant in British Columbia; three wheels, each direct connected to a 1000-kw generator for the Keswick Electric Power Company, Shasta County, Calif.; a 1000-hp wheel, connected to generator, Big Creek Power Company, Santa Cruz, Calif.; one additional 1000-hp unit for the British Columbia Electric Railway Company; a 1500-hp unit for the electric transmission plant of the Tuolumne County Power Company, Columbia, Calif.; wheels for driving a 1000-kw electric generator at the Utica Mine, Angels, Calif., this being the second unit installed; four units, each consisting of a waterwheel and a 550-hp generator, for the electric transmission plant of the Sierra Power Company, of Los Angeles, Calif. The already great foreign demand for this class of machinery has increased.

THE BROWN HOISTING MACHINERY COMPANY, of Cleveland, Ohio, have just been awarded a $500,000 contract for a complete modern iron ore handling equipment for the new blast furnace now being erected at Clairton in Western Pennsylvania by the St. Clair Furnace Company. The plant will consist of a car dumper, two bridges and 700 ft. each of iron ore and coke bins. It is to be ready in time for the operation of the blast furnaces next fall. The motive power will be electricity, very large electric motors being used, as in several of the other recent Brown plants of this character. Some of the Elwell-Parker motors in these equipments run as high as two and three hundred horse-power.

BIDS FOR POWER EQUIPMENT FOR MINNEAPOLIS.—The Twin City Rapid Transit officials at Minneapolis opened bids a few days ago for the entire electrical equipment for the new steam power plant. The plans and specifications call for two 1500-kw engine type generators, two 3500-kw engine type generators, 10 rotary converters and 216 static transformers and impulse wheels. Bids were received from four companies: The General Electric Company, the Bullock Company, of Cincinnati; the Stanley Manufacturing Company, of Pittsfield, Mass.; the Jones-Underfeed Stoker Company. The cost of the electrical equipment will be between $400,000 and $500,000.

TELEPHONY IN NATAL.—The corporation of Durban, Natal, S. A., has acquired the obsolete system of a local telephone company, with the object of installing an up-to-date system. It is understood that the new exchange is to have a capacity for at least 2000 subscribers, and that particular stress will be laid on securing apparatus that involves least cost in maintenance, in order to secure greatest economy in the long run. Mr. John Roberts, borough electrical engineer of Durban, has charge of the matter, we believe, and he would appear to be now investigating the subject. Catalogues, etc., should, therefore, be forwarded to him.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has just closed a contract with the Rensselaer Telephone Company, Troy, N. Y., for one of its "major" relay type switchboards of 3000 lines' capacity, with a present capacity of 1500 lines. Included in this contract is all necessary power apparatus, chief operator's desk, wire chief's deck, and a toll board of 100 lines' capacity, with present equipment of 40 lines. These people will not rely wholly upon the city current for their source of energy, but will install a gas engine as a reserve in case of any trouble with the local electric light company's service.

THE SOUTHERN PACIFIC RAILWAY COMPANY has decided to improve its facilities at various points on its system for the building and repairing of rolling stock, and to this end has placed with the American Bridge Company, of New York, a contract for boiler shop at East Portland, Oregon; boiler and machine shops at San Francisco, Calif.; boiler and machine shops at Los Angeles, Calif.; machine shop at El Paso, Texas; machine shop at Houston, Texas. These buildings are all about 120 ft. by 250 ft., equipped with traveling cranes.

THE CLEVELAND CRANE & CAR COMPANY, Cleveland, Ohio, manufacturer of electric cranes, has purchased a large building site at Wickliffe, Ohio, east of Cleveland, and is preparing plans for a large plant. The main shop will be 160 ft. by 125 ft., and there will be a separate power house, as it is the intention to install electrically-driven machinery.

THE BALL ENGINE COMPANY, Erie, Pa., is building for the Mt. Vernon shops, Baltimore, of the Pennsylvania Railroad, a 200-hp tandem compound engine arranged for direct connection to a Westinghouse alternator. The engine is provided with synchronizing devices, as it is to run in parallel with another engine.

ELECTRIC RAILWAY FOR SHANGHAI.—The council of Shanghai, China, has, as already noted, invited bids until March 7 for the construction of an electric railway system in that city. Similar improvements will probably be carried out in Hong Kong, Tien-Tsin, and other Chinese ports.

General News.

THE TELEPHONE.

[illegible] incorporated, will have Yuma as its principal place of business. The directors are A. Modesti, R. S. Patterson, J. Gandolfo, F. G. Blaisdall, E. Sanguinetti, [illegible]

ALMA, ARK.—The Alma Telephone Company, capital stock $2,500, has been incorporated. Col. Jacob Yoes is president.

SAN FRANCISCO, CALIF.—A telephone franchise has been granted to C. L. Hafey by the Commissioners of Dona Ana County, New Mexico. The proposed line will extend from Mesilla to Las Cruces.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has on hand estimates for extensions of its lines and other improvements, amounting to $2,141,035, for the present year. The first shipment of Pupin coils to the Coast is expected in April, when several lines will be equipped with light copper wires and the new coils. It is probable that the new line in course of construction across the Cascades Mountains from Seattle to Spokane, Wash., will be the first one on the Coast to use the new system. The distance is over 300 miles. It may also be applied to a line from Portland, Oregon, to Los Angeles, Calif., where it would greatly increase the commercial efficiency of the line. It is probable that the company's California and Arizona long-distance systems will be connected during the year. A fine three-story telephone exchange building is being constructed in Los Angeles, and the underground system there, and in other cities, is being extended. New exchanges are being built in Walla Walla and Everett, Wash. A lot 100x100 has been purchased on the East Side in Portland, Ore., where an exchange will be erected for the districts east of the Willamette River. The company will float additional bonds, amounting to $1,000,000, April 1. There are more than 30,000 telephones in use in San Francisco on this system.

GREELEY, COLO.—The Morgan County Telephone Company has been incorporated, with a capital stock of $35,000. Incorporators: D. E. Gray, Geo. Settle and E. J. McMurray, all of Greeley.

BEASON, ILL.—Residents of Beason have organized a mutual telephone company.

GIBSON CITY, ILL.—The Gibson Telephone Company has increased its capital stock from $12,000 to $15,000.

CARTHAGE, ILL.—The Hancock County Telephone Company has increased its capital stock from $2,500 to $10,000.

CHAMPAIGN, ILL.—The Home Telephone Company at Champaign is planning to expend $6,000 in improving the service.

COLFAX, ILL.—The Village Council of Colfax granted a franchise for a local telephone exchange to J. Fielding and William Gaddis.

WAPELLA, ILL.—The Long Point Mutual Telephone Company has been incorporated by C. S. Swearingen, J. M. Rollofson and J. S. Williams.

CHICAGO, ILL.—The Kempton Telephone Company, of Kempton, Ill., has been incorporated by Carl Shulz, John Bergan and J. T. Corkill; capital, $1,200.

NEPONSET, ILL.—The Osceola and Neponset Telephone Company, capital stock $10,000, has been incorporated by F. W. Bates, Charles Lewis and E. B. Hill.

FOREST CITY, ILL.—The Forest City Telephone Company, with a capital of $2,500, has been incorporated by E. J. Bowser, E. J. White and John Pemberton.

HOOPPOLE, ILL.—Hooppole & Annawan Telephone Company, capital stock $1,875, has been incorporated by F. A. Lohman, C. W. Berge and George Mathais.

CHICAGO, ILL.—A committee of the Chicago City Council is investigating the financial affairs of the Chicago Telephone Company to aid in determining the proper rates to be charged for telephone service.

BLANDINSVILLE, ILL.—There is talk of the farmers organizing a new telephone line from the east side of Hire Township extending to Blandinsville, the company to be called to Hire Township Telephone Company.

CHICAGO, ILL.—The Illinois Manufacturers' Association has started suits to recover $2,500,000 paid by subscribers for metallic circuit telephones to the Chicago Telephone Company the past eight years in excess of what Judge Tuley recently decided was the legal rate permitted by the terms of the franchise.

CHICAGO, ILL.—It is stated that the Illinois Telephone & Telegraph Company has drawn plans and made contracts for installing an exchange of 25,000 telephones in the business district by July 1. It has completed more than half of its wire tunnels under the downtown streets. Its backers, organized as the Automatic Electric Company, have recently bought the patents on the Strowger automatic switchboard, which will be used.

CHICAGO, ILL.—The Chicago Telephone Company has appealed the case to the Supreme Court in which Judge Tuley decided that $125 is the maximum rate the company can charge for yearly rental of a business telephone. On metallic circuit telephones, the rental has been $175 since 1893. The company has now asked subscribers paying the $175 rate to pay $125 and furnish bond that they will pay the other $50 if the decision is favorable to the company, or if the $175 is paid the company will pay $50 per year back without interest if the decision is against the higher rate.

CENTERVILLE, IND.—The Centerville Telephone Company, composed of business men and farmers, has been organized here to build lines and operate [illegible]

WHITESTOWN, IND.—The Whitestown Telephone Company, $5,600 capital stock, has been incorporated. Directors: Benj. F. Hawkins, Preston Smith, H. John Burnes, Francis A. Stark, Alva E. Hine, Roy Smith, Jos. P. Van Camp and Robert G. Ferguson.

INDIANAPOLIS, IND.—The People's Co-operative Telephone Company filed articles of incorporation, with a capital stock of $6,000. The directors are M. L. Clouser, John H. Hutchinson, Lewis Kirk, George W. Deek and Marshall Hampton. The company will operate in Montgomery and Boone counties with headquarters at Bowers.

PLAINFIELD, IND.—The Plainfield Telephone Company, recently organized, has had a rapid growth and is prosperous. In addition to the 360 telephones now in use the enterprising managers have line connection with Danville, Avon, Cariby, Jopa, Friendswood, Bridgeport and Indianapolis. The line to Bridgeport was completed recently at which point 14 telephones were added.

FONDA, IA.—The Northern Telephone Company has increased its capital stock from $20,000 to $50,000.

HANCOCK, IA.—The Hancock Telephone Company, capital stock $10,000, has been incorporated by J. T. Armstrong, Chas. Warner and others.

ARMSTRONG, IA.—There is a movement on foot to build a number of rural telephone lines in the spring to connect with the local exchange here.

SHANNON CITY, IA.—Articles of incorporation were filed by the officers of the Shannon City Telephone Company. P. W. Miller is president and Clarence McConnell, secretary.

SHADYGROVE, IA.—A farmers' telephone line is being talked of between this place and Brandon. It is also reported that the Wettstein line will be extended from La Porte to this place in the near future.

SPRINGVILLE, IA.—The Springville Telephone Company, which was recently organized, contemplates extending its lines to adjacent towns. It now has about seventy miles of line in operation and 180 subscribers.

DES MOINES, IA.—Mr. Sweeley has presented a bill in the House providing for municipal ownership of telephone exchanges and lines, the regulation of rates and to compel the systems to connect with one another for toll line business.

MANCHESTER, IA.—The Delaware County Telephone Company, of Manchester, capital stock $10,000, has been incorporated by F. L. Durey, Burton Clark, W. D. Hoyt, G. W. Miller, G. S. Amsden, Charles A. Peterson and W. N. Wolcott.

WINTERSET, IA.—The farmers between Winterset and Pitzer are constructing a rural telephone line between these points. As soon as the line is completed to Winterset a company is to be formed and a franchise asked for to operate the line in the city.

TULSA, I. T.—The Indianola Telephone Company, of Tusla, will construct a line from Claremore to Sapulpa, a distance of forty-five miles.

BELLE PLAINE, KAN.—The Valley Telephone & Electrical Company has been incorporated; capital, $10,000.

FAIRVIEW, KAN.—The Fairview Telephone Company has increased its capital stock from $5,000 to $10,000.

WICHITA, KAN.—The Kansas Long Distance Telephone & Telegraph Company has been incorporated. Capital stock, $500,000. Fred. and M. C. DeLand, of Pittsburg, Pa.; L. A. Stebbins, C. J. Evans and H. A. Branaman, of Topeka, Kan., are the incorporators.

LUDLOW, KY.—The Kentucky Telephone Company will extend its lines into Boone County.

EMINENCE, KY.—The city of Eminence sold a telephone franchise to R. M. Barker, of Carrollton for $50 for twenty years. It is said that Barker will establish a service and connect with the Home Telephone Company, of Louisville, Ky.

MOUNT VERNON, KY.—While Judge Durham, magistrate in the Wildie district, was in town on business he was called up over the telephone by Constable Harry Jones, who said he had in charge Dan Dickerson, charged with breach of the peace. Dickerson asked an immediate trial, and it was agreed to conduct the trial over the telephone wires. Half an hour's use of the wire by Judge Durham and County Attorney Bethurum at this end and the constable and defendant at the other concluded the trial. The defendant was fined, and the fine with costs, amounting to $12, was promptly paid.

PORTLAND, ME.—The New Portland & Kingfield Telephone Company, of New Portland, Me., has been incorporated with a capital stock of $1,000 by B. F. Bartlett and E. B. Quint, of North New Portland.

NORTH ADAMS, MASS.—Local men are said to be interested in the proposition to form an independent telephone company whose lines shall cover Northern and Central Berkshire.

BOSTON, MASS.—The American Telephone & Telegraph Company reports its output of instruments for the month ended Jan. 20, with comparisons, as follows: Gross output—1902, 87,412; 1901, 66,048; increase, 21,364. Returned—1902, 34,796; 1901, 25,766; increase, 9,030. Net output—1902, 52,616; 1901, 40,282; increase, 12,334. Total outstanding Jan. 20—1902, 2,578,626; 1901, 2,081,208; increase, 497,418.

JACKSON, MICH.—The Farmers' Telephone Company, capital stock $10,000, has been incorporated.

LESLIE, MICH.—The Bunker Hill Telephone Exchange has been incorporated, with a capital stock of $500.

LITCHFIELD, MICH.—The Litchfield Telephone Exchange has been incorporated, with a capital stock of $10,000.

DETROIT, MICH.—The Co-operative Telephone Company, of Detroit, will apply to the Common Council for an ordinance to authorize it to construct a quasi-municipal or co-operative telephone system in the city.

PONTIAC, MICH.—D. P. Yerkes has accepted a telephone franchise granted him by the Common Council of Milford village and proposes to begin the erection [illegible] The lines will probably connect with the Oakland lines running out of this city.

ST. PAUL, MINN. [illegible] capital stock from $1,000,000 to $1,500,000.

ELLSWORTH, MINN.—The Ellsworth Automatic Telephone Company has been incorporated with a capital stock of $10,000.

KANSAS CITY, MO.—At the annual meeting of the stockholders of the Missouri and Kansas Telephone Company, the capital stock was increased from $2,500,000 to $5,000,000.

BATTLE CREEK, NEB.—The Battle Creek Telephone Company has been incorporated by F. C. Meinecke and others; capital stock $5,000.

ODELL, NEB.—The Deller Independent Telephone Company has secured the required number of subscribers to enable it to put in an exchange and extend its lines to Odell.

OGALLALA, NEB.—Business men here have effected a temporary organization for the purpose of building a telephone line to extend from Keystone and Lincoln to Ogallala.

DAWSON, NEB.—The Dawson-Nemaha Telephone Company, capital stock $2,500, has been incorporated. Directors: O. C. Ayres, F. L. Blakeny, Rice Page, R. E. Fenton and J. G. McGinnis.

HUMPHREY, NEB.—The Humphrey Electric Light & Telephone Company has been organized, with a capital stock of $15,000, to conduct an electric light and telephone business in Humphrey. The promoters are H. J. Bruenig, J. E. Hugg and P. E. McKillip.

WAHOO, NEB.—A franchise for an independent telephone company has been granted to H. H. Hurst and M. White, of Iowa, and Mayor T. C. Parmelee, of Plattsmouth, Neb., who are the principal promoters. The exchange and all lines will be completed by May 1.

OMAHA, NEB.—The Plattsmouth Long Distance Telephone Company has just been granted franchises in Aurora, York, and Norfolk, Neb., to which points it will extend its lines. This will require several hundred miles of line. This company already has exchanges in over a hundred towns and cities.

HUMBOLDT, NEB.—A new company has been organized, with a capital stock of $2,500 to build rural telephone lines from Dawson to Middleburg. Following are the directors: J. G. McGinnis, Oliver Ayers, Rice Page, Frank Blakeney, and R. E. Fenton. Many farmers along the line have taken stock.

HOOPER, NEB.—The stockholders of the Hooper Telephone Company at a special meeting decided to consolidate with the Farmers' Telephone Company now operating forty miles of line in the western part of the county. The consolidated company will cover all of Dodge County, establish a local exchange in every town in the county and give service for 80 cents per month.

REIDSVILLE, N. C.—The Reidsville Telephone & Telegraph Company proposes to install exchanges in a number of near-by towns, and also to build several long-distance lines. Mr. R. J. Oliver is the manager. The exchange has a switchboard capacity of 144 drops and 140 subscribers. It is operating 110 miles of toll lines.

MEDFORD, N. J.—The Interstate Telephone Company is building a new line from here to Marlton.

AUBURN, N. Y.—The Auburn Telephone Company has made application to the Board of Trustees of the village of Skaneatales for a telephone franchise.

NEW YORK, N. Y.—Mr. Stokes, proprietor of the new Ansonia Hotel, at Broadway and Seventy-third Street, New York, has just closed a contract with the New York Telephone Company for a private branch exchange in that hotel with 360 stations. This will be the largest private branch exchange in New York City.

POLK, OHIO.—Howard Shwartz is promoting a new telephone company with a view to building up a farmers' system.

WASHINGTON C. H., OHIO.—The Washington Home Telephone Company has been incorporated with $100,000 capital stock.

ATHENS, OHIO.—The Hickory Grove Telephone Company, of Athens County, has been incorporated, with $1,375 capital stock, by T. C. Robinson, P. W. McLenahan, C. S. Griffin, L. J. Oxley, J. C. McLain, D. W. Kenney and W. A. Barnhill. They will build a farmers' system.

YOUNGSTOWN, OHIO.—The Beaver Telephone Company, which is preparing to erect an exchange at North Lima, has been incorporated, with $10,000 capital stock, by Allen Rickert, W. H. Ruhlman, Rudolph Metzler, S. M. Cupp and W. E. Metzler. Over 200 farmers in Beaver Township have subscribed for the service. Bids for long-distance service have been asked for from both the Bell company and the United States Telephone Company.

CLEVELAND, OHIO.—Officers of the United States Telephone Company and the Cuyahoga Telephone Company were elected Feb. 3. The bankers' committee in charge of the Everett-Moore affairs and of several of the leading creditors were given representation on the boards of directors. The officers of the United States Telephone Company are H. A. Everett, president; E. W. Moore, vice-president; J. B. Hoge, secretary; R. W. Judd, treasurer. Directors: J. B. Hanna, B. Mahler, H. A. Everett, J. B. Hoge, E. W. Moore, K. G. Roebling, J. W. Marsh, C. W. Wason and Maxime Reber. Cuyahoga Telephone Company: H. A. Everett, president; E. W. Moore, vice-president; J. B. Hoge, secretary; R. H. Judd, treasurer; directors, W. H. Lamprecht, H. A. Everett, J. W. Marsh, R. A. Harmon, B. Mahler, E. W. Moore, F. T. Pomeroy, K. G. Roebling, F. M. Stearns, H. R. Newcomb and C. W. Wason.

OKLAHOMA CITY, OKLA.—A company has been formed here for the purpose of selling, leasing and operating telephone exchanges in Texas, Indian Territory and Oklahoma. It will be known as the Automatic Telephone & Supply Company. The first towns to be equipped are Afton, I. T.; Fairland, I. T.; Tecumseh, Wakita and Billings, Okla.

WORCESTER, PA.—The Montgomery Telephone Company has been organized at Worcester, with a capital stock of $5,000. It is to be a farmers' telephone line.

PHILADELPHIA, PA.—The crossing of two wires in the main office of the Bell Telephone Company recently rendered useless 4600 telephones in the business section of the city and practically paralyzed the service for a day. This is the first time such an accident has happened in this city.

ELKTON, S. D.—The farmers living in the vicinity of Elkton are negotiating for the construction of a telephone line.

MENNO, S. D.—The Town Council has granted to the South Dakota Telephone Company, of Mason City, Ia., a franchise for a local telephone system.

SIOUX FALLS, S. D.—A company has been organized by farmers living in Hutchinson County for the construction of a telephone line connecting their homes with the systems of the towns in their localities.

SIOUX FALLS, S. D.—Farmers in the vicinity of Forestburg have decided to construct a telephone line from that place to Huron. An organization having this purpose in view was perfected, with George Alley as president and George Bonney as secretary.

LYNNVILLE, TENN.—The American Telephone Company is building a line from Nashville to Athens, Ala.

FORT WORTH, TEX.—The Southwestern Telegraph & Telephone Company is arranging to build telephone lines twelve miles into the country from Fort Worth for the accommodation of stock men.

NORFOLK, VA.—The Smithfield Telephone Company and the Isle of Wight Telephone Company have consolidated and merged in the Home Telephone Company. Of the consolidated company, J. W. Holloway is president; B. P. Gray, manager, and A. S. Barrett, secretary and treasurer. These, with Messrs. P. D. Gwaltney, P. D. Gwaltney, Jr., Z. W. Joyner and F. R. Berryman are directors.

MOUNT HOPE, WIS.—The People's Telephone Company has increased its capital stock from $4,200 to $6,000.

RACINE, WIS.—The Bristol Telephone Company has applied to the City Council of Kenosha, Wis., for the right to build its line from Pleasant Prairie into the city.

SOUTH MILWAUKEE, WIS.—The Wisconsin Telephone Company is installing an exchange in this city. There will be about forty telephones and the rate will be $1 per month, with extra charges for long-distance calls.

FOND DU LAC, WIS.—The Eagle Point Telephone Company has decided to extend its line to many principal points in the county and connect with the Chippewa County Telephone Company.

EAST TROY, WIS.—The Wisconsin Telephone Company has completed installing a new switchboard in the central office. The East Troy Telephone exchange, which is operated in connection with the Wisconsin Telephone Company has about 125 telephones.

MILWAUKEE, WIS.—The fourth annual meeting of the Wisconsin Independent Telephone Company will be held in this city on Feb. 19 and 20. The question of establishing an independent exchange in this city will be discussed. An alliance with the Rapid Transit Company of Minneapolis will also be considered and acted upon. The Rapid Transit people are desirous of building a long-distance copper metallic line into the State. They have already built a toll line from Minneapolis to Superior and Duluth and have let the contract for a toll system between Eau Claire and Minneapolis, and La Crosse and Minneapolis by way of Winona.

ELECTRIC LIGHT AND POWER.

DENVER, COLO.—The Colorado Coal Company will install electric machinery in its Tyron mine.

SAN FRANCISCO, CALIF.—The Ontario Power Company's stockholders have authorized a bonded indebtedness to the amount of $400,000, for carrying out the plans of their enterprise in California.

SAN FRANCISCO, CALIF.—The City Trustees of Healdsburg, Calif., recently adopted resolutions to the effect that it would be necessary to increase the capacity of the municipal electric lighting plant in the near future.

SAN FRANCISCO, CALIF.—The Electrical Construction Company, of San Francisco, is engineering the construction of an electric light and power plant for the proprietor of the hotel at Camp Taylor, Calif. It will be operated by a water wheel, direct connected to an alternating generator of large capacity. The current will be used to supply lights and also to operate the Taylor Paper Mills.

SAN FRANCISCO, CALIF.—The Standard Electric Company recently completed its main electric transmission line, 145 miles in length, from Amador County to San Francisco, after a vexatious delay in procuring the last right of way. A gap of six poles existed at the Dunphy ranch, near Milbrae, and a legal decision prevented the payment of what the company considered an excessive price for the privilege.

SAN FRANCISCO, CALIF.—The Central Light & Power Company, San Francisco, recently submitted a statement for 1901, showing that its revenue was $128,485.69, expenditures $81,688.07, cost of plant $238,600, floating debt $10,000. The company's electric light and power plant has a capacity of about 2000 horse-power. Material has been purchased for extensions of the underground mains and the plant will be considerably improved.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, San Francisco, reported its revenue for 1901 as $119,958.85. Expenditures, $111,624.32; original cost of plant, $421,018.51; capital stock, $500,000, of which $410,000 has been issued; floating debt, $35,286.53. The company's present plant has a capacity of 3000 horse-power, and plans have been prepared for a large additional generating station at a new site near the water front.

SAN FRANCISCO, CALIF.—The San Francisco Gas & Electric Company recently submitted its annual statement to the Board of Supervisors. The revenue from electricity was $643,063.75; cost of producing electricity, $573,389. The profits were $367,439.69, of which $227,042.70 was paid out as dividends, leaving the surplus $140,359.99. The company has received a 1000-kw General Electric generator, which will be direct connected to an engine constructed by

... Union ... Works ... alternator and a 150-kw motor generator, both of General Electric manufacture, were installed in 1901.

SAN FRANCISCO, CALIF.—A new generator, having a capacity of 1000 horse-power, has been placed in operation at the Stanislaus Milling & Power Company's water power plant near Knight's Ferry, Calif. It will be used to supply current to operate the 40-stamp mill at the Alta Mine in Calaveras County, the distance of transmission being seven miles. The towns of Knight's Ferry and Oakdale have been lighted from this plant, in which Messrs. J. W. and C. T. Tullock are interested. It is their intention to extend their power line to Modesto, on the completion of the Modesto Irrigation District canal. At present, Modesto's streets are lighted by a municipal electric plant, but there is a demand for current for commercial lighting.

MOLINE, ILL.—Deere & Company, manufacturers of plows, will install a new power plant, using two 500-horse-power vertical engines with direct-connected generators.

NASHVILLE, ILL.—The Nashville electric light plant, owned by the Mineral Springs Light & Power Company was sold Feb. 1 to C. M. Forman, of East St. Louis, for St. Louis capitalists.

LEWISTON, IDAHO.—The Lewiston electric light plant has been sold to the Lewiston Water & Power Company. The new company's plans contemplate the erection of a large power plant at the mouth of the Grand Ronde River in Oregon to supply electric power to factories in Lewiston. The purchasers include Chas. Francis Adams and other Eastern capitalists.

BALTIMORE, MD.—The Morgantown Electric Light & Power Company has secured a franchise after a long struggle. The franchise carries the privilege of constructing street car lines.

COLDWATER, MICH.—Ex-Mayor A. A. Sherman was awarded the contract for the enlargement of the city water works and electric plant. His bid was $1,029. Coldwater is going to supply its citizens with light and has new and larger dynamos to take the place of the smaller ones which are nearly worn out.

MARQUETTE, MICH.—The Peninsula Electric Light & Power Company, of Marquette, has contracted with the Nordberg Engine Manufacturing Company for a 1500-hp cross-compound Corliss engine, and with the General Electric Company for a generator. The company has spent $100,000 in the last two years extending and rebuilding its lines throughout this county, and its capacity when the new machinery is installed will be 40,000 16-candle lights.

BUTTE, MONT.—This city will soon be supplied with electric power from a second electric transmission plant. The Madison River transmission system is nearing completion, and will have a good deal of power to sell. Current will be transmitted over an aluminum wire at an electro-motive force of 80,000 volts. The Butte Light & Power Company now supplies the city with electricity at 40,000 volts.

HUMPHREY, NEB.—The Humphrey Electric Light & Telephone Company has been incorporated, with a capital stock of $15,000, to conduct an electric light business here.

GARDNERVILLE, NEV.—An electric power plant is projected for the purpose of transmitting current to Gardnerville. It is the intention to locate the power-house on the main fork of the Carson River. Mr. George Lamy, of Gardnerville, is one of those interested in the proposition.

GRANVILLE, N. Y.—The Granville Light & Power Company has been incorporated, with a capital stock of $31,000.

PATCHOGUE, N. Y.—The Patchogue Electric Light Company has decided to extend its lines into Blue Point and is now making contracts there for wiring private houses.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company of Binghamton; capital, $500,000, has been incorporated to furnish electricity in Binghamton, Lestershire, Port Dickinson, Union, and other places in Broome County. Directors: Frank Cunningham, T. M. R. Meikleham, and Thomas J. Waters, of New York City; William B. Dinsmore, of Tuxedo Park, George W. Dunn, Clarence F. Hotchkiss, F. W. Jenkins, and George F. Johnson, of Binghamton, and Chauncey Eldredge, of Boston, Mass.

BAKER CITY, ORE.—The city authorities have granted A. B. Frame an electric lighting franchise.

EL RENO, OKLA.—The El Reno Light & Power Company is in the market for entire equipment for its new electric light plant. It recently purchased the plant of the El Reno Electric Light & Telephone Company, which will be replaced by one of increased capacity. The officers are Henry Lassen, president; John A. Masters, secretary and manager, and C. M. Jackman, treasurer.

BRADFORD, PA.—E. R. Caldwell & Company will extend their plant. There will be installed in the new building a 20-ton electric crane.

CHAMBERSBURG, PA.—Mr. F. S. Knight, superintendent of the city plant, issues a statement to the public as to its finances. He shows a total cost of operation of $14,902.28, and receipts of $20,624.97. They have expended for betterments and improvements $10,758.98, which added to bond issues makes a total cost of $55,758.98. Mr. Knight figures out a balance of $1,097.68, after allowances for the free lighting and the regular lighting.

SEWANEE, TENN.—A plan has been drawn for an electric light plant at this place.

HOUSTON, TEX. The Leesville Light & Water Works Company has increased its capital stock from $20,000 to $40,000.

SALT LAKE CITY, UTAH. The Salt Lake Supply Company was awarded the contract for the electric light plant and the wiring for the State prison of Utah.

SALT LAKE CITY, UTAH.—The Red Boy Mining Company, of Baker City, Ore., may develop the Olive Lake water right for the operation of the mine and mill. There is enough waterfall for 4500 horse-power. All the mine's machinery, including the hoist, will be operated by electric power. Power also will be furnished Cracker Creek and Cable Cove. The Sumpter and Bourne, Ore., electric road will be operated by power from this source.

SEATTLE, WASH.—The City Council of Seattle, Wash., recently received a detailed report from the Board of Public Works on the estimated cost of a proposed municipal electric light and power system. Three different sites for the plant have been considered in making the estimates.

PLAINFIELD, WIS.—An electric light plant will be built in the large grist mill of Stark & Skeel. It will furnish electricity for lighting the city.

THE ELECTRIC RAILWAY.

PRATT CITY, ALA.—The Steel City Railway is surveying for an electric line to be built from Ensley to Pratt City and adjacent mining towns west.

BIRMINGHAM, ALA.—At the annual meeting of the Birmingham Railway, Light & Power Company, Mr. S. H. March, representing Ladenburg, Thalmann & Company, and Mr. Davis, the engineer and general manager of the company, were elected to the board. Mr. Robert Jemison was elected president; Mr. A. Walker, vice-president; Mr. George H. Davis, vice-president and general manager, and Mr. J. P. Ross, secretary.

TUCSON, ARIZ.—The street car system of Tucson will be changed over to electric power, and the local electric light and gas company will rebuild and enlarge its present plant.

SAN FRANCISCO, CALIF.—The North Shore Railway Company, the successor to the North Pacific Coast Railway Company, has issued a call for a stockholders' meeting for April 5 at the San Francisco offices of the company. It is the purpose of the company to create at that time a bonded indebtedness of $6,000,000. Each of the 6000 bonds will have a par value of $1,000, and will be payable in forty years, with interest at the rate of 5 per cent a year. The road, which extends from Cazadero to Sausalito, will be improved and rebuilt during the next eighteen months at an expense of more than $1,000,000. A tunnel 4000 feet in length will cut down some of the heavy grades and do away with seven trestles. The southern end of the road from Mill Valley to San Rafael and Sausalito will be changed over to an electric road and operated and equipped in the most modern style. An order has been placed in the East for twenty-one vestibuled trolley cars which will be operated in trains of four or more, as desired. The electric power will be supplied from the lines of the Bay Counties Power Company. Under the supervision of J. A. Fillmore, the new general manager, who was for thirty years with the Southern Pacific Railroad, the present narrow-gauge road will soon be transformed into a model transportation line. There will be a high speed ferryboat, with twin screws at each end, to give quick connection between Sausalito and San Francisco.

ATLANTA, GA.—Mayor Mims has approved an ordinance granting the consolidation of the Atlanta Railway Power Company, the Atlanta Rapid Transit Company, the Georgia Electric Light Company and the Atlanta Steam Heating Company. The several companies will be taken over by the Georgia Railway & Electric Company, which applied for incorporation in December, 1901. The authorized capital stock of the company is $3,000,000.

ELWOOD, IND.—A company is being organized by local capitalists to build an electric railway from this place to Fortville.

JEFFERSONVILLE, IND.—Capt. E. J. Howard is considering the advisability of substituting automobiles for street cars in this city.

LAFAYETTE, IND.—The Standard Construction Company has been incorporated with a capital stock of $100,000, to build electric railways, etc. The directors are Addison Bybee, Allan R. Jewett, Nicholas W. Box, Hiram Kerlin, Arthur A. McKain, Charles A. Mecker, and Jacob F. Marks. The company contemplates the building of a line between this city and the Shawnee Mound country.

INDIANAPOLIS, IND.—Incorporation papers have been filed here by the Smith Construction Company, organized to build the Indianapolis & Western Traction Company. The capital stock is $25,000. The directors are Arthur B. Hogue, Amory T. Irwin, and Edward G. Hendrickson. The capital stock of the Indianapolis & Western Traction Company has been increased from $100,000 to $500,000.

MENOMINEE, MICH.—The Consolidation of the Menominee Electric Light, Railway & Power Company and the Marinette Gas, Electric Light & Street Railway Company has been effected.

GRAND RAPIDS, MICH.—The Grand Rapids Railway Company has elected officers as follows: President, C. M. Clark, of Philadelphia; first vice-president, Lester J. Rindge; second vice-president and general manager, G. Stewart Johnson; secretary and treasurer, Benjamin S. Hanchett, Jr.

GRAND RAPIDS, MICH.—The first official trip over the new Grand Rapids, Grand Haven and Muskegon Interurban Railway was made a few days ago from Grand Rapids to Muskegon. A distance of 34 miles was covered in 61 minutes. This road is operated on the third-rail system, the working voltage being 600. Current is generated at 23,000 volts and transmitted to sub-stations, where it is stepped-down.

FISHKILL, N. Y.—The Beacon Mountain Railway Company, with a capital stock of $150,000, has been incorporated.

ALBANY, N. Y.—The Buffalo, Springville & Cattaragus Railway Company has been incorporated. The capital is $1,000,000, and the road is to be operated by some power other than steam.

ALBANY, N. Y.—The Lake Erie Traction Company, of Westfield, has been [illegible] Among the directors are F. B. [illegible] M. J. Wilson, of Niagara Falls, and Wm. J. Mentor, of [illegible]

ALBANY, N. Y.—Certificates of consolidation of the Lewiston Avenue & Lewiston Railway Company with the Buffalo & Lockport Railway, the Niagara Falls Whirlpool & Northern Railway into the Niagara Falls & Suspension Bridge Railway Company, and the Buffalo, Bellevue & Lancaster Railway Company and the Buffalo Traction Company into the Buffalo Railway Company, have been filed with the Secretary of State. W. C. Ely is president of the various companies, and H. Radley secretary.

FINDLAY, OHIO.—A company said to be composed of New York people is securing right of way for a new line to extend from Findlay to Défiance by way of Leipsic and McComb.

UPPER SANDUSKY, OHIO.—The Bucyrus, Upper Sandusky & Lima Electric Railway has been organized by the election of George D. Whipple, of Cuba, N. Y., president. The company was recently incorporated.

CLEVELAND, OHIO.—The Ohio Brass Company, of Mansfield, Ohio, has filed a lien against all the property of the Lake Shore Electric Railway Company for material furnished the company, amounting to $8,869.88.

CINCINNATI, OHIO.—A construction company has been formed to build the Fort Wayne, Dayton & Cincinnati Traction Company. The road will be 300 miles long, double tracked throughout, and will be operated on the third rail system.

CINCINNATI, OHIO.—The stockholders of the Southern Ohio Traction Company have ratified the purchase of the Miamisburg & Germantown Traction Company for $100,000 and for the Hamilton & Lindenwald Traction Company for $250,000.

LANCASTER, OHIO.—The Lancaster Traction Company held its annual meeting a few days ago. The officers are: H. B. Peters, president; A. Bauman, vice-president; E. K. Stewart, secretary-treasurer. The company is building a new power station.

MARION, OHIO.—Franchises through town have been granted to the Columbus, Marion, Tiffin & Toledo Railway and the Findlay & Marion Electric Railway. The first mentioned company was given permission to build a double track through the town.

TOLEDO, OHIO.—Stockholders of the Toledo & Bryan Air Line Railway Company have agreed to the consolidation of the property with the Ohio & Indiana Traction Company of Fort Wayne. The new corporation will be known as the Ohio & Indiana Air Line Railway Company.

COLUMBUS, OHIO.—All track has been laid on the Columbus, Buckeye Lake & Newark Traction Company's line, and overhead work will be completed by March 1, at which time the line will be placed in operation. Power will be furnished from a temporary power house. A large permanent power station is being erected at Hebron.

LIMA, OHIO.—The Lima Electric Railway & Light Company held its annual meeting a few days ago. The officers are: President and general manager, Joseph B. Mayer; vice-president, Hardin H. Little; secretary-treasurer, H. St. C. Denny; assistant treasurer and superintendent, Wm. T. Harwood. The company was reported to be in an excellent financial condition.

DAYTON, OHIO.—The Mining & Operating Company, with headquarters in this city, has an option on 10,000 acres of coal lands in Muskingum and Guernsey counties. It is the intention to operate the mines by electricity and build an electric railway from West Lafayette to New Concord. It is possible that the line may be extended to Zanesville and used for passenger traffic.

FOSTORIA, OHIO.—The Ohio Northwestern Railway which is building a line from Fostoria to Mungen, has filed a trust deed for $350,000, furnishing funds for the building of the road. Contracts have been let for the construction of car barns, offices, construction cars and a fifteen-ton electric locomotive for construction work to the Consolidated Railway & Light Company, Philadelphia.

PORTLAND, ORE.—The City & Suburban Railway Company, Portland, has purchased from the General Electric Company a 400-kw alternating motor-generator set. The new machinery will be installed in the company's electric power station.

YORK, PA.—The stockholders of the several electric street railway companies, which form the York Traction Company, recently held their annual meeting and elected officers. Captain W. H. Lanius was re-elected president. The companies will extend the Dover Line as far as Dillsburg, a distance of some twenty-one miles. This will take in on the route Wellsville and Franklintown. It is possible that a number of the suburban towns will be lighted from the company's power plant. It is contemplated to have when completed the York Haven Power & Water Company furnish the current to operate the various lines, and then make the present plant a storage for the distribution of the current.

SALT LAKE CITY, UTAH.—J. E. Flattery, of Detroit, asks for a franchise to construct an electric road from Hot Springs, Utah, to Salt Lake City.

APPLETON, WIS.—The new interurban electric railway between this city and Kaukauna has been opened, thus completing the thirty-four miles of interurban accommodation between Oshkosh and Kaukauna, including Neenah, Menasha and Appleton.

NEW INDUSTRIAL COMPANIES.

THE HARLOE INSULATOR COMPANY, of Hawley, Pa., has been incorporated, with a capital stock of $150,000, for the purpose of manufacturing electrical machinery.

THE ELLISSON BROWN ELECTRIC HEATER COMPANY has been formed at Philadelphia to manufacture electric heating apparatus. The capital stock is $250,000.

THE NATIONAL LIGHT SUPPLY COMPANY, of Bloomfield, N. J., has been incorporated; capital, $50,000. Incorporators: Irving H. Brown, Harry B. Perkins and Wm. E. Billings.

THE MASON-BROWN ELECTRICAL SUPPLY COMPANY, New York City, capital, $3,000, has been incorporated by J. H. Mason, G. Brown and Sara Brown, Brooklyn, New York.

THE LAWTON ELECTRICAL COMPANY has been organized at Cincinnati, Ohio, by M. C. Dow, E. M. Lawton, C. H. Schlochter, W. L. Lawton and G. A. Wiltsee. The capital is $10,000.

THE ANGLO-AMERICAN SWITCH & SIGNAL COMPANY has been incorporated in New York City; capital, $5,000. Directors: C. T. B. Rowe, F. V. R. Turk, and A. C. Bostwick, New York City.

THE LOCOMOBILE COMPANY OF AMERICA, New York City, capital $5,000, has been incorporated. The directors are L. A. Beebe, Yonkers, N. Y.; W. L. Marshall, Brooklyn; J. A. Cunnen, New York.

PERSONAL.

MR. ROBERT W. BLACKWELL, of London, England, has returned to New York from his Western trip and will spend some days in this city before sailing.

MR. C. O. MAILLOUX, the consulting electrical engineer, has left for the West, and will spend some time in Arizona, where he has important work in hand.

MR. J. A. MUIR has been appointed general manager of the Los Angeles, Calif., Railway Company, vice Mr. Epes Randolph, retiring for other service, dating from Feb. 15.

MR. W. OWEN THOMAS, lately associated with Mr. Bion J. Arnold, has become chief electrical engineer of the Michigan Lake Superior Power Company, at Sault Ste. Marie, Mich.

MR. C. E. YOUNG has recently been appointed advertising manager for the Western Electric Company of Chicago, and Mr. Ketcham has been promoted to be superintendent of the stock department.

MR. S. SUGIYAMA, a recent graduate of the electrical engineering course of Tokyo University, Japan, is on a visit to the United States with the intention of remaining some months, to be spent in gaining practical experience by entering an American manufacturing works.

PRESIDENT C. A. COFFIN, of the General Electric Company, is expected to make his return from England, it is rumored, in about a week. On his return, it is possible something may be done in the readjustment of General Electric capital. At least, that is the gossip of "the Street."

LIEUT. CALDWELL, U. S. N., of the United States submarine boat "Holland" has been detailed to New York on a special trip to investigate storage batteries for such work, not forgetting the Edison. The desire of the department is to increase the radius given by the batteries without adding to weight, space, etc.

MR. M. C. SULLIVAN, of the N. G. N. Y. Signal Service Corps, has been entrusted with the task of training Company M of the Thirteenth Regiment, of Brooklyn, in signal service work, which he has so successfully specialized of late years. The company is composed mainly of graduates from the Brooklyn High School.

MR. FRANK J. SPRAGUE, who, as everybody knows, was formerly in the Navy, has a charming letter in the *New York Sun* of Feb. 17, full of his reminiscences of Admiral Sampson, who was at the head of the department of physics and chemistry when Mr. Sprague was a cadet in the United States Naval Academy at Annapolis.

MR. MAX LOEWENTHAL has been appointed electrical engineer of the Prometheus Electric Company, of New York, which is now making and introducing electric heating apparatus of a type that has been very successful in Europe. It is based upon the resistance of a fired metallic paint on strips of mica, which gives a great radiating surface.

MR. W. R. BRIXEY, the well known manufacturer of insulated wires and cables, is now recovering rapidly from the severe wounds he received in his rooms at the Murray Hill Hotel in the recent subway dynamite explosion. That he escaped with his life is a miracle. He is at the German Hospital, and will be some weeks before he is able to get about, while some time will probably elapse before he can resume the conduct of his large business.

MR. WILLIAM J. ARKELL, for the last fifteen years president of the Judge Company, has recently severed active connection with it. He has accepted the position of American representative of the new Diesel Motor Company, which was organized in Europe some time ago and which is about to begin operations in this country. The company will have a capital of about $30,000,000. He expects that operations will be begun in New York about June 1. A plant has already been established at Providence, R. I.

MR. THOMAS B. BOOTH, formerly of Washington, D. C., has associated himself with Frederick L. Emery, patent attorney, Boston. Mr. Booth is a graduate of the Massachusetts Institute of Technology, is a member of the bar, and has had several years' practical experience in actual manufacturing, supplemented by a number of years' experience in the United States Patent Office. While in the Patent Office Mr. Booth was examiner in the Electrical Division, where he became thoroughly familiar with the art relating to alternating and direct current systems, generators, motors, controllers, etc., and is generally familiar with the allied and other mechanic arts.

MR. W. H. WHITESIDE, who has for the past three years been manager of the Washington office of the Westinghouse Electric & Manufacturing Company, has been promoted to the position of manager of one of the important commercial departments of the company at the home office in East Pittsburg. Mr. Whiteside has been associated with large electrical projects, and his engineering work in connection with the installation of electrical power in the new dry docks of the United States Navy, especially those at Portsmouth, League Island, and Boston, has been widely recognized. He has also been a strong advocate of the change of voltage from 80 to 125 volts in connection with electrical installations on our battleships and cruisers. He is receiving the congratulations of his numerous friends.

NEW YORK ELECTRICAL SOCIETY.—At the 221st meeting, Feb. 13, 1902, the following were the new members elected: Geo. S. Humphrey, C. W. Hunt Company, West New Brighton, S. I.; William Seaton, Jr., C. W. Hunt Company, 45 Broadway, New York; H. D. Babbitt, 51 Wall Street, New York; H. Lyles Zabriskie, 28 Regent Place, Brooklyn, New York; F. E. Kinsman, 26 Cortlandt Street, New York; John J. McAlister, 1212 Jefferson Avenue, Brooklyn, N. Y.; John T. Blake, 155 South Eighth St., Newark, N. J.; Leroy Harris, 17 Stirling Street, East Orange, N. J.; Axel J. Lundin, 1329 Third Avenue, Brooklyn, New York; Adler B. Gaucher, 208 West Twenty-first Street, New York; David A. Martin, 118 Maple Street, Hoboken, N. J.; E. L. West, J. G. White & Company, 29 Broadway, New York; Ray D. Lillibridge, 20 Broad Street, New York; Clifton V. Edwards, 220 Broadway, New York; David E. Drake, Westinghouse Electric & Manufacturing Company, 120 Broadway, New York; S. Sidney Neu, 20 West Ninety-fourth Street, New York; D. N. Force.

Jr., 138 Mountain Avenue, Montclair, N. J.; W. F. D. Crane, Sanderson & Porter, 31 Nassau Street, New York; Hugh C. Pierce, American Engine Company, Bound Brook, N. J.; Eustace Oxley, General Electric Company, 44 Broad Street, New York; C. H. Van Slyck, General Electric Company, 44 Broad Street, New York; L. H. Lewis, General Electric Company, 44 Broad Street, New York; A. Parshall, General Electric Company, 44 Broad Street, New York; Martin Loewing, 58-60 Reade Street, New York; Albert B. Pacini, 148 West Twenty-fourth Street, New York; Frank W. Smith, The United Electric Light & Power Company, 55 Duane Street, New York; J. P. Burleigh, 180 Stewart Avenue, Arlington, N. J.; William F. Reilly, 12 Manhattan Square, S., New York; M. E. Sanger, 62 Cortlandt Street, New York; Frank H. Berger, 316 Third Avenue, New York; N. A. Cornell, Tucker Electric Construction Company, 35 S. William Street, New York; G. A. Annable, The Cutter Company, 15 Cortlandt Street, New York.

EDUCATIONAL.

THE CREAM CITY ELECTRICAL SOCIETY has been formed in Milwaukee, Wis. It is composed of practical electricians, and will hold meetings every Thursday evening. The following-named officers were elected: Chairman, C. M. Johnson; secretary, James A. Rigby; treasurer, Charles Kruse; instructor, Arthur G. Henrick.

THE QUESTION OF A CAREER.—Thousands of young men are asking themselves how they shall make a start in life. What can they do that will increase their chances of success and lessen the chances of failure? It is significant that many of the great leaders of industrial enterprises are men who have worked with their hands in their youth and have seized their spare moments to train their minds so that they could do the work of their hands with the greatest intelligence, the greatest economy of labor, time and material. Young men who wish to make the most of themselves will be interested in the announcement of the American School of Correspondence. This school teaches entirely by mail and enables students to secure an excellent knowledge of engineering without leaving home or interrupting their regular work.

Trade Notes.

THE ARNOLD & WEATHERBEE COMPANY, electrical contractors, Galveston, Tex., has opened a branch store at 118 Broadway, Oklahoma City, Okla.

ELECTRICAL PORCELAIN.—The Hartford Faience Company, Hartford, Conn., is manufacturing a complete line of electrical porcelain. It will be glad to send catalogues on the subject to all persons interested.

FARADAY CALENDAR.—The February calendar of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, contains an excellent colored portrait of Michael Faraday. On the back is an outline sketch of the great scientist's work and discoveries.

JENNEY UNIVERSAL MOTORS are briefly described and illustrated in Bulletin No. 176, just issued by the Jenney Electric Manufacturing Company, Indianapolis, Ind. A full-page table gives the dimensions, speeds, etc., of the different styles of these machines.

THE TELEPHONE DEPARTMENT of the Electric Appliance Company, Chicago, is having a great demand for its No. 36 cabinet type bridging telephone. This telephone especially equipped with a five-magnet generator is the one the company is pushing for rural line work.

ELECTRIC COFFEE MILLS.—The Enterprise Manufacturing Company of Pennsylvania, Philadelphia, Pa., manufactures electrically driven coffee mills of various sizes and electrically driven meat choppers. Motors for any voltage or class of current are used to drive these machines.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, is running day and night to fill orders for its special coil filament lamps. Mr. Fish, secretary of the company, reports business very satisfactory, the month of July having been one of the best months in the history of the company.

THE WESTERN ELECTRICAL COMPANY, Omaha, Neb., suffered a loss of $20,000 by a recent fire, and before the ruins had cooled off had made arrangements to purchase a complete new stock. It secured temporary quarters at 1515 Howard Street, and is now rebuilding on the old premises. The old stock was completely destroyed by the fire.

HEAVY LATHES.—The Pond Machine Tool Company, 136 Liberty Street, New York, describes and illustrates in a recently issued pamphlet its latest line of heavy and powerful engine lathes. These machines are regularly manufactured in stock sizes, and are uniform and interchangeable. A huge 84-inch lathe is shown in one of the illustrations.

TELEGRAPH SUPPLIES.—Catalogue No. 11 of the Bunnell Telegraphic & Electrical Company, 110 Beekman Street, New York, is devoted almost entirely to descriptions and illustrations of telegraph instruments and supplies. An extensive line of instruments is shown. Wires, bells, pushbuttons, small motors, battery lamps, and some novelties are also listed.

AMERICAN INTERIOR CONDUIT COMPANY, of Waukegan, Ill., claims that the absence of enamel on the thread of its electro-galvanized conduit, elbows and couplings reduces the cost of installation and that the experience of the electrical trade throughout the country supports the assertion, while tending materially toward the rapid increase of its business.

BROWN & SHARPE CATALOGUE.—The 1902 catalogue of the Brown & Sharpe Manufacturing Company, Providence, R. I., has just been issued. It contains 441 pages, and includes a large number of tables and much general in-

THE CHASE-SHAWMUT COMPANY, Boston, Mass., announces that it has secured large and commodious quarters, and is now manufacturing a full line of fuse wire, fuse links and enclosed fuses; rail bonds, junction boxes, nipples, couplings and cables clips. It states that it is now in a position to make prompt deliveries, having fully recovered from its recent loss by fire.

THE "JONES" UNDERFEED STOKER.—The Underfeed Stoker Company, Limited, New York, points out the good features of the "Jones" Underfeed Stoker in a monthly calendar for this year. There are twelve sheets, corresponding with the number of months, and on each sheet some illustrations and facts about the stoker are given, also illustrations of some of the plants in which this stoker has been installed.

D. L. BATES & COMPANY, of Dayton, Ohio, manufacturers of electric fans, have just issued a very pretty and taking calendar, in which, on a large dark [illegible] are photographed standing before a Bates fan of 1902, enjoying its grateful breeze, while their hair—just after a sea bath—is being blown about most charmingly and is drying as it streams in the wind. The young ladies look as though they are having a most delightful time.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is meeting with unusual success with its Browning type of Milwaukee small dynamos and motors. They are entirely new, and embody the latest up-to-date ideas, and are adapted for any and all purposes where any electric dynamos or motors could be used. The concern has issued a very attractive bulletin describing this apparatus fully, which is mailed on application.

THE ELECTRIC APPLIANCE COMPANY, Chicago, calls attention to "American" conduit, formerly "Richmondt." The American Interior Conduit Company, the manufacturer of Richmondt electro-galvanized conduit and fittings, has decided to change the name of its product to conform with the name of the company. There is nothing changed but the name, however, unless it is its facilities for handling an increasing business more satisfactorily for the trade.

ELECTRIC SUPPLY & MAINTENANCE COMPANY, formerly of Troy, N. Y., is notifying its friends and customers of its recent removal to Pittsfield, Mass., where it is now located on Reune Avenue, in a building formerly occupied by the Stanley Electric Manufacturing Company, where it will be able, with increased facilities to give better attention than ever to repair work, etc. The officers are J. E. Wilson, President; A. V. Phillips, secretary, and H. G. Hammett, treasurer.

PRESSURE REGULATORS.—The Foster Engineering Company, 107 Monroe Street, Newark, N. J., manufacture the well-known Foster pressure regulator (reducing valve) and other high grade specialties for steam, water, gas or air. In a recent pamphlet the company gives a lot of facts worth knowing about pressure regulators and kindred devices, and describes its very complete line of these goods. These devices are very clearly illustrated. There is a private telegraph code at the back of the book covering five pages.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., is meeting with encouraging success in its recently established department for winding and repairing. It is doing satisfactory work for a constantly increasing number of customers, reaching over a large territory. This department is fitted out with the latest and most improved machinery. Only the best workmen are employed. While all kinds of repair work are solicited, special facilities are offered for winding armatures and repairing commutators.

EXHAUST HEADS.—The B. F. Sturtevant Company, Boston, is sending out some new literature on the subject of its exhaust head. The underlying principle of this exhaust head is centrifugal force. The exhaust steam is given a circular motion in the exhaust head and the weight of water being much greater than that of steam the separation of the watery particles from the steam is effected by the centrifugal force. Hence nothing but dry steam escapes into the atmosphere, while the abstracted water returns by gravity to the proper receptacle.

DISTRIBUTION OF ELECTRICAL ENERGY.—The paper of Mr. L. A. Ferguson, read before the American Institute of Electrical Engineers Nov. 22 last, entitled "Distribution of Electrical Energy in Large Cities," has been reprinted by the Electric Storage Battery Company in its Bulletin No. 69. The particular system dwelt upon in the paper is that of the Chicago Edison Company, in which service there are 912 cells of chloride accumulators employed, having a total of 94,720 ampere-hours' capacity, at normal rate of discharge.

INCREASE OF CAPITAL.—At its annual meeting the Milwaukee Electric Company, Milwaukee, Wis., increased its capital stock from $150,000 to $200,000. The company expects to move into its new plant at West Allis about March 1. The new plant will have triple the capacity of the present one. Officers were elected for the ensuing year as follows: President, John A. Whaling; vice-president, Walter Carey; secretary and assistant treasurer, Thomas G. Whaling; treasurer, Otto R. Hansen. Mr. W. P. Harper, former president, recently resigned and also disposed of his interests in the company.

CENTRIFUGAL PUMPING MACHINERY.—Messrs. R. D. Wood & Company, Philadelphia, Pa., have issued a catalogue of 100 pages describing and illustrating their line of centrifugal pumping machinery. The pamphlet is more of a general handbook for users of centrifugal pumps than a mere list of sizes of the company's machines, and contains more descriptive matter and tables of general information than is usually found in catalogues of this class. Messrs. Wood & Company have given close attention to the development of pumps of this class and with their years of experience in this line produce a machine that is regarded as highly satisfactory in practical work. Some of the illustrations show pumps operated by electric motors.

BABY BOOK.—A booklet, entitled "The Baby Book," issued by the American Electric Fuse Company, New York and Chicago, is devoted entirely to protective apparatus manufactured by this concern. Its title is taken from the fact that it contains pictures of forty babies, but the relation between the babies and the subject of the pamphlet is not quite clear, unless it is assumed that the youngsters needed protection. The protective devices are recommended for the protection of electrical apparatus, and as such are now well known in the trade. They are illustrated in all styles, and a brief description accompanies the illustrations. The variety of protectors made by this company may be appreciated [illegible] "Baby Book" can be had on application.

THE LOMBARD GOVERNOR COMPANY, [illegible], Mass., has issued a very neat and attractive catalogue illustrating its different types of water wheel and steam engine governors and allied appliances. As the Lombard Governor Company has under control by its governors over 300,000 horse-power of water wheels in this country alone, some idea may be had of the rapid strides that first class speed regulation has made within a comparatively short time. From this fact alone, the new catalogue is well worth reading, as it shows how generally the best results have been sought after in water wheel plants by prominent engineers the country over. Concise and accurate descriptions of all types of Lombard governors are given, while several good photographic illustrations of modern plants with tables are included within its covers.

HOW TO CONSTRUCT RURAL TELEPHONE LINES.—The rapid development in this branch of the telephone business has led the Kellogg Switchboard & Supply Company, of Chicago, to produce a neat 24-page pamphlet (Bulletin No 6), giving directions for the construction of rural telephone lines. Among the contents is a good argument setting forth the advantages and reasons why the farmer should have a telephone, and by following the instructions laid down any farmer should be able to build a telephone line himself. To get the farmers interested in this indispensable instrument so that he can be in touch with the world is the object of the Bulletin. Illustrations of tools used in construction work and apparatus accompany the text and on the last page is given an itemized estimate of the cost of constructing one mile of telephone line.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEBRUARY 11, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

692,248. MUSICAL STRINGED INSTRUMENT; G. H. Davis, New York, N. Y. App. filed April 29, 1899. An electric banjo playing device in which a perforated music strip is used to close the circuit of electric magnets whose armatures fret and pick the strings. (Issued Feb. 4.)

692,700. INSULATING LINING FOR INCANDESCENT LAMP SOCKETS; H. T. Paiste, Philadelphia, Pa. App. filed June 8, 1901. Sheet material roller up to fit the interior of a lamp socket. (Issued Feb. 4.)

692,531. ELECTROLYTIC CELL; E. A. Le Sueur, Rumford Falls, Me. App. filed March 8 ,1898. (See Current News and Notes.)

692,688. APPARATUS FOR PRODUCING FLUORIN; M. Meslans, Paris, France. App. filed Nov. 10, 1900. (See Current News and Notes.)

692,817. ELECTRIC SYSTEM FOR RAILWAYS; D. S. Bergin, Chicago, Ill. App. filed May 11, 1901. A contact plow is secured to the car through a slip-joint, so that the jolting of the car will not alter the relation between the contact device and the conductor.

692,825. OPERATOR'S KEY; A. Carliss, Chicago, Ill. App. filed April 1, 1901. The key consists of a lever projecting through a slot in a plate and having an arc-shaped portion adapted to ride through the slot, thus keeping the slot always closed against dust during the movements of the lever.

692,834. METHOD OF BURNING METALLIC PARTICLES FROM PAPER, ETC.; G. H. Davis, Orange, N. J. App. filed April 17, 1901. The strip of paper is passed between two metal plates forming the terminals of a circuit which is closed when metallic particles in the paper are carried between the plates; the current is heavy enough to burn up the particles.

692,851. TROLLEY HARP AND WHEEL; W. A. Heller, Muskegon, Mich. App. filed Oct. 29, 1901. The harp is provided with upwardly extending angular portions, the inner faces of which approach each other over the flange of the wheel, whereby the wheel is less liable to leave the wire.

692,870. CONTROLLER FOR AUTOMOBILE VEHICLES; H. Lemp, Lynn, Mass. App. filed Nov. 9, 1898. The controller arm is constrained to move in three planes by means of a slotted link. The first motion acts to control the motor circuits to give a forward rotation, the second to break the circuits and retard the vehicle, and the third to connect the circuits in such manner as to give backward rotation. Means are provided for disconnecting the storage battery from the load circuit and including the load for braking purposes on a local circuit with an external resistance. When the armature brake is applied current is shut off from the motor and the controller handle must be returned to the off position in order to re-engage the controller cylinder.

692,874. ELECTRIC AUTOMOBILE; H. Lemp, Lynn, Mass. App. filed Nov. 2, 1900. (See Current News and Notes.)

692,890. ELECTRICAL CONNECTING CORD; C. H. McEvoy, Lowell, Mass. App. filed Nov. 15, 1901. This invention comprises a plurality of insulated or separately covered conductors inclosed nearly throughout their length by a common covering which may be continued to the end of one conductor, while the end portion of another conductor outside or beyond the common covering is provided with a second covering having a continuation which serves as a suspending cord.

692,897. TELEPHONE RECEIVER; James G. Nolen, Chicago, Ill. App filed April 29, 1901. (See page 346.)

692,898. ELECTRIC RAILWAY SYSTEM; B. E. Osborn, Auburn, N. Y. App. filed May 13, 1897. The main conductor runs in a conduit above ground, said conduit being of conducting material and in sections, which are energized from the main conductor by an electromagnetic switch in boxes under the conduit.

692,901. ELECTRICAL GENERATING MACHINE; J. N. Phifer, Shumway, Ill. App. filed Aug. 6, 1901. The casing of a friction generator is connected with air circulating pipes which lead through a moisture-absorbing apparatus for the purpose of keeping the air in the case dry.

692,915. SIGNALING SYSTEM FOR SINGLE TRACK RAILWAYS; W. W. Salmon, Chicago, Ill. App. filed July 21, 1894. Details.

692,916. ELECTRIC RAILWAY SIGNALING SYSTEM; W. W. Salmon, Chicago, Ill. App. filed July 21, 1900. A feature of this invention is the cutting in and out of a large resistance instead of actually breaking and making the circuit. It is claimed that the life of the batteries is prolonged by this method.

692,917. ELECTRIC SIGNALING SYSTEM; W. W. Salmon, Chicago, Ill. App. filed Feb. 4, 1901. Details.

692,959. ELECTRIC SIGNALING SYSTEM; A. J. Wilson, Westfield, N. J. App. filed Nov. 6, 1900. The signal circuit includes a neutral magnet and a polarized magnet by means of which the home and distance signals are controlled, respectively.

692,960. ARMOR OR SHEATHING FOR ELECTRIC CONDUCTORS; E. Witzenmann, Pforzheim, Germany. App. filed Nov. 16, 1901. Lengths of metallic spiral hose capable of being compressed longitudinally and secured together by easily separated couplings whereby the whole of the encased conductor may be exposed piece by piece.

692,966. CONTACT DISK FOR COIN CONTROLLED APPARATUS; C. A. Yale, Burlington, Vt. App. filed April 18, 1901. Details of construction of a contact disk used for advertising and vending purposes.

692,967. TELEGRAPHIC TRANSMITTER; C. E. Yetman, Oakport, Ill. App. filed Feb. 8, 1901. This invention relates to improvements in electric code transmitters of the type which are operated by finger keys similar to those of an ordinary typewriter, and more particularly to such transmitters as are combined with typewriters, the operation of which is governed from the same keys. The improvements are in the various details of construction.

692,974. COMBINED UNDERGROUND AND OVERHEAD ELECTRIC RAILWAY; D. S. Bergin, Chicago, Ill. App. filed March 27, 1901. The trolley pole and the underground collector are connected together electrically and to the motor, so that either of them can be used at will.

692,989. APPARATUS FOR REMOVING METALLIC PARTICLES FROM STRIPS OR WEBS; G. H. Davis, Brooklyn, N. Y. App. filed April 17, 1901. Covers the apparatus for carrying out the method described in patent No. 692,834.

693,001. PRIMARY BATTERY; J. W. Frees, Reading, Pa. App. filed May 15, 1901. The outer cell is lead, next comes a porous vessel containing the zinc and between the lead and porous vessels, lead chlorid is inserted to prevent the formation of hydrogen on the surface of the lead vessel.

693,003. FIRE DETECTOR AND ALARM; F. G. Gaschlin, San Francisco, Calif. App. filed May 13, 1901. Detail.

693,013. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed April 8, 1889. Relates generally to the details of circuit controllers such as are used for automatic signal transmission.

693,014. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Aug. 5, 1890. A chemical annunciator comprising a series of line terminals, a co-operating marking surface arranged to be brought into and out of contact with the terminals together with a reservoir holding a supply of electrolyte and arranged to feed it to the said surface.

693,023. ELECTROMAGNETIC REGULATOR FOR ELECTRIC CURRENTS; J. D. Ihlder, Yonkers, N. Y. App. filed April 17, 1900. The contacts of a rheostat constitute the movable armatures of a magnet having a number of poles, the armatures being placed at gradually increasing distances from the poles and the resistance being cut out as the strength of the magnet increases.

693,035. PROCESS OF THE ELECTROLYTIC MANUFACTURE OF CHLORATES AND PERCHLORATES; P. L. E. Lederlin, Chedde, France. App. filed July 19, 1901. (See Current News and Notes.)

693,038. ELECTRIC ELEVATOR; N. O. Lindstrom, New York, N. Y. App. filed Nov. 9, 1901. The armature of the actuating machine carries two circuits, one a driving circuit and the other a generating circuit. The circuits contain resistances which are controlled from the car to alter the speed, whether the machine be driving or itself driven.

693,041. ELECTRIC ARC LAMP; S. M. Meyer, Brooklyn, N. Y. App. filed March 12, 1901. A lamp adapted for incandescent circuits and fitted with a plug and portable so that it can be readily carried from one room to another and put into circuit wherever desired.

693,063. ELECTRIC MASSAGE ROLLER; W. B. Breston, Chicago, Ill. App. filed Dec. 4, 1901. Three rollers are arranged on the same axis side by side, the middle roller being of insulating material and the outer ones, the terminals of a circuit.

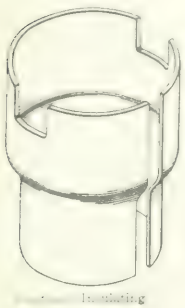
693,067. ELECTRIC BURGLAR ALARM; H. C. Roome and W. G. Roome, Jersey City, N. J. App. filed Feb. 28, 1895. Details.

693,068. ELECTRICAL BURGLAR ALARM; H. C. Roome and W. G. Roome, Jersey City, N. J. App. filed March 24, 1899. A choke coil is placed in the circuit of the guarded structure, whose value can be altered at will from the central office without unbalancing the indicating device at the central office. The coil renders it impossible for a burglar to tamper with the circuits without sending in an alarm.

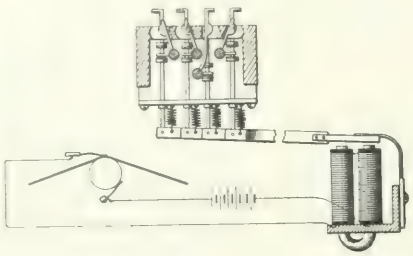
693,092. ELECTRIC HOSE SIGNAL SYSTEM; G. G. Weitz, Medford, Mass. App. filed July 19, 1901. A mechanical construction of a coupling at the end of the hose where it joins the engine, whereby the coupling is made a part of the signaling circuit without including the engine itself.

693,094. SIGNAL AND SIGNALING CIRCUIT; J. A. Wilson, Westfield, N. Y. App. filed Aug. 13, 1900. The home and distant signals are operated by one motor, the clutches for connecting one or the other signals with the motor being automatically operated.

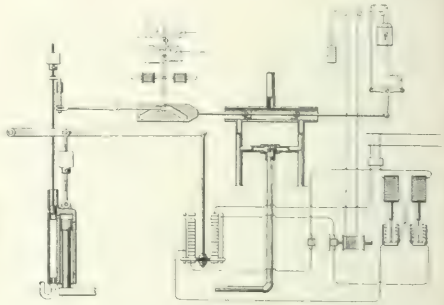
693,098. ROTARY TRANSFORMER; R. E. Ball, New York, N. Y. App. filed Dec. 19, 1900. In a rotary transformer, an armature wound with a coil for



Lining for Incandescent Lamp Sockets.



692,248.—Music Stringed Instrument.



693,038.—Electric Elevator.

both primary and secondary currents, a plurality of commutator segments connected at intervals to the coil, primary brushes conveying current from an outside source to the armature through the commutator, secondary brushes conducting current from the armature and means independent of the armature for producing rotation between the commutator and brushes.

693,109. SIGNAL OPERATING APPARATUS; C. W. Coleman, Chicago, Ill. App. filed Oct. 24, 1900. The motor is adapted to operate automatically two signals independently of each other.

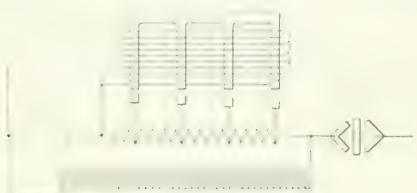
693,110. ELECTRIC CIRCUIT CONTROLLER; C. J. Coleman, New York, N. Y. App. filed Nov. 24, 1900. A circuit controller including a cup designed to hold mercury, as one contact, an immersing point as the other contact, and a vessel adapted to contain a suitable liquid to envelope the cup and the point.

693,144. ELECTRICALLY HEATED APPARATUS; V. Monath, Vienna, Austria-Hungary. App. filed April 16, 1901. Details.

693,146. MEANS FOR PRESERVING AND RENDERING SHARP CUTTING EDGES, ETC.; O. Newhouse, San Francisco, Calif. App. filed May 11, 1901. The edge of a blade is placed in proximity to a magnet and retained in that position for a period of time in order to rectify its edge.

693,152. HOT AIR SYRINGE; A. W. Schramm and E. B. Wilford, Philadelphia, Pa. App. filed May 15, 1901. An electric heater is inserted in the nozzle of the syringe, to heat the air on its passage therethrough.

693,184. ELECTROPNEUMATIC CONTROL SYSTEM FOR ELEVATORS; A. Sundh, New York, N. Y. App. filed Sept. 20, 1901. Pneumatic devices



693,023.—Electromagnetic Regulator for Electric Currents.

and connections for calling and sending the car from one station to another and operating in conjunction with the electric motor controlling means.

693,206. WIRE CONNECTOR; H. W. Wyckoff, Chicago, Ill. App. filed May 6, 1901. The connector consists of two metal plates having opposing faces each provided with two grooves of different cross-sections located opposite similar grooves in the other face, and a bolt to hold the plates together.

693,213. ANCHOR FASTENER FOR LIGHTING CONDUCTORS; C. Bajohr, St. Louis, Mo. App. filed Dec. 4, 1901. A con-corrosive bracket adapted to be set between the bricks of a wall and to receive the conductor at its projecting end.

693,216. ELECTROLYTIC ELECTRICITY METER; C. O. Bastian, London, Eng. App. filed Oct. 14, 1901. The method of preventing over-heating of the electrodes of an electrolytic meter at the upper surface of the electrolyte, which consists in preventing the access of air or other gases to the electrode at that point.

693,222. INCANDESCENT LAMP; H. Hoehm, Youngstown, Ohio. App. filed Oct. 11, 1901. Signal lamps made with recesses in the sides of the bulb to which the leading-in wires lead and are there connected with plates set into the recesses.

693,244. ELECTRIC RAILWAY CONSTRUCTION; F. P. Derr, Baltimore,

693,257. ELECTRICAL DEVICE FOR THE TREATMENT OF DISEASES; W. J. Gavigan, New York, N. Y. App. filed Nov. 19, 1901. One electrode is made flexible and of a shape to fit against the spinal column, while the other is to be applied to a diseased part.

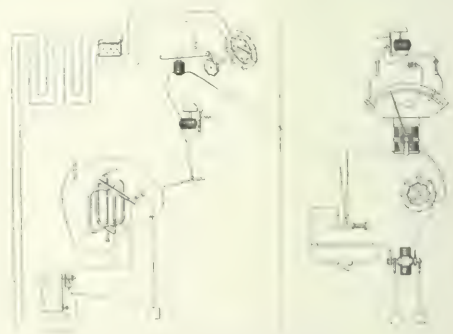
693,262. SELF-ADJUSTING ELECTROMAGNETIC CIRCUIT CLOSING MECHANISM; G. W. Gillespie, London, Canada. App. filed April 27, 1901. A claim describes the invention as follows: The combination with an electromagnetic motor and a counter-tension device, of a circuit closer connected for actuation to said motor and counter-tension device, and means operating upon a variation in the magnetic force acting upon said circuit closer for effecting a proportional change in said counter-tension device,

whereby substantially the same differential force is maintained in each of a series of adjustments.

692,274. ELECTRIC AUTOMOBILE; H. Lemp, Lynn, Mass. App. filed Nov. 2, 1900. The motor is mounted in such a manner that its armature shaft extends at right angles to the plane of the axle; a worm on the motor shaft drives a worm wheel, to which is attached the keeper of a magnet, the magnet itself being mounted on the hub of the driving wheel—the latter arrangement forming a magnetic clutch. The coil of the clutch is in series in the motor circuit and is broken each time the supply of energy to the motor is interrupted.

693,275. ELECTRIC SWITCH; J. Jones and J. Jones, Jr., Brooklyn, N. Y. App. filed May 31, 1901. An ordinary hand-operated rotary switch placed out of reach, is arranged to be operated by means of a cord and devices which engage with the rotary button of the switch.

693,308. SIGNAL SYSTEM; E. Peterson, St. Hilaire, Canada. App. filed July 5, 1901. A box containing train order blanks interlocks with a signal



693,068.—Electrical Burglar Alarm.

in such a manner that a signal is operated while an order black is out of place.

693,309. TROLLEY HEAD; D. A. Petre, Duluth, Minn. App. filed May 7, 1901. Details.

693,320. VALVE AND ALARM; F. Gray, Chicago, Ill. App. filed July 13, 1899. An alarm device applied to sprinkler systems to give notice when the system is out of order or is tampered with.

693,322. ALARM FOR FIRE EXTINGUISHING SYSTEMS; F. Gray, Chicago, Ill. App. filed June 11, 1897. In connection with a dry-pipe fire extinguishing system, an alarm apparatus is used which gives a preliminary alarm upon the escape of the air from the pipe and a subsequent alarm upon the introduction of the water into the dry-pipe.

693,351. OVERHEAD TROLLEY ELECTRIC RAILWAY; B. D. Gilson, Alexandria, Ind. App. filed June 3, 1901. Details.

693,355. ELECTRICAL DISTRIBUTOR; C. J. Springer, Somerville, Mass. App. filed Oct. 15, 1900. A duplex automatically operating relay adapted to be set in motion by the closing of a circuit and in turn either successively or simultaneously to close one or more secondary circuits, which may include light, bells or other devices.

693,356. TELEPHONE SYSTEM; Frans Birger Stafsing, Stockholm, and Carl Egner, Klippan. App. filed July 16, 1900. (See page 346.)

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GERMANY AND AMERICA.

The visit of Prince Henry of Prussia serves to emphasize the good feeling which is entertained in this country toward Germany, a land from which so many of our best and most valuable citizens come, but which has in various unfortunate ways occupied a position more or less unfriendly. Those of us who happened to be on the Continent during or soon after the war with Spain could not dispute the evidence of our own senses in this respect, and with mingled pain and indignation had to endure contumely that was the more surprising when only friendship was expected. However, that period has closed, if we may judge from the hearty expressions of good will now emanating from Germany, while on our side the cordiality of the popular and official reception to Prince Henry is only another proof of our continuing admiration for the great German nation and for its high-minded ruler, that greatest of modern statesmen, the Emperor William. We believe that the Prince, who has won such golden opinions since he landed on our shores, will carry home with him further irresistible proofs of the desire of the United States to cultivate the closest amity with the German Empire.

Our trade relationships with Germany are very important, and many of the economic and social problems we have to solve have to be faced also in the Fatherland, under conditions of graver difficulty. With Germany we do a greater business than with any other country in the world, except the United Kingdom—a commerce which has grown since the close of the Civil War from $30,000,000 to just about $300,000,000. Trade which can be increased tenfold in less than 40 years is in itself the best of arguments for peace and friendship. Both countries have benefited by this intercourse, and on the face of it the division has been on very equal terms, for we took from Germany last year $100,000,000 of her manufactured products and sent her $192,000,000, largely in agricultural product, but including some characteristic American goods and apparatus, the chief item being $77,000,000 for raw cotton and $33,000,000 in corn and pork. In fact, the trade is likely to continue on such lines broadly if not interfered with by harsh and prohibitive tariffs.

Again, as our leading illustrated article this week shows—that on the new electric elevated and underground road in Berlin—Germany is meeting social and economic problems similar to our own, and is applying to them engineering genius second to none in the world. It is, indeed, from such examples that the two countries can learn most, and, as we have said, the visit of Prince Henry should be regarded as a sign that in the future they will be brought together more intimately by mutual respect and a closer understanding

A REMARKABLE CAREER.

We close this week Mr. Behrend's valuable discussion of the engineering work of C. E. L. Brown. It is a very striking resume of the debt that modern electrical developments owe to a single man. For the last 15 years Mr. Brown's name has been constantly before the public, and always in connection with something new and important. His work has been in great measure that of the pioneer, but distinguished from ordinary pioneering by the fact that he has not only blazed the path, but has cleared the country and left fertile fields behind him as monuments to his brilliant and thorough work. It is hard to tell at this epoch just how all his work will stand in the history of the electrical arts, but if his influence were stricken out from the development of the modern multipolar dynamo, the direct-

coupled slow-speed unit, the theory and practice of general power transmission, the induction motor and its application to railway working, and half a dozen other branches of electrical engineering, the world would be far poorer than it is and electrical industry far less advanced. Great designing skill, keen judgment and extraordinary practical common sense have marked his work throughout, and the blunders that can be charged to his account are uniquely few and small. Altogether, we feel that we do no injustice to the genius of our own countrymen or to their part in the world's electrical work in saying that no single engineer in this or any other country has in the past score of years done more to promote the substantial growth of electrical engineering, or to put electrical industry on a sound scientific basis than Charles Eugen Launcelot Brown.

CARE OF LAMPS BY CUSTOMERS.

The advent of the Nernst lamp in the field of commercial lighting brings to the central station man some interesting questions as to just how these lamps are to be maintained, whether by the customer or by the electric light company. This was a matter brought up in the discussion at the last Northwestern Electrical Association meeting, and a variety of ideas were expressed as to what would be the proper way to maintain these lamps. One suggestion was to furnish the customer with all renewal parts free of charge and allow customers to make the renewals. Another was that the company should do all the work of maintenance, and still another that the lamps be sold outright and maintained by customers. The Nernst lamp is hardly far enough along yet in every-day use to enable these suggestions to be disposed of in a definite manner, but central station men will do well to remember, not only in introducing the Nernst lamp, but in connection with their present service, that it is convenience above all else that has led to the popularity of the electric light, which has won out almost entirely on this basis so far in its history. As a matter of actual expense, there are plenty of illuminants which are cheaper than the electric light for small customers, and which approach it even for the lighting of large stores and city streets; but when it comes to a question of convenience, freedom from annoyance and reliability, the electric light is so far ahead that it has won its way in spite of cost. Whatever a company can do to furnish a light that requires no attention whatever on the part of the consumer will put the electric light on that much firmer basis. The Welsbach lamp, for example, has had a very popular run, but the trouble of renewing mantles and lighting lamps has so militated against it that its use has been limited. Mr. H. L. Doherty struck the keynote in the discussion referred to when he said "The nearer you can come to giving people a light where they have simply to press the button and you do the rest, the more likely are you to retain their patronage. People do not want to be bothered in taking care of their own lamps, and the one thing to aim at is to give customers convenient service."

WAVE PROPAGATION OVER NON-UNIFORM CONDUCTORS.

Dr. Pupin's admirable article on this subject, printed elsewhere in this issue, is practically an extension of his earlier analysis of non-uniform electric line conductors to include the case of leakage, with the addition of an elegant generalization of the analysis into a single mathematical expression from which special cases are capable of deduction. The deduction from the consideration of the influence of leakage is that whereas a perfectly insulated telephone line can be loaded with advantage to any reasonable desired degree, a leaky line cannot be loaded with advantage beyond a certain limit. While this limit is fortunately well within bounds as to commercial land and cable lines, yet it becomes desirable to maintain the insulation of loaded telephone conductors to the highest commercial standard, since a given leakiness will have more disadvantage in a loaded line than in an unloaded line. Referring to submarine cables with 0.3 microfarad and 5 ohms per mile, and an insulation resistance of 100 megohm-miles, the deduction of the article is that a proper artificial cable should be in lumps of inductance, capacity and insulation of 64 miles each. Incidentally, a submarine cable would be considered defective in insulation if after laying its insulation were as low as figured, and 1000 megohm-miles would be nearer actual conditions at one minute of electrification. It is, however, difficult to say just what the actual insulation of a cable is at an electrification of only one second, or a small fraction of a second.

Dr. Pupin, in the concluding portion of the article, points out that the theory of wave propagation over non-uniform conductors is, in its most general aspect, really nothing more than the extension of well-known engineering practice. That is to say, it has been known that in the case of transmission lines the inductance could not only be lumped but also placed at any point of the line. This, however, follows from the fact that the frequencies used on such lines are so low that the length of the corresponding wave is many times that of the line. The investigations of Dr. Pupin have shown that with high frequencies such as are used in telephony, a line may be divided into a number of sections corresponding in length to a sub-multiple of the highest useful wave-length or frequency employed, and then each of these sections loaded as in the case of an ordinary transmission line, in the latter case the whole of the line constituting but a single section with respect to a sufficient sub-multiple of the wave-length employed.

THE HUMMING TELEPHONE.

A very instructive short paper on this subject appears in the current number of the British I. E. E. *Journal*. It is well known that when a telephone is connected in direct circuit with a microphone and battery, under certain conditions the telephone, if allowed to face the microphone, will sing a loud note. This tone is self-sustaining, since it is delivered into the microphone. The microphone and telephone may be said to carry on conversation in a loud, continuous monotone. The writer describes various experiments upon this self-sustaining tone. He draws attention to the remarkable fact that if the terminals of the telephone be reversed in the circuit the tone is markedly changed, the pitch at one direction of contacts being much higher than at the other direction. It is also pointed out that the pitch of the tone is affected by the impedance of the circuit. A rough measurement of capacity was capable of being made, by observing the pitch of the tone when a condenser was connected to the circuit. The theory outlined is that the case is one of forced vibrations in the telephone, as dependent upon the period of free vibration of the circuit. The effect appears to depend upon the length of the air-column between telephone and microphone, the free period of the circuit, and the free period or periods of the telephone diaphragm. In the appendix a number of interesting numerical data are given relating to the telephone apparatus used in the experiments. The amplitude of vibration of the telephone diaphragm is given as varying between one and seventeen microns.

BRITISH I. E. E. INAUGURAL ADDRESSES.

The February number of the British Institution of Electrical Engineer's *Journal* has just made is appearance, and contains some interesting papers. Among the papers no less than five are inaugural addresses, the first being the inaugural address of the main body in London, and the others those of sections in Newcastle, Glasgow, Manchester and Birmingham. At the present indicated rate of increase in local sections, one trembles to think of the share of transactions which may, in the fulness of time, have to be devoted to inaugural addresses. The address of the main body in London is printed in the ordinary size of type, and the addresses of the sections

are in more subdued type. Most of them refer in some way, either directly or indirectly, to the reasons for the encroachment of foreign electrical manufacture upon British soil. An excellent abstract appears of the inaugural address of Dr. Lodge in Birmingham. Judging from this abstract it seems a pity that the address was not reported at greater length. It is evident that Dr. Lodge believes that electromagnetic inertia of ions may be found to account in full for the observed inertia of matter.

An excellent paper is contributed by the Calcutta section. This deals largely with the effect of the East Indian climate on insulation. The intense humidity and relatively high temperature of the air make good insulation difficult to maintain. The casualty list appears to be very heavy in 225-volt fan motors, but this is not to be wondered at, considering the climate and the duty. One particular fan motor, operated by the writer of the paper, is stated to have been run for three months continuously without turning off the current. Of such is the climate of Bengal. It transpired through the subsequent discussion that overhead bare copper wires are occasionally apt to be crossed by flying foxes, small animals, about 18 inches long, indigenous to those localities, so that just as in some districts of California, overhead wires have to be mounted at safe "eagle distance" from one another, so it appears that in some districts of Bengal wires are mounted at safe "flying-fox distance."

The Negative Booster.

A recent paper by Kapp abstracted in the Digest last week takes up anew the always troublesome problem of avoiding electrolysis. His present plan is a modification of the general "current-pump" idea, based upon using negative boosters to assist the current's faltering footsteps homeward. The present practice is to tap the rails at various points by return lines through which reversed boosters, operated by current from the positive feeders, assist the returning current. The expedient is effective but costly, and Kapp suggests for long lines the use of negative boosters cut directly into the rail circuit to keep the return current "on the run," so to speak, too actively to permit of much straying. The suggestion is interesting, and while the process would seem to be less effective than the usual one, its simplicity commends it for use within a limited field. The longer lines, particularly interurban lines, are in our own country at least not much afflicted by electrolysis as compared with urban systems, and in many cases no unusual devices are needed. Sometimes, however, local conditions exist which call for action, and here either of the booster devices referred to, or both of them, may prove useful. The whole matter of electrolysis is in rather a curious state just at present. A few years ago the matter was so stirred up as to cause a very undue amount of anxiety and excitement. An analysis of the whole body of complaints received would in nearly every instance show that the moving cause was less the actual damage than the desire of some one to gratify a grudge against a traction company or to exploit some premature device. Real injury has, of course, been done in many cases, but with the later investigations of the matter it has become evident that such injury has been far less severe and widespread than was supposed a few years ago. Thorough bonding has done much to lessen trouble of this character, and it is now usually found to be very local in its manifestations.

The Osmium Lamp.

The Digest of last week contained an interesting account of the performance of the osmium lamp to which we have several times called attention. On its face the performance is most striking. A life of more than 1000 hours at a nearly uniform economy of a trifle less than 1.5 watts per candle is certainly most sensational. From the curves shown it would appear that the osmium filament ends its usefulness not so much by decay as by breakage, since the light and efficiency seem to hold up well almost to the end. This being so, it is of interest to inquire into the average life of such filaments, and the answer given is that at 1.5 watts per candle the life is at least as great as that of a 3-watt carbon filament. This is encouraging so far as it goes, but a trifle vague. If the statement refers to the ultimate life of a so-called 3-watt lamp the result is phenomenal, but if, as seems altogether probable from the data presented, it refers to the normal useful life of a 3-watt lamp, the case is materially altered. For this life is but 400 to 500 hours at most in lamps as now ordinarily used; i. e., at the end of this time the lamp has so far run down in efficiency and candle-power that it should be scrapped. Life in candle-hours is the real criterion of usefulness. An incandescent lamp equal in this particular to the best now in use and working steadily at 1.5 watts per candle would entirely change the situation in electric lighting, provided that the cost of lamp per candle-hour were not unreasonably great. So far as one can judge, fragility seems to be the weak point of the osmium filament, so that it has not yet proved possible to make a practicable lamp for 100 volts; 50 volts seems a far more feasible figure, and lamps for 10 or 20 volts are inferentially suggested for commercial use. The filaments from which the remarkable life curves are derived appear to be computed from the data given, for about 22 volts.

This low voltage for a lamp of moderate candle at once suggests some serious practical difficulties. Lamps connected in series have always been rather unpopular and require extraordinary uniformity in manufacture to secure good operative conditions, even putting aside the question of inconvenience in case of breakage. Osmium is about as intractable a material as could be found. Not only is it nearly infusible, but it is troublesome and dangerous to work with, and is only semi-metallic at best. Hence the manufacture of osmium filaments can hardly be improved without limit, and the chance of getting a good lamp for ordinary voltages seem very remote. A far more serious practical question, as we intimated some time since, is that of cost. Osmium is formed in platinum ores in the form of an alloy with iridium. This alloy contains from 25 to 40 per cent of osmium, and is present in platinum ores generally in very small proportion, the Ural ores from which most of our commercial platinum is derived carrying less than one per cent of osmiridium. Only in certain platinum ores themselves small in aggregate amount, does osmiridium occur in reasonably large proportion, 25 per cent or thereabouts. It would be well within bounds to say that osmium is 100 times as scarce as platinum. It is at present used in very small amounts as a chemical reagent. When one considers the tremendous increase in the price of platinum produced by its use for the leading in wires of incandescent lamps, and the enormous sensitiveness of rare materials to the law of supply and demand, it is obvious that unless some new and fruitful source of osmium should be discovered, the cost of the material would rise to a prohibitive amount at the first material indication of commercial use. Of course, the osmium would be recoverable from burned-out lamps, but so is platinum, else its cost would be far greater than even the present high figure. There seems, therefore, good reason to believe that even were the osmium incandescent lamp to fulfil all the ordinary commercial requirements which seems in itself doubtful, it would have to encounter a difficulty which seems insurmountable in the extreme rarity of the material. Of course, then would ensue such a hunt for iridosmium as not even the rush for the Klondike could equal, but the conditions of its occurrence are not such as to encourage hope. Still, the osmium lamp is another link in the chain of improved illuminants, and whether it succeeds or fails it may operate to bring nearer the day of more efficient illuminants than we now have.

A Prince Among "Captains of Industry."

One of the most interesting features of the presence of Prince Henry of Prussia in New York has been the breakfast given on Wednesday of this week at Sherry's by 12 leading American citizens to enable him to meet the country's "captains of industry" and those who, by invention and skill, have helped to place the United States in the position it now occupies in all the arts and in all branches of commerce. The hosts were: J. P. Morgan, E. D. Adams, A. E. Orr, G. F. Baker, W. Rockefeller, L. P. Morton, A. S. Hewitt, M. K. Jesup, E. H. Gary, John Claflin, J. Stillman, W. K. Vanderbilt, aided by Mr. L. M. Goldberger, who is now in this country on behalf of the German Government, investigating industrial conditions. These, with their guests, numbered 144, seated at 11 tables, of which 10 faced the table at which sat the Prince and his hosts. The breakfast was given in the ballroom, with the utmost luxury, but in the quietest good taste, the aim being to make the affair as nearly as possible devoid of ostentation and display. The management and preparations were largely in the hands of Mr. Edward D. Adams, the banker, financier and railroad manager, famous for his development of the Niagara power enterprise, and who has also represented the German Government, the Deutsche Bank and Siemens & Halske in this country. The electrical arts and industries were most flatteringly recognized in the persons of George Westinghouse, Thomas A. Edison, Frank J. Sprague, Professor F. B. Crocker, Professor Elihu Thomson, Dr. M. I. Pupin, C. M. Hall, Alex Graham Bell, C. F. Brush, Edward Weston, E. G. Acheson, H. H. Vreeland, Alex E. Brown, E. W. Bliss, C. A. Moore, Dr. H. Morton, P. A. B. Widener, J. Ogden Armour, Edwin Reynolds, George G. Ward, John Markle, George J. Gould, W. A. Roebling, Professor R. H. Thurston, Coleman Sellers and Nikola Tesla.

Electrical Engineers of the Day—XXXV.

H. H. WAIT.

Mr. Henry Heilman Wait was born in Chicago, Oct. 27, 1869. His first training, from a technical standpoint, was at the Chicago Manual Training School, which he entered with its first class, graduating at the age of 16. His practical electrical work began while at the Manual Training School during vacations. A large amount of building was at that time under way in the residence districts of Chicago, and as there was a large demand for electrical work, Mr. Wait appreciated his opportunity and secured a number of wiring contracts which he completed in a very satisfactory manner. This experience fixed strongly his determination to become an electrical engineer.

With this in mind he went to the Massachusetts Institute of Technology at Boston, taking the course in electrical engineering from which he was graduated in 1891. His vacations were profitably spent in visiting and investigating various manufacturing establishments in this country. Desiring to also understand European methods in the electrical industries, he went abroad during the summer of 1890, and in an extensive tour visited many electrical plants, both in England and on the continent.

After graduation from the Institute, Mr. Wait entered the employ of the Economic Electric Manufacturing Company, of Brockton, Mass., an establishment manufacturing chiefly incandescent lamps, although it also did a small business in dynamos built from the designs made by Professor Hooper, of Tuft's College. The exigencies of a small establishment gave experience in all sorts of work, including the design of photometric apparatus and semi-automatic devices for making and measuring lamp filaments. In conjunction with Lieutenant H. P. Huse, U. S. N., who was on special leave of absence to study incandescent lamps, he developed curves and formulæ for the predetermination of the approximate action of lamp filaments, which proved highly valuable at that time.

In 1892 Mr. Wait returned to Chicago, where he entered the drafting department of the Western Electric Company. In this position he remained the best part of the year, but his abilities brought him quickly to the front, and he soon became assistant to Mr. E. P. Warner, chief electrical engineer of the light and power department. At this time most dynamos were of the bipolar type, and Messrs. Warner and Wait redesigned the entire line of machines as built by the company, and as soon as these were completed, designed a line of multipolar machines, which at that time were just

In 1894 Mr. Wait made a radical departure in the design of arc-light machines, bringing out the now well known 100-light W. E. arc machine for the municipal plant in Detroit. Mr. Alexander Dow, the engineer of the Detroit plant, was severely criticised at that time for specifying machinery so far in advance of current practice, but it proved to be a success from the start, and justified Mr. Dow and the manufacturers for this step in advance. This machine had a surface wound Gramme armature, but realizing that the use of an iron-clad armature could be utilized for arc machines, as well as for constant potential generators, Mr. Wait completed a line of iron-clad arc machines. He was successful in developing insulation which would be suitable for such high voltage windings, enabling the machines to stand continual service without burning out. The successful solution of this difficult problem at that time gave Mr. Wait a wide reputation, especially in the West.

In 1896 Mr. Wait began the design of a line of enclosed and open motors with interchangeable parts, adapted for application to machine shops and similar work, following this up slightly later with a line of elevator motors. These latter machines had iron-clad armatures and were of unusual proportions in their electrical designs, producing results as to starting current and other elevator characteristics, which at that time were entirely new. Along with this work Mr. Wait designed a line of direct-current fan motors on which much care and thought was expended, resulting in the well-known Western



Electric fan motor. It is probable that the standard requirements for this class of machinery were in general much advanced by the introduction of these motors.

In 1900 the Western Electric Company brought out, from Mr. Wait's designs, their type L multipolar direct-current generators and motors, these machines being built in sizes ranging from 10 to 1000 kw, and adapted for both lighting and railway work. They are known especially for their peculiar form of armature winding, which makes it possible to obtain normal results with a machine of dimensions considerably below the usual size. This is accomplished by means of a continuous-bar winding, which has enlarged ends, but reduced cross section in the slots. By this means it is possible to keep the resistance of the armature low, and at the same time reduce the size of the slots, insuring a stable field and small armature reaction.

Mr. Wait is a patentee of numerous inventions on dynamo designs and special machinery for manufacturing the same. Among these may be mentioned a varipolar motor for dynamos and a semi-automatic machine for winding small armatures, spools, etc., which has done much to cheapen the cost of such work. In conjunction with Mr. Warner he has also been granted patents relating to the well-known Western Electric type of arc lamp.

In December, 1899, Mr. Wait read a paper before the American Institute of Electrical Engineers, of which he has been a member since 1893, on "Cost of Arc Lighting by Means of Various Systems." The features applying to street illumination were afterwards amplified and given in a paper before the Northwestern Electrical



Fig. 1.—Elevated Road and Station on Canal Bank.

Opening of the Electric Elevated and Underground Road, Berlin, Germany.

WITH due celebrations and solemnities, the new elevated and underground electric railway at Berlin, Germany, was opened on Feb. 15. It forms an important addition to the rapid transit facilities of that great city, and is of more than usual interest at a time when cities like New York, London, Paris, Boston—in fact, all the great modern centers of population—are struggling with the same problems of inadequate transportation. The cities of the Old World equally with those of the New have turned to electricity in the hope of affording the local public better service, and of late have left the surface to try conclusions by adopting either elevated lines or underground service, or both.



Fig. 2.—Entrance to the Prinz-Eugen-Strasse Station.



Fig. 3.—Gorlitzer Station.

It is not necessary here to discuss the earlier formative stages of this work, but we may note that Siemens & Halske transferred to a new company the franchise rights it had secured for this work, and that in 1897 the State and municipality gave to this company the right of way under a 90-year franchise from the Warschauer Bridge to the Zoological Gardens, with a spur or loop to the Potsdam Station, the network being shown on the accompanying map. For this concession the company has agreed to pay 2 per cent on yearly receipts up to 6,000,000 marks; 2½ up to seven, and ¼ per cent for each additional million, with a minimum of 20,000 marks at the end of the first four years. The city of Schoneberg also comes in for a nibble, getting from 8-36 up to 9-36, and an additional 1-36 for each million, and a minimum of 3500 marks. Right of purchase is reserved after 30, but not after 40 years.

The Siemens & Halske Company agreed to build and equip the road at its own risk and run it one year for a guaranteed 4 per cent net, and 25 per cent of any profit above the 4 per cent; and presumably this part of the arrangement is now in operation. The total length of the road is 10.4 km. It is standard guage and double track. The roadbed has a width of about 7 m. At several points the road has sharp curves, one in the switchback at the Potsdam Station having a radius of 90 m., and another 80 m. The curved portion of the road is 27 per cent of the whole. The pillars of the structure are never less than 2.8 m. in height from the street level. In general, the superstructure is of iron and steel. The entire structure is lined with sheet iron covered with gravel, etc., in such a manner as to prevent those drippings to the street which are such a disagreeable feature of the elevated roads in New York and Chicago. Views are shown herewith of part of the metal structure and also of the stone viaducts and bridges employed at various points. The road has been kept very level, there being no steeper grade than 1.38. There are 13 stations on the line, and the average distance between them is 930 m. Th maximum speed permitted is 50 km. per hour. The stations are unusually handsome and substantial buildings, as will be seen from the photographs and drawings; indeed, they look too large for their duty; but this is a fault of which the passengers rush-

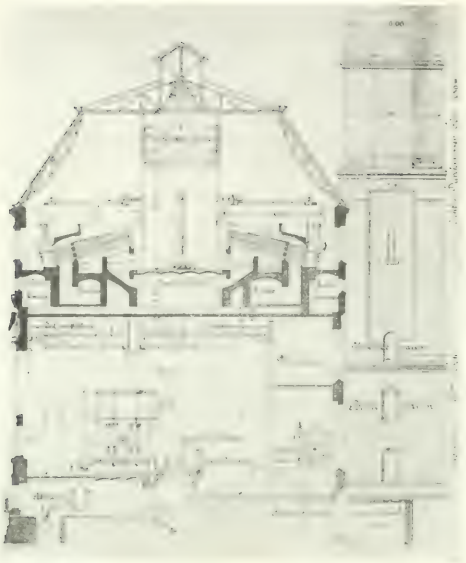


FIG. 4.—CROSS SECTION OF POWER HOUSE.

of 100 amperes up to 140 amperes. The motor cars accommodate 40 passengers, and the trailers 60, so that an ordinary three-car train will seat 140 people. The cars have longitudinal seats. A hand brake is provided, although it is proposed to use magnetic brakes. It is intended that the trains shall have a 5-minute headway, at which we presume the road has started operation. The normal speed is put at 30 km. per hour.

The power house, of which a cross-section view is shown, contains



FIG. 6.—UNDERGROUND STATION AT POTSDAMER PLATZ, SHOWING THIRD RAIL.



FIG. 5.—MAP OF NEW ELECTRIC ELEVATED AND UNDERGROUND ROAD, BERLIN.

ing in and out of them will never complain. The platforms are 3 m. in width, and the overhead shelter is ample. The largest station, the terminal at the Warsaw Bridge, is 300 m. in length and 26.5 m. in width. Besides the depot, which is 50 m. in length, with three platforms each, 80 m. long, there is a car barn, which will store 12 trains. There are also car shops at this point.

The underground portion of the road, or tunnels, are excavated along the main streets, and then covered in, somewhat as in the shallower sections of the Paris Metropolitan along the Rue de Rivoli. The transverse concrete arches are 22 cm thick at the crown, the surface of the road being about 60 cm. higher than that. The arches are of cement concrete, on wooden centerings, and the distance between the transverse girders is about 1½ m. The rise of the arch is 20 cm. The width of the subway is 6¼ m. A view is shown herewith of one of the three underground stations, taken just before the opening of the road, and showing at one side the third rail resting on its insulators.

The trains will consist of two motor cars and one ordinary car. The motor cars run on two bogies, and each of the four axles is driven by a single reduction motor wound for 750 volts and a current



FIG. 7.—METAL STRUCTURE AT BRIDGE OVER THE SPREE.

three vertical 1200-hp engines, built by Borsig, each coupled to a Siemens & Halske 800-kw vertical pole generator, with 10 poles. The power house was designed by Mr. Wittig, engineer of the company. As will be noted the boiler room is above the dynamo room. It is equipped with six Gehre water tube boilers, and above the boilers are sheet iron pockets and funnels by which the coal is delivered automatically to the furnaces, the coal being transferred from canalboats by Hunt conveyers. Feed water is drawn from the Landwehr Canal. The smokestack is 80 m. high, or 7 m. higher than the tallest building in Berlin, the City Hall. Steam is furnished at a pressure of 10 atmospheres, and with 200 degs. C. superheat. We hope to furnish further details at an early date of this interesting system, which has now gone into service.

A Modified Wehnelt Interrupter.

By Prof. A. L. Foley and R. E. Nyswander.

THE form of interrupter herein described has been used in the Indiana University Physics Laboratory for more than two years, and has given better results with less trouble than have other interrupters of the electrolytic type.

A block of wood some 3 cm. thick and 15 cm. square has a hole, about 1 cm. deep, bored or turned in it to receive the cell *c* (Fig. 1), which is made of lead, and which serves as the cathode. The lead cell rests upon a plate *p* of sheet lead, which lines the bottom of the hole and which is connected to a binding post not shown in the figure. Thus the cell can be removed and replaced without interfering with the electrical connection.

A second binding screw is connected with the vertical tube *T*, and hence with the platinum wire anode. The brass tube *T* has a slit cut lengthwise through one wall at its upper end, and extending downward to within 2 or 3 cm. of the top of the cell. This slit permits of the vertical motion of the rod *a*, which passes through it, and it prevents any horizontal motion. Thus the anode is held in the center of the cathode cell, and there is no danger of short circuiting by the arm swinging around and bringing the tube and cell into contact. When removing and replacing the cell, the arm *a* may be lifted entirely out of the slit, turned horizontally, and allowed to rest on the upper end of the tube *T*.

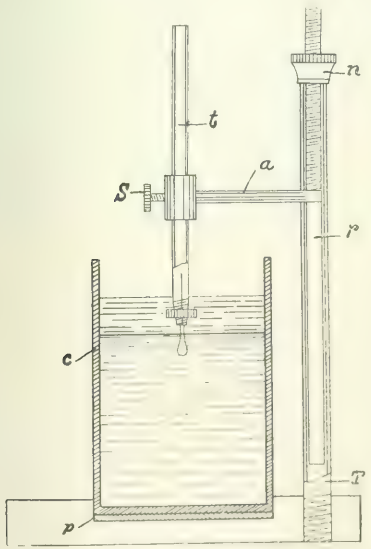


FIG. 1.—[illegible]

The arm *a* is carried by a vertical rod *r* fitting snugly the tube *T*. The rod is threaded for several cm. at its upper end, and its position in the tube is controlled by a thumb-nut *n*. The arm *a* supports a rod *t* through which a hole is bored to within 1 cm. of the lower end. This end is tapered and threaded. Two slits at right angles to one another are sawed through the axis of the cone, forming four jaws, which hold the platinum wire anode. A nut threading on the cone serves to clamp the wire firmly. The hole in the rod permits the use of platinum wires of any length.

The lead cell is partially filled with the electrolyte and a layer of kerosene 3 or 4 cm. thick is poured over it. The platinum wire, which may be single, double or in the form of a loop, is clamped so that it projects a cm. or so below the end of the rod. By means of the set-screw *s* the tube is adjusted so that the platinum wire dips a few mm. in the electrolyte, when, upon closing the electric circuit, the interruptions should begin. The nut *n* gives a more delicate adjustment of the depth of the wire, which should depend on the nature of the electrolyte, size of the platinum wire, voltage, inductance and size of the lead cell. The latter is 7 cm. in diameter and 14 cm. high.

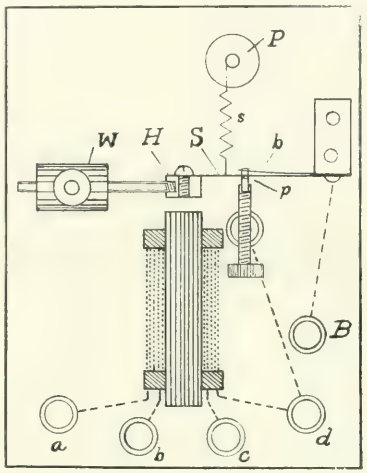


FIG. 2.—MAKE-AND-BREAK DEVICE.

The kerosene keeps down the temperature of the portion of the wire not in the electrolyte,[1] so it makes little difference in the action of the interrupter how much wire projects below the end of the rod, provided it is all in the oil. However, the heat generated in the kerosene is wasted energy and by it the temperature of the cell is unnecessarily increased. The kerosene tends also to decrease the fumes and spray from the electrolyte.

When long-continued use of the interrupter is required it will be necessary to have, in connection with the lead cell, a cooling coil or jacket. Where the interrupter is to be used for only a few minutes at a time with several minutes' rest between times, the plain cell will suffice. In our work, where the interrupter was in action during half the time for periods of 2 or 3 hours, we found that the temperature could be kept sufficiently low by soldering or leading to the cell some 35 vertical, radial, equally spaced vanes. The vanes were made of copper strips about .15 cm. thick, 3 cm. wide, and long enough to reach from the upper edge of the cell to within 2 cm. of the lower edge.

One of the difficulties of the Wehnelt interrupter, particularly in using certain electrolytes, is that the action may cease at any moment. With some electrolytes, a 5 per cent solution of caustic potash for instance, the action is usually resumed without attention from the operator. This is not true in most cases, as with a 20 per cent solution of sulphuric acid, a 10 per cent solution of potassium-sulphate, or a warm potassium-nitrate solution. It has been found that, to make the interrupter resume, the circuit must be broken and connection again made. A momentary break is sufficient, and so the device of Fig. 2 was constructed to break and make the circuit automatically. It might be thought of as a make-and-break, which works backwards.

An electromagnet with laminated core has two sets of coils with terminals brought to the four binding posts *a, b, c, d*. The magnetizing coils may be connected singly, in multiple, or in series, thus giving the instrument considerable range as to magnetizing current.

The instrument is connected in series (binding post *B* and one of the others) with the interrupter. When the current is passing and

[1] This point is mentioned by Rossi, *Accad. Sci. Torino Mem.*, 33, 1899. The above described interrupter was in use in the Indiana University Laboratory several months before Rossi's article appeared.

the interrupter is in action, the hammer H is drawn to the core, against the action of the flat spring S and the spiral spring s, the latter of which can be controlled by the screw P. The moment the action of the interrupter ceases the current is so far diminished that the springs pull the hammer from the core. The inertia of the weight W carries the vibrator beyond its normal position, it strikes the break spring b and the circuit is broken between the platinum points at p. As the vibrator returns the circuit is completed, the interrupter begins to act, and the hammer is again drawn to the core.

The authors have studied the action of the interrupter with some 50 different electrolytes, some of which work better on high and low voltages than the usual 10 per cent solution of sulphuric acid. The addition of nitric acid to the sulphuric acid solution lowers the voltage required to produce interruptions. The writers use a 10 per cent solution of sodium sulphite on a 115-volt circuit without any other resistance. The discharge was exceedingly heavy and of high frequency. It was noticed that, with a solution of hyposulphite of soda, the interrupter ceased working when the secondary of the induction coil was short circuited, while a solution of ammonium nitrate worked best on a short circuit.

Slaby-Arco Wireless Telegraph Apparatus.

By A. Frederick Collins.

AT the successful conclusion of the tests for the German Government, of the system of wireless telegraphy designed by Count d'Arco and Dr. A. Slaby, of Charlottenburg, negotiations were entered into and consummated by the Allegemeine Electricitats Gesellschaft (General Electric Company), of Berlin, to construct and supply the apparatus.

This system of wireless telegraphy was originally designed with special reference to obtaining a tuned or syntonic method, and there are three types of the apparatus now manufactured—the permanent station apparatus, the portable field equipment and a modification of the standard set adopted especially for war vessels.

The theory upon which the Slaby-Arco sets are constructed is well known, having been published in detail in previous issues of ELECTRICAL WORLD AND ENGINEER, and I shall, therefore, confine myself to an account of the apparatus employed.

In the permanent station type shown photographically in Fig. 1 and diagrammatically in Fig. 2, the current is supplied from 110 or 220 volts, direct current. The Ruhmkorff coil (Figs. 1, 2 and 3) is enclosed in a box and sets under the table. A mercury turbine interrupter 2 is employed to insure a uniform and rapid "make-and-break" (Fig. 2). It is driven by a small motor, 3, and to regulate the number of revolutions there is a sliding resistance, 4. By this means any number of interruptions may be had at the will of the operator from 10 to 10,000 per minute.

In circuit with the primary winding of the coil or inductor, is the interrupter, one or two high-potential condensers, 5, a Morse key, with platinum contact points, 6, and a resistance, 7, for regulating the primary inductance. The terminals, 8 and 8_2 (Fig. 2), are connected with the binding posts, 8_1 and 8_2 (Fig. 3). The binding posts of the regulating resistance, 7 (Fig. 2), are connected, as shown, to the terminals, 8_1 and 8_2. The two other binding posts of the resistance, 7, are connected with the inductor terminal, 2_1, and the other carries the current through the turbine interrupter, 2, and the Morse key, 6, to the second terminal of the primary winding, 2_2.

This Dr. Slaby terms the low-tension circuit. The condenser, 5, is connected parallel to the interrupter. The terminals, 8_1 and 8_2, are connected by the sliding resistance, 4, to the motor, 3. In order to protect the dynamo generating the current from lightning, which might strike the antennæ, A (Fig. 3), a special lightning rod or conducter, shown by the arrow in Fig. 2, is used by way of equalizing the high-potential between the apparatus and the ground.

The high-tension circuit consists of the secondary coil of the Ruhmkorff (Fig. 3), with the binding posts, 8_1 and 8_2, a battery of Leyden jars, 9, a tuning coil, 10, and the antennæ, A, which, according to a literal translation from the German text of Slaby, is a transmitter conductor. The terminals of the oscillator system may consist of two points or of two balls 3 mm. in diameter. One of the poles of the spark-gap, 14, is connected with the inductor by 8_1. (Fig. 2). The opposite terminal, 8_2, is connected by the binding post, 11, to the earth at B. A well insulated rubber-covered wire connects the spark-gap with the plug plate, 12, of the battery of electric jars, 9, which consists usually of three Leyden jars placed in a cylindrical box made of pasteboard. The inner coating is carried by a rubber covered wire with plug connections to the plug or connecting plate, 12, and is insulated from the upper cover by hard rubber. The outer coatings are connected by a tinfoil coating at the bottom of the jars to binding posts of the box, 13.

The tuning or syntonizing coil, 10, is wound on the outer side of the cylinder of pasteboard forming the box of the battery. It is formed of four or more turns of No. 12 wire, connected with the binding post, 13, and the binding post, 8_2. The binding post, 13, is also connected with the antennæ, A, and by this means it is grounded through the tuning coil earthed at B.

According to the Slaby theory the antennæ, A, has only a small amplitude of vibration near the ground, while its greatest amplitude of vibration is near the top, and for this reason any lightning rod may be employed as an emitter for the electric waves without the possibility of any fatal physiological effects. The transmitter is shown schematically in Fig. 4.

The receiver consists of (a) the light current circuit, (b) the heavy current circuit and (c) the electric wave system. In practice, the wires of the light current circuit are surrounded with white insulation, and those of the heavy circuit with black insulation, thus it is apparent at a glance, to which circuit the wires belong. In the light current circuit are the coherer, the tapper or jigger, the coherer cell for operating the relay, the relay, the condensers which are connected in parallel to the cell and the circuit and the switch for the antennæ connecting it with the coherer.

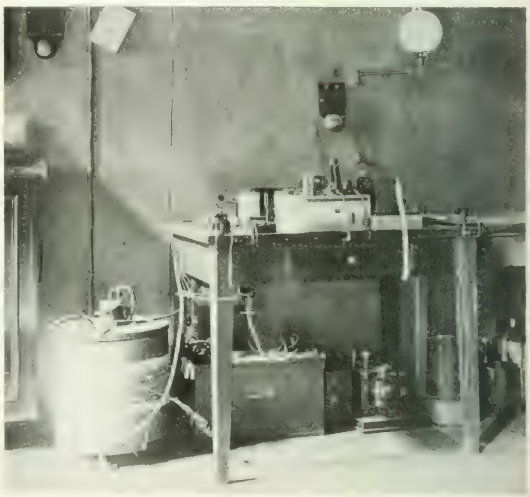


FIG. 1.—GENERAL VIEW OF STATION APPARATUS.

The coherer tube is exhausted to protect the filings from oxidization, and that they may at all times remain dry and movable. This permits the grouping of the filings in the same manner after each stroke of the tapper. The plugs of the coherer are made of silver and connect with platinum terminals sealed in the tube and attached to metal caps fastened to the coherer with gypsum, as in a Geissler tube. This is to prevent the connecting wires from breaking off. The capacity of the coherer is about 0.0001 microfarad.

It will be observed that the end surfaces of the conductor plugs of the coherer are not parallel, but wedge-shaped. This "split" of the coherer allows its sensitiveness to be regulated, though the tube is exhausted and sealed. If the position of the tube is such that the narrow part of the split is down, the filings assume a vertical position, the pressure is increased by gravity and the sensitivenes is at its maximum value. If the broad part of the split points downward, the filings are spread lengthwise, the pressure is diminished and the sensitiveness decreased. The coherer may be placed in different positions by an adjusting wheel and locked with a catch spring, when the desired sensitiveness is obtained. The metal caps make the exchange of coherers a simple matter. It is not claimed that these coherers are very sensitive, but their precision may be relied upon.

By moving the tapper-lever the light-current circuit is made, and

the current from the cell is cut off from the coherer. The advantages of this arrangement are (1) an easier and more exact interruption, (2) greater duration of life of the coherer, (3) exclusion of the sparks through the coherer, and (4) non-inductive resistances usually connected in parallel with the interupter are not necessary.

The coherer cell is a dry battery, having an e. m. f. between 1.2 volts and 0.4 volt. If the voltage is higher than 1.2 the coherer does not work with the requisite precision. If the voltage is less than 0.4 volt the e. m. f. is not sufficient to operate the relay. The relay is wound to a resistance of 2000 ohms to correspond to the normal resistance of 2000 ohms of the coherer when in operation. The relay is polarized, and works in the following manner: A permanent magnet of steel magnetizes the cores of the coils which are of soft iron, the pole pieces being magnetized to the same sign. The permanent magnet likewise magnetizes a tongue of soft iron between the pole pieces to the opposite sign of polarity. This armature or tongue is forced into a fixed position by two contacts K_1 and K_2. K_1 is a stationary contact and K_2 is an operative or working contact. By changing the position of K_1 and K_2 the tongue is brought into an unstable magnetic equilibrium. The magnetism of the iron coils is now changed as the light current coming from the coherer cell is carried through the relay coils. The original magnetism of one core is strengthened and the magnetism of the other core is weakened proportionately. By this means the equilibrium of the tongue is disturbed and the tongue strikes the fixed contact. The relay tongue is balanced for each position by a counterweight, and this enables the relay to work well, even if the whole apparatus is in a vertical position.

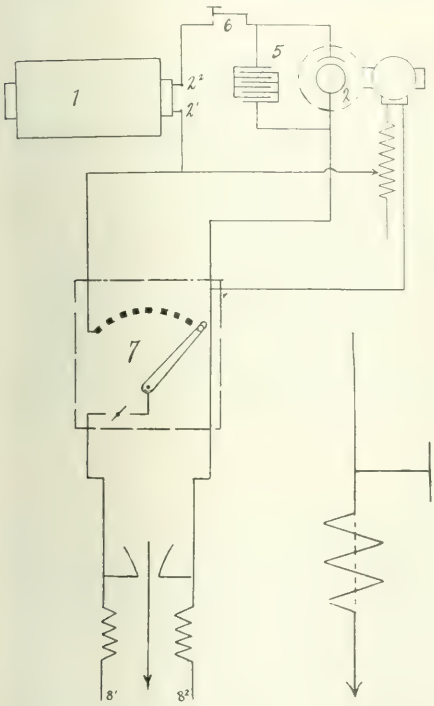


FIG. 2.—LOW-TENSION CIRCUIT TRANSMITTER.

FIG. 4.—DIAGRAM OF TRANSMITTER CIRCUITS.

The condenser is connected in parallel to the dry cell and the relay circuit. It has a capacity of 0.01 microfarad, and is of the standard mica type. It has a dual purpose. First, it takes up the excess of tension exerted on the coherer, originating from the self-induction of the relay coils, and so facilitates decohesion; second, the condenser connects the "ground" with the coherer through the tapper avoiding the self-inductance of the relay.

The regulating resistance is intended to weaken the strength of the receiving current where the stations are very near to each other. By operating the resistance the tuning is disturbed and the force of the waves reaching the coherer is diminished. There is a switch to protect the coherer while transmitting from the strong radiation in such close proximity, from the spark-gap of the transmitting coil of its own station. By a special device all metal parts are removed from the coherer, diminishing the possibility of electric waves in the neighborhood acting on it.

A second advantage of this switch is that of changing the antennæ from transmitting into a receiving wire by only one movement, that of opening the switch, when all connections to the receiving apparatus are broken, those to the coherer as well as to the antennæ. The switch has two binding posts, connected with each other if the switch is open, disconnected if the switch is closed. The primary current of the inductor passes through these posts. By this the inductor gets no current and no spark is produced if the Morse key is moved down, and the operator should have forgotten to open the coherer switch.

The heavy current circuit consists of (*a*) the heavy current battery, (*b*) the tapper, (*c*) the working contact of the relay K_2 and the tongue (*d*) the polarizing coils, parallel connected, (*e*) the Morse printing coils, (*f*) the alarm bell, parallel to the magnet. The heavy current battery consists of four dry cells having an approximate e. m. f. of 6 volts. The current from the battery is carried through the two contacts on the resistance box of the receiving apparatus, the working contact of the relay, the tapper coils, through a second plug contact and thence returning to the battery. The polarizing coils are connected in the heavy current circuit until the relay tongue is in contact with the stationary contact. The battery current ceases when the polarized coils are sufficiently magnetized and have, therefore, an opposing e. m. f.. For this reason the battery is not weakened by a current of long duration.

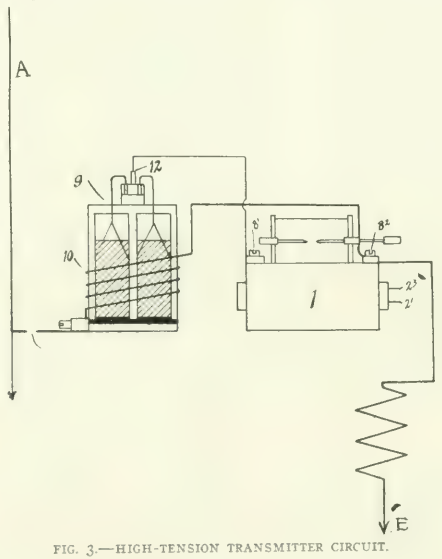


FIG. 3.—HIGH-TENSION TRANSMITTER CIRCUIT.

When the relay tongue makes contact the current is carried through the wiring of the tapper, the resistance of which is 6 ohms, and the polarizing coils, now short circuited, permit the tongue to assume its normal position. If the contact made by the tongue is broken the polarizing coils take up the energy originating from self-induction of the tapper coils and the Morse magnets preventing the spark arising from breaking the circuit and the attendant untoward effect on the coherer.

The Morse printing apparatus is connected parallel to the tapper. It has four binding posts connected in parallel in couples. One of these couples may be disconnected by a switch. The two posts permanently connected with the circuit operate the printing apparatus, and the other two posts are connected to an alarm bell, which serves to notify the operator when at a distance from the receiver.

In the second Slaby-Arco type of apparatus the instruments are much less complicated, and a self-restoring coherer made of aluminum and steel takes the place of the standard silver coherer, described in the preceding type. The Morse printer is supplanted

by a telephone receiver, the coil is of the portable type and the antennæ are suspended by means of kites and balloons. It is designed for portable work such as army and field use.

The third type is made expressly for use on war vessels. The transmitter, tuning inductances and capacities are arranged somewhat differently from the standard apparatus where the wiring is not difficult. For instance, it is hardly possible to have instruments on boats beneath the armored deck, because the carrying of high-potential wires is exceedingly dangerous. This is overcome by having the apparatus in a room beneath the deck and a spark-gap and multiplying coil mounted on the deck in a water-proof compartment. This is connected with the apparatus by a wire carried through the passage and hatchways to the coil.

Aspen Tunnel and Power House.

AMONG the many improvements on the Wyoming division of the Union Pacific that have been instituted under the regime of President Burt at a cost of over $10,000,000, the cut-off from Leroy to Bear River to avoid the celebrated Tapioca Hill is probably the most important. This includes the Aspen Tunnel, 5900 ft. in length, which is considered by engineers a masterful piece of work.

Owing to the character of the material encountered, the pressure of water and gas and flow of oil, the construction of the tunnel presents some features of particular interest to engineers. The formation is the carboniferous in which are found soft shells and sandstone.



FIG. 1.—INTERIOR OF TUNNEL.

With every little stream that trickled through the layers of shale the danger developed. Work was at one time stopped on account of an inflow of oil, water and shifting sand, which completely closed the tunnel. The question of a sufficient lining to the tunnel was thoroughly debated. Finally, it was thought that plumb timbers of Oregon pine, 12 by 10 inches, with steel "I" beams 16 by 16 by 6 would stop the swelling ground. Upon erection, however, it was soon made evident that this construction did not afford sufficient strength. Finally, 96-lb. rails were laid crosswise to a depth of 10 ft., and covered with a thick layer of Portland cement, thus making the tunnel to-day as safe as the surrounding hills.

Electricity has been used throughout as a lighting agent in the camp and workings, over 300 lights being used. A 60-kw Westinghouse alternator is driven by a 100-hp Westinghouse engine from a bank of four 100-hp boilers, which also supplies three large compressors and other machinery for repair work. The power house is 3000 ft. from the east portal, making the distance about 9000 ft. through which to transmit current. The current was transmitted at 1100 volts and transformed through transformers at each portal, 208 or 104 volts.

It was found necessary to have two separate circuits on account of the divided workings, as the "headings" were driven some distance in advance of the "bench" into the "head workings," the third wire was kept back of the "bench" so as to have a separate source of light, made necessary by the continual blasting. In the finished part of the tunnel the lights were alternated on either side 25 ft. apart, so that if short circuit occurred in either working, half of the lamps were left in circuit.

The transformers were fused considerably higher than necessary, so as to hold a short circuit for about one minute. A No. 8 waterproof cable was used in the tunnel and No. 6 wire from the power house to the east portal. A No. 8 bare copper line ran over the mountain to supply the west portal and camp. For the lamps No. 16 vulcanized lamp cord was used with four light clusters, the flexible lead enabling the lamp to be carried back out of the way from the blasts.

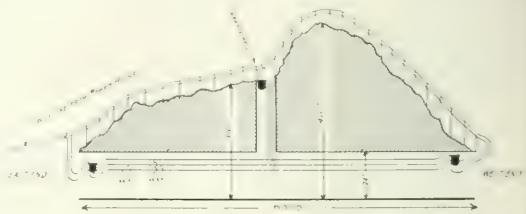


FIG. 2.—SECTION OF TUNNEL.

All shots were set off with electric current, electric exploders being used.

Incandescent lamps of 16 cp were used throughout the workings, as they gave better service than arc lamps, and were easier to handle and moved about. All mucking was done by steam shovels, which were lighted by six-lamp clusters in reflectors, moved along with the work. The entire plant was installed and is still in charge of Mr. T. E. Daniels, of Provo, Utah.

The National Telephone Company's New Exchange at Kensington, London.

An article appearing elsewhere in this issue deals very fully and interestingly with the telephone situation in London, and it will have been noted that mention is made therein of the new exchange which the British Post Office Department is building for the metropolis, in Queen Victoria Street. Meantime, the National Telephone Company has been "putting its house in order," and has just opened its new exchange at Kensington, the first in London, and also one of the very few in England, to operate on the common battery, lamp signal system.

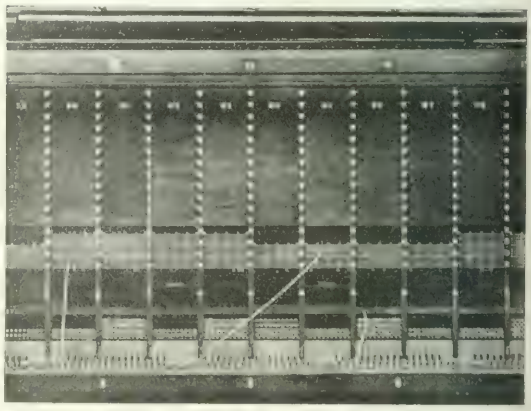


FIG. 1.—ONE SECTION OF SWITCHBOARD.

It will have been noted that the new government exchange is also of this modern kind, a fortunate and perhaps inevitable result of the intention to exchange business, while the further fact that they are of Western Electric Company's construction tends to ensure that smooth co-operation and uniformity of apparatus, without which the exchange of telephone calls between competitive networks is attended by no small amount of difficulty and with a serious diminution of efficiency and satisfaction.

To our American readers, and, indeed ,to all who are in the habit of reading this journal in any part of the world, there is not much



FIG. 2.—GENERAL VIEW OF SWITCHBOARD ROOM.

now that is new in a common battery lamp signal exchange, and we need not add much to our engravings by way of description. At the

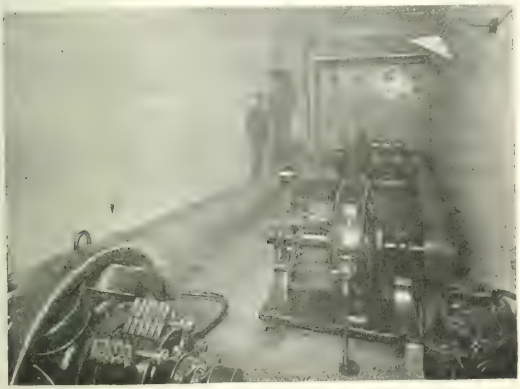


FIG. 3.—POWER ROOM.

present time, the exchange is equipped for 2000 subscribers' lines, and the ultimate capacity of the board is 12,000. Each section of the board has three operators' positions. At present there are only 60



FIG. 4.—RELAY BOARD.

subscribers per operator's position, but it is the intention to increase the number soon to 80, while when the message rate basis goes fairly into operation it is calculated that the lessening of work per line may enable an operator to handle 200 stations. At Bristol, England, the allotment is 120 subscribers to each position.

The switchboard includes 5305 relays, 1300 resistance coils, 600 condensers, 640 miles of wire and 4,500,000 joints or soldered connections. The subscriber's set includes the usual apparatus, the bell having a resistance of 1000 ohms, and the primary and secondary of the induction coil 1 and 25 ohms, respectively. The relays at the ex-



FIG. 5.—BATTERY ROOM.

change are situated in the basement below the switchboard room, together with the test board, the distributing board and the power plant. A view is shown of the power plant, situated in the basement. Two 15-hp Fuller-Wenstrom motors receive single-phase current at 100 volts from the mains of the Brompton & Kensington Company, and are belted to shunt-wound dynamos, each furnishing a maximum current of 330 amperes at 28 volts. The chief feature

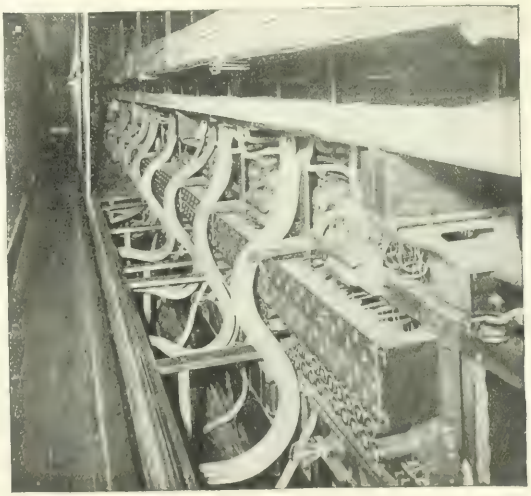


FIG. 6.—REAR OF SWITCHBOARD.

about the dynamos is the large number of segments to the commutators to avoid the possibility of induction disturbances in the circuits. There are two batteries, each of 11 cells. The charging e. m. f. is regulated by the shunt coils of the dynamo, and no regulating cells are employed. The present capacity of the cells is 2000 ampere-hours, and the ultimate capacity, when full of plates, will be 6000 ampere-

hours. The batteries are of the chloride type, and the Western Electric Company supplied the whole of the power plant, with the exception of the motors. Two small motor-generators, each of about ½ hp, take current from the cells and furnish alternating current at 75 volts and at a suitable frequency for ringing. The general planning of the work, the wiring of the switchboard, etc., has, of course, been carried out by the National Company's own engineering staff, which has introduced detail features of change and improvement adapted to London conditions and requirements.

The National Telephone Company's London system, which includes this new exchange, extends from Waltham Cross in the north to Redhill in the south. In the east it includes Tilbury, and in the west Harrow and Ealing, the whole covering 640 square miles. In this there are 50 exchanges, employing 910 operators and serving 44,700 subscribers' instruments (including 890 call offices). The junction lines between the exchanges have a total mileage of 18,190, their number being 2513.

The London Telephone Situation.

THE telephone question in London has been a lively subject of discussion during the past few weeks. The discussion culminated in a debate in the House of Commons, of which it was actually predicted by some of the London "yellow" journals that a Government defeat might result, the dissatisfaction over the famous telephone agreement between the Post Office and the National Telephone Company having been expected to crystallize into the voting of an amendment to the address in response to the King's speech. As a matter of fact nothing of the kind happened. On hearing, not by any means for the first time, however, the Post Office side of the case, the mover of the amendment—no less a person than the Lord Mayor of London—begged for leave to withdraw the amendment, which was refused; instead it was voted down by a comfortable Government majority of 88 in a rather thin house. Consequently, the agreement between the Post Office and the National Telephone Company governing the combined London telephone system stands, at least until 1905, when an opportunity occurs under the terms of the agreement for a revision of its conditions.

This brief recapitulation of recent events is putting the climax before the history of the case, which is a rather complicated matter, somewhat difficult to set forth clearly in a few words. There has long existed more or less discontent in London with the rates and methods of the National Telephone Company, and this discontent has been actively fostered by all sorts of irresponsible busybodies, County Council cranks, yellow journals and people with axes of their own to grind. Resulting from this agitation, there was held a Parliamentary inquiry into the telephone question in the summer of 1898. This committee had as its chairman Mr. Hanbury, a Treasury official, and its proceedings and report were in a spirit distinctly hostile both to the National Telephone Company and to the permanent officials of the Post Office, who had a short time before concluded an agreement with the National taking over the whole long-distance plant and business of Great Britain, previously operated by the company. The committee report advocated the fostering of competition against the National Telephone Company, both by the granting of telephone licenses to the municipalities and by the establishment of a post office exchange in London. Glasgow had long been agitating for a telephone license, and has since obtained it and has started its system. The example of Glasgow has been followed by several other large towns, and the National Company is now meeting competition from municipal exchanges in several places, and is threatened with it in a number of others.

As regards the Post Office London system, Parliament approved the recommendations of the 1898 committee report and voted a credit of two million sterling for the purpose of enabling the Post Office to provide London with an up-to-date and comprehensive system with which to fight the National Telephone Company. The Post Office proceeded in a thorough and systematic manner. Two of its most capable engineers made a thorough study of telephone conditions in the United States, traversing the country from Atlantic to Pacific, and reported at length on the progress and trend of American telephone engineering and practice. Then they went home and proceeded to lay out a telephone system in London on American lines. The Post Office Savings Bank staff was moved out to the country, and the Savings Bank Building, in Queen Victoria Street, in the heart [illegible] with an American common battery plant, constructed and installed by the Western Electric Company, of an ultimate capacity of some 9000 lines. This is to be the main "city" or downtown exchange, about corresponding to the Cortlandt Street exchange in New York, and is now nearly completed. Numerous other exchanges of a similar type are planned and in course of construction.

In London every electrical company builds its own distribution system in its own way, there being no subway or conduit system for general use, with the exception of the County Council subways or tunnels under the newer streets and avenues. These are few and far between, and are not available for a comprehensive system of underground cable distribution, while the existing Post Office underground telegraph lines consist of gutta-percha-covered wires, laid in iron pipes under the sidewalks, this system offering no facilities whatever for the accommodation of telephone cables. Consequently, for a good part of two years the Post Office engineers have made the lives of Londoners miserable by tearing up the main streets in all directions for the construction of an extensive system of iron pipe telephone conduits. Complaints were both loud and deep regarding the hopeless condition that this work threw the narrow London streets into, but the Post Office pursued the even tenor of its way, built its conduits as thoroughly, as slowly and as extensively as it had planned to, and the Londoners had to make the best of a bad job and content themselves with anticipations of a new and highly efficient Post Office telephone service at cheap rates that would bring the service within the reach of all and sundry.

Many prognostications as to the rates that would be charged by the Post Office appeared from time to time in the papers. Sir William Preece, before the 1898 telephone committee, had advocated a divided rate of £4 a year maintenance charge, with a message rate of 1 penny a local message—say, $20 a year plus 2 cents a message—and the general idea seems to have been that this style of rate would be adopted, with even a lower maintenance charge and perhaps a lower message charge, some prophecies going as low as $12.50 a year maintenance charge and 1 cent a message. Others believed that a low flat rate would be offered, at some figure that would about cut the National Company's charges in two. A flat rate at this figure (say, $50 a year) has long been advocated by the London County Council, which body for years past has taken a stepmotherly interest in the telephone service, and by its obstructive tactics and intensely ignorant and prejudiced criticism has done much to embitter the discussion and to manufacture difficulties for all concerned.

In one way and another the impression was created on all sides that the Post Office was about to embark in an active competition with the National Telephone Company for the telephonic business of London, starting with a new and comprehensive plant, and with rates that would enable the butcher, the baker, the candlestick maker, and, presumably, that sacred London institution, the chimney sweep, to become telephone subscribers. The unpractical features of such a scheme, considering that the National Company has about 40,000 stations in London and the Post Office none at all, and the wastefulness of it, in view of the high cost of work in London and the impossibility of conducting such a competition, and at the same time paying expenses, never seem to have struck anybody. The impression was general, sedulously fostered by the yellow press, that a sort of telephonic millenium was about to dawn in London. We did our best to combat such erroneous views at the time.

Judge, then, of the cry of mingled rage and horror that went up a couple of months ago when the announcement was made that the Postmaster General had executed an agreement with the National Telephone Co. under which the two systems are to charge the same rates and to exchange traffic. This agreement and the tariff adopted for both systems put an end to all talk of real competition, and also extinguished all hopes of the bargain-counter rates that the Post Office had been expected to establish.

The tariff provides for both message rate and unlimited service, abolishes the distinction between residence and business service and establishes two districts in the immense area of London, the County of London forming one district, and the area outside forming the second. Messages passing from one district to another pay double the charge of messages local to the inner district or to a single exchange in the outer district. The message rates are all on the divided plan. In the County of London the rate is $25 a year plus 2 cents each for messages local to the county and 4 cents each for messages to stations outside the county; outside the county the maintenance charge is $20 a year with 2 cents each for messages local to the

same exchange and 4 cents each for messages to any other exchange. In each case the minimum yearly payment for messages is $7.20, making the minimum rate $32.20 and $27.20, respectively, for a *maximum* of 360 local messages a year, if all the messages used are at 2 cents each. For two-party line service the maintenance charge is reduced to $15 a year, and for ten-party line service (available only in the outer district) to $10 a year, but the minimum yearly charge for messages in each case is $15, making the minimum rates $30 and $25, respectively, for a possible maximum of 720 local messages. A party-line subscriber, therefore, pays only $2.20 less a year than a direct-line subscriber(both at the minimum rates), but gets 360 more 2-cent messages (or 180 4-cent) for his money, which seems rather an anomalous arrangement. The flat rate is $85 a year for the first line and $70 a year for each additional line taken by the same subscriber. The pay station rate for a local message is reduced from 6 cents to 4 cents. The great change made by this tariff is the introduction of the message rate principle with a minimum rate of less than half the lowest figure at which telephone service has hitherto been supplied in London on an original subscription. For this great step in advance the Post Office is entitled to great credit, and will almost certainly reap its reward in causing an immense development of the telephone in London. Alongside this radical step, the other changes in the National Company's rates are of comparatively slight importance. The flat rate was formerly $100 for business and $60 for residence service, with a discount of 15 per cent on a five-year contract. Under the new tariff the five-year rate, $85 for business service, is applied to yearly contracts and the residence rates are abolished. Residence subscribers will, of course, be expected to take message rate contracts.

This tariff and the agreement to exchange traffic between the two systems, which, of course, precludes the idea of active competition, did not at all meet the views of the County Council and other local authorities, and a vigorous outcry was made in the press, the more hysterical journals indulging in columns of blatant nonsense on what they were pleased to term "The Telephone Betrayal." The agitation was ignorant, prejudiced and wholly unguided by any intelligent grasp of the question. It has utterly failed to upset the agreement, and it deserved to fail. The County Council, advised by a consulting engineer who has no acquaintance whatever with practical telephony, had set its heart on controlling the London telephone system and on establishing a $50 flat rate, and as the County Council has apparently an ability for making noise in inverse ratio to its other abilities most of the agitation originated with that body and was fomented by it.

Deputations waited on the Postmaster General. A conference of local authorities was held at the Guild Hall, which sent incoherent resolutions to the Postmaster General, to the Prime Minister and to various other officials. The agitation culminated in the debate in the House when the Lord Mayor found he had gone off at half-cock, so to speak, and felt forced to abstain from voting for *his own* amendment after trying to withdraw it! The reply of the Post Office to this outpouring of inexpert criticism may be summarized in a few words, though it has several times been stated in many. Real competition with the National had never been contemplated by the Post Office, as it was impracticable. A system with no subscribers could not compete with a system of 40,000, without intercommunication between the two networks, which, of course, would have been denied. Then, in active competition, the Post Office would have been obliged to withdraw the way leaves it now grants the National, and the London system would have been thrown into chaos. Further, a cut-throat competition in rates, in other words, a losing business, would have been unfair to the taxpayer, whose money supplies the capital for the Post Office system. On the other hand, the Post Office is in course of establishing a thoroughly comprehensive system in London equipped with the most modern appliances, and will furnish a service first class in every respect, competing with the National Company in efficiency and variety of facilities offered to the telephone user. It has introduced the message rate system and has caused the National Company to do likewise and also to modify its tariff in other respects. In so doing, it has brought the London telephone service within reach of the masses for the first time. The tariff and the working arrangements laid down in the agreement were arrived at as the result of an expert study of the situation and the Post Office rightly refused to budge an inch from the position it had arrived at after several years of investigation, estimate and negotiation.

This defence, put forward by the Postmaster General and by the Treasury, has very properly prevailed. The tariff and the agreement stand, and will have at least three years working trial. The tariff is open to criticism from an American point of view, but this historical article is concerned merely with a record of a highly interesting telephone controversy in what is undoubtedly the most tempting telephone territory in the world—the city of London, with its magnificent distances, its business and social activity, and its teeming millions inclosing hundreds of thousands of possible telephone users. It must be admitted that the technical and permanent staff of the Post Office have made the best of a bad job. Telephone competition was forced on them by Mr. Hanbury's committee, and all must admit that competition to be carried on with public money against the public licensee (mulcted 10 per cent of its gross receipts for the mere right to do business) was an act of questionable morality. It is unquestionable that in 1898 Mr. Hanbury meant real competition, the object being to hamper and restrict the National Telephone Company and to depreciate its securities against the time when the Government will have to buy up the whole business. When the Post Office experts got to work on the question they naturally determined that real competition was impracticable unless the two millions of public money were to be thrown into the gutter; and they further found that the National Company's principal rate was so far from being unreasonable and extortionate that they adopted it themselves, although it means 10 per cent more to them than to the company, since the Post Office has to pay itself no royalty. The present plans of the Post Office should result in an improvement of London's telephone service, and in its rapid development. The adoption of message rates will be a real boon to the London public, as is proved by Mr. Chamberlain's statement that the Post Office canvassers were taking a dozen message-rate contracts to one flat rate. In fact, Mr. Chamberlain thinks that the flat rate should be abolished altogether.

While, however, the partnership between the Post Office and the National Company, for that is what the arrangement really amounts to, should result in improving and developing the London telephone service, the whole controversy furnishes a striking illustration of the disadvantages of Government control of telegraphs and telephones. Had the National Telephone Company been allowed to put its wires underground and to develop London telephonically without continually meeting the obstructions and restrictions imposed by every authority, from Parliament down to the meanest vestry that rules a few miles of streets, the ultimate result would have been better and cheaper for all concerned.

An English Banker on American Competition.

The chairman of the London & County Banking Company, at the recent annual meeting of the shareholders, had this to say of the commercial situation and the "American invasion": "If in Asia and Africa we have had to withstand the attack in arms of our enemies, we have had also to withstand, on the other hand, the almost too impetuous advances of our cousins in America. They desire to be in such close relations with the mother country that, with their many-million-dollar power, they desire to possess, in order to show us how to utilize them better than we have done, our mercantile marine, our suburban railways, and much of our manufacturing enterprise.

"Well, let us welcome them, and if they have useful lessons to teach, let us learn them. We need not sell our ships or our enterprises, except on satisfactory terms, and the result of the first stage is that Englishmen find many American dollars, or their equivalent, safely in their pockets, and I do not think they will long lie idle there. The world is big enough for us both—big enough for far more friendly competition, even between England and America, than there has ever been yet—and I welcome the thought that the two great Anglo-Saxon races will go hand in hand to civilize the dark places of the world, even faster than it was thought possible a very short time ago."

Tower for St. Louis Fair.

A giant tower is one of the special features proposed unofficially for the St. Louis Fair, to cost $1,500,000, consisting chiefly of a globe 350 ft. in diameter, carried on pillars 250 ft. high, with an observation tower 100 ft. above the top of the globe. It is to be built of steel and bristle with electric lights. The Eiffel Tower has disfigured two Paris expositions, and it is to be hoped St. Louis may escape this hideous infliction.

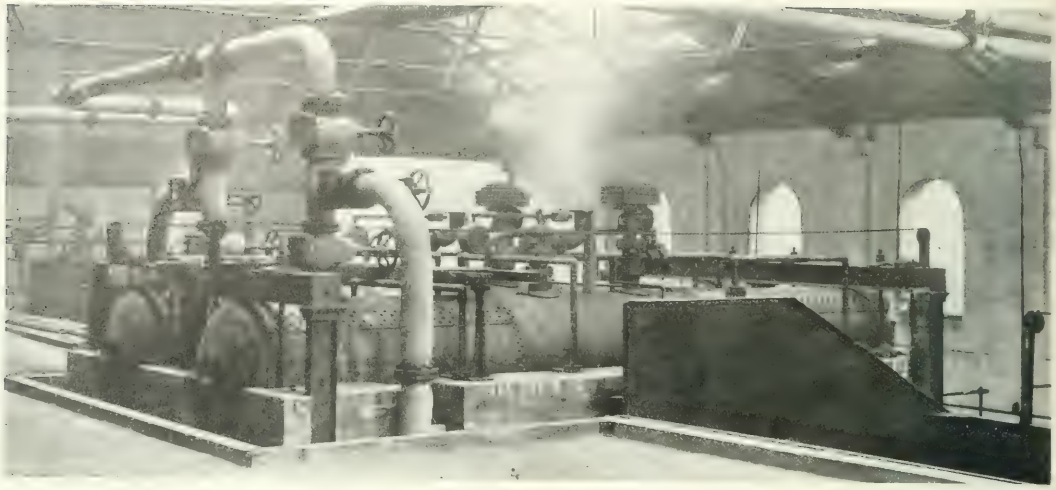


Fig. 1.—Steam Piping, Boiler Room, Bermondsey Plant.

Two Recent English Central Stations.

ONE of the most interesting of the recent central station plants started in England is that of the borough of Bermondsey, a populous district of London. Its main feature of unfamiliarity to Americans is its use of street refuse, a practice which somehow has made no headway in this country, and which, so far as we can judge, has not altogether proved its case to the satisfaction of European engineers. The plant at Bermondsey is close to the Town Hall, and comprises destructor house, pump house, engine room, battery room, etc. The destructor is at present made up of six cells, arranged to the design of Mr. A. J. Liversidge, for a maximum consumption of 50 tons of domestic and trade refuse daily. The rubbish is brought by carts up an inclined roadway to the tipping platform, where it is shot into the receiving hoppers, from which it is pushed through traps on to the drying hearth. The principle moisture is here driven off by heat, and the refuse can then be raked, from the firing doors, on to the grate bars, where it is burned in the usual manner. Each cell has a grate area of 25 sq. ft. The heat from the refuse passes through flues to the water-tube boilers, thence through duplicate flues to the stack. Forced draught is applied to the furnaces, and the pressure, regulated from the firing door, is created by three fans, two driven by steam engines through spur gearing, and one by an electric motor directly coupled to the fan. A stand-by to this draught is provided in steam jets fitted to all the furnaces.

The boilers, three in number, are arranged for firing with coal if necessary, and they have a grate area of 39 sq. ft., a heating surface of 2010 sq. ft., and an evaporative capacity of 6000 lbs. of water per hour. The boiler furnaces are also provided with both the fan and steam draught pressure [illegible] low water alarm and Dew

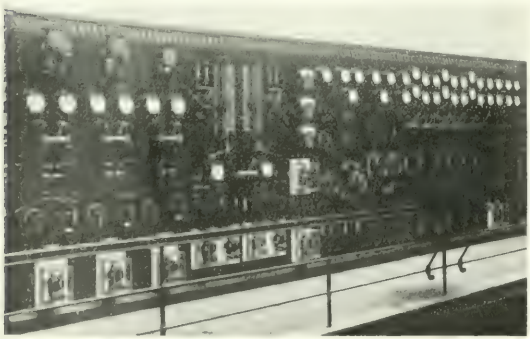


Fig. 2.—Switchboard, Bermondsey Plant.



Fig. 3.—Boiler Room, Bermondsey.

rance fittings are mounted on the boilers. The steam pressure is 150 lbs. per square inch. Boiler feed is obtained from duplicate pumps, delivering through a twin set of piping to the boilers either direct or by way of a Green economizer of 240 tubes at the base of the stack. The economizer scrapers are motor-driven. At present the feed water is taken from the town mains, through a water softener, to a tank holding 10,000 gallons. The delivery to the softener is controlled by a ball valve acted upon by the water in the tank, the same delivery driving a water motor on the softener for mixing the chemicals with the water to be dealt with. The apparatus will soften 2000 gallons of water per hour. An artesian well is being bored for the supply of water, not only to the works, but to the adjoining public baths also, and it will provide 6000 gallons per hour. A motor is to be fitted for the operation of a single-throw pump to deliver the water either to the softener or the baths. It is interesting to note that the surplus steam, of which there is expected to be a quantity, is to be utilized in one instance for heating the feed water, and in the other for driving the draught fans, two of which are steam propelled. The stack is 150 ft. high, and it has been erected by the contractors for the destructor plant.

The engine room contains three generating sets, one of 75 kw and two of 150 kw output, comprising Willans engines directly coupled to dynamos made by the Thames Ironworks Company. The engines are Willans two-crank and three-crank types, respectively, the small set of 100 hp running at 450 revolutions, and the large sets of 220 hp at 285 r. p. m. At present the engines run non-condensing and exhaust into the chimney. The dynamos are shunt wound, as there is no likelihood of power being required for street cars at present, but should this arise the extension plant will be supplied compound wound. Current is generated at 480 volts, and is distributed on the

three-wire system, equalizing being effected by balancers and battery in the usual manner.

The switchboard, mounted on a platform above the engine room floor, is made up of controlling arrangements for three dynamos, six feeders, eight arc circuits, battery, balancers and and boosters. Wattmeters are fitted on the dynamo panels and also in the bus-bars between machines and feeders, so that the generating units can be balanced against those registered by the feeder wattmeters. The dynamo main switch is interlocked with the field-breaking switch, and reverse current cut outs are fixed to these panels also. The feeders are supplied with duplicate fuses, and compensating voltmeters for measuring the volts at the feeding point are included in the fittings. The arc circuits are controlled from the board, 10 arcs being run in series across the outers of the system, while resistances are inserted for the regulation of the potential to the lines. The balancer and booster panels are fitted in the usual manner, and the battery regulating arrangements are also of the ordinary type. Wattmeters are inserted in the charge and discharge circuits of the cells, as it was thought that separate instruments were more accurate than the reversing pattern. A useful adjunct to the board is found in a switch which, should breakdowns to the generating plant occur, can be closed to put the battery on to the Town Hall circuit, thus maintaining the supply to that important building. A panel fitted with recording ammeter and circuit breaker in the earth circuit completes the switching arrangements.

The balancers, placed under the switch gallery, are capable of

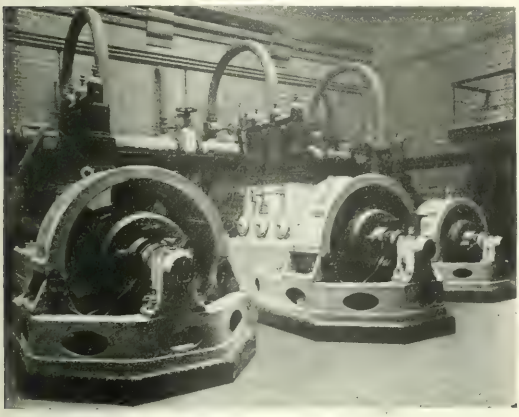


FIG. 3.—GENERATING PLANT, BERMONDSEY.

dealing with an out-of-balance current of 50 amperes, their armatures revolving in separate fields on a common bedplate. The boosters, fixed near the balancers, are each driven by a common motor placed in the center of the bedplate, and the pressure in the battery circuit when charging or discharging can be raised from 10 to 100 volts. A hand-power crane, capable of lifting 10 tons, runs the entire length of the engine room, and a temporary end is at present erected to the building to allow for future extensions.

The storage battery cells of the Tudor Company's make are mounted in a room behind the switchboard, in two tiers, the positive battery forming the upper and the negative battery the lower tier. A maximum discharge of 300 amperes for one hour can be obtained from the battery without injury, the charging current of 100 amperes being maintained for 5¾ hours.

The mains of Glover make are laid solid in the case of distributors, and drawn into Doulton conduits in the case of feeders and arc circuits. A tile trough is employed with the distributors, which are laid with a view to sectionizing in case of fault.

Feeder pillars are fixed above the pavement level at suitable points in the network, and they provide for the fusing of both the feeder cables and the distributors. The boxes are so arranged that a demand indicator can be inserted in the feeder circuit at the point in question, and the maximum load at that spot can be recorded without difficulty. The feeders are triple-concentric cables of 0.25 square inch section, lead-covered, paper-insulated, the distributors of similar pattern, but of 0.10 square inch section, and the arc light lines of twin conductor, 0.023 square inch section. The connections throughout the entire distributing system are sweated in every case.

The 70 arc lamps are of Crompton double carbon pattern, burning 32 hours. Two incandescents, of 16 cp each, occupy the lower part of the arc posts, and these are automatically operated by an Edmunds switch in the base of the column. The design of the posts received the first prize at the Edinburgh School of Art.

The bye-products of the destructor plant are to be utilized for making flagstones, and the machinery used is electrically driven. The

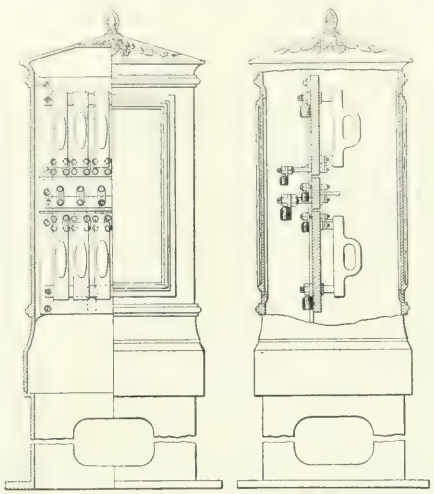


FIG. 4.—FEEDER PILLAR, BERMONDSEY.

clinker is ground in a mill and mixed with water into a paste, which is hydraulically pressed into a die the size of the flag required. A 25-hp motor will drive a countershaft from which the grinder, mixer and hydraulic pump will be driven.

Chamberlain and Hookham meters are used, and the Wright system of charging has been adopted for lighting, the rates being 12 cents for first hour, 6 cents all time after; for power, a flat rate of 5 cents per unit will be put in force, and a preferential charge of 6 cents per unit is to be made to churches. Mr. W. H. Vincent is the

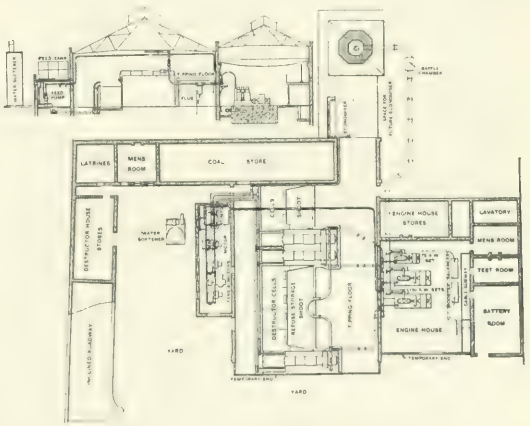


FIG. 5.—SECTION AND PLAN, BERMONDSEY STATION.

borough electrical engineer, and Messrs. Kincaid, Waller and Manville were the consulting engineers.

The other recent plant is that of the Crystal Palace District Electricity Supply Works, at Sydenham, and is one that will doubtless be visited by a good many Americans this year during the continuance of the American Exposition within the glass walls of the world-famous Paxton palace. The station which will furnish much of the current for running American apparatus on view does not, however,

present any particular feature of great interest, and may be taken as a good example of current English distribution practice on medium-sized stations. The original plant was put out of commission by a disastrous boiler explosion in July, 1900. The present works consist of an engine room measuring 79 ft. by 32 ft. 6 inches, and a boiler house running parallel to it which is 57 ft. long and 30 ft. wide. The building is covered by an iron-stayed roof and a skylight surmounted by louvres runs the full length. The chimney shaft has been lengthened 20 ft., thus making the present height 110 ft., the internal measurement being 6 ft. square. The pump and heater rooms are situated alongside the shaft, and in a separate building are the transformer and battery rooms, also large stores, fitters' and carpenters' shops, meter rooms and offices.

Three Hornsby double water tube boilers, each of 276 hp, have so far been erected, each boiler having two steam drums of 4 ft. diameter by 26 ft. long. Vertical tubes lead from either end of the drums, those from the front being connected into headers, which each contain a set of 72 four-inch tubes, and, at the back lead into a common mud-drum, which is connected by a number of horizontal tubes to the headers. A cast-iron breeches pipe connects the steam drums. All the boiler fittings are by Messrs. Hopkinson, and consist of the usual complement, including high-pressure and low-water alarms. The boilers are fed from the pumps through 2½-inch valves fixed on each steam drum, and in addition a Buffalo injector is fitted at the front for emergency purposes. An extra blow-off with internal pipe is fitted to each steam drum to prevent accumulation of mud. The very best Welsh coal is at present burned to avoid smoke nuisance, as private houses are situated on the adjoining hill level with the top of the shaft. Feed water is passed through Berryman exhaust heaters,

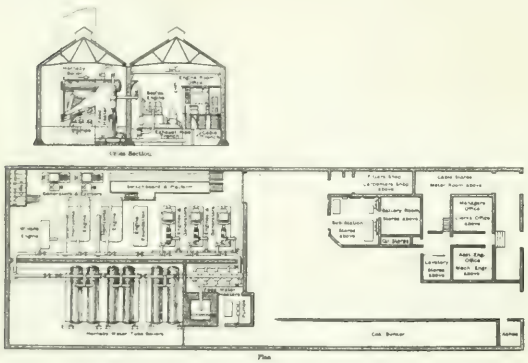


FIG. 6.—SECTION AND PLAN, CRYSTAL PALACE STATION.

and three Worthington pumps are installed, each capable of supplying two boilers on full load.

The generating plant comprises three 210-kw sets, two 90-kw sets and one 45-kw set. The 210-kw sets consist of two-pole Electric Construction Company's dynamos, giving 1050 volts at 420 r. p. m., directly coupled to Messrs. Belliss' standard type three-crank compound engines. The 90-kw sets are the old Hornsby slow-speed horizontal engines, driving with ropes E. C. C. two-pole dynamos. The 45-kw combination is a Willans of 80 hp directly coupled to an E. C. C. machine. The foundation has been laid ready for the erection of another 210-kw generating set. A 15-inch exhaust main runs nearly the entire length of the engine room below the floor, and after passing through the heaters is taken up the chimney shaft to within 30 ft. of the top. This pipe was not reduced in size in the engine room, with a view to allow of the installation of a condenser at the far end. A 5-ton traveling crane traverses the engine room at a height of 15 ft.

Five feet above the engine room floor the switchboard is mounted on a gallery, which is constructed of steel joists resting on 14-inch wall with a facing of white glazed bricks. The floor in front of the switchboard overhangs, and is filled in solid with concrete, which is paved with glass as a safeguard against shocks; rubber mats are also used for further protection. The panels of the board are designed in standard widths of 1 ft. 6 inch and 2 ft. The generating panels each consist of one double-pole chopper switch, interlocked with a field-breaking switch, one pair of single-pole enclosed fuses, and main and exciting ammeters. The distributing panels have voltmeter and pilot plugs, circuit ammeter, double-pole chopper switch, transformer starting and regulating switches, and one pair of single-pole enclosed fuses. The live parts of the switches are protected with plate glass shields.

There are six generating and 10 distributing panels, and a blank slate is fixed on the top of each panel to provide space for wattmeters, which would be connected with generator and sub-station circuits. A copper bus-bar, designed to carry 1500 amperes, runs the full length of the board, and is supported on porcelain insulators.

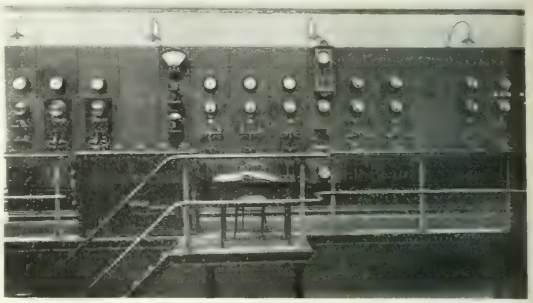


FIG. 7.—SWITCHBOARD, CRYSTAL PALACE STATION.

An ammeter is inserted in this bar, between the generating and distributing sections. There is also a low-tension bus-bar from which the generators are excited. The exciting regulating table stands in front of the generator panels, and the back of the switchboard is covered with glass and is dust-proof. Resistances are, when necessary, switched in the sub-station circuits to regulate the volts on the low-tension feeders. There are 15 pilot wires from various feeder points in the district. Most of the sub-stations are connected with the works by means of telephones, and thus the attendants can be communicated with, so that with judicious arrangements of battery charging the resident engineer is able to report that a running station load-factor of over 90 per cent has been obtained.

A small sub-station in a building separate from the works supplies the works lighting and the exciting current for the generators. Including this one, there are 10 sub-stations, at six of which E. P. S. storage batteries are installed with approximate total maximum discharge rate of 180 kw. These batteries are charged by means of boosters run off the 100-volt bus-bars. The booster switch-gear is a

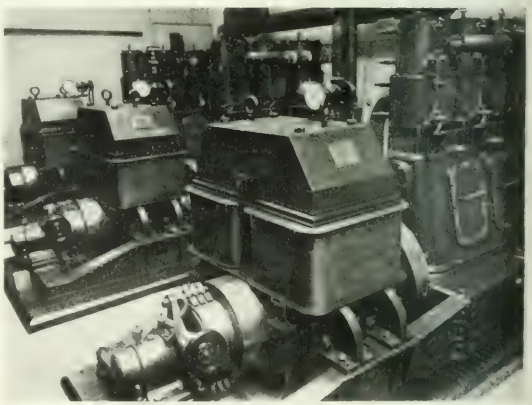


FIG. 8.—DYNAMO ROOM, CRYSTAL PALACE STATION.

specially designed rock-over type of switch, and is fitted with an automatic release worked by a relay connected in series with the high-tension circuit of the transformer, so that in case of failure of the supply to any particular sub-station that battery would be at once switched on to the mains. It also interlocks and prevents the sub-station attendant switching on the booster when the transformer is not running. Only six of the sub-stations are provided with batteries. Most of the sub-stations are connected on the feeder system

to the low-tension network. The largest of the sub-stations is at the Crystal Palace, and was designed for an output of 500 kw. There are four 70 kw, three 40 kw and two 66 kw. fixed ratio E. C. C. transformers. The last-named two machines give 440 volts for arc lighting, etc., and switch gear is provided so that, if necessary, some of the 100-volt machines can be switched in series to furnish a higher bus-bar pressure. The battery room contains 56 E. P. S., 45 plate cells charged by means of a 17-kw double-field booster.

The high-tension feeders vary in size from 0.25 square inch to 0.06 square inch. The 0.25 square inch mains, of which there are three, are Callender lead-covered concentric, drawn into 4-inch cast iron pipes. The smaller mains are British Insulated single cables, lead-covered and steel armored, laid directly in the ground. The lead-covered low-tension cables are being gradually replaced by vulcanized bitumen make, laid solid in masonry troughs. All services are protected by means of fuse boxes connected on to the distributors. The number of lamps connected is nearly 29,000 equivalent 8 cp.

The New Toll Line Boards of the Chicago Telephone Company.

The Chicago Telephone Company has just put in operation a new method of handling its toll line business, which places its toll office at the head of the toll line offices of the world in the matter of convenient equipment for rapid work. The general plan of handling messages is somewhat similar to that in use in the San Francisco exchange of the Pacific States Telephone & Telegraph Company, described in Electrical World and Engineer, of May 11, 1901, page 759. The change in Chicago has been made under the direction of Mr. F. W. Alston, superintendent of equipment of the Chicago and Central Union Telephone companies, who came from the Pacific States at the time Mr. John I. Sabin took the presidency of the Central Union and Chicago companies. The toll line room in the San Francisco exchange has been one of the features that attracted special and favorable attention from telephone visitors from other parts of the country, and from Europe, and it is quite natural that Mr. Alston introduced the same ideas in fitting up the new Chicago

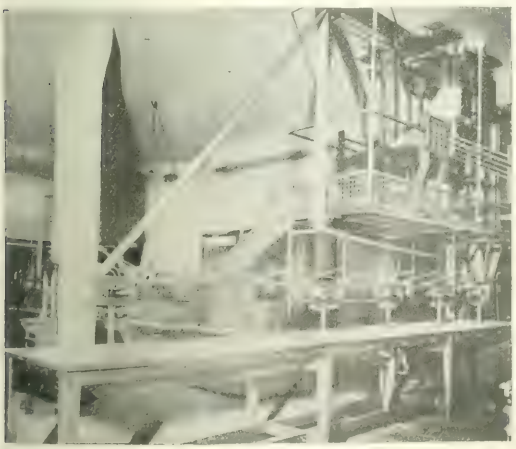


FIG. 1.—TOLL ROOM.

toll room after such a successful experience with it on the Pacific Coast.

Before going into the details of the new equipment, it may be well to call attention to the amount of toll business done by the Chicago Telephone Company over its own lines, which is the greatest in volume of any toll switchboard in the United States. The Chicago Telephone Company's toll lines reach all the numerous towns within a radius of 60 miles of Chicago in the States of Illinois and Wisconsin, with a few lines to nearby towns in Indiana. They reach Rockford on the west, Kankakee on the south, Lake Geneva northwest and Kenosha on the northwest. The directory shows nearly 200 points outside the Chicago Telephone Company's exchange, which are reached by toll lines. The volume of business in number of complete switches per day is the true index of work done, and this averages 5000 in the toll room of the Chicago Telephone Company.

The number of calls per subscriber in the Chicago exchange is higher than in any other large city. In January, 1902, the Chicago exchange, with 37,000 subscribers connected, made an average of 511,000 complete switches per day, and the New York City exchange, with 65,000 subscribers, made 440,000 complete switches per day. This, however, is due to the fact that in Chicago subscribers still revel largely in a flat rate service, whereas all New York is now practically on a measured rate basis.

The new toll room of the Chicago Telephone Company has 72 operating positions and 24 positions where orders for connections

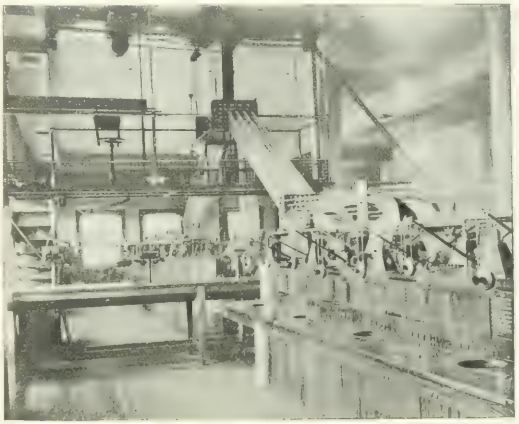


FIG. 2.—TOLL ROOM.

are received and recorded. The general plan of operation is that one set of operators does nothing but make out order tickets for long distance connections as the orders come in from subscribers. These order tickets are carried by traveling belt to a central ticket distributor, who sends each ticket to the toll operator who has the toll line wanted terminating on her section. When the toll operator has secured the toll connection she calls up the local subscriber desiring the connection. To go more into detail: When a request for a toll line connection is received by an exchange operator, she connects the calling subscriber with one of the long distance receiving or recording clerks who are stationed at the 26 positions, some of which are shown in the foreground (Fig. 1). These positions have a row of answering jacks, with lamp signals set in the table in front of each operator. The toll recording or receiving clerk who receives the call puts down the number and name of the party called for, and of the subscriber calling. She then tells the calling party he will be called up when the connection is secured and disconnects. Now comes the method of getting the ticket quickly to the right toll operator, which is the essential feature of the new system. Running over the middle of the table just above the incandescent lamps in Fig. 1 are a pair of endless belts, run one on top of the other, except when passing through the receiving boxes in front of each operator, when one belt is carried up to the top of the box and the other runs in the bottom. The slip of paper thrown in the box is immediately whisked away between the belts up to the central distributing clerk in the elevated office, seen in Figs. 1, 2, 3 and 4. From the distributing clerk's office similar belts run to the 24 positions occupied by the toll operators. The distributing clerk has simply to put the slip in a slot bearing the name of the toll line wanted, and the belt deposits the slip in front of the toll line operator, who has that toll line terminating in front of her. Each of these operators has several toll lines terminating in jacks at the bottom of her section. Figs. 3 and 4 show these operators' sections in detail. Besides the toll line jacks and lamp signals, each section carries multiple trunk jacks, which run to the various exchange offices in Chicago. These trunks come into the toll operating board and appear on the multiple jacks in front of every position on the board. By means of these trunks, the toll line operator can call any office, and through the office any subscriber. When the toll operator receives the order ticket, it is her duty to call

up the toll line party wanted, and when connection is secured, the toll operator calls up the Chicago subscriber who ordered the connection, and conversation is established. Orders for toll line connection are taken up in their regular turn, as they are deposited on the toll operator's desk. Under the old plan with toll lines terminating on multiple jacks in front of a number of toll operators, an operator by good luck in making the busy test might get a toll line ahead of one who had been waiting for it some time. For connecting one toll line with another, a set of trunks runs the length of the operator's board with multiple jacks in front of each operator. In order to know which of these trunks is busy a toll operator depresses a key connecting her with a supervisory clerk who has in front of her



FIG. 3.—TOLL ROOM.

lamp signals connected with all the trunks which indicate when a trunk is busy. The supervisory clerk directs which trunk is to be used in making the connection from one toll board section to another.

The distinctive features of the new toll office are the complete separation of the receiving of orders and the actual work of making toll connection, and the rapid mechanical method of delivering order tickets from receiving clerks to operators.

The conveying belts are practically noiseless. They are driven by small direct-current motors suspended from the ceiling above the distributing clerk's gallery. The arrangement of belts can be seen by a study of the four illustrations shown herewith. For conveying

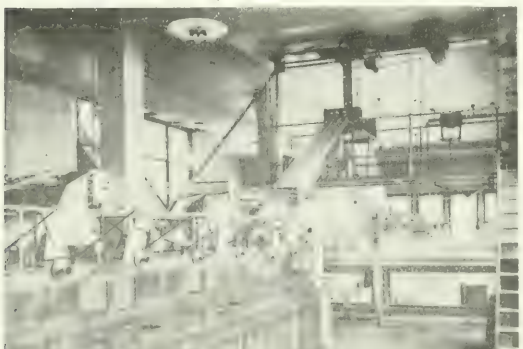


FIG. 4.—TOLL ROOM.

to the distributing clerk one wide belt is sufficient, as all the slips are to be delivered at one place. From the distributing clerk to the 24 operators' positions, 24 belts are run, one for each destination. As shown, these are placed in three tiers of four each.

The long-distance business also goes through this office, but the long-distance switching is done at a long-distance terminal office on the edge of the city. An operator in the toll room reads the orders for long-distance connections to the long-distance terminal office.

The new toll room is much lighter and more comfortable than the old quarters, and is a fitting place in which to carry on the largest toll business in the world.

The General Problem of Wave Propagation Over Non-Uniform Conductors.

By M. I. Pupin.

I. NON-UNIFORM CONDUCTORS OF THE SERIES TYPE.

THE most general form of a non-uniform wave conductor of the series type is represented in Fig. 1. It consists of two different sets of uniform conductors, set *ab, cd,* . . . . represented by thick lines, and set *bc, de,* . . . . represented by thin lines. The members of each set are equal to each other.

This paper shows that the mathematical solution of the problem of wave propagation over such a conductor is the most general solution, because every other case can be deduced from it.

A discussion of this general problem seems necessary, because it exhibits clearly the relation between the various forms of non-uni-

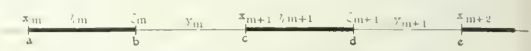


FIG. 1.—DIAGRAM OF NON-UNIFORM CONDUCTOR.

form conductors of this type, and demonstrates that they are all subject to the same general rule, which will be formulated further below. In order to make the discussion more complete the effect of leakage is also considered.

Section 1. *Wave porpagation over uniform conductors possessing uniformly distributed leakage.*

The problem of wave propagation over a uniform wave-conductor, with uniformly distributed leakage, was first solved by Oliver Heaviside. A brief statement of this theory will be given here first, in order to explain briefly the effect of the leakage current upon the mathematical treatment of the problem in this case, and thus pave the way for the more general discussion.

The same symbols will be employed as in Section 1, Part II., of my paper read before the American Institute of Electrical Engineers, May 18, 1900, and published in Vol. XVII. of the *Transactions* of this Society.

The principle of equality of actions and reactions in any element of the conductor is expressed by

$$L\frac{dy}{dt} + RV + \frac{\delta V}{\delta s} = 0 \qquad (1)$$

We have also the following relation between the current y and the potential V,

$$\frac{\delta y}{\delta s} = C\frac{dV}{dt} + aV \qquad (2)$$

where a is the leakage conductance per unit length. This investigation is limited to waves of the simple harmonic type, hence

$$u = \frac{\delta y}{\delta s} = (ipC + a)V = \alpha V \qquad (3)$$

The operator $(ipC + a)$ shows that the lateral current u consists of two components, one in phase with V and the other in quadrature. *The energy accompanying the first is dissipated, and that accompanying the last is stored up.*

From (1) and (3) we obtain

$$L\frac{dy}{dt} + Ry + \frac{1}{\alpha}\frac{\delta y}{\delta s} = 0 \qquad (4)$$

Therefore,

$$y = Ae^{-(\beta x + \alpha s)} \qquad (5)$$

will be a solution if

$$\alpha\beta = ipC + a, \quad \alpha\beta^2 L = R + \alpha \qquad (6)$$

This may be called the equation of propagation because it expresses a relation between α and β, the characteristic constants of wave propagation, and the constants of the wave conductor, namely, C, L, R, and a.

Equation (6) can also be written

$$\alpha = \sqrt{ipC + a} = \sqrt{ipC}\sqrt{\left(1 - \frac{aR}{p^2C}\right)} + \frac{aL}{C}$$

$$= \sqrt{ipC} + \frac{1}{2}\frac{aL}{C} + K_1 \qquad (7)$$

The equation of propagation is now of the same form as in the

case of a perfectly insulated conductor. *The effect of leakage is, therefore, to diminish the effective inductance and to increase the effective resistance of the conductor.*

It can be seen, however, that the change in inductance produced by leakage is insignificant when compared with the change in the resistance. The fact that this increase in the effective resistance produced by leakage is proportional to the inductance introduces the well-known difference between a leaky wave conductor and a perfectly insulated one. In this one the efficiency of transmission increases indefinitely with the increase of inductance; in that one there is a definite limit beyond which an additional increase of inductance will be harmful.

If by (β) we denote the minimum value of the attenuation constant β, then it is easily shown that

$$(\beta) = \sqrt{aK}$$

and the limiting value of the inductance is given by the equation

$$L = \frac{KC}{a}$$

In this case the attenuation is independent of the frequency, and we have Heaviside's distortionless circuit.

In submarine cables and in telephone cables the insulation resistance is so high that a is extremely small, and the limiting value of L is far beyond practicable limits. But in the case of air lines there is, on account of low insulation resistance, a definite practical limit. Thus let the line have the following constants per mile:

$$R = 2$$

$$C = .01 \times 10^{-6}$$

$$a = \frac{1}{2.5 \times 10^{6}}$$

This corresponds approximately to a long-distance telephone line. In this case the limiting value of the inductance is

$$L = .05$$

This is about 25 times as much inductance as long-distance telephone lines have, but it is by no means more than the inductance which can be put quite readily upon a telephone line by the introduction of inductance coils. Hence, if it should be required to load a telephone line of the above description with inductance coils and introduce more than .05 henrys per mile, then it would seem as if the insulation resistance will have to be larger than 2.5 megohms per mile. It is important, therefore, to develop the mathematical theory of wave propagation over a non-uniform conductor possessing leakage.

It should be observed here that long-distance telephone lines have an average leakage resistance considerably larger than 2.5 megohms.

Section 2. *Wave propagation over a non-uniform conductor of the most general series type, possessing leakage.*

Referring to Fig. 1 it will be seen that the currents at any point of the shaded and unshaded portions of the conductor are denoted by η and y, respectively. Thus η_m denotes the current at any point of a shaded section like cd, and y_m denotes the current at any point of a section of the type bc. The constants of these sections are distinguished by suffixes. Thus L, R, C, a, are the inductance, resistance, capacity and leakage conductance, per unit length, of any unshaded section like bc. Its length is l. The corresponding quantities for the shaded sections like cd are denoted by $L_1 R_1 C_1 a_1 l_1$. The currents at the homologous boundary points $a\ c\ e\ \ldots\ bd\ \ldots\ .$ are denoted by $x_m\ x_{m+1}\ \ldots\ \eta_m\ \eta_{m+1}\ \ldots$

Referring now to Section III. of my paper, cited above, it will be seen that

$$y_m = \ldots \qquad (1.$$

$$\eta_m = \ldots \qquad (2$$

Boundary condition at point c is expressed by

$$\frac{1}{\sigma}\left(\frac{d y_m}{dz}\right) \ldots = \ldots \qquad (3)$$

where

$$\sigma = \ldots$$

$$\sigma_1 = \ldots$$

Equation (3) gives

$$\ldots = 0$$

$$\left.\begin{aligned} \text{or,}\quad & A x_{m+1} - B x_m - C x_{m-1} = 0 \\ \text{similarly,}\quad & A y_m - B \eta_m - C y_{m-1} = 0 \\ & \ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \qquad (4)$$

These equations may be called homologous, because they express the boundary conditions at the homologous points $a, c, e, \ldots .$

Boundary condition at d is expressed:

$$\frac{1}{\sigma_1}\left(\frac{d \eta_m}{dz}\right)_{z=l_1} - \frac{1}{\sigma}\left(\frac{d y_{m+1}}{dz}\right)_{z=0} = 0$$

This boundary equation gives:

$$\left.\begin{aligned} & A \eta_{m-1} - B x_{m+2} - C x_{m+1} = 0 \\ \text{Similarly,}\quad & A \eta_m - B x_{m+1} - C x_m = 0 \\ & \ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \qquad (5)$$

This is also a system of homologous equations representing the boundary conditions at the homologous points $b, d, \ldots .$

From (4) and (5) result the following two systems of equations between homologous boundary currents:

$$\left.\begin{aligned} & A^2 - \left(\frac{B^2 - C^2}{BC}\right) x_m - x_{m-1} - x_{m+1} = 0 \\ & A^2 - \left(\frac{B^2 - C^2}{BC}\right) x_{m-1} - x_m - x_{m+2} = 0 \\ & \ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \qquad (6)$$

$$\left.\begin{aligned} & A^2 - \left(\frac{B^2 - C^2}{BC}\right) \eta_m - \eta_{m-1} - \eta_{m+1} = 0 \\ & \ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \qquad (7)$$

These two systems are of the same form as system (6), Section 2, Part II., of my paper referred to above. We can write, therefore,

$$\left.\begin{aligned} x_m &= K_1 \cos 2m\theta + K_2 \sin 2m\theta \\ \eta_m &= K_3 \cos 2m\theta + K_4 \sin 2m\theta \end{aligned}\right\} \qquad (8)$$

where $K_1\ K_2\ K_3\ K_4$ are constants, which must be determined from the conditions at the transmitting and at the receiving terminals of the non-uniform conductor.

In order that (8) represent the solution of (6) and (7) we must have

$$A - \left(\frac{B^2 - C^2}{BC}\right) = 2\cos 2\theta$$

Giving A, B and C their values and introducing for convenience $l = l_1$ we obtain

$$\ldots = 2\cos 2\theta \qquad (9)$$

This is the most general equation of wave propagation over a non-uniform conductor of the series type. Every other case can be derived from it as will be shown now.

First Case.—*The conductor consists of equal resistance coils connected in series, each coil having a resistance equal to* 1 R. *Equal condensers of capacity* 1 C_1, *and leakage conductance* 1 a_1, *connect the conductor to ground, one condenser at each juncture between two consecutive resistance coils.* This is the well-known arrangement which has for so many years been employed as artificial cable.

We can pass from the general arrangement of Fig. 1 to this arrangement by making $C = l = a = 0$ and $L_1 = R_1 = 0$. Hence

$\mu = 0$

Equation (9) reduces, therefore, to

$$\text{— } = -4 \sin^2$$

α and β the characteristic constants of wave propagation over a non-uniform conductor of this kind.

When there is a sufficiently large number of resistance coils per wave-length, the wave-length being estimated on the corresponding uniform cable having a capacity C_1, leakage conductance a_1, and resistance R per unit length, then $\sin \frac{1}{2}(\alpha - i\beta)l$ is so small that we can put, approximately,

$$\sin \frac{1}{2} \qquad = \frac{1}{2} \qquad \text{(10)}$$

Equation (10) reduces to

$$\qquad \text{(11)}$$

But this is the equation of propagation over the corresponding uniform cable. In other words, the non-uniform conductor is equivalent to its corresponding uniform cable. All experimental data obtained with an artificial cable of this kind have the same intrinsic weight as those obtained with the real cable, which corresponds to this article cable, that is, provided that the frequencies employed are withi nthe limit defined by (10).

Example.—Suppose it is required to make an artificial cable which shall be equivalent to a real submarine cable up to a frequency of 25 p. p. s. The submarine cable has a resistance of 5 ohms, a capacity of .3 microfarads, and an insulation resistance of 10^8 ohms per mile. The wave-length on the corresponding uniform cable corresponding to a frequency of 25 p. p. s. is very nearly 1020 miles Sixteen resistance coils and condensers per wave-length gives a close approximation. Therefore, each resistance coil should have a resistance, and each condenser should have a capacity of 64 miles of cable, that is, a resistance of 320 ohms and a capacity of 192 microfarads. The insulation resistance of each condenser should be $\frac{10^8}{64}$ ohms.

Second Case.—*Add in the preceeding case to each resistance coil another coil of resistance* $l R_1$, *and inductance* $l L_1$. Equation (10) becomes now

$$\qquad \text{(12)}$$

This case is identical with the one which I discussed in Sections 2 and 3 of my paper read before the American Institute of Electrical Engineers on March 22, 1899, and also in Section 2, Part II., of the paper cited above, except that leakage was neglected there. It is evident, therefore, that the construction of the artificial line described in Sections 2 and 3 of my paper of 1899, is equivalent to loading a uniform cable with inductance coils at periodically recurring intervals, the length of these intervals being small in comparison with the wave-length.

Third Case.—*A uniform wave conductor possessing uniformly distributed leakage has condensers of capacity* $l C_1$, *and leakage conductance* $l a_1$, *at periodically recurring intervals of length* l *connecting the conductor to ground.*

The equation of propagation for this case is obtained from (9) by

putting $= 0$, $\sin \frac{a_1 l}{\ldots} l$, as follows:

$$\qquad \text{(13)}$$

When the distance l is small in comparison with the wave-length on the conductor before the introduction of the condensers, then

$$\sin \frac{l}{\ldots} = \ldots$$

Equation (13) reduces, therefore, to

$$\qquad \text{(14)}$$

If, again, the distance l is sufficiently small in comparison with the wave-length on the uniform conductor corresponding to this loaded conductor, then we can write

$$\qquad \text{(14)}$$

Equation (14) shows that the wave propagation on a loaded conductor of this kind is approximately the same as on the corresponding uniform conductor.

An interesting illustration of a non-uniform conductor of this kind is the following: Suppose a number of inductance coils are wound bifilarly, so-called twin coils, so as to give each half of each coil the following constants:

$l L_1$ = effective inductance of each coil.
$l C_1$ = effective capacity of each coil.
$l R_1$ = effective resistance of each coil.
$l a_1$ = leakage conductance of each coil.

Introduce them into the line represented in Fig. 1 in place of the shaded portions so that one-half of the twin coil is on one leg of the uniform line and the other half is in the other. Now, short circuit each half, then we have a non-uniform conductor of the description just given, that is to say, a non-uniform conductor, which is equivalent to a uniform conductor having the following constants:

L = inductance per unit length.
R = resistance per unit length.
$C + C_1$ = capacity per unit length.
a = leakage conductance per unit length.

Provided that l is small in comparison with the wave-length on this uniform conductor.

Fourth Case.—Suppose now that the short-circuiting wires are removed, introducing thus the inductance $l L_1$, and the resistance $l R_1$, of the coils into the circuit. This is equivalent to loading the uniform line just described with perfectly insulated inductance coils. If the wave-length on the uniform conductor which corresponds to the resulting non-uniform conductor is large in comparison with the distance between the coils, then equation (9) gives

$$\qquad \text{(15)}$$

This is the equation of propagation over a uniform line having the following constants:

$L + L_1$ = inductance per unit length.
$R + R_1$ = resistance per unit length.
$C + C_1$ = capacity per unit length.
$a + a_1$ = leakage conductance per unit length.

A careful analysis of the last two cases shows that if we have two different sets of coils similar to the twin coils described above we can by proper combinations investigate experimentally most of the problems which may arise in connection with the general theory of wave propagation over non-uniform conductors. The results obtained that way will have the same weight as if they were obtained on

actual air lines or submarine cables. Coils of that description can be made very easily. It is preferable to wind them not on a wooden spool but in the manner indicated in Section 1, Part I., of my paper of May, 1900, referred to above. Each coil when finished should be carefully boiled in beeswax. It will maintain then a fairly high and steady insulation resistance, and a steady capacity. Iron cores should be avoided if the coils are to be employed for lecture room purposes as well as for investigation.

It will be seen that non-uniform conductors follow the same rule with regard to leakage as their corresponding uniform conductors. The limitations imposed by insulation resistance upon the amount of inductance which can be introduced by loading is of no consequence in the case of telephone and submarine cables. Even in the case of properly insulated long-distance telephone and telegraph lines the upper limit of inductance allowed by leakage is as high as other practical considerations will sanction. But it is nevertheless important to keep in mind that heavy loading requires high insulation.

The preceding results can be summed up as follows: A non-uniform wave conductor is a conductor made up of periodically recurring sets of preferably equal parts, which may be called its component parts. Each component part has definite reaction constants, that is, definite resistance, capacity and leakage conductance, and corresponds, therefore, to a definite part on the corresponding uniform conductor. Any two consecutive sections on the non-uniform conductor have, therefore, a perfectly definite angular distance, as defined in my papers, cited above. This paper demonstrates that the rule of equivalence between any non-uniform conductor and its corresponding uniform conductor can be expressed mathematically in terms of this angular distance by the same equation which was established in these papers for the particular cases discussed there. This mathematical rule translated into English says that the length on the uniform conductor corresponding to any two consecutive sections of the non-uniform conductor must be small in comparison with the wave-length. One-sixteenth of the wave-length is a close approximation. Smaller approximations permit larger sub-divisions. Four sub-divisions per wave-length is a worse approximation. For any sub-division consisting of between four and sixteen sections of two component parts per wave-length, the approximation can be calculated by the mathematical rule just cited, with an accuracy which will be sufficient for all practical purposes, particularly if the number of sub-divisions is not too near four.

When this rule is fulfilled, then it does not matter how the reaction constants of any one of the sections are distributed within that section; *they may be lumped or uniformly distributed.* This principle has long ago been recognized in all engineering practice dealing with alternating-current transmission of power over distances which are small in comparison with the wave-length on the transmission wire connecting the transmitting and the receiving apparatus to each other. In all such cases, the inductance and resistance of the transmission wire was replaced by a coil of the same inductance and resistance, and the capacity and leakage conductance of the transmission wire was replaced by a condenser of the same capacity and leakage conductance, the condenser being connected between a terminal of the coil and the ground. The theory of wave propagation over non-uniform conductors, in its most general aspect, is, therefore, nothing more nor less than an extension of this well-known engineering practice.

Wireless Telegraphy on the Kronprinz Wilhelm.

Several interesting tests were made on the "Kronprinz Wilhelm" on her voyage across last week with Prince Henry of Prussia on board, in the use of wireless telegraphy, and the Marconi wireless telegraph operators on board were much elated with the workings of the system. On leaving Bremen the operators got in touch with the station on the Borkum Lightship. They kept up communication for three hours, during which time many messages were received for passengers and many were transmitted for delivery ashore. The next station communicated with was on the English coast at North Foreland. Talk with station was maintained until the instrument began to tick the call from Niton on the Isle of Wight. The next station to be called was the Lizard, and in the communication with it all records of talking from ship to shore were broken. When 100 miles off the Lizard, and an animated conversation was being carried on, the induction coil of the "Kronprinz's" instrument broke down and the operators had to stop temporarily for repairs. When the instrument was ready for use again the liner was 300 miles off the Lizard, and the operator at the instrument was much surprised when a plain signal was received from the station. When 310 miles distant this message was received: "Stand by a moment; I have got to fix apparatus."

The next day, the 19th, the "Lucania" was picked up and messages of greeting between Prince Henry and that vessel were exchanged. Another message to the captain was received from the "Lucania," telling him to look out for a sunken schooner in 30.32 north, 73.10 west. The "Kronprinz" also got in communication at the same time with the "Campania," which was coming this way.

On Saturday morning at 10.30 o'clock, while 70 miles from the "Campania," she again got in communication with her, but could not understand her signals. Communication was begun with Nantucket at 9 P. M. on Saturday night, but the first working message could not be got through until 11.30. Prince Henry sent a message to the President.

On board the "Kronprinz Wilhelm," off Nantucket Island, via Marconi Station, Siasconset, Feb. 22.

President Roosevelt:

Hope state of health of Master Roosevelt favorably progressing with speedy recovery. Permit me to congratulate you and American Nation of to-day's commemoration of Washington's Birthday. Sorry disappoint you so late arrival. Very heavy persistent easterly winds which make fast progress impossible even for this beautiful vessel. I look forward to meet you.

Henry of Prussia.

The President replied:

White House, Feb. 22.

Prince Henry of Prussia, the "Hohenzollern, New York City.

Accept my heartiest greetings on your safe arrival. I thank you for your message. In the name of the American people I will see you, and I look forward to meeting you personally to-morrow.

Theodore Roosevelt.

It would appear, however, that although the "Hohenzollern," the Emperor's yacht lying in port in New York, has a Marconi set on board, of the usual character, it was not used, as the "Kronprinz" approached, for fear of interfering with the signals to and from that ship and the Nantucket Light Station.

Mr. Marconi on Wireless Telegraphy

In London, on Feb. 21, at a general meeting of the Marconi Wireless Telegraph Company, Mr. G. Marconi, referring to the transatlantic experiments, announced that the next series of tests would include the transmission of words and messages. He added that there was nothing to prevent the company from undertaking commercial communication with ships at sea. The system at present was in permanent use on board 70 ships, and there were 25 land stations. His transmission of 22 words in a minute did not compare badly with the work of the cables.

The defects with reference to secrecy, said Mr. Marconi, had been removed. After perfecting arrangements in Canada he would challenge Sir William Preece and Professor Lodge to intercept messages. He added that the monopoly claimed by the British postal-telegraph system had hitherto impeded the establishment of a wireless service in England and Ireland.

Mr. Marconi complained that obstruction was thrown in his way on that side of the Atlantic, which was in marked contrast to the generous encouragement which he had received from the governments and press of the United States and Canada.

In regard to the commercial side of the system, Mr. Marconi said that on the recent arrival of an American liner upward of 8000 words were received within 16 hours. The transmission of this number of words daily across the Atlantic would represent an annual income of £73,000 for each pair of stations, and the company, in the first instance, was proceeding to install two pairs of stations.

A special cable message says as to the challenge above referred to: "As to the assertion that wireless telegraphy could not be commercially valuable, inasmuch as any one with an installation could read the messages, he said he had overcome that by a synchronic device, and challenged Sir William Preece or Professor Lodge to make a trial if they thought that, after giving him a week's notice, they could steal, intercept and read the messages passing between two of his stations. He was willing to place the adjacent station at their

disposal, and let them try. Mr. Marconi's speech made quite a sensation, and he is said to have promised that wireless telegraphy in the future would apparently be achieved despite the opposition of enormous vested interests."

The German Navy Department has decided to establish a chain of wireless telegraph stations along the entire German coast. For the last few days trials have been conducted at Kiel to determine whether the department shall use the Braun system or the Slaby-Arco system, in the latter of which Emperor William has shown great interest. Thirty-two German warships have already been equipped with the Slaby-Arco system, while eight more are to have this system installed. Official reports say that the Slaby-Arco system gives the more satisfactory results.

Power Transmission Plant for Lighting the Cornwall Canal, Canada.

An interesting installation of American apparatus in Canada is that to which reference has already been made in these columns, for lighting the Cornwall Canal. The plant is now in full operation and the illustration herewith shows one of the generators and exciters in place direct connected to the waterwheel shafts. Three additional units similar to this are to be installed later. The large rotating field generator has a capacity of 1000 kw, or about 1350 hp, and runs at 180 r. p. m. Having 40 poles, it gives a frequency of 60 cycles per second, delivering current at the bus-bars at a potential of 2200 volts. The exciters have a capacity of 50 kw, and are sufficient to excite four generators similar to the one described. Two exciters have already been installed so that in case of accident to the exciter or wheels connected with it, the other unit can be immediately put into operation.

At the switchboard, connections are made with cables leading to the wire tower, on the second floor of which are located the raising transformers which increase the pressure from 2200 volts to 11,000 volts for the power transmission circuits, and to 8800 volts for use in connection with the 100 light circuits of series enclosed alternating arc lamps, 250 of which are at present distributed along the canal banks and at the locks, bridges and guard gates for lighting the Cornwall Canal. The power circuits distribute current for operating canal gates, swinging the bridges and controlling the weirs at the various points from Lock No. 15 to Lock No. 21, a distance of about 11 miles, step-down transformers being provided at the locks to reduce the line pressure from 11,000 volts to 550 volts, at which it is used in the induction motors. This work does not utilize the full capacity of one generator, but it is proposed to shortly install additional generator capacity so as to provide power for other enterprises which are now operating by steam, or which may later be attracted to the spot by moderate priced power delivered electrically in shape ready for utilization in various classes of industry.

The power house building is 40 ft. by 90 ft., built of brick above the line of cut stone arches over the tail-race, and has a steel frame which supports a 25-ton traveling crane running the whole length of the building, and is covered by a steel trussed roof of heavy plank

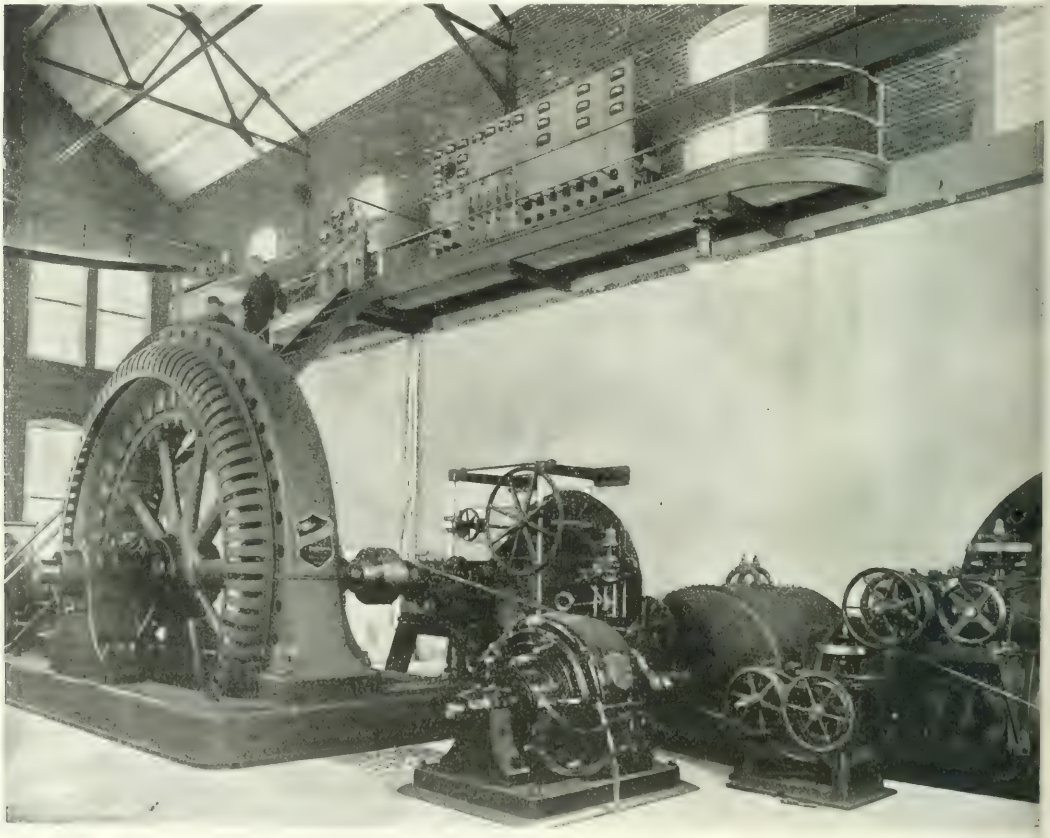


FIG. 1.—INTERIOR OF STATION.

the whole construction being practically fireproof. On the side of the power house next to the head-race is located a steel framed tower 13 ft. by 15 ft., with brick walls three stories in height, the lower story of which is occupied by the high-potential switchboard, and the next story by step-up transformers, while the top story is devoted to lightning arresters and the ends of the cables distributed onto arms which support the transmission lines so that they leave the tower from the two opposite sides to serve lines running in opposite direction from the power house.

The main floor of the power house is occupied by the generators, exciters and governors for the waterwheels, the bulkhead extending

about 8 ft. into the power house, the top of which at an elevation of about 19 ft. above the main floor, serves as a switchboard gallery, the width being increased about 4 ft. by brackets, over which the floor is extended. Communication between the gallery and main floor is obtained by means of an iron staircase at the center with brass railing, which also extends around the gallery to both ends of the power house where there are iron ladders on the face of the bulkhead, giving additional means of communication from the generating floor to the switchboard gallery.

The switchboard is of the Wagner type with illuminated dial dead-beat instruments for indicating the current in each phase on the generator panel, a voltmeter switch being provided so the single voltmeter indicates the voltage on any phase. Totaling wattmeters are also located on the generator panels, as well as static ground detector, synchronizing lamps and main switch of the oil type and double break knife switch for generator fields. A double-throw switch provides for lighting the station either from the exciter circuits or from a transformer on the generator circuit.

The exciter panel has a direct-current voltmeter and ammeters for each exciter with double-throw switch, so either exciter can be used on any generator or both can be run together to excite all the generators. The feeder panels have ammeters in each phase and oil switches for opening and closing the circuits, as well as expulsion fuse-blocks in each phase. One panel feeds the Milleroches power and lighting circuit at 2200 volts, another connects the 11,000-volt, step-up, air-cooled transformers in the tower with the 2200-volt bus-bars, while another connects the three 60-kw, 8800-volt arc lighting transformers to the bus-bars, space being left for five additional feeder panels.

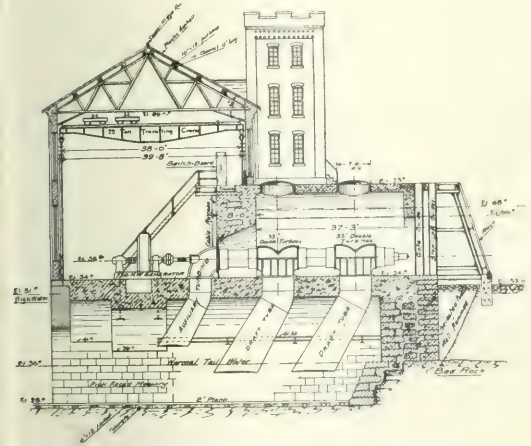


FIG. 2.—SECTION OF STATION.

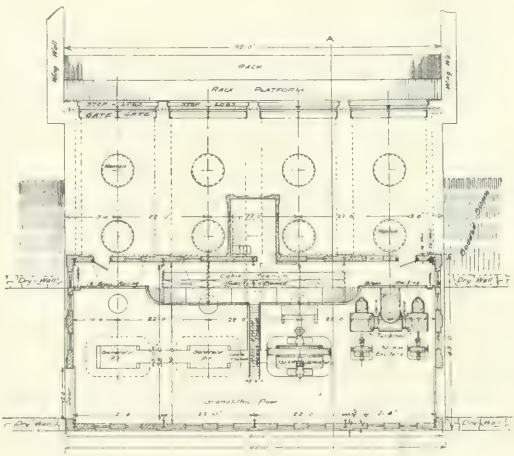


FIG. 3.—PLAN OF STATION.

The arc switchboard and regulators are located beyond the space left for additional generator panels at the left of the gallery—the circuits being controlled by plug switches, which are also used for making up connections to the transformers. Hot-wire ammeters are used to indicate the current in each circuit, and a static ground detector provided with plugs for each circuit. The arc regulators are finely finished with blue Vermont marble tops to match the switchboards and polished brass trimmings.

In the lower floor of the tower is located a high-tension plug switchboard with enclosed fuses for making up circuits on the 11,000-volt power lines and for connecting primaries of transformers to cables; but these switches will seldom, if ever, be used for opening circuits as the oil switches on the main switchboard will serve to open the circuit on the low-tension side at the bus-bars. It is expected later to install dummy panels in the main switchboard to operate electrically-controlled automatic overload switches built in brick compartments in the tower.

The load-covered cables connecting the dynamos and exciters with the switchboard are hung in brackets located in trenches left in the concrete, and ascend on the face of the bulkhead, where they are distributed from a central point in either direction through a trench back of the switchboard, which is covered with hardwood gratings oiled and shellacked. The cables are also supported in brackets and stanchions in regular order in this trench, which also conducts the cables from the switchboard into the space below the ground floor of the wire tower, up the sides of which the cables are supported on insulating brackets until they reach the top floor where the three wires in each cable are separated at the cable heads and connected to the outside lines on the arms inside near the ceiling of the top floor. Iron brackets outside of the tower near the top support two timbers, one above the other, into which the insulator pins are inserted, below which a platform outside the upper windows is located at a convenient height, making the wires accessible for connections, etc.

The line construction is plain and substantial. Shaved cedar poles are used with the exception of a few iron structures at the bridge piers and locks. All poles are exceptionally straight and stocky, and are located 100 ft. apart on the canal banks, each pole being located and lined by the Government engineers. All poles on curves are guyed with galvanized signal strand, and where guy stubs are not used two globe strain insulators are used to insulate the guys anchored in the ground. All the poles are painted, and lamp poles are stepped and pipe brackets 2½ ft. long support the lamps, which are hung on Cutter porcelain insulating hangers, in addition to the loop and porcelain insulator on the lamp. Six-pin arms are used on the line with pins 16 inches on centers and braced with steel braces. Double arms are used on all sharp turns bolted through the poles and at the ends. The upper cross-arm carries the two three-phase 11,000-volt lines, and the arm below carries the arc circuits except near the two ends of the line, where one-half of the arm is used for three-phase and the other for arc circuits. No. 6 medium hard-drawn bare copper wire is used for both arc circuits and power feeders, supported on 4½-inch triple petticoat glass insulators.

The total line drop is about 5 per cent, and in some cases less, but on account of mechanical strength it was not deemed advisable to reduce the size of the copper. A line of barbed wire is stretched the whole length of the line on insulators on the pole tops and grounded at every fourth pole as a protection from lightning, though lightning arresters are provided at the power house and at the cable crossings. The high-potential lines cross the canal in paper-insulated lead-covered and armored cables and provision is made for tying the lines together at various points so that in case of breakdown the lines can be connected so as to work around the point in trouble.

At each lock little sub-stations or cabins are located to contain the transformer fuse boards and switchboards for controlling the motors for operating the gates, etc. These cabins also serve to cover the joint in the cables, which passing through the floor go underground to the masonry walls of the locks, then through the course below the coping stone and down the spare stop log checks at the head of the lock, crossing on the bottom out of danger of injury, as they are below the level of the top of the breast wall and covered with a 10 by 12-inch timber, thence up the other side in the check in the masonry to

the same level as the starting point, then through the wall and earth into another switchboard cabin on the island between the two locks. The motors on each side of the two locks and at the weirs are controlled from separate switchboards though the cabins between the two locks, side by side, contain switches for motors operating one side of each lock.

The three-phase high-potential is reduced in a bank of three transformers from 11,000 to 550 volts, and only the lower voltage distributed about each group of locks, except for series arc lighting which crosses back and forth for each lock and bridge pier.

Near the easterly end of the line a spare cable is laid across in a trench dug in the mud bottom of the canal to connect the circuits on the north bank to the south bank in case of trouble in either line.

The horizontal waterwheels for this plant were furnished by the William Hamilton Manufacturing Company, Limited, of Peterboro, Ont., and operate under a working head of 30 ft. They are arranged in two pairs with a fifth wheel used only in case of high back water, the draft tubes of which pass through the concrete arches below the floor of the power house and empty into what was formerly the river bed of the St. Lawrence, a dam having been built just above the power house by the Government for the purpose of widening the canal, which cut off the channel between the Canadian shore and Sheiks Island, leaving a large lake on the up-stream side of the power house, so that with the still water in this lake troubles from ice, which are such frequent evils in connection with most Canadian power plants, will be entirely overcome.

The Cornwall Canal is part of the deep waterway system of the St. Lawrence connecting the great lakes with ocean navigation at Montreal, and has locks capable of handling vessels 250 ft. long, 30 ft. wide and drawing 14 ft. of water.

The head race for the power house is cut from the broad channel leading to the canal waste weir, and is paved with stone on a slope of 2 to 1 to protect the banks. A steel frame supports the fine racks, back of which are located the head gates operated by heavy gearing which admit of cutting off the water from any of the four-wheel chambers to admit of inspection or repairs of any of the wheels. Valves are provided for drawing off the water after the gates are closed as well as valves for refilling. The register gates on the wheels are operated by rods passing through the plates in the bulkhead where they are attached to the Lombard governors for regulating the speed.

The power plant for this interesting installation was built by the Bullock Electric Manufacturing Company, of Cincinnati, and we are indebted to Mr. R. T. Lozier and Mr. F. H. Leonard, E. E., of that concern for the above data. The transformer plant was furnished by the Wagner Electric Manufacturing Company, of St. Louis, Mo., and the arc lights, etc., were made by the General Incandescent Arc Light Company, of New York. The entire plant was designed from the drawings of Mr. M. P. Davis by T. Pringle & Sons, Montreal.

French Engineering Studies in America.

At Pittsburg recently, M. Lazare Weiller and M. Maurice de Lagotellerie, in an interview, said they would recommend to the French Government that a school for educating French engineers be located in Pittsburg, and a school for political science be located in New York. The French visitors were selected by their government to carry out the ideas of M. Millerand to have French students educated in the United States. With Vicomte de Faramond, French Naval Attache at Washington, they spent several days with H. C. Frick. M. Weiller said that George Westinghouse, Jr., and H. C. Frick would be patrons of the Pittsburg school. He outlined the plan as follows:

"M. Millerand and other Frenchmen were much interested in the many Americans who came to Paris to study art and music. Knowing that the United States had forged ahead in the mechanical arts and political science, and desiring to perpetuate the Republican form of government in France, the idea presented itself of studying American institutions on the ground, as American art students do in France. Hence the Government will select the brightest students at the various academies, and will pay their expenses, allowing them a reasonable amount of spending money while here.

"They will take courses of from three to five years. For this they are expected to devote so many years to the service of the Government. Many wealthy and influential Americans will be patrons of the schools, among those in New York whom I have talked to on the project being J. Pierpont Morgan and Charles M. Schwab, who will aid the work. I have no doubt our recommendations will be carried out by the Government."

The Economic Design and Management of Telephone Exchanges—VIII.

By ARTHUR V. ABBOTT, C. E.

UNDER certain distributions of stations, the location of the telephonic center will become partially indeterminate, or rather a number of sites may be found from any or all of which the mileage will be equal. Such a condition exists when there are no subscribers in the immediate vicinity of the center of the district. To illustrate, turn to Fig. 7. Here are 26 stations so distributed as to fall in 4 groups with no stations near the center of the territory. Evidently the condition of placing one-half the stations on each side of each axis is fulfilled by drawing the axis of y anywhere between y y

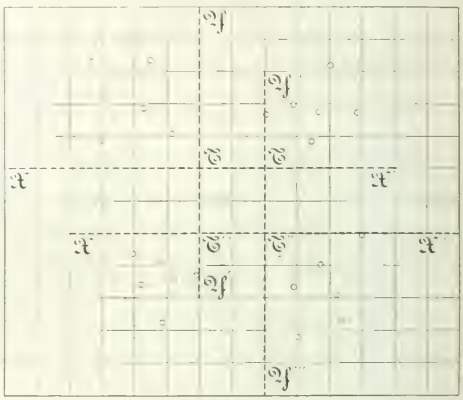


FIG. 7.—DETERMINATION OF TELEPHONIC CENTER.

and y'' y''', and the axis of x anywhere between x x and x'' x''', and any location of the telephonic center within the rectangle T T' T'' T''' is equally good. To provide this, suppose the line y y' to start from the position y y' and move toward y'' y'''. As there are 13 stations on each side of the line, every unit that the line moves to the right will add one unit to each of the lines to the stations on the left, and will

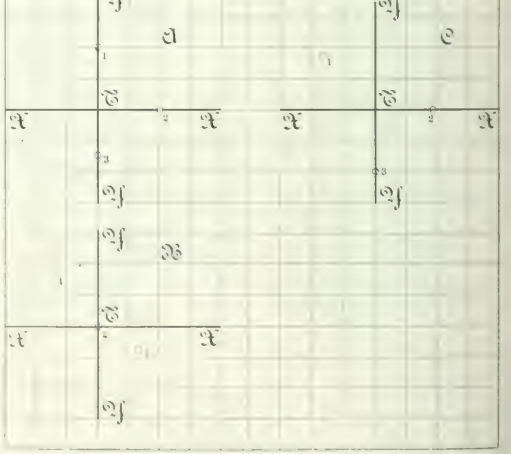


FIG. 8.—DETERMINATION OF TELEPHONIC CENTER.

subtract one unit from each of the lines to the stations on the right, as the number of stations is equal, equal amounts of mileage are added and subtracted, and the sum remains constant. Suppose, however, the moving axis in passage to the right *crosses* a station, *then* in the next unit that it moves, 14 mileage units will be *added*, and 12 units will be subtracted, hence there will be a net increase of two

nits. The same reasoning may be applied to the x axis. Hence the rinciple is established that there will be *no* change in mileage unless he moving axis *crosses* one or more stations. Thus if there are n tations in any territory, there will be $\frac{n}{2}$ stations on each side of each xis. Suppose a be the length of the average perpendicular distance rom the axis to the n stations, then the sum of the total perpendicular distances to the axis will be $\frac{a\,(n)}{2}$ $\frac{a\,(n}{2}$. Now, suppose the

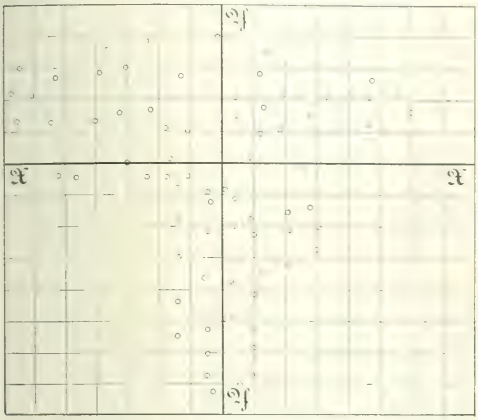


FIG. 9.—DETERMINATION OF TELEPHONIC CENTER.

is to move and cross m stations, then there will be $\frac{n}{2} + m$ stations one side of it, and $\frac{n}{2} - m$ on the other side. The mileage in this se will be $a\left(\frac{n}{2} + m\right) + a\left(\frac{n}{2} \quad m\right)$. Subtracting this latter antity from the first, it is seen that the resulting mileage is greater 2 *am* than the former.

In Fig. 8 three examples are given of types of special cases that at st sight might seem to be exceptions to the rules as stated. At *a* ere are three stations, or groups of stations. If $x\ x$ be drawn to

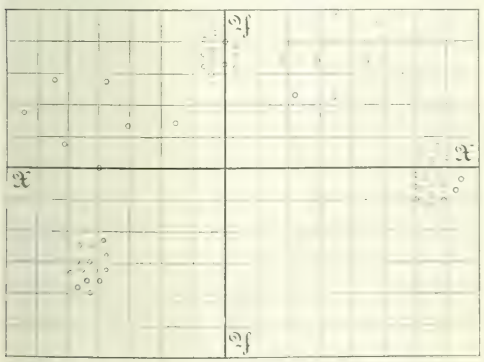


FIG. 10.—DETERMINATION OF TELEPHONIC CENTER.

ce an equal number of stations on either side of it, it will pass ough station 2, and if $y\ y$ be drawn perpendicularly to $x\ x$ and so ced as to give as nearly as possible an equal number of stations each side of it, it will intersect 1 and 3. In this case the axes cut three groups of stations. The total mileage is $T1 + T2\,T3$, it is self-evident that if either axis be moved in either direction, s quantity will be increased. Turning to *B*, where the stations 1, nd 3 represent three isolated bunches of stations nearly in line h each other, if $x\ x$ and $y\ y$ be drawn to place equal numbers of tions on each side of them, and parallel with the section paper s they will intersect at 2, leaving 1 and 3 in diagonally opposite quadrants. Here T is at the telephonic center, and it is quite clear that any change in location thereof will augment mileage. In the distribution shown at *C*, if $x\ x$ be drawn to place an equal number of stations on each side of it, it will cut 2, and $y\ y$ under the same conditions will intersect 3, leaving 1 in the upper left-hand quadrant.

IV. TYPES OF SUBSCRIBERS' DISTRIBUTION.

At first sight it might be supposed that the distribution of subscribers would be radically unlike in different towns or cities, but examination shows that the majority of cases, to say the least, will fall under six distinct and specific types of distribution. These six types may be denominated as follows:

1. *The Symmetrical System.*—In this type of distribution, the subscribers are spread over a territory approximately circular in contour, the greatest station density per unit of area being at the geometrical center of the district, and decreasing regularly radially in all directions. This is the simplest and probably the distribution most frequently met with, and is illustrated in Fig. 5. Examples of this type of distribution are so numerous that particular citation is superfluous, almost every small town or village affording an instance.

2. *The Isolated Group System.*—In this type there are two or more irregular groups of stations separated by territory telephonically sparsely populated. The station density is usually greatest at the center of each group, decreasing approximately radially toward the circumference of each. The usual form of this type of distribution is illustrated in Fig. 6, where there are four groups of stations, each entirely distinct from each other. The isolated group type of distribution is of very frequent occurrence. It is always met with where some natural obstacle, such as a river, dividing a town into two or more parts, and is usual where a city is made by the absorption of several small towns. The upper part of New York City and the environs of Boston and Philadelphia are good examples. In Fig. 10, an extreme case of the isolated group type is given, such as would be presented by the establishment of an exchange to serve three small towns, or a group of large factories. The rule for selecting the telephonic center is perfectly applicable, and even though it indicates a spot that is apparently a telephonic desert, a little consideration shows that neither axis can be moved without increasing the total mileage. The next most common type is the *Cruciform System*, shown in Fig. 9. This distribution is always found where there are two principal streets at right angles to each other, a very common urban feature. In this case the axes are almost certain to lie either on or very close to the chief thoroughfares, and the telephonic center may, with reasonable certainty, be located at the intersection of these streets without undertaking the task of map making or station plotting. The city of Chicago is an example of this type. In Fig. 11 the *Comet System* is exemplified. This type is of importance, as it is found in some of the largest cities, such as New York and Boston, though

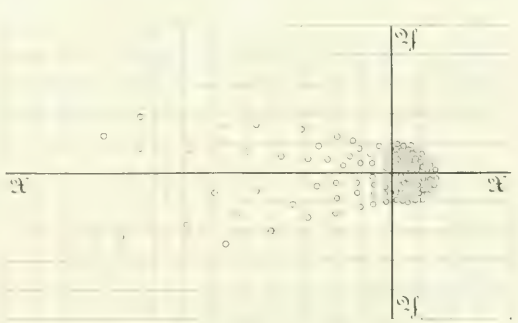


FIG. 11.—DETERMINATION OF TELEPHONIC CENTER.

it is of less frequent occurrence than those previously mentioned. It is usually the result of geographical conditions, such as the building of a city on a peninsula, that forces all business interests into a small space at the apex of the peninsula, but allows residences to distribute themselves over the adjacent country. The territory is more or less fan shaped, or wedge-shaped, with a group of stations of great density located at the small end of wedge; the density being maintained clear to the boundary lines, while toward the thick end, the station density very rapidly falls away, though the demand for telephones may extend many miles into the country.

The Crescent System is shown in Fig. 12, and in it, as its name in-

dicates, the stations are arranged roughly in a lune-shaped figure, the density being usually greatest along a line through the center of the crescent. This is really a modification of the cruciform system. It is found in the lake and river cities, such as Cleveland, Milwaukee, Cincinnati, New Orleans, etc. Lastly, in Fig. 13, the *Linear System* is shown. Here the stations are scattered over a rectangular area much larger than it is wide, with the greatest density approximately at the center of figure. This type is of quite rare occurrence.

In the selection of the central office site it is impossible to give too much care and consideration to station distribution. If a telephone plant is in existence, its directory may be obtained and the subscribers plotted by dots on a large scale map. Such a representation gives a

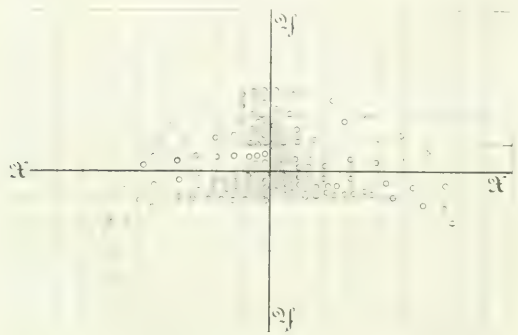


FIG. 12.—DETERMINATION OF TELEPHONIC CENTER.

good idea of the arrangement of existing telephonic population, but the telephone engineer, more than any other mortal, lives in the future, and in order to make a successful design a reasonably accurate forecast both of the number and location of subscribers for a decade or more in advance must be made. To this end it is well to obtain the opinions of a large number of the oldest and most experienced residents, as to the probable growth both in amount and direction of the various kinds of business represented. For, in all towns, trades are clannish, and sooner or later districts spring up, and leather, law, dry goods, brokers, etc., segregate away from each other, each forming little communities by themselves, and the opinion of conservative representatives of each class as to its probable future furnishes the only basis on which a telephonic prediction can be made. It is particularly necessary to consider the effect of transit facilities, such as railways, freight stations, elevated and electric roads, etc., on the probable relation of the business and residence districts, and in this

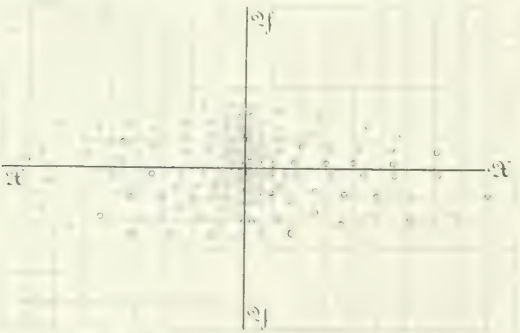


FIG. 13.—DETERMINATION OF TELEPHONIC CENTER.

connection the steadying or anchoring effects of the modern office building is particularly noticeable. After the widest and most thorough canvass yielding the most complete obtainable information as to the expected future trend of the city under consideration is obtained, an estimate of probable subscribers may be made. The tendency is always to make such an estimate too low, because, for many reasons, telephonic business is growing faster than even its most sanguine promoters expect, so a liberal allowance should be made for future growth. Then, this estimated distribution should be plotted on a large scale map, from which the telephonic center may be located. In addition, it is most useful and instructive to construct a relief model of density and distribution. This is done by cutting out a board to scale, say, four inches equal one mile, representing the area under consideration. A number of strips of wood one-half an inch square, thus representing an area of 1-64 of a square mile, are prepared, and these strips cut of various lengths to represent the number of stations on each of the areas they represent. For example, suppose in the least dense portion 10 stations are estimated per block and in the densest portion 500 per block. Let the vertical scale be 100 subscribers per inch, then a piece of strip 1-10 of an inch thick will represent areas of minimum density, and a piece 5 inches will stand for the spots of greatest density. By thus cutting a piece of wood for each city block of such a length as to represent the expected number of subscribers on that block, and fastening it on the board in its proper place, a relief map of density and distribution is obtained that conveys the most vivid possible idea of the expected telephonic population.

The Debt of Electrical Engineering to C. E. L. Brown—XI.

By B. A. Behrend.

(*Concluded.*)

TRANSFORMERS.

WE have already called attention to some transformers designed ten years ago by Mr. Brown. We now give in Fig. 70 a photograph of a modern oil filled, water-cooled transformer, and in Fig. 71 we give a drawing of it. This transformer is

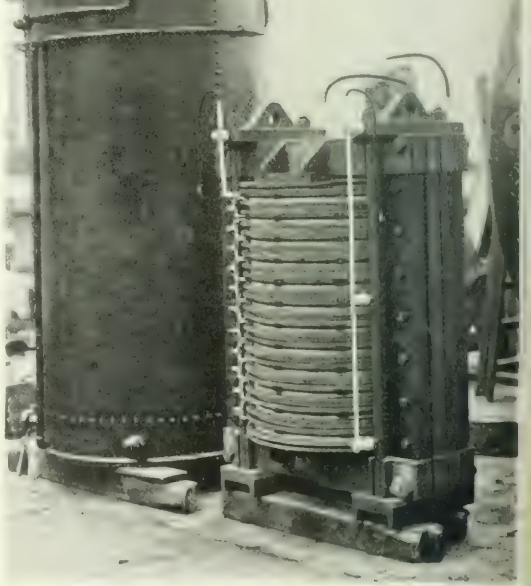


FIG. 70.—250 KW. SINGLE PHASE TRANSFORMER.

for an output of 250 kw at 40 cycles. The losses at full load are:

	Watts.
Core loss	3385
Copper loss primary	1263
Copper loss secondary	1322
Total	5970

The efficiency at full load is, therefore, 97.6 per cent. The weigh of the complete transformer with oil is 11,700 lbs., the oil weighin

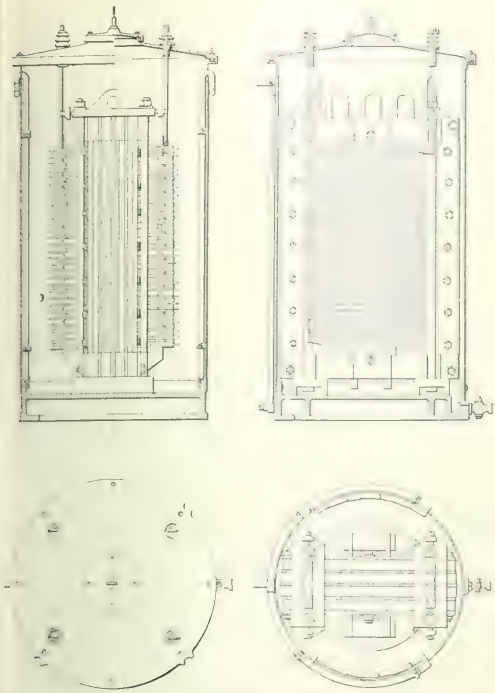


FIG. 71.—250-KW SINGLE-PHASE TRANSFORMER

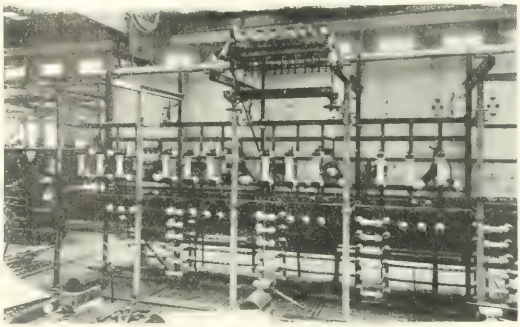


FIG. 76.—PADERNO SWITCHBOARD

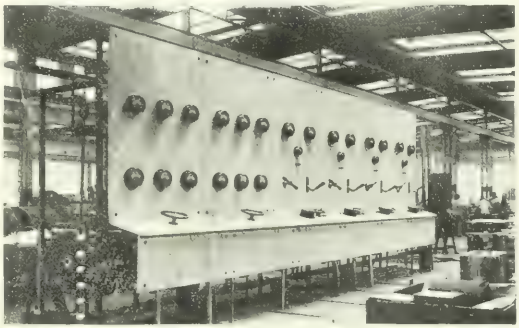


FIG. 77.—PADERNO SWITCHBOARD

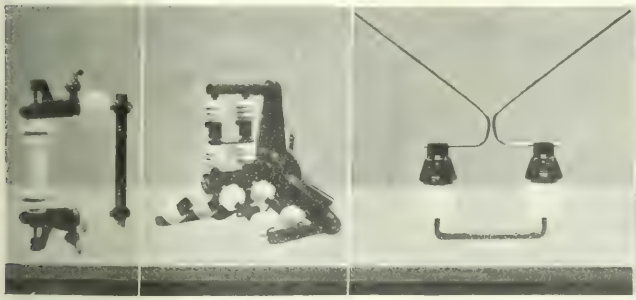


FIG. 72.—HIGH-TENSION FUSE. FIG. 73.—DOUBLE-BREAK SWITCH. FIG. 74.—LIGHTNING ARRESTER

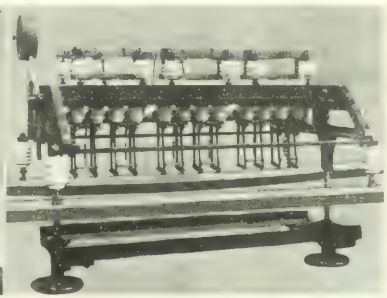


FIG. 75.—OIL SWITCH



FIG. 78.—WORKS IN BADEN, SWITZERLAND

1800 lbs. To increase the radiating surfaces of the transformer cases, Mr. Brown introduced ribs, and early in 1891 he proposed for Lyons the cooling of large oil-filled transformers by means of water circulation.

SWITCHES AND SWITCHBOARDS.

Switches, fuses and switchboards for high-tension work had to be developed, and Mr. Brown's fertility in designing shows itself here to good advantage. Fig. 72 shows an enclosed high-tension fuse used as disconnector. Fig. 73 shows a three-phase double-break switch. Fig. 74 shows the horn lightning arrester, which goes by the name of Siemens lightning arrester, though used by Brown almost two years before the Siemens patent was applied for. Fig. 75 shows the large Paderno oil switch. The arc is broken under oil by the small switches, with exchangeable blades, and after it is broken the main switch is opened. Figs. 76 and 77 show the Paderno switch-board, with the iron framework mounted on insulators. The main switch is clearly visible.

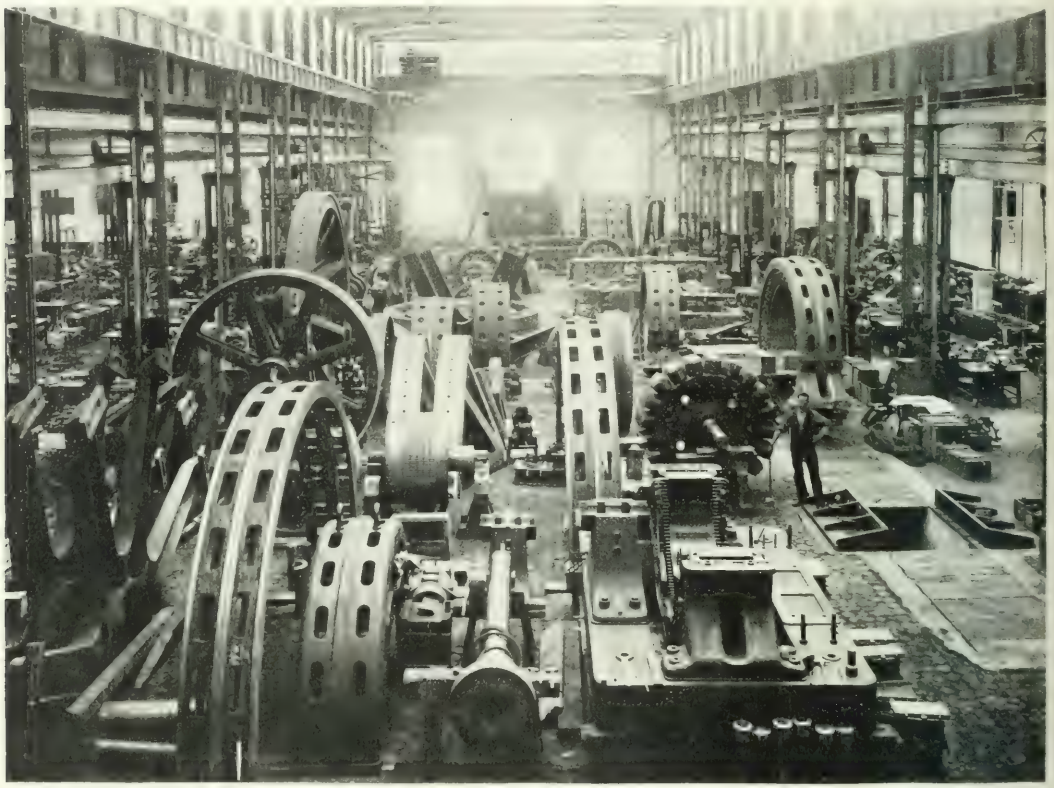


FIG. 70.—INTERIOR OF ONE OF THE SHOPS IN BADEN.

CONCLUSION.

We have more or less briefly outlined the work of C. E. L. Brown and its influence on electrical engineering. From a small beginning a huge industry has arisen that has entirely transformed the aspect of the mechanical industries, and among the pioneers in this field the name of Brown runs as little risk of oblivion as those of Siemens and Westinghouse, of Gramme and of Hopkinson. He gave a great stimulus to electrical engineering, and his work has found the recognition which it deserves. In Switzerland he has created a powerful industry, and his own works are among the largest and best in Europe. In fact, for an electrical engineer of any nationality, one of the most interesting parts of a trip to Switzerland is that which includes his visit to the splendid shops which dominate the beautiful landscape at Baden and which illustrate so admirably the genius of the little Republic in all that relates to modern engineering.

The Foreign Commerce of the United States.

The Department of State has just issued an interesting summary of American foreign commerce by Mr. Frederic Emory, chief of the Bureau of Foreign Commerce. The commercial reports of our diplomatic and consular officers for last year record continued growth in the sales of many lines of manufactures from the United States in foreign markets and an increase of the general concern felt throughout Europe as to the possible results of our industrial competition. Although the figures for our exports compiled by the Treasury Department show a considerable falling off in the total value of manufactured goods sent abroad, it is said that there seems to be a steady and uninterrupted spread in the popularity of what may be termed American "novelties" all over Europe. By the word "novelties" is meant not only labor-saving implements and machinery, but a great variety of articles of merchandise, all of which possess distinguishing points of excellence and relative cheapness, which commend them to purchasers in Europe in preference to similar articles of home manufacture. In other words, while the aggregate of our exports of manufactured goods has shrunk in value, the variety of our sales in Europe is being extended and the territory upon which they are encroaching is being steadily enlarged.

The falling off in American exports is attributed, not to the goods being in less favor, but rather to business depression in Europe, which has limited the purchasing power. The elimination of Hawaii and Porto Rico from the list of countries to which we export is also a factor. The Treasury figures show that during the calendar year there was a falling off of $12,565,194, compared with the previous year, manufactures having fallen off $46,262,912, offset by a gain in agricultural exports of $35,591,077. It does not seem, however, that there is any decline in quantities.

Mr. Emory says it is evident that the American invasion of Europe

has ceased for the time being to be of that sweeping character that distinguished it at first as an economic phenomenon. He recalls what was said in the review a year ago of the chance of more strenuous European competition, the use of new processes and our own models of machinery, but he says that Europe has not made any sensible progress in that direction. As to restrictive legislation, pending measures in Europe might be abandoned, according to the review, if the United States modified its tariff policy and permitted more imports from Europe. As factors making in our favor, the review points to alleged obstruction by British labor, which increases our trade opportunities, to the combination of labor and capital here, as shown at the recent conference of employers and employes in New York, and to the fact that our competitive energy is so far but partly developed. On the whole, Mr. Emory finds that the United States has hardly more than entered upon a novitiate in fitting itself for international competition, and he notes with encouragement the growth of popular interest in the value of foreign trade and our well-directed efforts for expansion.

Mr. Emory says: The relation of the economic forces of the United States to those of Europe may be taken as the surest index to the probable future of our trade with the rest of the world; for it must be evident that, if we can continue to compete with European industries in their home markets, we shall have but little to fear from their rivalry in the neutral or undeveloped markets, where we would meet them on an equal footing. Even in Canada, notwithstanding a preferential tariff of 33 1-3 per cent in favor of British imports, we continue, says Consul-General Bittinger, of Montreal, to enjoy "more of Canadian custom than the rest of the world put together," and many classes of goods which some years ago were bought in Great Britain are now more cheaply and more conveniently purchased in the United States. Last year, our sales to Canada amounted to more than $110,000,000, while those of Great Britain were only about $43,000,000. In Mexico, Consul-General Barlow reports the purchases from the United States show a large increase—over $4,000,000, or 11.8 per cent—while those from every other country exporting largely to Mexico, except Germany, show a large decrease. The German gain was only about $411,000, or 5.8 per cent. In the reports from Central America and South America, there are gratifying indications of substantial growth in the sales of our goods, and we are steadily widening the variety of our exports to Africa, Asia, Australasia—in other words, to every part of the world.

Manufacture of Soluble Barium Compounds in the Electric Furnace.

Mr. Charles B. Jacobs read a paper Feb. 21 before the Society of Chemical Industry, in which he described the manufacture of soluble barium compounds from barytes in the electric furnace. The electrical process is based upon a discovery which brought to light a new chemical reaction, which takes place beyond the range of temperature attainable in combustion furnaces. The furnace charge is made up of a mixture of ground barytes and coke in the proportions of four molecular equivalents of barium sulphate to four molecular equivalents of carbon. When this mixture is heated there is an immediate reaction between the carbon and the barium sulphate, in which one part in every four of the latter is reduced to barium sulphide and a mixture is produced containing approximately three molecular equivalents of barium sulphate and one molecular equivalent of barium sulphide. Under the high temperature of the electric furnace these react such that not more than 2 or 3 per cent of unconverted sulphate is left in the charge, the other product being barium hydrate and a small amount of sulphide.

The furnaces used in the process are a new type of continuous electric furnaces of the tapping variety. They are tapped periodically as in the case of iron blast furnaces, and have a maximum power consumption of 500 kw and a maximum output of 8 tons of furnace product every 24 hours. The product tapped from the furnace is dissolved in hot water, and the insoluble impurities filtered off, these latter consisting of a saturated solution of barium hydrate containing a small amount of barium sulphydrate. The barium hydrate is crystalled out by cooling, and the sulphydrate remaining is carbonated or converted into some of the acid salts of barium. The barium hydrate crystals are freed from the last traces of sulphydrate liquor by washing with a spray of cold water, and after drying are melted and the fused mass poured into thin iron drums, where it solidifies on cooling into a solid shape of crystallized hydrate weighing about 500 lbs. and containing less than 1 per cent of impurities.

The largest consumption of barium hydrate is in the sugar industry for the recovery of sugar remaining uncrystallized in the molasses, replacing lime for this purpose, owing to its much greater efficiency and the low price at which the hydrate can be produced by the present process. It is also applicable to the treatment of the residue of plantation sugar houses and certain low grades of molasses which, while rich in sucrose, cannot otherwise be crystallized, and are unfit for domestic use. Another use is in the purification of water for steam boilers, replacing sodium for this purpose, as it precipitates the scale-forming impurities and does not, as in the case of lyes, induce priming. Another use is in tanning. Hides immersed in dilute solution of hydrate show that the hair is loosened at the roots so that the hides can be worked in from three to five hours after being put into the vats, and longer immersion does not appear to injure them.

One of the important fields for cheap barium hydrate is in the manufacture of pigments. Its strong affinity for the sulphuric acid of soluble sulphates, and the fact that it interchanges its hydroxyl, precipitating in many cases insoluble hydrates simultaneously with barium sulphate in intimate molecular mixture, makes it especially adapted for these purposes. A permanent white pigment may thus be produced which combines the valuable covering properties of white lead and the staple white color of zinc white.

The paper states that so rapidly has the demand for barium hydrate increased, that after less than a year's commercial operation it has been found necessary to increase the capacity of the plant to a basis of 60 tons of hydrate per day. This demand has been such that no attention has been given to the great capabilities of the present electrical process for the economical production of other compounds of barium.

Kettle River Power Development.

The development of 3000 hp on the Kettle River, at Cascade, British Columbia, about 15 miles east of Grand Forks, will soon be an accomplished fact. The work has been in progress for nearly two years. Electrical power will be conveyed by wire to the various mining camps, thus reducing the cost of mining development. Several of the smelters are also figuring on utilizing the same energy. Next spring will see the plant in full operation. The Cascade power is controlled by the London & British Columbia Gold Fields Company, of London, England, and the late J. Roderick Murray, who was killed in the Murray Hill Hotel, New York, by the recent dynamite explosion, was general manager, with headquarters at Nelson, B. C.

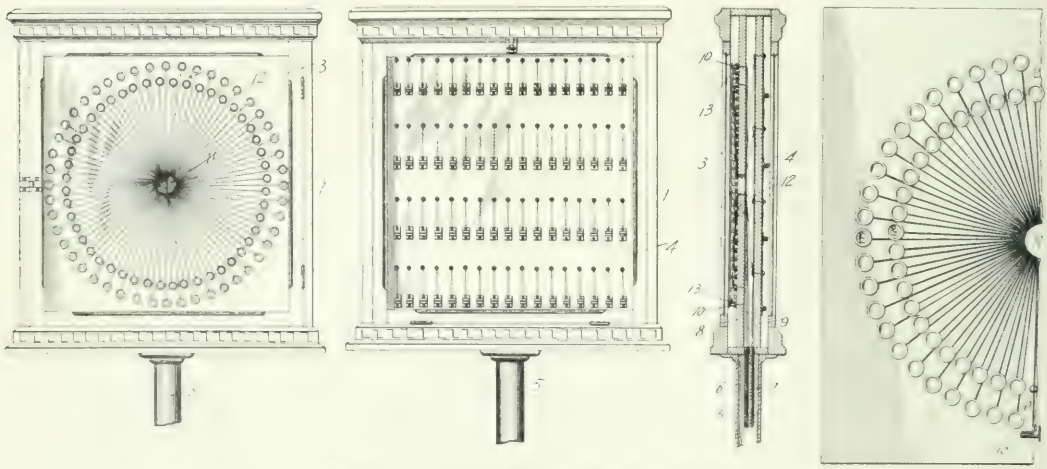
At Cascade, the Kettle River rushes through a rocky gorge for a distance of half a mile, and has a natural fall of 121 ft. A dam, 400 ft. long and 50 ft. high, has been constructed at the head of this gorge, which raises the water 36 ft. above the natural level, thus giving a working head of 156 ft. at low water. The dam, which is 40 ft. thick at the base and 24 ft. thick at the top, is constructed of timber crib work filled with rock. About 1000 yards of rock are required to fill the crib. The dam is on a solid rock bed throughout, and the foundation timbers are solidly bolted to the rock. The permanent water level will be 10 ft. below the top of this dam. Provision has been made to control the water level, during the periods of high water, by a series of sluiceways, 12 in number, which can be opened to a depth of 12 ft. below the normal level, giving an area of about 2000 sq. ft. of waterway through which to pass the flood water. These sluiceways are closed at low water by means of stop logs, 12 inches square, dropped one on top of the other, in a groove provided for their reception, thus maintaining the same head at all stages of water.

From the dam the water is to be conveyed to the power house, first by an open cut 225 ft. long, thence through a tunnel in the solid rock a distance of 410 ft., the tunnel being 12 by 14 ft., thence by an open cut in the rocks for a distance of 500 ft. From this point, where a concrete bulkhead will be built, the water will be conveyed through a circular flume, 12 ft. in diameter, to the power house. The power house is nearing completion. It is a fireproof structure of stone and brick, and is situated at the foot of the falls, 2000 ft. from the dam. Electrical machinery of the most approved pattern, together with six turbine wheels of the horizontal type, is now being manufactured especially for this plant. At the outset, the horse-power developed will be 3000, but later it is expected that a maximum of 9000 hp will be reached. A right of way has been cleared from Cascade to Phœnix, via Grand Forks, a distance of 21 miles. Two separate duplicate lines are being constructed. Poles have been erected, and a heavy copper wire will be strung for the transmission of power.

New Telephone Patents.

The issue of Feb. 18 is a maiden issue as regards telephone patents proper, telephony being represented only by a patent granted to Mr. A. Bishop Chance, of Centralia, Miss., on a transfer board for telephone and telegraph circuits. Mr. Chance says that "in the ordinary transfer board the transfer of any one wire from one connection to another is made of bridging over from one connection to another with a piece of wire. The object of the present invention is to obviate this crude and objectionable practice and to provide means whereby the transfer from one connection to another may be easily and speedily effected."

The means provided by Mr. Chance are a spring-jack or socket as the terminal of one wire and a plug as the terminal of the other. Where wires are handled on a small scale this is all right enough, but what there is crude or objectionable in the modern telephone distributing board with its soldered cross-connecting wires it is difficult to see. It is the general practice to solder distributing and cross-connecting wire connections wherever possible and a soldered connection would seem to be less crude and objectionable than a plug and socket connection. Moreover, the transfer board designed by Mr. Chance is not adapted to handle large numbers of wires, and would be relatively expensive. Further, it is difficult to see where the patentability of the device comes in. In general design it is an exact copy of the old French *rosace*, and plug and jack connections for changing circuits are used in every large telegraph office in the country. The drawings illustrate the invention quite clearly, Fig. 1 being a front view, Fig. 2 a back view, showing the fuse-board, Fig. 3 a cross-section, showing the two cables 6 and 7 to be cross connected, and Fig. 4 an enlargement of part of Fig. 1. The line wires are attached to the jacks or sockets 10 set into the face of the board 8, and the transfer wires 12, extending from the fuse-borad terminate in spring plugs or pins 13 for engagement in sockets 10. Each jack and plug is suitably numbered or lettered, and by putting any plug in any jack any two wires may be connected. As all the free wires 12 radiate from a common center changes may be made easily and neatly.



FIGS. 1, 2, 3 AND 4.—CHANCE'S TRANSFER BOARD.

Electricity for Main Swiss Railways.

Mr. Henry H. Morgan, United States Consul at Aaron, Switzerland, writes to the State Department as follows: Some days ago the representatives of the five largest electrical engineering companies of Switzerland held a meeting at Olten, at which the question of replacing steam with electrical power on the Swiss railway system was discussed. The representatives of a firm which makes a specialty of the construction of turbines (having lately received a large order to provide turbines for Niagara Falls) proved by scientific demonstration that the power which could be derived from Swiss waterfalls would be sufficient to provide enough electrical force for the entire railway system of the country.

It was decided to follow the example of Germany and constitute a society, composed of all the companies interested, which will furnish the funds necessary to investigate the subject.

The *Aargauische Nachrichten*, commenting on the project, says: The Swiss Government, which will, within a few years, be the owner of all the great Swiss railway lines, is aware of the importance of the plan, and competent officials have expressed the opinion that the authorities will not fail to largely subsidize the intended experiments. The question of rendering Switzerland more and more independent of foreign coal by transforming her water-power into electricity is of vital importance for the country.

The turbine firm referred to by Mr. Morgan is Escher, Wyss & Co., of Zurich. Among the electrical concerns are Brown, Boveri & Co. and the Oerlikon Works.

The Gilbert Club "De Magnete."

With regard to our recent announcement of the completion of the Gilbert Club's translation of Dr. W. Gilbert's "On the Magnet" ("De Magnete"), we have now heard further from Professor S. P. Thompson in regard to this interesting subject. He says: "The actual cost of simple printing, binding and postage exceeds £1 per copy; and if we include the cost of circulars and incidental expenses of the formation of the club, it runs to over £1.2 per copy. To keep faith with our original subscribers and members, we had to issue the book in half holland bindings at £1.1.6, so that there is an actual loss on each copy. The rather more expensive copies bound in limp vellum have cost us about £1.10.6 to £1.12 each, and as we supply these to subscribers who prefer that style at £1.12.6, that is also practically at cost price. The few remaining copies will be sold to non-members of the Gilbert Club at £2 for half holland copies and £2.10 for vellum copies (i. e., $10 and $12.50)."

It will be seen from the above that copies for American purchasers will cost a little more than our first estimate. As soon as possible we shall announce the exact cost, laid down in this country, and meantime would request that any of our readers who desire to secure spare copies enter their names at once, as it is evident very few will be available. The original subscribers and members of the Gilbert Club in this country were Dr. Park Benjamin, Professor Alex Graham Bell, C. L. Clarke, R. N. Dyer, T. A. Edison, T. D. Lockwood, T. C. Martin, Professor A. M. Mayer (deceased), Dr. H. Morton, Dr. M. F O'Reilly (Brother Potomian), F. L. Pope (deceased), A. L. Rotch, Profesor Elihu Thomson, Nikola Tesla, Joseph Wetzler, Dr. H. C. Bolton.

An Ohio Telephone Association.

Representatives of the various independent telephone companies of Preble, Darke, and Montgomery counties, Ohio, met at Lewisburg, Ohio, Feb. 12, for the purpose of forming an association for mutual benefit. The chief object of the organization is for the establishment of a uniform schedule of tolls and to bring about closer relations between the various companies. The organization was perfected by the election of Colonel Rush, of Greenville, president; D. E. Horn, Lewisburg, vice-president, and C. E. Brooke, Jr., of Eaton, treasurer. A committee composed of Judge Elam Fisher, of Eaton; J. S. Stewart, of Gratis, and Fred Emerick, of West Milton, was appointed to outline a plan for the regulation of tolls. The committee is to report at a later meeting to be held in Greenville. The members of the association are the Eaton Telephone Company, the Southern Ohio Telephone Company, the Greenville Telephone Company, the Camden Telephone Company, the Winchester Telephone Company, the Lewisburg Telephone Company, the West Union Telephone Company, the West Milton Telephone Company, the Phillipsburg Telephone Company, the Brookville Telephone Company, the West Manchester Telephone Company, the Gratis Telephone Company and the Arcanum Telephone Company.

A Society Badge.

The New York Electrical Society, in order to fittingly celebrate its coming of age, is adopting a badge this year, and is now struggling with the problem. Two or three good designs have been worked up and submitted. The triangular ones, though good, are hackneyed, and have, moreover, the objection that the corners always catch in the material to which they are pinned. One design shown at the meeting on Feb. 13 became popular at once, and received twice as many votes as the triangular type. It is circular in form, like a compass, and has the initials of the Society arranged to the four cardinal points, the Y answering for the W. The ground is dark green, but President Williams has suggested making this of amber, or in yellow tint, with red or dark blue letters and border, etc. It seems probable that this idea will be carried out.

Telephone Girls Must Tell.

Because the telephone girls in the Boston exchange refused to repeat messages they had heard over the wires, the Post Office Department is endeavoring to have passed a law imposing a penalty of $500 for any employe of a telephone or telegraph company who neglects or wilfully refuses to deliver any message to any person other than the one for whom it is intended. The same penalty is also to be imposed on any employe who fails to inform the authorities of any attempt to use the telephone or telegraph for unlawful purposes. Those responsible for this bill are Postmaster Hibbard, of Boston; Inspector Evans and Inspector Swift, of New York, who have had experience with the telephone companies recently in trying to locate "green goods" men and others, who have been using up-to-date methods in their businesses. A prominent firm of brokers lost bonds worth thousands of dollars recently by doing business over the telephone with an unknown person, and cases of this sort have been so frequent of late that the detectives are not very well disposed toward telephone girls in general. The bill is meeting with considerable opposition.

More Long Distance Transmission in Southern California

It would seem that the engineers and capitalists responsible for having made Southern California, in the neighborhood of Los Angeles, a past leader in long-distance high-voltage transmission work, are determined not to let that reputation get away from them. As noted before in these columns, the Edison Electric Company, of Los Angeles, which has transmission and distributing systems covering all the principal valleys south of the Sierra Madre Mountains for the 80 miles between Redlands and Los Angeles, is now developing a water power in the Kern River Cañon north of the Sierra Madre Mountains. As W. H. Workman, Jr., assistant to the president, modestly puts it: "The main line connecting the Kern River stations with the remainder of the system will not greatly exceed 130 miles."

Besides the Kern River additions to this immense network of high-tension lines contracts have been let for four 750-kw revolving field Bullock generators to go in Station No. 3 on Mill Creek to be run by waterwheels under 1900-ft. head, the highest yet employed in Southern California. This is but a few miles from the company's Santa Ana Cañon plant which now transmits to Los Angeles over an 83-mile line at 33,000 volts.

CURRENT NEWS AND NOTES.

CONFEDERATION OF AUTOMOBILE CLUBS.—The Automobile Club of America, the Philadelphia Automobile Club, the Long Island Automobile Club, the Rhode Island Automobile Club and the Chicago Automobile Club propose to organize a federation of such bodies, and have called a convention at the Chicago club's headquarters at the Coliseum, for March 3 and 4. The contemplated premises for organization are, briefly, that all regularly constituted and active automobile clubs of acceptable repute be eligible to membership on an equitable basis of representation in all deliberative matters within the purview of the Federation; conventions to be held annually in the East and West, alternately; an executive and other standing committees to be instituted. It is proposed that the executive body meet once each calendar month; the practical objects which it is believed may be attained by any club corporation are: Enactments of liberal laws regulating the use of automobiles on public highways; protection of the legal rights of users of motor vehicles; improvements of public highways; development and introduction of the automobile; equitable regulation of automobile racing and trials of endurance and efficiency; a medium for counsel and interchange of information, ideas and suggestions tending to the development and advancement of the art.

CARNEGIE INSTITUTION PLANS.—At the banquet of Johns Hopkins Alumni and guests in Baltimore last week, President Gilman outlined his plans for the Carnegie Institution to an audience of 600. No such complete statement has previously been made. It turned out, quite as it had been foreshadowed, that President Gilman intends to build up a permanent advisory staff of specialists in all branches of science. He means also to foster science in the broadest sense of the word. He mentioned economics alone of the historical sciences, but the numerous historians, philologists, and philosophers present assumed that their favorite studies would not be neglected. For a considerable period, the Carnegie Institution will confine its work to examining the present condition of American scholarship. The publications in the various fields will be examined by experts, who will finally present exhaustive reports, on the present condition and needs of every branch of learning in America, on the quality and promise of the workers in their several fields. These reports will in the sum constitute a kind of survey of the present state of learning in America. Upon this sound basis assistance will be granted to productive scholars, for the institution, all rumors to the contrary notwithstanding, will confine itself strictly to the encouragement of scientific research.

HERTZIAN WAVES FOR CONTROLLING TORPEDOES.—A patent issued Feb. 18 to John Gardner, of Fleetwood, England, describes an apparatus for controlling actions at a distance by means of Hertzian waves. The inventor states that the apparatus may be employed to control distant signal stations, automobiles, dirigible balloons, light stations, etc., but the specifications refer to its use only in connection with torpedo or submarine vessels. Briefly, the receiving apparatus consists of a shaft carrying a small centrifugal governor, motion being given to the shaft by an electromagnetic ratchet mechanism, the circuit of which is controlled by a coherer. At different speeds of the shaft the governor makes different contacts, by means of which the propeller motors of the boat are controlled or the torpedo charge fired. At the transmitting station a mechanical device is employed whereby the induction coil circuit can be closed for definite periods, and with greater or less intervals between the periods. At a normal rate of closure the governor shaft at the receiver is turned at such a speed that a lever on the governor muff will make a contact such that both propelling motors will operate. With a less number of periods a different contact will be made such that only the port motor will operate, and with a greater number the starboard motor only will operate. Finally, at the highest rate of speed a contact will be made whereby the charge of the torpedo will be fired.

MORE PACIFIC CABLES.—The *London Daily Telegraph* says it understands that Canada has definitely decided to lay a cable to Great Britain, independent of the existing Atlantic lines, and also a Pacific cable. This hardly seems credible. If it is true, the competition will keep all the Pacific cables on a starvation basis for many years to come.

LONDON UNDERGROUND.—A recent cable message from London says: Robert William Perks, M. P., chairman of the Metropolitan District Railway, presiding at a meeting of the shareholders of the road, said he regretted to present a report which was the worst in 35 years. He attributed the loss of £53,000 in the last six months to the fact that the road was not electrified, and added that he hoped the worst was past. Mr. Perks objected to Charles T. Yerkes and other Americans interested being termed "foreign speculators," and also to the assertion that the road was dominated by an American syndicate.

THE CAR "IDLER."—Work has been completed at the Wilmington, Del., shops of the Pullman Palace Car Company on the car "Idler," which will be used by Prince Henry of Prussia and his suite during their tour of this country. The "Idler" is a combination observation and stateroom sleeper, and is one of the handsomest cars ever fitted out in the Wilmington shops. The interior decorations are of bronze and mahogany, and all the rooms are lighted by electricity. The upholstery is of blue plush and brown tapestry, and the curtains are of brown silk. Electric fans will cool the air in the different compartments.

PACIFIC CABLE LAYING.—It does not seem to be generally known that cable laying is already in progress in the Southern Pacific. Last January the Telegraph Construction & Maintenance Company, of England, dispatched two ships. The "Scotia" had on board 1700 knots of cable to be laid between Glenelg and Fremantle, Australia. The "Anglia" had on board 2500 knots for the southern portion of the Colonial Pacific Cable. Her connections are for three sections, Brisbane, Queensland to Norfolk Island; Auckland, N. Z., to Norfolk Island, and Fiji to Norfolk Island. The company's new steamer will take out the whole of the Vancouver-Fanning section of 3500 knots, and should be available for a similar load this time next year should her services be in requisition.

MERCURY CATHODE CELL.—A cell for the electrolysis of brine for the production of chlorine and caustic soda, patented Feb. 18 to George M. Wilson, of Sault Ste. Marie, Canada, is a modification of the device patented in 1894 to Sinding-Larsen. A mercury cathode is circulated beneath the anodes by means of a horizontally mounted paddle-wheel, passing thence through traps into the presence of water and, when denuded of its amalgam, returning by lateral passages to the wheel. Two features of the cell are adopted directly from recent devices described by Rhodin. These are the carbon plate covers serving both to support the anodes and to convey the current to them, and the means whereby fresh electrolyte is continuously introduced into the field of most rapid decomposition.

PURIFICATION OF SUGAR SOLUTIONS.—MM. Lavollay and Bourgoin, of Paris, have recently patented a method for the purification of crude sugar juices, consisting in outline in electrolyzing them between zinc plates while maintaining in suspension a pulverized mixture of calcium fluoride and manganate. After a few minutes' treatment barium carbonate is stirred in to complete the decolorization. An effective defacation is said to be obtained, although the character of the action is not clear, especially since the effect seems to be independent of the material of the electrodes, and since both salts are substantially insoluble in the liquid. It is possible that the unstable manganate acts as a carrier of the oxygen derived from the decomposition of water, accentuating its bleaching action. The inventors have heretofore patented the application of the manganate alone, in presence of the current, to the purification of various liquors and to the rectification of spirits.

WIRELESS TELEGRAPHY.—In connection with the interesting article by Mr. Emerson in our issue of Feb. 15 on Edison's wireless train telegraphy some years ago, Mr. W. J. Hammer, who was connected with the experiments and practical work at that time, has called our attention to the broad United States patent granted Mr. Edison on the subject in 1891 upon an application filed in 1885. There are five broad claims for the use of condensing metallic surfaces and static effects so as to signal at considerable distances, and the drawings show balloons, sails of ships, etc., employed for the purpose. Mr. Hammer reports that on one of the train trips on Long Island Mr. Seligman, the banker, bought and sold stocks by means of messages thus exchanged through the air. Mr. Hammer sent a message to himself at Newark, N. J., while the train was running 40 miles an hour, and the nearest telegraph wires were between 300 and 400 ft. from the condenser roof of the car.

THE TELEPHONE IN JAPAN.—Some interesting facts about the telephone service in Japan have recently been published by the London *Electrician*. The Japanese telephone service is regulated by the Department of Communications, which has charge of all affairs connected with the postal, telegraph, telephone, railway, lighthouse and navigation services, and regulates all matters affecting electric lighting and power. At Kobe there is a telephone exchange which, at the end of October last, had 1176 subscribers. There is a telephone trunk service available between Kobe and Tokyo, a distance of 377 miles; Kobe and Yokohama, 359 miles; Kobe and Nagoya, 161 miles, and between Kobe and Osaka and Kioto, which are comparatively short distances The charge made for trunk communications appears to be about 20 cents (Japanese money) per 50 miles for five minutes' conversation. The public service within the city of Kobe is 5,400 cents per annum. All the lines, instruments and fittings are owned by the Government.

PARIS UNDERGROUND.—The Paris Municipal Council has formally adopted in its main lines the recommendation to grant a concession for a new "tube" railway running between Montmartre at the north end of the city, and Montparnasse at the south end. The company offers to pay to the municipality a tax or due of 1 centime per passenger carried over its line up to 30,000,000 passengers, and 2 centimes per passenger for any number over 30,000,000. This is for second-class passengers; for first-class passengers the due will be 2½ centimes. The concessionaire company is also to provide not less than $100,000 nor more than $400,000, toward the completion of the new Boulevard Raspail. The new line is to be sunk at a much greater depth than the Metropolitan electric lines now in course of construction or already running; the tunneling will be at a depth of from 24 ft. to 115 ft. beneath the street surface. Contrary to what has happened in the case of the City Metropolitan line, the new company is to carry out the entire work at its own expense, and is to undertake to link up with existing lines at certain points. The work is to be carried out without any necessity arising to take up the roadway. The concessionnaires are Messrs. Berlier and Janicot, engineers and contractors. The Omnium Lyonnais, one of the most important electric traction concerns in France, is financing the scheme.

TROLLEY CAR STREET CLEANING.—As a result of suggestions by President Vreeland, of the Metropolitan Street Railway Company, of New York, and of conferences on the subject, a proposition will be submitted to the city, which, if accepted, will revolutionize existing methods of snow and garbage removal. The railroad company stands ready, on reasonable notice, to assume the functions now performed by contractors and sweepers employed by the Street Cleaning Department in Manhattan Borough. Should this proposition receive favorable consideration its scope may be broadened to embrace the removal by the transit companies of snow and household refuse in all of the five boroughs. This can be done, it is said, by the introduction of gondola cars on the several lines of street railway to be operated on a night schedule, and in emergencies by daylight. The cars will have to be constructed on a special plan, which Mr. Vreeland now has under consideration. The extent to which they may be adopted will depend upon the success or failure of the experiment in practical operation. If it is found that the cars can be operated without interference with passenger traffic and to better advantage than carts, there is little doubt that they will be generally adopted. The use of the cars as an adjunct of the Street Cleaning Department in the removal of ashes and garbage then will become a subject of negotiation between the street railway companies and the city. It is argued in favor of this plan that the city's refuse could be removed in the cars at night. It would be necessary to complete this system to use carts in the cross streets for a "short haul" to the nearest trolley line. The city already has the carts, and with the assistance of the railroads, it is contended, the service would be brought up to a high standard.

MR. MARCONI RETURNING TO NEW YORK.—A cablegram from Southampton announces that Mr. Marconi sailed for New York on the American Line steamer "Philadelphia" on Feb. 22.

ENGLISH CABLE WORKS COMBINE.—A cable dispatch from London, Feb. 22, states that the directors of the Henley Telegraph works announce in a circular issued to the shareholders that terms have been arranged by which the company will amalgamate with Callender's Cable Works.

THE KING'S TROLLEYS.—A cable dispatch from London of Feb. 15 says: Profiting by the example of Mr. Yerkes, the King is going into trolleys himself. He is furthering a plan to gridiron Windsor with trolley lines so as to open up some of the prettiest parts of the royal demesue and enable him to sell off some ineligible real estate at a good profit. The railways are opposing the scheme, but it is reported that the King is determined to obtain the grant of a franchise from the Windsor authorities.

CHEAP TELEPHONY.—A new telephone company has offered to Utica, N. Y., what is said to be the best return for a 25-year franchise ever extended to any city by a telephone corporation. The company offers to install a telephone in every house in the city where one is wanted and to charge a uniform rate of 2 cents for a five minutes' conversation. There will be no charge for instruments and none for messages received. Any merchant who wants more than one telephone can have as many as he desires at the same rates.

WIRELESS TELEGRAPHY IN CANADA.—In the speech from the throne, the Governor General of Canada, Lord Minto, said last week: "The inventor, Mr. Marconi, having met unexpected obstacles to the carrying on of his experiments in wireless ocean telegraphy in a sister colony, my ministers deemed it expedient to invite him to continue his operations on the coast of Nova Scotia, and they availed themselves of his presence in Canada to enter into negotiations, resulting in an arrangement through which, should the project prove as successful as is hoped for, the Government and people of Canada will enjoy the benefits of the invention on very favorable terms, including rates for transatlantic messages very much below those now existing."

IOWA TELEPHONE ASSOCIATION.—The sixth annual meeting of the Iowa Telephone Association will convene in the clubrooms of the Savery House at Des Moines, Iowa, on Tuesday, March 11, 1902, at 2 o'clock P. M., for a two-days' session. Among the important subjects which will be discussed is that of a clearing house for checking and settling balances between companies for interline toll business. The subject of rural lines is sure to receive much attention at this time. The programme committee will present fewer subjects than usual this year, and allow more time for general discussion. The programme will be announced in advance of the meeting, and it is hoped that members will take active part in the discussions following the presentation of papers. The secretary is Mr. Charles C. Deering, of Boone, Iowa.

ELECTRO-MAGNETIC GUN.—It is reported from London via Copenhagen, that experiments have recently been made in Christina with the new electro-magnetic gun invented by Professor Birkeland "The electric connection between the battery and the gun was made in less than a second by the aid of a current-breaker. The electric spark was seen, and then there was a loud report, which was not, however, caused by the firing of the gun, which is absolutely silent, but was the impact of the projectile, a 1-lb. shell, on a wooden target, which it penetrated. The gun works magnetically. The shell is drawn out of the bore, and not, as hitherto, impelled by gunpowder. The use of magnetism as motive power, according to Professor Birkeland, will enable 1000-lb. shells to be hurled much further than by the old-fashioned methods."

SHORT CIRCUITED NERVES.—Electricity appears to be rapidly extending its magical charm over the medical profession, to judge from the frequent announcements of medical "discoveries" involving electricity. The latest is an announcement of a discovery by Dr. C. C. Carroll, whereby consumption, pneumonia and other diseases may be cured. The discovery of the wave theory of electric transmission, he says, permitted the discovery of the possibility of "short circuiting" a nerve. Dr. Carroll took up the subject of oscillations along the nerves and experimented and computed until he found that the rate of oscillations along a nerve is 300,000 per second, approximately. He then applied to Mr. Tesla and asked him to build an electrical oscillator capable of 300,000 oscillations. "After some hesitation he built the machine. It contains several miles of wire and is peculiar in that it requires but one pole for its practical use. The wave action is so rapid that they are neither positive nor negative." When the oscillator is set in motion the nerve action is "short-circuited because the oscillations of the electric current are the same as those of the nerve current, and all sensation is cut off from the brain. Only the sensatory nerves are affected. Voluntary muscular action is left normal." Such "short circuiting," he says, will allow of the performance of surgical operations, particularly on extremities and on external surfaces of the body, without pain to the patient and without the necessity of putting the patient under the influence of an anæsthetic. Dr. Carroll will shortly read a paper before the Medico-Legal Association and the Tuberculosis Congress, having for its subject "A New Theory of Medicine," and will deal with the application of electricity to the cure of consumption.

REDUCTION BY GRAPHITE.—Mr. Edward Goodrich Acheson, whose name is synonymous with the inception and development of the carborundum and artificial graphite industries, has just received a patent covering an interesting and important metallurgical application of the latter substance—its use as a conducting and reducing agent in electro-metallurgy. While graphite has been heretofore named as the equivalent of amorphous carbon for sundry reductions, it has remained for Mr. Acheson to clearly point out its advantages for resistance furnaces in which the current is carried by the charge. These are, first, its high purity, the contamination by the artificial graphite in particular being practically negligible; second, its high electrical and thermal conductivity, whereby current sufficient for the reduction can be transmitted and the heat distributed evenly throughout the mass, and, third, its extreme divisibility, which permits a truly intimate mixture with the ore to be reduced. That the above advantages are real is indicated by the fact that Mr. Acheson has succeeded in effecting the direct reduction of silicon from a mixture of silica and graphite, containing rather less than the theoretical proportion of the latter, and inserted as a resistance in a 100-volt circuit. It is true that Moissan has produced silicon by reduction by carbon (*Comptes Rendus*, June 4, 1895), but this was effected by heating mixed quartz and carbon in a cylinder of coke, by means of the arc. Mr. Acheson's discovery is that graphite, not in excess of the ratio required by the reaction, renders the charge a conductor and permits application of the resistance principle. Data as to the resistance of a charge so prepared indicate for a column 2 by 2 by 3 inches an initial resistance of 33 ohms, falling to 5 ohms as the reduction proceeds.

LETTERS TO THE EDITORS.

An Interesting Static Effect.

To the Editors of Electrical World and Engineer:

Sirs.—I have noticed a curious and very pretty effect of static electricity, an account of which may be of interest to some of your readers.

Sprinkle a thin sheet of white paper with finely powdered carbon dust and then hold beneath it a piece of hard rubber, such as a telephone receiver cover, which has been briskly rubbed with a piece of chamois. The dust will then form itself in rings and lines on the paper almost identically the reverse of those formed by iron filings when placed over a magnetic field. By gently tapping the paper many beautiful effects may be obtained, which are heightened if the piece of hard rubber is moved around beneath the surface of the paper. While this, of course, is of no practical value, yet it forms a very clear and pretty method of illustrating the presence and effects of a static charge.

LORAIN, OHIO. C. H. HINES.

Synchronous Motor on Grounded High-Tension Lines.

To the Editors of Electrical World and Engineer:

Sirs.—Thinking it might interest some of yours readers to hear of a curious experience we had recently, I give below the particulars:

The 20-stamp mill in the works of the Standard Consolidated Mining Company, at Bodie, Calif., is run by a three-phase, 6600-volt, 180-kw Stanley synchronous motor, supplied with current from a water power generating plant 12½ miles distant, the line running over very rough and rocky country. During a sleet storm a short circuit on the line caused the motor to go out of step, but it was started immediately without any apparent trouble. The ground detector showed nothing wrong, but 10 days later, in going over the line, the cause of the trouble was discovered. On a high peak two of the wires were lying on rocks and on bushes, and not more than 6 inches apart. The third wire was caught on the top of the pole, the cross-arm being completely burned off. Of course, the fault was immediately repaired, but the motor had been running 10 days with the line on the ground.

Bodie, Calif. F. J. Greisberg.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers

Starting Resistances.—Ott.—A long, illustrated paper, read before the Newcastle section of the (Brit.) Inst. Elec. Eng. He complains that most starting resistances at present in use are made after the rule of thumb, and are quite unsatisfactory. Several types of earlier and present starting resistances are described. The principal point against which is sinned most is the sub-division of the resistance. The correct way is a geometrical sub-division with armature resistance as one extreme and total resistance as the other extreme. Certain modifications are required, however, as suggested by considerations of voltage, number of steps available in switch, and conditions of manufacture. The general rule is given by the formula that the total resistance must equal $A \times F^n$, where $A =$ armature resistance, $F =$ common factor, and $n =$ number of sections of resistance. For instance, a motor has to take 38 amperes at full load with an armature resistance of .25 ohms. The current on moving from one step to the next is not to exceed 10 amperes. The percentage increase is, therefore, $10 \times 100 \div 38 = 26$ per cent, and the common factor to be used is 1.26. The resistance, including the armature to the end of each section, is, therefore, $A \times 1.26$; $A \times 1.26^2$; $A \times 1.26^3$; and so on until $A \times 26^n$ equals the total resistance decided upon. For 14 sections the total resistance in this case becomes $0.25 \times 1.26^{14} = 6.3$ ohms. He then discusses the difficulties of construction, the supply requirements, the initial current, the condition of high voltage, the barrel type controller, variable torque, mechanically operated switches, liquid resistances and regulating resistances.—Lond. *Elec. Eng.*, Jan. 24, 31.

Best Degree of Saturation for Polyphase Generators.—Korrodi.—A brief article in which he proves that an increase of the induction in the field magnets up to a certain limit, diminishes the voltage drop and that to such a degree that a machine with a straight characteristic curve when loaded shows less variation of voltage, than a too highly saturated one, equal excitation being assumed. This is shown by means of diagrams.—*Elek. Zeit.*, Jan. 16.

Lights and Lighting.

REFERENCES.

Regina Arc Lamp.—An illustrated article on this enclosed arc lamp of German make, for which the following advantages are claimed: The life of a set of carbons is 160 hours. The Rosemeyer system of shutting out the oxygen is used, in which the amount of oxygen entering the lamp is regulated by the arc itself. According to tests, by Wedding, of a 6-ampere, 110-volt Regina arc lamp, it consumes only 1.075 watts per Hefner candle.—*Elek. Rund.*, Jan. 15.

Electric Night Lamp.—Hopkins.—An illustrated description of a home-made ½-cp electric night lamp, fed from dry cells.—*Sc. Amer.*, Feb. 15.

Arc Lamps.—The conclusion of the article on "Applications and uses of arc lamps," in which illustrated descriptions are given of various arc lamps of English make.—Lond. *Elec. Rev.*, Jan. 17.

Power

Power in English Railway Shop.—An article on the new power equipment of the Metropolitan Railway, Carriage & Wagon Company's shops at Birmingham. Electric power is transmitted to the different departments of the works from the generating station which is equipped with gas engines and contains four gas generators, each capable of serving a maximum of about 250 hp. The generators are of the two-phase, alternating-current type and directly connected to the engines. The motors vary in size, most of them being between 30 and 60 hp. Different machines are not driven by separate motors, except in a few instances, but usually a 30 or 40-hp motor drives the shaft for each separate section or department of the works. The motors are self-starting under load, and have a considerable overload capacity. No part of the electrical circuit is exposed, and there are no rotating windings so that the motor is particularly adapted for the driving of machinery in dirt, or in corrosive or inflammable surroundings. Some particulars are also given of the arrangement of the shops themselves, and the car building machinery employed therein.—*St. R'y Jour.*, Int. Ed., Feb.

Solenoid Drills for Hard Stone.—Heubach.—A summary of the principles on which solenoidal percussive rock drills have been built, notably by Van Depoele, who used a combination of three solenoids surrounding an iron core, the center one being excited by direct current, and the two end ones by alternating current, which was derived, with a suitably low period, from a direct-current dynamo, by a pair of brushes revolving on the commutator with a speed governing the period. The more modern construction by Marvin using two solenoids alternately energized, and the special dynamo for use with this type of drill, are described. The method of obviating the difficulties of insulation by mica insulated coils of wire of square section is described. In the second part the electrical working is discussed, and the current and power factor with various lengths of stroke of the drills are shown by means of curves. The method of winding multipolar generators to give a number of periods, that is, of oscillations to the drill, equal to or greater than the number of revolutions of the machine, is described. Tables are given of actual results as to speed of working and cost. A comparison of weight and power is given, and the respective merits of percussion drills driven by a motor and flexible shaft, with those of the solenoid type, are discussed.—*Zeit. Ver. Deut. Ing.*, Oct. 19, 26; abstracted in *Science Abstracts*, Jan.

Electrically-Driven Shipyard Tools.—An illustrated description of two powerful electrically-driven tools of English make for shipyards. One is a plate-straightening machine, driven by a reversing motor, which is geared direct by spear-wheel and pinion to the rolls, and is provided with a liquid reversing switch that prevents injury to the armature through excessive current at the moment of reversing. The machine is fitted, in addition, with a magnetic brake, which brings the rolls to a dead stop the moment the current is switched off. Plates up to 6 ft. in width and 1 inch thick can be flattened in this machine. The other tool is an electrically-driven four-sided combined lever and eccentric type punching and shearing machine.—Lond. *Eng'ing*, Jan. 31.

REFERENCE.

Transmission of Energy.—W. C. L. Eglin.—A paper read before the Engineers' Club, of Philadelphia, on the economical conversion and transmission of energy. He discusses in a general way, the development of the use of water power, the progress made in the construction of steam engines and gas engines, the use of compressed air, the development of electric transmission and the principal features of direct and alternating-current motors. He then deals with the load factor of the entire plant and gives a series of load diagrams, one of which is a composite diagram of the load of several

stations, showing the character of the load which must be carried, and also demonstrates conclusively that most of the work can be done by one main generating station operating under the most economical conditions, with the smaller stations acting as auxiliaries, the location selected being the best suited to the particular requirements of the load that they must carry.—*Proc. Eng. Club.*, Phila., Jan.

Traction

Engines and Batteries for Traction Power Stations.—An anonymous article in which the writer urges that as a gas engine is essentially an engine to run at a steady load, it should be supplemented by a storage battery. If a shunt generator is used with a falling characteristic of sufficient range, and is worked in conjunction with a battery of liberal proportions, the battery will work in parallel with the generator and take up load when this passes the mean load, or it will absorb current at low loads. There appear to be certain advantages in placing the battery at a sub-station. The maximum output of the battery is the surplus of the maximum above the mean load. On a small system, the battery output will be much greater for short periods than the station output, and the divisions into which the battery sub-station divides the line will correspond with the ratio of battery output with station output. For example, with a load factor of one-third the battery output at a maximum will be two-thirds, and the battery would be placed so as to divide the line into sections having a ratio of 2 to 1, the longer section being between power house and sub-station, or approximately so, then at times of maximum load, one-third the current goes from the battery outwards towards the extremity of the line, one-third goes from the battery towards the stations, and the remaining third goes from the station towards the battery. After some calculations, however, the writer comes to the conclusion that only in the case of a single line extending from the power station can a battery be installed other than at the station, except at considerably enhanced cost, and this is more particularly so in small than in large systems, because in a small system the load factor improves rapidly with the growth of the system up to a moderate figure, and thereafter but slowly. The accumulator at present stands as the greatest obstacle in the way of extending polyphase working to small and moderate systems.—Lond. *Elec. Rev.*, Jan. 25.

Earth Currents Derived from Distributing Systems.—Wedmore.—A paper, illustrated by many diagrams, read before the (Brit.) Inst. Elec. Eng. He considers the current distribution, accompanying the use of the earth as a return in a simple traction system, and approaches the problem from the magnetic side. Should the whole current return by the rails, then the magnetic effects due to the current in the trolley wires and rails would practically cancel, except in the immediate neighborhood. A large proportion of the current, however, returns by the earth, and at a distance from the trolley wire. The magnetic effects due to the current in the trolley wire, therefore, are not canceled by the return currents. On the assumption that the specific conductivity of the earth is uniform, and that the return currents enter and leave at points, it follows that the magnetic force directly due to the earth currents has no vertical component. No part of the vertical component due to the current in the trolley wires and feeders is canceled by the earth currents. Except close to the line, the magnetic field due to the current in the trolly wire has no horizontal component. His discussions are largely theoretical, and the results obtained by various investigators are dealt with. At the end of the paper he makes the following remarks. In the past, electrolytic troubles have been much over-rated, and in many cases corrosion not due to earth return currents, but to the use of inferior metal, have been attributed to the return current. Cast iron has been found more free from corrosion than wrought iron, and oxides produced at the seat of electrolysis increase the resistance, and reduce the electrolytic current. "If one had in one's power to lay both pipes and track in the best possible manner, it would seem best, where metal pipes are used, to use cast iron, to introduce resistance at every joint, to introduce any possible surface resistance, and to avoid all connections with the rails, leaving the rails to take their own potential." An account of the discussion which followed is also given. —Lond. *Elec.*, Jan. 24, 31.

Aurora, Elgin & Chicago Railroad.—An illustrated article on construction work on this road, which is an important high-speed line now being built. The schedule speed is 40 miles per hour, including stops, with stations 3 miles apart. The cars weigh about 40 tons each. The maximum speed is 65 miles per hour. Each car will be equipped with four 125-hp motors. There are no grade crossings. The rails weigh about 80 lbs. per yard, and are laid in 60-ft. lengths. The third rail is to be used, except in two towns, where the trolley system will be used. The third rail will weigh about 100 lbs. per yard. Power is distributed at 26,000 volts, and the generating units will be of 1500 kw capacity. The feeders will be of aluminum.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

REFERENCES.

Electrification of Railways.—An article referring to a recent statement of Langdon that it was to the main lines that he looked for the greatest success in the application of electric power. This is called a speculation on the probabilities of the future, while the urgent needs of the present are the extension of the suburban electric lines.—Lond. *Elec. Rev.*, Jan. 24.

Electric Locomotives.—An article giving statistics on electric locomotives and containing a table compiled by the General Electric Company of the main dimensions of the electric locomotives built by it.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

Hartford and Springfield Street Railway.—A short illustrated description of this interurban trolley line.—*St. R'y Jour.*, Feb. 1., and Int. Ed., Feb.

French Tramway Line.—Pausert.—A long illustrated description of the tramways between Vincennes, Nogent, and Ville-Evrard; the trolley system is used.—*L'Eclairage Elec.*, Jan. 25.

British Electric Tramways.—A map of the United Kingdom, showing the electric railways and tramways in operation and under construction.—Supplement to Lond. *Elec.*, Jan. 31.

Dangers from Trolley Wires.—Jamieson.—An illustrated article on dangers from trolley wires and other aerial electric conductors, and on the methods used in Great Britain to guard against them.—*Cassier's Mag.*, Feb.

Street Car Platforms.—Partridge.—The third and concluding part of his well illustrated serial on this subject.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

Installations. Systems and Appliances.

Economy of Isolated Electric Plants.—Parsons.—The conclusion of his article in which he deals with buildings for residential purposes, including apartment houses, hotels and clubs. He analyzes carefully the cost of operation in several buildings in New York. The statistics of the 17 buildings which he has discussed in detail show, as a whole, the decided advantage of the isolated plant over the central station service. Curiously, it is usually in the smaller buildings that the greatest percentage of gain is found, this being due partly to the greater proportional saving brought about by heating the building with the exhaust, and partly to the fact that there is more relative difference between the central station rates which the small building would pay and the cost of production in the isolated plant, than there is between the central station rate the large buildings would pay and the cost of generation in its isolated plant. The small plant is, however, much more sensitive to unfavorable conditions of any kind. Though the central station rate never reaches so low a point as the least cost per kw-hour in a very large isolated plant, the decrease as the amount of current increases is greater in the central station rate than in the cost of production in the isolated plant. The following factors are of the greatest importance for the economy. The insallation of the right number of generators, of such size that they may be operated as nearly as possible at full load. Heating in the smaller buildings is a very important factor, and, in some cases, the current is produced for exactly the price at which it would be furnished by the central station, the only gain being the cost of heating. Could the central station supply steam at low rates along with electricity, the days of the isolated plant, in the smaller apartment houses and clubs and in many loft and office buildings, would be numbered. When the building is large, the amount which would be expended for heating, were no plant installed, is still gained, but it is a much smaller proportion of the total cost of running the building, and is relatively a less important factor. Important for economy are the shape of the load diagram; the keeping of careful daily records of output, supplies and expenses; the competency of the engineer; the temperature and ventilation of the engine room; the amount of coal storage capacity. The type and number of elevators used, apart from their efficiency as elevators, also affects the economy of operation. In one of his instances, an electric elevator is used and necessitates the operation of a large dynamo

most of the day at an extremely light load, whereas were no elevator present, or were a hydraulic elevator used, a very small dynamo could be employed for the small constant day load; or this small amount of current could be taken from the central station at very little extra cost. In this connection the potential regulator may play an important part. The storage battery is one of the most important factors in the economy of the isolated plant, and it furnishes another means by which electric elevators can be run from the same dynamo as the lights and at the same time sudden fluctuations of voltage can be avoided.—*Eng. Mag.*, Feb.

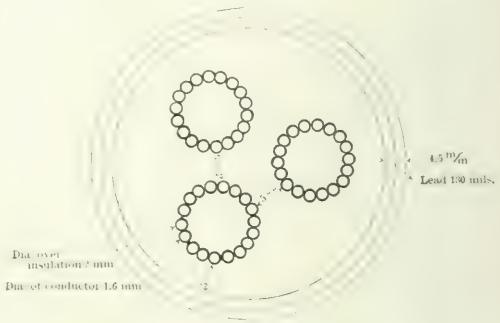
Melbourne.—An illustrated description of the Melbourne municipal electric lighting station. There are four 350-kw sets and one 200-kw set of direct-current dynamos, supplemented by a battery. The three-wire system of distribution is used at a pressure of 460 volts across the outers, being carried out at present to a distance of about 1.5 miles from the power house. The outlying area of the city is supplied with alternating current at 100 volts, the transmission being at 2000 volts, two 75-kw alternators in the station being driven by direct-current motors.—Lond. *Elec.*, Jan. 24.

Electric Installation in an Asylum.—A well illustrated description of the electric light and power installation at the Lancashire County Asylum, Rainhill. There are three 118-kw shunt-wound direct current generators, the voltage being 230, and a battery of 130 cells, with a capacity of 1200 ampere-hours at a nine-hour rate. The total number of lamps connected exceeds 3520 of 16 cp, and in addition there are motors for ventilating and refrigerating purposes.—Lond. *Elec. Eng.*, Jan. 17.

Devices for Disconnecting Transformers.—Geist.—An article on devices used for connecting and disconnecting the high-voltage winding of a transformer from a distance, when, from the low-voltage side, current is taken off or not, respectively. Such devices have been used in order to diminish the no-load losses and also the phase difference. He discusses in a general way under which conditions they are economical, and reaches the result that in general they are not. In special instances, of course, they may be used to advantage. —*Elek. Zeit.*, Jan. 16.

Wires, Wiring and Conduits.

French Cable Factory.—O'Gorman.—An illustrated description of the cable works of Berthoud Borel & Co., at Lyons, of which he speaks very highly. They take 400 hp exclusively from the public three-phase, 2500-volt supply at 8 cents a unit. The lead press pumps are actuated by 50-hp motors, and they do not absorb more than 30 hp each at full load and at 700 revolutions of the motor, and 180 throws per minute of the three-throw pump. They use a system of double-lead covering, with bitumen between the coats. They have given up the use of the water tank. In the drive of the lead-press pumps the three-phase motor is ideal, the drive being steady and the motor nearly always working at full speed. The textile machines, the paper coverers, lappers, cotton coverers, braiders, etc., gain a most important advantage from the use of the three-phase motor. The speed is independent of the local drops of voltage which may be caused by the sudden starting of the two or three lead presses, and breakages, if they occur, are due to weak places in the material and not to the jerks of the machine. Several of the machines are illustrated. The most interesting cable made at these works is their standard model which embodies a new arrangement of the conductor intended to diminish the impedance of large copper sections, and at the same time improve the resistance to puncture of the dielectric. The adjoining diagram gives a section of a 3500-volt cable, of which very many miles have been working for years in Lyons. Three wires each of 100 sq. mm. section, insulation thickness 5 mm. paper impregnated with hydro-carbon oils; insulation on each fine wire, 0.2 mm. paper and 18 fine wires round each main conductor. Each conductor is thus surrounded by a complete ring of what might be called pilot wires all at the same potential as the main conductor which they encircle. The amount of insulation on each outside wire is very small, only 0.2 mm., and the diameter of the copper of the outside wires is always kept at 1.6 mm. for uniformity of manufacture, no matter what size of main conductor is in use. The immediate effect of adopting the system has been to reduce the radial length of insulation from 7 mm. to 5 mm., with a corresponding cheapening of the cable. The improved conductivity of the cable at 50 periods for three-phase 150 sq. mm. cable, was 6 per cent, i. e.; the impedance factor with stranded copper was 1.46; the impedance factor with the insulated wire was 1.32 coincident with the diminution of the thickness of insulation over it. The novelty is the arrangement of conductors, namely, the separate insulation of the outer strands. The insulation consists of the ordinary low-tension material, resin and vaseline oil, on a basis of good, dry paper. He witnessed the experiment of breaking down a 5000-volt cable. At about 20,000 volts, when breakdown occurred, each separate insulated strand sparked across to its main conductor at the cable end exposed to the air, owing to the main being reduced to the potential of the lead sheath at the point of internal breakdown. He gives a table of capacities of these three-phase cables, from which the following is an abstract: For



SECTION OF 3500-VOLT CABLE.

3500 volts, section 3 by 10 sq. mm., 0.177 microfarad per mile; 3 by 150 sq. mm., 0.37 m. f. p. m. For 5000 volts, 3 by 30 sq. mm., 0.209 m. f. p. m.; 3 by 120 sy. mm., 0.321 m. f. p. m. For 10,000 volts, 3 by 20 sq. mm., 0.16 m. f. p. m.; 3 by 170 sq. mm., 0.29 m. f. p. m. For 20,000 volts, 3 by 18 sq. mm., 0.145 m. f. p. m. The capacity is measured between any one phase, and the other two connected to earth. For the three higher voltages the capacities are for cables having insulated strands round each phase.—Lond. *Elec. Times*, Jan. 16, 23.

High-Tension Fuses.—Semenza.—A description of the various forms of high-tension fuses now in use. Of those in air, he prefers the type in which the fuse wire is enclosed in a tube open at the ends, so that the expansion of the air blows out the arc. When used for large currents, the amount of metal vaporized is considerable, and the vapor cloud may cause the formation of an arc between the fuse-blocks. This having frequently occurred in the Paderno installation, he substituted fuses immersed in oil, and found them in every way more satisfactory. The size of the wire for the same fusing current is less in oil than in air, and it is of decided advantage to reduce the amount of metal to be fused. Copper, however, is not suitable, owing to its high temperature with a normal working current. Of pure metals tin was found to have the lowest temperature for a working current taken as a given fraction of the fusing current. A lead-tin alloy of equal parts is still better in this respect, but alloys have the disadvantage of uncertainty in their fusing points. The ratio of the maximum working current—for a given temperature of the wire—to the fusing current, may be increased by the use of heavy oils, such as ordinary cylinder oil. He has used fuses in vertical tubes filled with oil on 14,000-volt circuits and obtained satisfactory results.—*Elettricita*, Aug. 3, 10; abstracted in *Science Abstracts*, Jan.

REFERENCE.

Manufacture of Submarine Cables.—An illustrated article on the new cable works of Siemens & Halske. The article is divided into the following portions: Heavy cables, spun and braided wires, gutta percha and rubber cables, paper-covered cables.—*Sc. Amer.*, Feb. 8.

Electro-Physics and Magnetism.

Electric Tubes of Force.—De Nicolaieve.—A description of some novel experiments concerning the properties of electric tubes of force, illustrating the tension along the tubes in an instructive manner. Two bands of tinfoil, immersed in distilled water, serve as electrodes. They are separated from one another by plates of mica or other insulating substances, various arrangements being used. When the current passes, the tinfoil electrodes are displaced, owing to the contraction of the tubes of force. Or if the electrodes are fixed and the diaphragm floats, the latter moves. On dissolving some common salt in the water, the current becomes stronger, but the electro-

static field becomes less, and no motion of the electrodes or of the diaphragm is observed.—*Comptes Rendus,* Dec. 30; abstracted in Lond. *Elec.,* Jan. 17.

Sensitive Vacuum Discharge.—Von Czudnochowski.—A description of an experiment in which he uses a vacuum tube consisting of two spheres 6 cm. in diameter, joined by a tube 12 cm. long and 1 cm. in diameter. Each sphere contains a cathode, placed so that the rays are at right angles to the connecting tube. One of the cathodes is plane, while the other is concave. The anode is contained in a side tube attached to the middle of the connecting tube. When both cathodes are working in parallel the whole connecting tube is filled with positive light. But at a certain exhaustion one-half of the connected tube becomes dark, while the other remains light, the whole discharge passing through the plane cathode. If at this stage the sphere containing the concave cathode is touched with the finger the whole discharge jumps across into the neighboring portions of the connecting tube and returns as soon as the finger is removed. After further exhaustion the same thing happens when the observer merely approaches within a couple of yards, but the sensitive state disappears on still further exhaustion.—*Phys. Zeit.,* Jan. 1; abstracted in Lond. *Elec.,* Jan. 17.

Reflection of Radium Rays.—Tommasina.—An account of experiments with which he succeeded in proving the existence of radium rays which undergo reflection, and in separating them out from among those which do not. A small tube, containing a radium preparation, was mounted in the axis of a parabolic mirror made of silvered copper, which concentrated the rays upon a charged electroscope. The measurements showed that the mirror doubled the effect of the preparation. This great increase cannot be due to the secondary rays emitted by the surface of the mirror. This was proved by the author by introducing an iron cylinder on the axis of the mirror in such a way that the points of the mirror which could send secondary rays in the directions of the electroscope were not exposed to the direct rays of the radium preparation. It was found that the cylinder intercepted two-thirds of the radiation. A sheet of brass 0.5 mm. in thickness completely intercepted the reflected rays, but did not sensibly affect the main radiation.—*Comptes Rendus,* Dec. 30; abstracted in Lond. *Elec.,* Jan. 24.

Primary and Secondary Röntgen Radiation.—Allen.—A preliminary note on the relation between primary and secondary Röntgen radiation. When the Röntgen radiation from a focus-tube falls upon the surface of certain solids, the surface becomes the source of a secondary radiation. The object of his investigation was to compare the total ionization produced by the secondary rays with that which would be produced by the primary if they continued their path in the original medium. Then, supposing that the total ionization if not equal to, is at least proportional to the energy of the radiation, he obtains a measure of the ratio of the energies in the two kinds of radiation. From his experiments it follows that the total energy of the secondary radiation only amounts to about one-two-thousandth part of the energy of the primary radiation.—*Phil. Mag.,* Jan.

Radio-Activity of Thorium Oxide.—Fehrle.—An account of experiments showing that at least the more penetrating radiation of thorium oxide is due to the emission of particles of matter. He regards the radio-active oxide as in a perpetual state of decomposition, one of the products of this decomposition being the rays which possess the greatest penetration.—*Phys. Zeit.,* Jan. 1; abstracted in Lond. *Elec.,* Jan. 17.

Electro-Chemistry and Batteries.

Formation of Peroxide Plates.—A description of a process used by a German company. A metallic lead plate is first used as anode in dilute sulphuric acid, until a brown layer of peroxide of lead is formed. The plate is then washed and put into a bath of very dilute nitric acid in pure water. When it then gets a gray color, it is taken out and again used as anode in dilute sulphuric acid, and so on. This alternative treatment is continued until the plate has the capacity which is wanted. This treatment not only saves time, but also enables one to get a high capacity as the formation enters more deeply into the plate. Only a relatively very small amount of nitric acid in water must be used. A solution of 1.5 per cent has been found to be sufficient. A too concentrated solution injures the subsequent formation.—*Elek. Rund.,* Jan. 15.

Electric Manufacture of Carbon Bisulphide.—Taylor.—Illustrations, with a description of an electric furnace for making carbon bisulphide. The furnace is of upright or stack form. Sulphur is placed in the bottom of the working chamber of the furnace and as far around the electrodes as may be deemed advisable. Fragments of broken carbon or coke are placed upon or between the electrodes, and the whole upper body of the furnace is filled with charcoal. As the sulphur is vaporized, the vapors pass off through the hot charcoal, combining with it and forming the vapor of bisulphide of carbon, which passes off through a side pipe at the top to a condenser.—*Elec. Rev.,* Feb. 1. (A detailed description of the Taylor furnace will be found in Electrical World and Engineer, Dec. 21, 1901.)

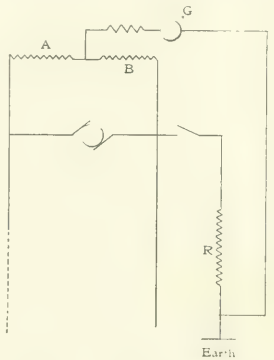
REFERENCES.

Electrolytic Deposition of Lead.—Linn.—A brief note on an Am. Chem. Soc. paper, stating that lead can be deposited electrolytically in a form suitable for weighing, from a solution containing free phosphoric acid.—*Science,* Jan. 24.

Primary Batteries.—An editorial note on primary batteries. Standard cells for laboratory and testing purposes excepted, the only really important improvement in primary batteries during the last two decades has been the introduction of the dry cell. The difficulty in "dry" cell construction has always been to keep the cell moist.—Lond. *Elec.,* Jan. 24.

Units, Measurements and Instruments.

Bridge Method for Measuring Insulation Resistance.—Eisler.—An illustrated description of a bridge method for measuring the total insulation resistance of a direct-current network during the time of service. The adjoining diagram shows the method as applied to a



MEASURING INSULATION RESISTANCE.

two-wire system. At any point of the system, for instance, at the switchboard, two adjustable resistances A and B are connected between the two sides of the system. The joining point of A and B is connected to one pole of a galvanometer, the other pole of which is connected to earth. A known resistance R can be connected between a point of one side of the sytem and earth. At the beginning R is disconnected, and A and B are so adjusted that the galvanometer shows no current. The ratio of A to B in this case may be M. Now R is connected between the system and earth, and A and B are again so adjusted that the galvanometer shows no current. The ratio of A to B in this case may be N. Then the total insulation resistance is R multiplied by the ratio of $N - M$ to $M + 1$. The same method may be used for a three-wire system. A and B are here connected in series between the outers, and R between earth and a point of that outer to which B is connected. The total insulation resistance is then again given by the same formula. Several numerical examples are given for illustrating the method.—*Elek. Neu. Anz.,* Feb. 1.

Quadrant Electrometer.—Dolezalek.—A description of a new form of quadrant electrometer. Owing to the disturbing influence of magnetic forces, the galvanometer has reached the limit of improvement. It is, therefore, desirable that the electrometer should be brought up to the same high standard of efficiency. The chief difficulty in the way of improvement in the quadrant electrometer is the necessity of charging the needle. If this is done through the suspending wire, the latter offers a considerable turning moment, unless it is made of silvered quartz fiber, which, however, is extremely difficult to pre-

pare and manipulate. He, therefore, suggests the use of a quartz fiber rendered slightly conducting by dipping into a solution of some deliquercent salt, such as calcium, or magnesium chloride. The conductivity thus acquired is practically permanent, and is sufficient for charging the needle. The latter is of the lightest kind, made of what is sometimes called in Germany "silver paper," i. e., paper covered with a layer of zinc and cut into the form of the usual needle. In the actual instrument the quartz fiber is 0.009 mm. thick, and the needle has a period of oscillation of 18 seconds. The instrument measures a difference of potential of 0.001 volt within 10 per cent and 0.1 volt within 2 per cent or less. He also tried to avoid the use of a conducting fiber altogether by suspending with the needle a small dry cell, which would keep it charged, but he found the cell got exhausted in a few months.—*Zeit. f. Instrumentenkunde,* Dec.; abstracted in Lond. *Elec.,* Jan. 31.

REFERENCE.

Cable Testing.—Savage.—The conclusion of his article on the methods of eliminating corrections for the leads, etc., in cable testing. The article is well illustrated by diagrams.—Lond. *Elec. Rev.,* Jan. 24.

Telegraphy Telephony and Signals.

Wireless Telegraphy.—Some editorial notes on the business scope of wireless and cable telegraphy. Marconi's achievement "is far more likely to lead to more rapid methods of working submarine lines than to general instantaneous communications through the air." . . . "The greater the knowledge of the subject the more assured is the conviction that the true field of this latest method of electric communication is for comparatively short distance, and in cases where it is difficult or impossible to maintain wires." . . . "It would be a thousand pities if etheric communciation were to be set to bridge great distances, for which it shows no sort of fitness, to the neglect and injury of the potentially vast field of usefulness where it is urgently needed—namely, principally in connection with shipping." Reference is made in this respect to a recent speech of Barry to the stockholders of the Eastern Telegraph Company.—Lond. *Elec.,* Jan. 31.

Wireless Telegraphy versus Submarine Cables.—A second and third article, giving the opinions of various British engineers on the probable commercial results of Marconi's experiments. Most of them do not think that the submarine cable would have to fear anything from the competition of wireless telegraphy. There is, however, a long eulogy of Marconi's achievement by Guarini.—Lond *Elec. Rev.,* Jan. 24, 31.

REFERENCES.

Wireless Telegraphy.—Tobler.—The first part of a long and well illustrated description of various forms of transmitting and receiving instruments for wireless telegraphy, as made at present for commercial installations.—*Jour. Teleg.,* Jan. 25.

Wireless Telegraph Apparatus.—Collins.—An illustrated article giving practical suggestions for constructing an efficient wireless telegraph apparatus at a small cost.—*Sc. Amer. Sup.,* Feb. 15.

Telegraphy in 1901.—A general review of the development of telegraphy and telephony in 1901 in various countries.—*Jour. Teleg.,* Jan. 25.

Telegraph Steamer.—An illustrated article on the new British steamer "Viking" for laying and repairing telegraph cables.—Lond. *Elec. Rev.,* Jan. 31.

Submarine Cables.—The first part of an illustrated article in which, after a brief description of the construction of the usual types of submarine cables, the general formulas are given which govern the dimensions of the design.—*Jour. Teleg.,* Jan. 25.

Miscellaneous.

Electric Arc Furnace for Making Glass.—Du Welz.—An illustrated account of experiments made by Henrivaux. There are three steps, made of a refractory material, on each of which a powerful arc is at work. The glass-making mixture is fed from a hopper on the top step, and passes successively through the arc on each step, finally falling in molten drops itno a basin, where it is kept fused by coke or gas for refining. The results obtained up to the present show that the system is very wasteful of heat, as compared with modern gas-fired glass furnaces, which can be worked with from 1.5 to 2.8 kilogram of coal per kgr. of glass made, while the figures obtained show that "a current equivalent to 9.3 kgr. of coal" was used per kgr. of glass made electrically. The inventors believe that they will finally succeed in reducing this to an equivalent of from 1 to 1.5 kgr.—*Ass. Ing. El. Liege,* Sept. 21; abstracted in *Science Abstracts,* Jan.

British National Physical Laboratory.—An article stating that the alternations required to fit up Bushey House as a laboratory are now practically complete. Up to the present the work of the laboratory has been carried out at Kew observatory. Immediately after the opening, attention will be directed to the following new branches of testing work: Tests of pressure gauges and engine indicators; magnetic tests of iron for permeability, hysteresis, etc.; insulation and resistance tests; tests on electrical apparatus not coming under the purview of the Board of Trade; microscopic and other tests of steel for rails and other metals; measurements of gauges and standards for use in engineering works; measurements of standard screws; tests on glass measuring vessels; flasks, burettes, etc., for use in chemical laboratories and elsewhere; tests on weights for laboratory use; thermometer and pyrometer testing.—Lond. *Elec.,* Jan. 24.

New Books.

Wireless Telegraphy. A Popular Exposition. Second Edition. By C. W. Tunzelman, B. Sc. London: Office of Knowledge. 104 pages, 30 illustrations. Price, 1 shilling 8 pence.

The author of this treatise has found space within the confines of 100 pages to tell much, and with considerable detail of the rapidly advancing art of wireless telegraphy. To those who are interested in the classical experiments which led finally to the magnificent practical results achieved by Marconi, this book will be well worth the reading. For instance, the phenomenon Faraday discovered showing the relation between light and a magnetic field, is explained clearly in a few lines; and again the fact that a wave of light excited from a given source does not emit the radiation from the source itself, but from a point a quarter of a wave-length in advance of it, are only two of the many bits of information, allied to wireless telegraphy of interest contained therein.

The analogues given to illustrate mechanically the principles of the Leyden jar and those of the ether, seem a little out of proportion for so popular an exposition, and one is lead to suspect Fleming is right when he says that it is easy to become a slave to analogues. However, the mechanical models are much clearer than the more vague and untangible disturbances in the ether we call electricity and others we term electric waves.

The last quarter of the book treats of the Marconi system to the exclusion of all others, and to one unfamiliar with the work of other investigators they would be justified in believing Marconi is alone in the field, which brings to mind the story of the young lady who, on seeing for the first time an electric light, exclaimed, "Is it not wonderful how Edison invented electricity." As a history of what Marconi has done it is very good what there is of it.

Central Electrical Stations, Their Design, Organization and Management. By Charles Henry Wordingham, A. K. C. London: Charles Griffin & Co., Limited. 500 pages with 136 illustrations and folding plates. Price, $7.50 net.

Judging from the title of this work, one would expect to find a broad and comprehensive and at the same time deep and exhaustive treatise on the subject of central stations, dealing with the problems which arise in their design, organization and management. On the contrary, and greatly to the disappointment of the reader, this volume is little more than a description of the methods employed and the apparatus used by a corporation or municipality in operating its central stations for the supply of light and power to be used in the same city in which the plant is located; commencing with the location and structure of the station building, describing the generating and distributing apparatus, the connection to the customers' premises and the laying out of the general office work.

If the description had a broader scope and a more universal sympathy, not only would its value be greatly enhanced, but it would also be much more convincing; but the author has confined his treatment, almost entirely, to engineering customs from an English standpoint, and that very largely from the experiences of a single plant located in Manchester, England.

The book presents a very good picture of English central station engineering and business policy as viewed by English eyes, but lacks

the breadth of experience to be of universal value and lends itself merely as a single example of one branch of electrical art.

The point of view of the author is evidenced in a characteristic manner by the attitude assumed in the following statement, quoted from the chapter on "Central Station Work as a Profession."

Speaking of whether a youth should seek his technical training in England or abroad, the author writes: "Now, if the years in question be spent abroad, golden opinions may be earned, but they will be wasted so far as advancement is concerned, because those holding them do not come into contact with the persons among whom the student is thrown. He returns to England unknown, and has to start afresh, and to make new friends with far fewer opportunities of doing so than he had at college." It may be added that the author is directly connected with a technical institution in his own city.

As a text-book for schools or colleges, this work should find a place, as it deals with many of the engineering problems of central station work, and describes in detail apparatus in use and methods of operation which are of interest to the student, but which would be but little more than a matter of history to the modern electrical engigineer.

In some parts of the book the author goes needlessly into detail in the description of some minor piece of apparatus, while at another time a matter of greater importance is lightly passed over with merely an allusion being made to it. There are a number of gems throughout the book which are very valuable, the subjects being treated in a straightforward and masterly manner, but they are set in such a profusion of commonplace material that a reader tires before they are discovered and rescued. The book would have been far more valuable if a considerable part of it had been omitted, and the remainder stated in a more concise manner with a broader view and from various standpoints.

The first five chapters are in the form of a general introduction, treating the subject of central station work as a profession and investment, also the establishment of the central station and the system of supply from the station of the customer. Chapter VI. to VIII. deal with the generating station, discussing its location, architectural features and general design. The discussion is rather general and somewhat theoretical, but contains many interesting and important facts which, although already known by the engineer, are of interest to the student.

The chapters from the ninth, including the seventeenth, have to do with the apparatus contained in the station, such as boilers and boiler accessories, the generators, both steam and electrical, as well as the switches, instruments and electrical connections. There are also discussed the firing and feeding of boilers, the handling, weighing and storage of coal, the transmission of steam and condensing appliances. These chapters are very elementary in character, a great deal of space being devoted to describing and illustrating different types and makes of apparatus with minute description as to their mechanism and manner of working.

Chapters XVIII. to XXIV. are devoted to underground systems of electrical transmission, beginning with those which have long since outlived their usefulness and describing others which are being installed at the present time. There are treated in this section different kinds and makes of distributing mains (both the "drawing-in" and "built-in" systems), various dielectrics, insulation resistance and cost, distributing networks, service mains and feeders, also the testing and recording of the laying of mains.

This discussion has a very local flavor, terms being employed and usuages being described which would have little application in another locality or under different conditions.

Chapter XXV. describes somewhat in detail the different classes and types of meters and other appliances located on the customers' premises, followed by a chapter on the testing of meters, also the design and use of a general testing laboratory. Chapter XVII., on secondary batteries, is a general and somewhat superficial description of storage batteries with regard to their structure, use and methods of charging, together with the switches for operating the same.

Chapter XXVIII. deals with the general subject of street lighting, discussing the different systems employed, kinds of lamps used, the operation of the lamps and the supply of current to them. The cost of producing electrical energy is taken up in Chapter XXIX., and is rather above the average in point of practicability and cleanness; statistics in the form of tables and curves being added which increase greatly their interest and value.

Chapter XXX., on the methods of charging, is an up-to-date discussion of the subject, and is one of the most valuable chapters in the book. It takes up very fully the different classes of customers, together with the rates of charging justifiable in separate cases, also the various ways of measuring the amount and character of the current used. Chapter XXXI., on the regulation of consumers' installations, contains little of interest to the American reader. Chapters XXXII. to XXXVIII. deal with the organization of a central station, taking each department separately, and giving a list of the officers and clerks required, as well as the forms to be used, both of which would vary in almost every instance, and hence are of interest merely as an illustration of what has been done under certain conditions.

The last two chapters, on the consumer and the routine of main laying, are a general description of the movements necessary, and the instruments to be used in laying the underground conductors and connecting the same in the customers' premises, ready for service. The various blank forms added throughout the book are extremely local and cumbersome, and are valuable only as suggestions rather than models.

As stated before, the work, as a whole, is better fitted for a general text-book than for a guide to a practical engineer.

Handbuch der Elektrischen Beleuchtung. Von Joseph Herzog und Clarence Feldmann. Second Edition. Berlin: Julius Springer. 619 pages, 517 illustrations, 5 plates. Price, 16 marks.

The authors of this work are well known to the reading electrical engineering public, and both have largely contributed to the literature of the calculation of closed and open electric networks. The book is divided into nine chapters, the first of which is devoted to the sources of illumination, including projectors, illuminated fountains, and combinations of sources of light for advertising purposes. The second chapter deals with electric wiring, describing in detail the construction of insulators for indoor and outdoor work, conduit systems, and cables. In the third chapter the different combinations of the generators and transformers in the central station are described, including discussions on the potential drop in alternators and the oscillation of alternators operating in parallel. A paragraph is devoted to single and polyphase induction motors.

The regulation of direct and alternating-current systems is described in the fourth chapter, space being given to some very ingenious end-cell regulators widely in use in European central stations built by the Schuckert Company. Regulators for alternating current systems are treated rather briefly, American constructions not even being alluded to.

In the fifth chapter on auxiliary apparatus we miss the description of oil switches which, owing to their constantly growing importance, should not be omitted in any book in which switches for alternating currents are treated; also the space given to lightning arresters seems utterly inadequate, considering the many pages devoted to electric fixtures.

The book winds up with two chapters on central station work, giving descriptions of some interesting stations, and being full of interesting and useful suggestions to the thoughtful and critical reader.

A work like that of Mr. Herzog and Mr. Feldmann, intending to cover almost the entire field of electrical engineering, must needs be of a somewhat encyclopædic character, and, therefore, slur over difficulties, and dwell on details and unimportant subjects at greater length than it would be desirable in a work of a more special character. The authors, however, have succeeded in writing a very interesting work, the study of which will well repay the reader, and the practical engineer will find many interesting paragraphs which reflect the valuable experience of the authors.

We have received from H. Alabaster, Gatehouse & Co., of London, the new 1902 edition of their Berly's "Universal Electrical Directory," bound in scarlet cloth, and issued in England at $2.50. It is a standard publication, and is very useful to all having international correspondence or business. It comprises the names of the members of the electrical and kindred industries throughout the world. The book has been most thoroughly revised, and the British alphabetical section now comprises about 10,640 distinct names; Continental alphabetical section now comprises about 9240 names; United States alphabetical section now comprises about 5830 names; colonial alphabetical section now comprises about 3190 names; or a total of 28,900.

For simplicity and facility of reference it is divided into four

groups, namely: British, Continental, American and Colonial, which are again sub-divided into alphabetical and classified sections. In the case of the British a geographical section is given, making in all nine sub-divisions.

In addition to the new names incorporated in the present issue, much financial information is given, the telegraphic addresses and local telephone numbers are given, and the pages added to the work are 36 in number, as compared with that of 1901, making in all about 1280 pages entirely of directory mattery. The lists of central stations in the United Kingdom and colonies have been considerably added to, and the engineer's name, system of distribution and voltage has been included. This is in itself a valuable feature, and typical of the enterprise shown in maintaining the high standard of the work.

BOOKS RECEIVED.

A TRAVERS LA MATIERE ET L'ENERGIE. By Dr. F. E. Blaise. Paris: Librairie Ch. Delagrave. 344 pages, 68 illustrations. Paper cover. Price, 12 francs.

LES TRAMWAYS ELECTRIQUES. By Henri Marechal. Paris: Ch. Beranger. 328 pages, 188 illustrations. Price, 10 francs.

[illegible] AND MAGNETISM. An Elementary Book on Electricity and Magnetism and Their Applications. By Dugald C. Jackson and John Price Jackson. New York: The Macmillan Company. 482 pages, 358 illustrations. Price, $1.40.

ELECTRIC POWER TRANSMISSION. A Practical Treatise for Practical Men. By Louis Bell, Ph.D. Third Edition, revised and enlarged. New York: ELECTRICAL WORLD AND ENGINEER. 632 pages, 21 plates, 285 illustrations. Price, $3.

THE BEACON BIOGRAPHIES. Samuel F. B. Morse. By John Trowbridge. Boston: Small, Maynard & Co. 134 pages, frontispiece portrait. Price, 75 cents.

L'ANNEE ELECTRIQUE. Electrotherapie et Radiographie. By D'Foveau de Courmelles. Paris: Ch. Beranger. 430 pages. Price, 3½ francs.

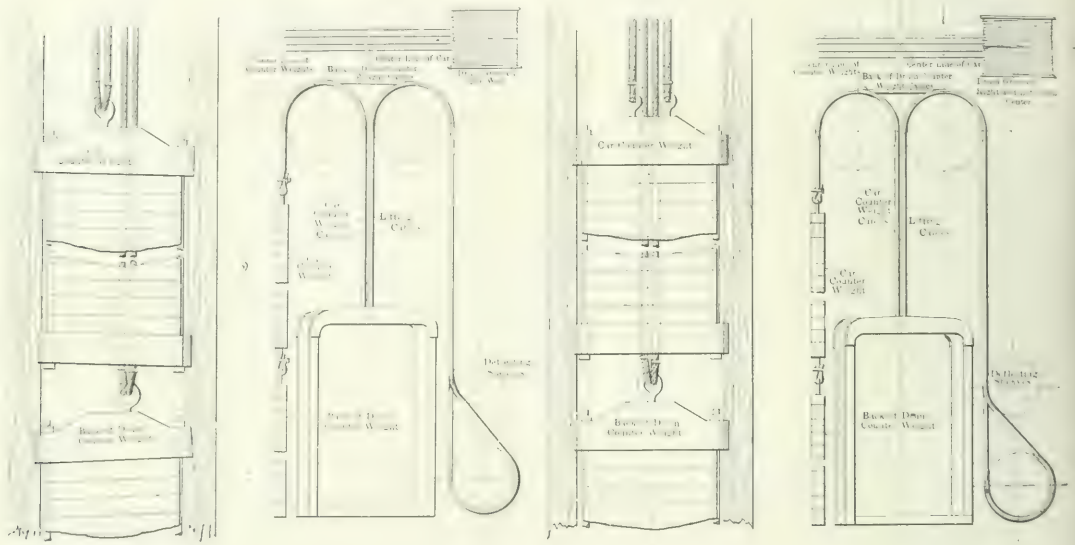
A New Arrangement of Counter-Balance for an Elevator Car.

[illegible] B. KELLOGG.

The usual arrangement of counter-balance for an elevator car is shown in Fig. 1. The cables from the car are attached to the top weight, while those from the back of the drum are led through cored slots in the top and attached to the lower weight, as shown. Half the distance between the center lines of the eye bolts is the distance of the center of gravity of the weight from the line of the cables. The result is that the weight sags on the heavy side, somewhat as shown in Fig. 1. The guide thus soon becomes badly worn. Fig. 2 shows the overhead arrangement of the sheaves and cables, and also the grooving of the drum.

Fig. 3 shows a new arrangement of counter-balance. It will be noticed that the car counter cables are separated and fastened to individual eye bolts at equal distances from the center of gravity of the weight; while the back of drum counter cables pass through cored slots in the top, and are fastened to the lower weight by an eye bolt in a line of the center of gravity. There will thus be no tendency for the weights to tip over, and consequently undue wearing away of the guide will be done away with.

The arrangement of the overhead sheaves and cables and the grooving of the drum are shown in Fig. 4. Here it is seen that the grooving of the drum is right and left hand from the center, while in Fig. 2 it is grooved in one direction all the way across the face. It is also seen in Fig. 2 that the center of the drum, car, counter-



FIGS. 1, 2, 3 AND 4.—COUNTER-BALANCE FOR ELEVATOR CARS.

weight and sheaves are not on the same line. A happy medium must thus be struck, in locating the overhead beams and sheaves, the counter-weight being pulled out of center one way, and the car the other. In Fig. 4 the centers are all on the same straight line, and all the parts will therefore be balanced.

Paragon Fans for 1902.

The record of the Paragon fan for 1901 made it unnecessary to incorporate any radical changes in construction, and the only changes, therefore, in the 1902 model are an improved guard support on the desk trunnion and bracket fans, and an improved adjustment for the bracket and trunnion types. The new guard support consists of three radial arms secured to the body proper, while a fourth support is provided by the pedestal of the fan itself, thus making an attachment of such rigidity that the complete fan can be suspended or carried from the guard itself without straining it in the least.

The searchlight type of trunnion and bracket fan is retained, a new adjustment being added of such construction that the device

does not rely upon the friction between the fork and body to retain the fan in position; but, instead, the clamping screw is given such a position that a very slight friction or tension upon it secures the fan readily in any desired position. This is accomplished by placing

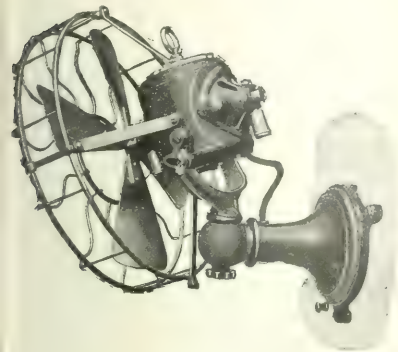
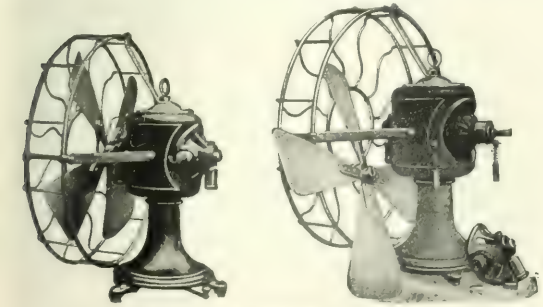


FIG. 1.—PARAGON FAN MOTOR.

the screw at a distance from the center about which the fan pivots.

The same excellence of material and workmanship, as has given the Paragon apparatus its present reputation, is maintained, and its manufacturers, the General Incandescent Arc Light Company, of New York, have retained such important features as rectangular carbon brushes, enameled resistances, one piece magnetic circuit, and



FIGS. 2 AND 3.—PARAGON FAN MOTORS.

the retaining shield for the bearings to prevent the creeping of the lubricant on the armature. The current consumption remains as low as ever, while the speed has been slightly increased, so that the actual efficiency has been raised.

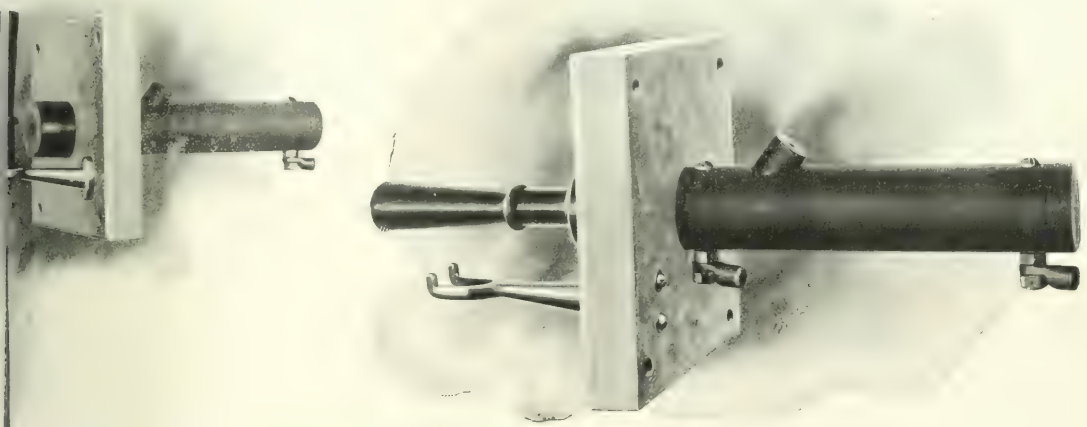
"Stab" Switch.

The "Stab" switch, shown herewith, has been designed particularly for series arc and incandescent lighting circuits. It is made of a thick fiber tube, which is held to the switchboard marble by the escutcheon *A* (Fig. 3). The escutcheon is of hard rubber and very neat in appearance.

The circuit is closed by inserting a rod connecting the front terminal and rear terminals, *D* and D^1. Withdrawing the rod to open the circuit allows the little marble ball *B* to drop out of its tube *C* into the main tube of the switch, smothering any arc that may form. In closing the circuit, the rod which is pointed, pushes the marble ball up into the tube *C*. When on open circuit the rod is supported on the fork shown in Fig. 1.



FIG. 3.—"STAB" SWITCH.



FIGS. 1 AND 2.—"STAB" SWITCH.

This switch operates satisfactorily at 6000 volts, and in its entirety is very neat and compact. It is readily removed from the marble by simply unscrewing the escutcheon. The manufacturers are the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

A New Test Truck.

We illustrate an English testing cart, made by Elliot Brothers, London, which has been introduced especially for rapid localization of faults on large underground networks, a matter of the utmost importance in England in view of the stringent conditions contained in recent legislation and government regulations.

The apparatus consists essentially of a small portable battery, a standard resistance (usually 1 ohm), and a very accurate voltmeter of high resistance. An adjustable resistance is provided for keeping the battery current constant, as well as the necessary reversing and change-over switches, while an ammeter is usually included for the purpose of regulating the charge and discharge of the cells. The voltmeter, as a rule, has a maximum range of 10 volts, the same scale being used to read the current flowing through the standard resistance. The design is the result of a wide experience in cable work,

and embodies, it is believed, everything and no more than is necessary. The results obtained by careful observers in actual practice by this method are said to be wonderfully exact. In a test on a 2700-yard length of concentric cable, in which there was a "short" and also an earth of about 1000 ohms resistance, the fault was localized to 5 yards. This distance was the mean given by five tests, the greatest divergence from the exact position being only 10 yards.



TESTING CART.

Such accuracy as this is not always obtained, however, the more usual course being to open up the joint box nearest to the indicated position of the fault if the length is over 1000 yards and make a new test on a shorter length.

The "Ideal" Engine Lathe.

An advance in engine lathes for general shop purposes has recently been placed on the market by the Springfield Machine Tool Company, Springfield, Ohio. This lathe has been designed to meet the demands of modern shop practice, being equipped in such a manner as to permit of effecting with dispatch all changes necessary for a wide range of feeds and screw cutting, and without removing any parts held by nuts and washers. A principal consideration was to have only such gears running as are necessary to transmit motion from the spindle to the lead screw, and although reverse gears have been added to the headstock, only seven gears are in operation when a right-hand thread is being cut, and eight for a left-hand thread.

All the change gears required on the lead screw have hub extensions on one side and revolve freely in brackets placed concentric in a disk, which disk is large enough in diameter to serve the purpose of a gear guard, since none of the gears, eight in number, is visible. The disk revolves on a stud secured to a case supended from the front lead screw box. By revolving the disk any of the gears, which, of course, are independent of each other, can be brought in line with the lead gear. This gear has a telescopically arranged extension controlled by a lever, which extension is reduced at its end to enter the hole of a change gear a distance equal to its width before the clutches with which the change gear and extension are fitted, come in contact with each other. It will thus be seen that when one of the change gears is connected with the lead screw it ceases to be supported by the disk, but is mounted on the screw as substantially as if it were secured to it by nut and washer.

As a sufficient range of feeds or screw pitches cannot be obtained by changing gears on the lead screws only, provision is made at the headstock for various ratios of speed. This is accomplished by means of three pairs of gears, contained in cases, which give ratios of 2—1, 4—1, 1—2, and 1—4, resulting in five different rates of speed for the fixed pinion which meshes with the intermediate gear transmitting the motion to the lead screw. The gears contained in this case are similar to those in the disk, and they are placed in position by slipping them on the reduced ends of the spindles, which are provided with clutches to engage them, and when in position for operation they are supported by the spindles instead of the cases, the only object of the latter being to facilitate handling and provide suitable guards. Since only one pair of gears can be used at a time, a receptacle is provided, as shown, in the leg of the lathe to receive the other pairs, where either is instantly available and can be placed in position in a moment.



FIG. 1.—END VIEW OF LATHE.

The intermediate gear referred to above revolves in a fixed stud in a quadrant, as it requires no radial adjustment. The quadrant has a projection on its lower side, which is machined to the pitch radius of the intermediate gear, and as the same provision is made on the disk for each of its gears, it is only necessary to trip the intermediate gear until these surfaces meet, and then secure the same with a clamp lever.

The actual swing over the bed of the lathe is 17 inches, and the

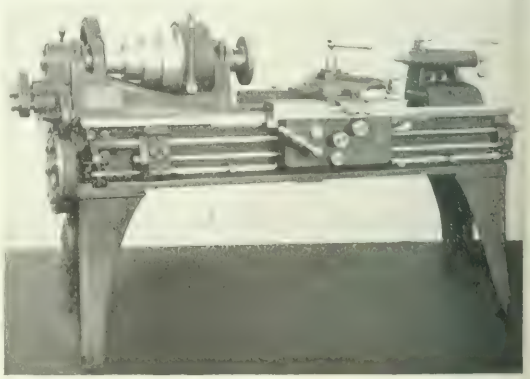


FIG. 2.—ENGINE LATHE.

range of threads that can be cut on the lathe is from 2 to 56 per inch, with a turning feed of from 8 to 224 per inch. Every change required to cut any of the threads or feeds between the extreme limits can be made when the lathe is in motion.

The reversing mechanism is of a type which does not require the use of a reversible countershaft for screw cutting purposes. This adjunct is controlled at the apron and is thus very convenient. Its

gears are placed between the end of the headstock and the apron secured to it, and are driven by a number of slip gears on the spindle, which may be slipped out of contact if no motion is desired. The reversible spindle engages the former or backing gears by means of a positive clutch actuated by the operator from his position in the front of the lathe carriage, by a lever suspended from the apron and sliding on a rod, to which it is keyed. This rod is connected to the clutch by suitable mechanism, and also serves the purpose of an automatic stop for either right or left-hand motion, both in turning or screw cutting. The frictions are susceptible of ample and convenient adjustment for wear, and will prove efficient during the life of the lathe. The spindle is hollow, made of hard, hammered crucible steel, and provided with journals of large diameter revolving in self-oiling bronze boxes.

Independent Telephone Association of Wisconsin.

The convention in Milwaukee of the Independent Telephone Association of Wisconsin is reported to have been a very successful one, about 100 local associations being represented. The election of officers resulted as follows:

President, Richard Valentine, of Janesville; vice-president, H. G. Slater, of Waupaca; secretary-treasurer, H. C. Winter, of Madison. Executive Committee: C. W. Twining, of Monroe, first district; T. H. Sweet, of Fond du Lac, second district; J. C. Harper, of Madison, third district; William Lohmiller ,of La Crosse, fourth district; B. R. Lewis, of Rhinelander, fifth district; Captain John M. Baer, of Appleton, sixth district; Senator Gaveny, of Arcadia, seventh district; H. H. Stewart, of West Superior, eighth district; W. J. Bell, of Baraboo, chosen as a member of the committee-at-large.

It was decided to hold the summer meeting at Waupaca some time in June next in connection with the Northestern Electrical Association, and to hold the next annual meeting in Milwaukee, Feb. 3, 1903.

Mr. R. A. Tompkins, president of the Illinois State Telephone Company, addressed the delegates with regard to telephone conditions in Illinois. The following papers were read:

"The Proposed Contract of the Wisconsin Telephone Company," by Judge Gainor; "Possibilities of Association Effort," by E. B. Fisher, Grand Rapids, Mich.; "Bridging Magneto Bells," C. W. Farr, of Chicago; "Transmitters," by the representative of the Eureka Electric Company; "Telephone Cables and Their Construction," R. B. Abbott, Chicago; "Telephone Construction and Material," H. R. Ritter, Madison.

Two Telpherage Plants.

The variety and magnitude of the work to which telpherage is now being applied is quite surprising, and yet not so surprising when one



FIG. 1.—TELPHER LINE IN A MANUFACTORY.

considers how readily this means of transportation lends itself to the haulage of freight of every character. The United Telpherage Company, of 20 Broad Street, New York City, has not only been called upon to construct plants for the most widely different classes of work, but has had to deal with obstacles and difficulties which were such that nothing but the handy little telpher traveling along its aerial track was able to overcome.

Two recent plants illustrative of separate branches of the work are here illustrated. One of the cuts shows a factory in New England in which the telpherage line runs from one building to the other. The system is worked automatically with a switch at either end. The telpher box is conveying saws in a water-proof carrier. The line



FIG. 2.—TELPHER LINE IN FACTORY ON NEW YORK WATER FRONT.

has a sustaining capacity of 1200 lbs. It is 50 ft. from the ground, and current is supplied at 250 volts.

The other plant here illustrated is in the vicinity of New York City, and is employed for handling ashes and refuse along the water front. Work of this kind suits the telpher plan admirably. In this instance, the plant has a capacity of getting out 150,000 lbs. of ashes in 10 hours. As will be noted, the telpher hauls a trailer, and the average energy consumed is 1 hp. At the present moment, the line is handling the ash output of 23 boilers, as well as other refuse. The elevated position of the telpher line permits the material to be dumped into the center of a barge, thereby obviating entirely the employment of labor to distribute and level, which was necessary when dump carts were used.

Mechanically-Operated Reversing Switch for Electric Motors.

Incidental to the design of automatic motor starters for elevator and similar service, a problem to be overcome is the destructive arcing caused by the discharge of the shunt field which invariably occurs when the combination of field and armature is broken. This arcing not only rapidly destroys the contacts of the switch, but also produces a dangerous strain on the windings of the motor, which fre-

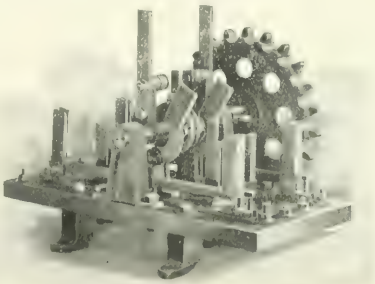


FIG. 1.—REVERSING SWITCH.

quently results in breaking down the insulation. In an effort to protect the insulation, it has been common practice to place across the field terminals a resistance to receive the discharge when the switch is opened, but this method was only partially effective.

The switch illustrated herewith is designed to completely over-

come these defects. This is accomplished by separating the parts which are used for making up the combination of field and armature from the main line switch, and mounting these independently. The throwing of the main line switch in either direction sets the combination which determines the direction of rotation, but the return of the switch to the center point does not disturb the combination thus selected; when the switch is thrown to the reverse position, a new combination is effected just prior to the entrance of the main line contacts. As the usual brake mechanism for stopping the armature will have set at or near the center of the switch throw, there will be no discharge from the field in reversing.

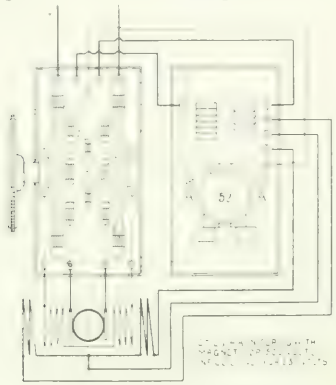


FIG. 2.—DIAGRAM OF CONNECTIONS.

Usually reversing switches are used on elevator motors which require heavy starting torque. To secure this, the motor is provided with one or more series coils, and it has always been necessary to carry the current through these coils before entering the switch, so that the direction of the current in both series and shunt fields would be the same. This resulted in keeping one side of the main line always connected to the motor. The present switch completely separates both sides of the line from the motor, as will be seen by an examination of the accompanying diagram of connections (Fig. 2).

As most of the wear comes on the main line contacts, these are readily and cheaply renewable, the blades and clips being easily detachable, and of simple form. The contacts may be removed and replaced without tools. All parts are interchangeable and are assembled by jig. This switch, which is made by the Automatic Switch Company, New York, is adapted for use with either shunt, series or compound wound motors, not exceeding 600 volts.

New Lathe.

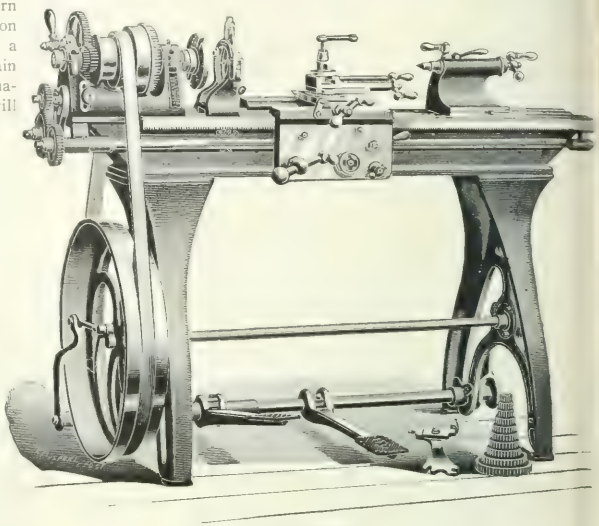
We show in the accompanying cut one of the latest types of "Star" foot lathes, adapted for repair shops, experimental and model work. These lathes are made in varying sizes, ranging from 9-inch swing, 24 inches between centers, up to 13-inch swing, 66 inches between centers, and are mounted on curved legs, when furnished with foot power, and on straight legs for shop use with countershaft, and on an oil pan for tool room use.

The head stock has a hollow spindle made from a crucible steel forging, running in long phosphor bronze bearings with an improved end thrust ball bearing. The tail stock is of improved curved pattern, which allows the compound rest to swing around parallel with the ways and over the base of tail stock with room to operate feed screw handle. The tail stock spindle is ararnged with self-discharging center and improved locking device, an adjustable side movement is provided for turning tapers.

The carriage has a long bearing on the ways, and is gibbed to bed both front and rear. It has interchangeable plain and compound rests with graduated base for making fine adjustments. The improved tool post collar and shoe excludes all dirt and chips and admits of a quick, easy and secure adjustment of the tool.

The automatic cross and longitudinal feeds are actuated by a phosphor bronze worm on the lead screw, which is splined. For all work except screw cutting it simply acts as a feed rod, and, therefore, the only wear on its threads is in screw-cutting. The feed may be thrown in or out of contact by simply moving a lever, and will feed in or out, right or left, and cut screws right or left. All standard threads from 3 to 64 can be cut without compounding the gears, and nearly all threads by compounding them.

The patent foot power consists of two treadles, with a walking motion. It can be started or stopped instantly, and may be operated



NEW LATHE.

with both feet sitting or one foot standing. When desired, a friction countershaft is furnished in place of the foot power.

The "Star" lathes are made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y., U. S. A.

Indiana Automobile Show.

The first annual automobile show given by the Indiana Automobile Association was opened in Indianapolis on Feb. 17. The exhibits are more extensive and the decorations more attractive than was expected. It is the purpose of the association to hold annually an automobile and bicycle show. Tests of climbing power will be made every day and evening by the various machines. The following companies and firms have exhibits at the show: Kokomo Rubber Company, Habbiek & Co., Indianapolis; Fisher Automobile Company, Indianapolis; Mueller & Co., Indianapolis; National Vehicle Company, Indianapolis; G. W. Westing, George Deitch & Co., Indianapolis; Haynes-Afferson & Co., automobiles, Kokomo; H. F. Hearsey, Vehicle Company, Indianapolis; Snyder Bicycle Company, the Union Automobile Company, of Union City, and many other out-of-town exhibitors. Tests of power and speed will be made during the week. On Feb. 18 automobilists from all over the State made a run to the city.

Lineman's Pliers.

We illustrate below one of the latest specialties of the Smith & Hemenway Company and the Utica Drop-Forge & Tool Company, consisting of a side-cutting plier, known by the trade name "Royal Blue." It is forged from the best tool steel, and made with reversible and renewable jaws, thereby saving considerable expense to the



LINEMAN'S PLIERS.

user, as it allows the changing of jaws from the upper to the lower, when they become worn. It has, also, rounded corners and sides. This plier is of great advantage to a lineman, because when worn out or chipped in the corner next to the joint, the ordinary plier is useless, while this one by changing or reversing the jaws is made practically new at no further cost.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a fair demand for time money, and the supply was very good, the rates being 3½@4½ per cent for 30 to 60 days, and 4@4¼ per cent for longer arrangements. In the stock market there was a general decline of values on Thursday on the announcement of proceedings by the Government to annul the Northern Securities deal. Liquidation by timid holders was general, although the declines were checked by the support from large financial interests. The steel stocks showed strength on reports that the preferred stock will be retired by an issue of 5 per cent bonds. This, however, is now denied. Amalgamated Copper was firmer on short covering and better reports about copper trade conditions. In the traction list the operations were somewhat curtailed in Metropolitan Street Railway, the sales aggregating 56,750 shares, closing at 168⅝, which is a decline of about 3 points. Brooklyn Rapid Transit was also quiet, sales aggregating 27,280 shares, the closing price being 61¾, a net decline of 1 point. The sales of General Electric were 2900 shares, the prices ranging between 288 and 292⅜, the former figure being the closing quotation, which represents a net loss of two points. Western Union closed at 90½—a fractional decline—and Westinghouse, common and preferred, closed at 174 and 180, respectively. Other closing quotations are: American District Telegraph, 33, and American Telegraph & Cable, 90. The closing quotations of Tuesday, Feb. 25, are as follows:

NEW YORK.

	Feb. 18.	Feb. 25.		Feb. 18.	Feb. 25.
American Tel. & Cable....	91	—	General Electric.....	290	293
American Dist. Tel.....	30	—	General Carriage.....	⅞	⅞
Brooklyn Rapid Transit	62	64⅜	Hudson River Tel.....	—	—
Ches. & Pot. Telephone	—	—	Metropolitan Street Ry...	171⅝	168¾
Commercial Cable.....	155	—	N. E. Elec. Veh. Tran....	—	½
Electric Boat.....	26½	28½	N. Y. Elec. Veh. Tran...	13½	13½
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n....	1¾	1⅝	Tel. & Tel. Co. America..	4½	—
Electric Vehicle.....	2	1¾	Western Union Tel.....	90⅛	90¾
Electric Vehicle pfd.....	4¼	4½	West. E. & M. Co.....	174	177
			West. E. & M. Co., pfd..	175	180

BOSTON.

	Feb. 18.	Feb. 25.		Feb. 18.	Feb. 25.
Am. Tel. & Tel.....	158	157¼	Mexican Telephone	2	2
Cumberland Telephone...	—	—	New England Telephone*	140½	140
Edison Elec. Illum.....	257		Westinghouse Elec.....	90	87½
Erie Telephone.....			Westinghouse Elec. pfd..	90	—
General Electric pfd.....	292	292⅝			

PHILADELPHIA.

	Feb. 18.	Feb. 25.		Feb. 18.	Feb. 25.
American Railways.....		64½	Phila. Traction.....		100
Electric Storage Battery..	—	—	Philadelphia Electric.....	—	4¼
Elec. Storage Batt'y pfd..			Pa. Electric Vehicle.....		—
Elec. Co. of America....	—	6¼	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Feb. 18.	Feb. 25.		Feb. 18.	Feb. 25.
Central Union Telephone.	—	—	National Carbon pfd....	83	83½
Chicago Edison.....		163	Northwest Elev. com....	—	37½
Chicago City Ry.....	210	216	Union Traction.....	15¾	13½
Chicago Telep. Co.....	—	—	Union Traction pfd.....	48½	—
National Carbon.....	26½	19½			

*Asked.

NATIONAL CARBON ANNUAL REPORT.—The National Carbon Company reports for the year ended Jan. 31, 1902, as follows:

	1902.	1901.	Changes.
Net earnings	$586,812	$508,739	Inc. $78,073
7 per cent on pfd..	315,000	315,000	
Balance	$271,812	$193,739	Inc. $78,073
Depreciation	214,461	150,000	Inc. 64,461
Balance	$57,351	$43,739	Inc. $13,612
Doubtful accounts.	3,282	1,456	Inc. 1,826
Surplus	$54,069	$42,283	Inc. $11,786

It is reported from Chicago, where the stock is listed, that National Carbon has been active on the local exchange of late on rumors that the common might be put on a 4 per cent basis. There is $5,500,000 common and $4,500,000 preferred stock. Dividends of 1¾ per cent quarterly have been paid regularly on the preferred since the second quarter in 1900. During last two weeks the common issue as a result of the bullish rumors, jumped four points, from 18 to 22. The preferred has been steady, ranging around 85 since 1899. The buying of Carbon stocks by Cleveland and Chicago investors has been regarded as good. The officials have not denied the report that the common will be put on a 4 per cent basis.

CLEVELAND TROLLEYS.—The bankers' committee of the Everett-Moore syndicate issued the following official statement concerning the sale of the "Big Consolidated" Street Railway system of this city: The deal for the Everett-Moore holdings of stock in the Cleveland Electric Railway Company has been practically closed. A syndicate headed by Horace E. Andrews has contracted for the entire holdings of stock of the Everett-Moore syndicate in the company. The price at which the stock will be sold is $80 a share. The Elkins-Widener-Dolan syndicate, which was negotiating for the property, failed to make a proposition satisfactory to the committee. Mr. Andrews and his associates are also large holders of the stock of the Cleveland City Railway Company, of which Senator Hanna is president. It is understood to be the purpose of those interested in the two companies to effect a consolidation, putting every street car line in the city under one control. The sale of the Big Consolidated will, it is said, in a great measure relieve the situation which forced the Everett-Moore syndicate to ask assistance of the bankers' committee. The sale of the stock at 80 returns to the holding members of the syndicate their equities in the Big Consolidated. With the collateral trust plan in full operation to relieve the telephone situation, it is believed the syndicate will practically be in shape to go ahead and conduct the affairs of its numerous other interests as formerly.

AMERICAN HOME TELEPHONE COMPANY.—Messrs. C. D. Knapp, Jr., & Co., New York City, offer $311,000 of the American Home Telephone Company's collateral trust 4 per cent bonds. The 10 constituent companies are operating "independent" telephone exchanges in various cities and towns in New York, Ohio, Indiana and West Virginia and their operations during 1901 showed net earnings of $59,093.04, with an increase during the year of 2337 telephones. The consolidation is expected to secure increased economy in management, long distance connections and the prosecution of an aggressive policy for the benefit of all the companies. The obligation of the company secured by deed of trust to the American Trust & Savings Bank, Chicago, is stated to equal in value 35 per cent more than the amount of bonds issued.

DENVER TROLLEYS.—It is alleged but also denied that negotiations which have been pending for some time involving the sale of the Denver City Tramway Company to the Morgan-Ryan-Widener-Elkins syndicate for $8,500,000, have been completed practically. The Denver City Tramway Company owns 150 miles of track, covering 88 miles of streets of Denver, including the former holdings of the old tramway company, the Metropolitan Street Railway Company, the Denver Consolidated Tramway Company, the Denver City Railway Company, the West End Railroad Company, the Denver City Traction Company, and the Colfax Electric Company. The company is capitalized at $5,000,000, and has $5,837,000 in bonds outstanding.

PENNSYLVANIA ELECTRIC VEHICLE.—At the annual meeting of the stockholders of the Pennsylvania Electric Vehicle Company in Camden a statement was read showing the company's operations for the past year. Directors were reduced from 9 to 7. W. W. Gibbs withdrew his name both as director and president. Vice-President Herbert Lloyd will be president pro tem until the directors organize. The annual statement ending Dec. 31, 1901, shows:

Value of property, vehicles, etc.	$825,000
Sales of vehicles for 1901	88,000
Loss during first six months of 1901 from cab service.....	17,000
Profit during second six months (about)	4,000

BIRMINGHAM (ALA.) BONDS.—Messrs. Ladenburg, Thalmann & Co. offer to investors at 101 and interest, the unsold balance of $3,750,000 first consolidated mortgage 5 per cent gold bonds of the Birmingham Railway, Light & Power Company, of Birmingham, Ala. These bonds mature July 1, 1951, or may be called at 110 after July 1, 1906, and are a first mortgage upon all the lighting plants and street railway systems in the county in which Birmingham is situated, subject to $1,250,000 outstanding bonds of the Birmingham Railway & Electric Company, secured by a first mortgage on one-half of the mileage of the street railway system, for the retirement of which a like amount of bonds are held in the hands of the trustee.

FEDERIAL TELEPHONE COMPANY.—Directors of the Federal Telephone Company have voted favorably on a proposition to issue $1,000,000 of new collateral trust bonds at once, to give the company working capital for proposed extensions, and a meeting of stockholders will be held as soon as possible to pass on the action of the directors. These bonds will probably be sold to Cleveland banks. The remaining issue of $5,500,000 of collateral trust bonds which are to go to the creditors under the plan approved by the bankers' committee, will be passed upon by the directors at a later meeting.

MINNEAPOLIS GENERAL ELECTRIC report for the year ended Dec. 31 shows gross $405,034 and net $213,852, an increase in net over 1900 of $47,099. The fixed charges were $107,615, leaving firm net $106,238, out of which $45,000 was paid in preferred dividends.

Commercial Intelligence.

THE WEEK IN TRADE.—The severe weather conditions somewhat affected mercantile operations and hampered the movement of general merchandise and the products of industry. Specially good reports, however, come from the jobbers of the West and Northwest, while those from the South and Southwest are not so satisfactory, trade being quiet and not as good as last year. Iron and steel were active, strong and advancing, and the structural mills are sold ahead to September, but plate mills are well up with orders. Business in copper was very quiet, none whatever being transacted for consumptive account. Interest centered solely in the sparring of the speculators. The market declined about ½c. during the week, closing quotation being 12¼c.@12½c., spot to May, Lake; 12¼c. to 12⅜c. for electrolytic, spot to May; 12⅜c. to 12⅜c. for casting, same deliveries. The business failures for the week, as reported by *Bradstreet's*, numbered 228, as against 265 the week previous and 221 the same week last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Feb. 19: Antwerp—1 pkg. material, $20. Argentine Republic—3 pkgs. material, $52; 5 pkgs. machinery, $249; 61 pkgs. material, $1,930. British West Indies—29 pkgs. material, $599. British Guiana—2 pkgs. material, $54. British Possessions in Africa—9 pkgs. material, $451. British East Indies—308 pkgs. material, $6,493; 14 pkgs. machinery, $4,600. British Australia—362 pkgs. machinery, $46,849; 30 pkgs. material, $7,559; 1131 pkgs. wire, $2,820. Bristol—22 pkgs. machinery, $7,210. Barcelona—1 pkg. material, $15. Cuba—71 pkgs. $2,002; 10 pkgs. wire, $137. Central America—20 pkgs. material, $506; 1 pkg. manufactures of copper, $23. Corunna—20 pkgs. wire, $368. China—58 pkgs. material, $1,794; 1 pkg. machinery, $9. Chili —1 pkg. wire, $28. Dunkirk—64 pkgs. machinery, $700. Danish West Indies—1 pkg. manufactures of copper, $19. Ecuador—2 pkgs. machinery, $92; 2 pkgs. material, $15. Genoa—2 pkgs. material, $70. Glasgow—52 pkgs. material, $661. Hong Kong—2 pkgs. machinery, $420; 1 pkg. material, $21. Hamburg—1 pkg. machinery, $45; 67 pkgs. material, $2,735; 2 pkgs. manufactures of copper, $110. Japan —53 pkgs. material, $4,127; 70 pkgs. machinery, $2,840. Lisbon—402 pkgs. electrical railroad material, $21,253. London—9 pkgs. cable, $1,700; 115 pkgs. material, $2,583; 45 pkgs. material, $6,064. Liverpool—96 pkgs. machinery, $13,485; 228 pkgs. material, $9,383; 1176 pkgs. material, $62,510. Mexico—209 pkgs. material, $4,314; 17 pkgs. machinery, $6,271. Marseilles—9 pkgs. machinery, $700; 3 pkgs. material, $150. Manchester—35 pkgs. machinery, $2,563; 2 pkgs. material, $17. New Zealand—8 pkgs. machinery, $1,120; 31 pkgs. material, $1,747. Philippines—18 pkgs. machinery, $756; 3 pkgs. material, $100. Peru—13 pkgs. material, $207. Rotterdam—2 pkgs. material, $15. Siam—21 pkgs. material, $741. Sheffield—3 pkgs. wire, $269. United States of Colombia—2 pkgs. material, $58.

MACHINE TOOLS FOR JAPANESE ARSENAL.—The Japanese Government arsenal now under construction at Maizuru is to be equipped with some 40 American labor-saving devices which will represent an expenditure of about $35,000. The contract, the major portion of which was closed through the Japanese house of Takata & Co., 10 Wall Street, New York City, is said to constitute the most important lot of American specialties of the description ever called for by the Japanese authorities. Manning, Maxwell & Moore, of 85-89 Liberty Street, have had orders placed with them for two large engine lathes and one big double punch and shear, which are to be built by Hilles & Jones, of Wilmington, Del. The American Tool Works Company, of Cincinnati, Ohio, will furnish seven of its specialties, comprising drill press, radial drill, iron planer and engine and gap lathes, the latter fitted with compound rests. The Hendey Machine Company, of Torrington, Conn., is to manufacture three large lathes fitted with compound rests. The Bradford Machine Tool Company, of Cincinnati, Ohio, will also forward four of its big lathes. The Riehle Brothers Testing Machine Company, of Philadelphia, is to supply an automatic and autographic testing machine fitted with screw beam, and having a capacity of 50,000 lbs. A tool grinder order is to be executed by Gould & Eberhardt, of Newark, N. J. The J. A. Fay & Egan Company, of Cincinnati, Ohio, is to build five machines, consisting of pattern makers' lathes, surface planer, band sawing machine and a mortising and boring tool. The W. F. & John Barnes Company, of Rockford, Ill., has been allotted an order for a screw cutting lathe, a friction disk drill and an upright drill. The Lodge & Shipley Machine Tool Company, of Cincinnati, Ohio, is to supply a large engine lathe with compound rest. Further orders are about to be placed for screw machine automatic bolt cutter lathe, with compound rest, milling machine and a set of twist drill grinders.

VARIOUS C & C ORDERS.—The C & C Electric Company, of Liberty Street, New York, reports receipt of an order for an 80-hp slow-speed motor to be shipped to South America. The company's domestic orders secured during February include one for 15 motors varying in size from 2 hp to 20 hp, to be utilized for the direct driving of fans and blowers in the New Mount Sinai Hospital, New York. Two 75-hp slow-speed motors (making the third order) have been requisitioned for by the William J. Moxley Company, of Chicago, Ill. A 50-hp motor and a 75-hp one are to be shipped for installation in a manufacturing plant at Ossining, N. Y. One 75-kw direct connected generator has been ordered for a Philadelphia apartment house. Joseph S. Champion, of Atlantic City, has sent in an order for a 50-kw and a 35-kw direct connected generator to serve as lighting equipment in a hotel at that New Jersey resort. The Standard Oil Company is to be furnished with a 60-hp slow-speed motor to be used for driving a well pump. Shoemaker & Co., of Philadelphia, have ordered a 40-kw direct-connected generator and six motors varying from 2 hp to 10 hp each for general use in machine works. The Hallenbeck, Wynkoop & Crawford Printing Company, of New York City, has called for a 20-hp series parallel equipment, which is to be used for driving a magazine press in that concern's new building, and a 65-kw generator, together with a 60-hp motor, has been ordered for irrigating purposes on a large Texas ranch.

MORE MACHINERY FOR GREAT NORTHERN STEAMSHIPS.—The two huge steamships, which are now under construction for the Great Northern Steamship Company at the yards of the Eastern Shipbuilding Company, New London, Conn., are to be equipped with a further lot of Westinghouse apparatus for electric lighting and ventilating purposes. As already mentioned in ELECTRICAL WORLD AND ENGINEER, Westinghouse, Church, Kerr & Co. were last fall awarded a contract for eight marine generating sets, consisting of Westinghouse compound engines of 150 hp each, to be direct connected to 75-kw generators. The order just placed calls for the supply of four more sets of the same description. The contract, as a whole, constitutes one of the most important ever let for marine electrical equipment. Its value is about $75,000. Several substantial contracts have yet to be decided upon for machinery to be installed in these vessels, which are being built for the Oriental trade. The large cargo conveyers are to be operated by electricity. The steering gears will be of the electrical tiller type, and the winches for handling cargo are also to be worked by motors. There will also be large ice machines of the ammonia compressor type, which will be operated electrically.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, Ill., have just closed a contract with the Case County Telephone Construction Company, of South Bend, Ind., for a central energy "major relay" type switchboard of 4000 lines' capacity, with a possibility of 7200 lines. Its present capacity will consist of 1500 lines. Included in this contract is all necessary power apparatus, arresters, frames, etc., and 1000 standard central energy telephones; a toll board of 50 lines' capacity, with a present equipment of 25 lines. The local company intends making this one of the most important toll lines in the West, giving service direct from Chicago to New York. At present the company will install 1000 telephones, and additional instruments will be delivered as required. The outside construction in general will be first class in all respects. All of the downtown district will have an underground conduit system. The Kellogg Switchboard & Supply Company also report having been awarded a contract for an extension on the Logansport, Ind., exchange before it was completed and ready for operation, which proves the satisfaction of the company with their switchboard, as well as their ability to secure favors from the citizens of Logansport.

IDAHO POWER DEVELOPMENT.—The Westinghouse Electric & Manufacturing Company, through its Western agent, Mr. L. M. Cargo, of Denver, has just closed a deal with the Boise-Payette River Electric Power Company, whereby it will furnish a complete generating power plant of 2500-kw generators direct connected to two 1100-hp Leffel turbines, including 26 miles of pole line to Boise and the two mining camps of Pearl and Neal. This plant will furnish energy for lighting and power of all kinds at these places. The contract price is $60,000. This is the largest electric contract made in Idaho, aside from the recent contract with the Short Line for the new shops at Pascatello. The pole line will be up in 60 days, and the plant itself will be ready for operation Oct. 1. Miles & Blanchard is the Boston firm backing the Idaho power corporation and floating its bonds.

NORTHERN ELECTRIC MANUFACTURING COMPANY, of Madison, Wis., is to supply generator capacity for a new 750-hp plant, put in by the Massillon (Ohio) Iron & Steel Company.

CANADIAN NIAGARA POWER EQUIPMENT.—A memorandum, prepared for Mr. J. W. Langmuir, chairman of the commissioners for the Queen Victoria Niagara Falls Park, Ont., shows the following details of work done, and contracted to be done, and machinery purchased by or on behalf of the Canadian Niagara Power Company: Conduit, cable and electrical machinery, for use during construction, purchased at a cost of $20,664; wheel pit excavation, $19,150; tunnel and shaft—the shaft has been completed and the tunnel driven 200 ft. under a contract which calls for an expenditure of $513,000; cofferdam, materials purchased, at a cost of $27,000; contract for cofferdam, $23,000; wheel pit and in-take canal, over $500,000; bridge across canal opening, $55,000; transformers, generators, exciters and switchboards, viz., contract let for nine transformers for proposed transmission to Toronto and elsewhere, $43,200; contract also let for three 10,000-hp generators, $209,475; contract authorized for exciters, etc., to cost $16,000; contract also authorized for switchboard, $75,000; turbines—contracts made for plans of 10,000-hp turbines, the plans and license fee involving a cost of $10,000. Upon receipt of these plans the company is authorized to order three 10,000-hp turbines at a cost of $130,000; land purchased adjacent to park and laid out for manufacturing sites and an industrial village, $75,000, making the total expenditures at present undertaken for this power plant at $1,716,489.

ANOTHER ELECTRIC ROAD FOR MEXICO.—The City of Mexico is to have another electric traction system. Advices from that part of the world state that a concession has been granted to an enterprise styled the Mexican Traction Company, of which John L. Moylan is president, for the purpose of building and operating an electric traction system to run between the Mexican capital and Tacubaya, one of its suburbs. The length of the road will be about 8 miles. The company absorbs the project of Senor Miranda y Marron, who, in 1898, was granted a franchise with a view to connecting the eastern part of the city with Tacubaya, but who only constructed a small portion of the line. The new company will be permitted to import equipment from the United States free of duty. Ninety-pound rails are to be used. The whole system must be built inside of 18 months.

PHILADELPHIA DEPARTMENT STORE.—The contract for the electrical installation in the new addition to Gimble Brothers' store, Philadelphia, has been awarded to Kellar, Pike & Co., of the same city, who, it will be remembered, recently installed the electrical equipment in the new Philadelphia Mint, described in these pages Feb. 1. Gimble Brothers' store, when the present addition is completed, will be the largest department store in the world. The current is to be supplied by the Edison Company, and the new addition alone will require 750 arc lamps, and about 5000 incandescent lamps. The work throughout is to be installed in loricated conduit, of which 75,000 ft. will be required. The wiring will all be done on the three-wire system, requiring about 150,000 ft. of wire.

NEW COPPER FIELDS.—The office of the Chartered South Africa Company, in London, received the other day from its agents in north Rhodesia the report of the discovery of a new copper field estimated to cover 40 square miles. The field is about 150 miles north of Victoria Falls, near the border of the Congo Free State, and runs over into that territory. Mining engineers in the service of the company are now taking out ore which assays 44 per cent copper, besides a large percentage of silver. It is said that the company attaches so much importance to this discovery that the route of the Cape to Cairo Railroad will be diverted a considerable distance to the west in order to pass through the copper field. It is expected that this section of the railroad will be completed early next year.

CONTRACTS FOR POWER GENERATORS.—The Redlands (Cal.) Electric Light & Power Co. recently closed a contract with the General Electric Company for four 750-kw, three-phase generators, which are to be direct connected to impulse wheels operating under a head of 1900 ft. The contract calls for revolving field machines generating current at 750 volts with 430 r. p. m. There will be step-up transformers with 33,000 volts on the secondaries. The apparatus will be installed at the Mill Creek No. 3 power station, about 10 miles up the creek from Redlands. It is probable that the current generated there will be used East of Pomona. It all goes into the general transmission system of the Edison Electric Company, of Los Angeles, which controls a number of plants.

POWER PLANT FOR MAINE.—Further developments of electric power are projected for the vicinity of Lewiston, Me., and Libbey & Dingley, of that city, are in the market for the complete equipment for a new power house at Deep Ribs, 2 miles above Lewiston, on the Androscoggin River. A stone and concrete dam will be constructed, and the plant will be laid out for 10 direct-connected alternating-current generators of about 1200 hp each. Libbey & Dingley own the Lewiston & Auburn Electric Light Company, Auburn; the American Light & Power Company, and the Lincoln Mill and Cumberland Mill, in Lewiston, and part of this new power will be used in connection with these electric light and power interests.

WESTINGHOUSE EQUIPMENT FOR ENGLAND.—Over $40,000 worth of various equipment has just been shipped from the Westinghouse works at East Pittsburg for the Bournemouth (England) Corporation tramways, a substantial contract in connection with which was secured by the British Westinghouse Electric & Manufacturing Company, Limited. Owing, however, to the new Manchester works of the British Company not yet being able to execute orders, the major portion of the machinery in reference to the many other British contracts recently secured is being turned out at the American Westinghouse Company's plants.

STORAGE BATTERY PLANT.—Among the recent installations of the Gould Storage Battery Company is that of the Collier Publishing Company, Little West Twelfth Street, New York, which consists of 56 cells in lead-lined tanks. The present capacity is 194 kw-hours, with an ultimate capacity of 225 kw-hours. The installation includes switchboard and the Gould patented c. e. m. f. regulating booster, the size installed with this booster being 12 kw. The battery is used for regulating the fluctuating loads caused by very heavy presses, and also to act as a reserve in case of a breakdown.

CALIFORNIA POWER TRANSMISSION.—The California Power Company has appropriated water out of the Kings and Kaweah rivers in Tulare County, and nearly all of the available power-water of the Kern River and its tributaries for use on its electric transmission lines. A large generating plant will be installed on the Kern River near Kernville. The hydraulic work is already under way, and 8 miles of tunnels will be required to convey the water through the hills. Electric power will be transmitted to Los Angeles and other points in Southern California.

ELECTRIC CRANES.—It is stated that the Cleveland Crane & Car Company, of Cleveland, formed to manufacture electric cranes, have secured a site at Wickliffe, 10 miles east of Cleveland, and are preparing plans for a building 160 by 100 ft. All machinery will be electrically driven, and a number of heavy tools will be installed. The Cleveland Crane & Car Company is capitalized at $100,000, and the officers are W. D. Sayle, president; Charles E. Thomas, vice-president and general manager; A. L. Assmus, secretary.

THE MORGAN ENGINEERING COMPANY, Alliance, Ohio, has decided to go into the manufacture of blowing engines and traveling crane girders, and to that end it has been decided to erect a new plant for each class of work. Plans are being prepared and bids will be called for shortly. The blowing engine department will be in charge of M. Pettit, formerly with the E. P. Allis Company. It is expected that the new plants will be in operation before the end of next summer.

INSULATOR FACTORY REBUILT.—The plant of Mr. Fred M. Locke, of Victor, N. Y., which was destroyed by fire early in January last, has now been entirely rebuilt, the new plant being twice the size of the former one. With double the facilities, Mr. Locke will be able to turn out twice as many insulators as before. He is now operating a large portion of the plant, and is filling orders in good shape. He expects to have the new plant in full operation by March 15.

RAILWAY EQUIPMENT CONTRACTS.—The Muncie, Hartford City & Ft. Wayne Railway, for which E. P. Roberts & Co., Cleveland, are engineers, has placed contracts with the John Stephenson Company for eight 44-ft. passenger coaches, to be delivered July 1. Also for 50 miles of copper wire with the National Conduit & Cable Company, New York. Poles have been ordered and 25,000 ties are being distributed along the right of way.

MICHIGAN POWER PLANT.—On Feb. 20 the Michigan Hydraulic & Electric Company (Samuel S. Reed, engineer) was granted a franchise by the Board of Supervisors of St. Joseph County, Mich., to construct four dams on the St. Joseph River. The first to give a working head of 22 ft., the second of 14 ft., the third of 8 ft., and the fourth of 14 ft. These powers will be used for electric plants.

THE NORTH JELLICO COAL COMPANY is adding to its electric power plant at Gray's Station, Ky., a 175-hp engine built by the Ball Engine Company, Erie, Pa., and arranged for direct connection to a 100-kw General Electric generator furnishing the increased power. This is a duplicate of plant furnished a year ago.

NORTH ELECTRIC COMPANY.—The board of trade of Mt. Vernon has made an informal proposition to the North Electric Company, of Cleveland, to remove its factory to that town. The North Electric Company has outgrown its quarters in Cleveland, and is understood to be figuring on making a change.

TELEPHONES FOR HOLLAND.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has just made a shipment to Gereke & Co., of Amsterdam, Holland, of one 12-point Clark switchboard complete for their offices in that city.

LORAIN TRAMWAY RAILS FOR SCOTLAND.—The Lorain Steel Company, of Lorain, Ohio, has just made shipment of 110 tons of special rails for the Ayr (Scotland) Corporation electric traction system.

CONTRACTS FOR MEAD CONVEYING MACHINERY.—John A. Mead & Co., of Rutland, Vt., New York office in the Bowling Green Building, have obtained a substantial contract for an automatic railway to be used for handling coal in a large electric power plant at Milan, Italy. The engineering firm of Kerkhoven & Mazel, of Tjibadak, Dutch East Indies, has also ordered a quantity of conveying machinery. Domestic contracts lately allotted the Mead concern comprise an order, valued at some $60,000, for an electric cableway plant, which is to unload coal from vessels to storage and from there to cars at the C. Creiss Coal Company's plant, Sheboygan, Wis. This equipment will be operated by three motors of 100 hp capacity each. The new power station being built by the Chicago City Railway at Fifty-second Street and Wabash Avenue, Chicago, is to be equipped with a Mead coal and ash-handling plant of 45 tons capacity hourly. This plant is to be installed with eight 400-hp water-tube boilers built by the Babcock & Wilcox Company. The new additions to the Syracuse, Ind., electrical plant of the Sandusky Portland Cement Company, of Sandusky, Ohio, is to be furnished with some 750 ft. of coal and ash-handling equipment. The contract for the necessary electrical apparatus for the extension of the Indiana plant has been placed by the Westinghouse Electric & Manufacturing Company.

SHEDD FANS FOR EXPORT.—The Shedd Electric & Manufacturing Company, of Roselle, N. J., whose New York offices are in the Electrical Exchange Building, has just taken a fair-sized order for 12-inch oscillating electric fans to be forwarded to Buenos Ayres, Argentine Republic. The order was secured through the Federal Electric Company, of 141 Broadway. Carlo Pfaltz, of Genoa, Italy, has sent an initial order for fans of the same description. The firm of Preece & Cardew, in which Sir William Preece, formerly engineer-in-chief of the telegraph department of the London General Post Office, is a partner, is negotiating with the Shedd people with a view to the introduction of these fans into the various government offices in British India. The company is also figuring on an order for 150 fans, which are intended to be used in carriages on the French State railways, the fans to be operated from storage batteries. Orders just secured in Boston, Providence and Worcester represent a total of 500 fans, 100 having been ordered by the Union Hardware Company, of Providence, R. I.; 50 from Belcher & Lewis, of the same place, and 100 from Plummer, Ham & Richardson, of Worcester, Mass.

LARGE CONTRACTS FOR VIRGINIA PLANT.—The more important contracts for the electrical power plant of the West Virginia Pulp & Paper Company at Piedmont, W. Va., have just been determined on. The structural material for the building has been ordered from the American Bridge Company, the contract calling for some 500 tons of steel. The boiler plant of a nominal capacity of 6000 hp has been undertaken by the Edgemoor Iron Works, of Edgemoor, Del. It will consist of 10 units of 600 hp each. The generators will be two in number, and are to develop 800 kw each. There will also be some 20 motors, aggregating over 2000 hp. This portion of the contract has been awarded to the Westinghouse Electric & Manufacturing Company. John A. Mead & Co., of Rutland, Vt., will supply the coal and ash-handling machinery capable of handling 45 tons per hour. The power station's smokestack, to be built of perforated brick, will be an unusually large one, as it is to be 235 ft. high and 13½ ft. inside top. The plant, it is said, has been planned so as to permit of the capacity being considerably extended. Mr. T. G. Tenbroeck, of 136 Liberty Street, is acting as consulting engineer in the matter.

HEINE BOILERS FOR AUSTRALIA.—The Heine Safety Boiler Company, of St. Louis, Mo., whose New York offices are in the Bowling Green Building, reports recent receipt of a contract through the export house of Henry W. Peabody & Co., 17 State Street, New York City, for shipment of three 200-hp and three 250-hp boilers for installation in a South Australian electric power plant. Among the more important domestic orders secured within the last few weeks for Heine boilers is one requisitioning for six units of 500 hp each. These boilers are intended to serve as equipment for the new power station of the Philadelphia & Lehigh Valley Railway. The new Astor Hotel now under construction at Fifty-fifth Street and Fifth Avenue, New York City, is to be furnished with four boilers of 350 hp capacity each. This equipment will be utilized for light and general power purposes. The Pawtucket (R. I.) Electric Company has ordered two 350-hp boilers, and the Keystone Improvement Company, of Hazelton, Pa., has called for four boilers of 300 hp capacity each for electric railway use.

NEW YORK RAPID TRANSIT STEAM PLANT.—The contract for the condensing apparatus for the Rapid Transit Railroad power station has been awarded to the Alberger Condenser Company, 95 Liberty Street, New York. This is the largest contract ever given for a condensing apparatus, the total capacity of the outfit being 80,000 hp, comprised of eight units of 10,000 hp each. The type selected by the engineers of the Rapid Transit Subway Construction Company is the barometric condenser recently brought out by the Alberger Company. This is a jet condenser, and operates on the dry vacuum system. The water, circulating and air pumps are to be operated by cross-compound steam cylinders, with cranks and flywheels. The whole equipment is new and original in design.

BROWN CORLISS ENGINE COMPANY.—Woolston & Brew, of 39-41 Cortlandt Street, which concern for some time past has acted as New York manager for the Ball Engine Company, of Erie, Pa., has entered into arrangements with the Brown Corliss Engine Company, of Milwaukee, Wis., for the purpose of representing the interests of that Western concern in the Eastern territory, both for export and domestic trade. The Roosevelt Hospital authorities, New York City, have just ordered two 160-hp simple non-condensing Brown Corliss engines, which are to be direct connected to 100-kw generators to be supplied by the Westinghouse Electric & Manufacturing Company. This equipment will serve to light the hospital.

WHITNEY INSTRUMENTS ABROAD.—Machado & Roller, of 203 Broadway, report receipt of fair-sized orders from the British electrical engineering and contracting firm of Robert W. Blackwell & Co., Limited, also from the Japanese house of Takata & Co. These instruments are manufactured by the Whitney Electrical Instrument Company. The orders include recorders varying from 100 to 15,000 amperes. Some of these instruments are intended for use in London underground railway plants. An order has been obtained for a large wattmeter for the Utica (N. Y.) Electric Light & Power Company; and the New Orleans & Carrolton Street Railway, Louisiana, is to be furnished with a 15,000-ampere recorder.

GOUBERT HEATERS FOR ENGLAND.—The Goubert Manufacturing Company, whose offices are in the Singer Building, Broadway and Liberty Street, has been recently allotted an order for an 1800-hp feed-water heater to be installed in the British Westinghouse Electric & Manufacturing Company's works now under construction at Trafford Park, England. The Goubert people have just secured a contract (making the second) for two feed-water heaters of 4000 hp each, from the Edison Electric Illuminating Company, of Boston, Mass., which concern is at present placing considerable contracts in connection with the extension of its plant at Atlantic Avenue, Boston.

PHILADELPHIA BELL TELEPHONE.—At the annual meeting of the Bell Telephone Company, of Philadelphia, the directors were re-elected, the only change being James E. Mitchell, elected president in place of Frederick P. Fish. A resolution was adopted at the meeting to provide for the calling of a special meeting of stockholders on April 22 for the purpose of authorizing an additional issue of $4,000,000 stock. It was also decided to issue at once the $1,000,000 of stock now in the treasury. The increase in capital stock of $4,000,000, makes the total issue $12,000,000. The money is for extensions.

VITRIFIED CONDUIT FOR SOUTH AMERICA.—The American Vitrified Conduit Company, of Akron, Ohio, has just been awarded two South American contracts. One is for 500,000 ft. of vitrified conduit for telephone wires in Buenos Ayres, Argentine Republic. The other contract calls for 250,000 ft. for both telephone and electric light purposes in Chili. The American Vitrified people have been allotted the contract for some 3,500,000 ft. of conduit to be made use of in the New York Subway.

OPPORTUNITIES IN BOLIVIA.—Attention is again called in the organ of the Bureau of the American Republics to the opportunities for electric light plants, under advantageous conditions, in the Bolivian cities of La Paz, Cochabamba, Potosi and Sucre. Abundant water power exists for the purpose within convenient distances. Any person interested can ascertain particulars from Senor Guillermo Sanjines, chief clerk of the Department of Interior, La Paz, Bolivia.

STEAM PLANT WANTED.—The Weston, W. Va., Electric Light, Power & Water Company is in the market for two 125-hp water-tube boilers with stack and feed-water heater capacity for both boilers. The new plant is required immediately. Mr. J. S. Mitchell is secretary and superintendent.

EVANSTON, ILL., LIGHTING.—The Evanston and Yaryan Electric companies have been merged, and will expend $1,500,000 on improvements. These companies have been cutting rates for two years, and it is expected that the consolidation will result in better service, with increased rates.

LIGHTING EQUIPMENT WANTED.—The village electric light trustees of Martins Ferry, Ohio, wish to secure bids on an alternating-current incandescent generator with exciter, boilers, feed water pumps, etc.

E. W. BLISS COMPANY.—It is reported that plans are in process of formation for the absorption of the United States Projectile Company by the E. W. Bliss Company, of Brooklyn.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER, Feb. 15, 1902.

LAMPS FOR HIS MAJESTY.—The [illegible] Company, Limited, have received the honor of appointment by royal warrant as purveyors of electric lamps to the King.

LEEDS TELEPHONES BOULOGNE.—The use of the English-French telephone cable seems to be quite small. It is noted that the first message from Leeds to Boulogne has just been sent over it, "or in fact from any place in England except London." The distance is but 300 miles from Leeds, a busy English city, to Boulogne, so that the clearness of transmission cannot be regarded as remarkable.

A TUBE FOR THE TYNE.—A bill for authority to connect North Shields and South Shields on opposite sides of the River Tyne by means of a tube railway operated electrically will be brought up this session in Parliament. A single tube only is contemplated with a diameter of 13 feet. They propose to erect a generating station in South Shields, and the capital is proposed to be $900,000, and the time sought for the construction of the railway is five years from the passing of the act. The proposed rates for passengers are to be 4 cents per single journey in the first-class carriages, and 2 cents in the second-class carriages.

ELECTRICITY AND HYPNOTISM.—A remarkable cure by electricity and hypnotism is reported from Prague, where a certain Adolf Resch met with an accident which resulted in serious nerve shock and loss of the power of speech, besides partial idiocy. Dr. Jacksch, of Prague Hospital, had him electricized by a powerful current, and then hypnotized. While hypnotized he was told to speak and tell them his name. He answered correctly, though he appeared to speak with difficulty. Further questions were answered sensibly and with increasing ease, and finally when brought to the patient had regained the power of speech and the full use of his intellect.

THE KING'S COACH.—The King has ordered two more motor cars, which are being built at Coventry. His Majesty began his career as an automobilist with a six-horse-power Coventry-Daimler mail-phaeton; but this has now been given up on account of the seating arrangements. Of the two new cars now being built for the King, the pleasure-car, according to the *Court Journal*, is to have a 22½-horse-power four-cylindered motor (making 720 revolutions at normal speed), under single lever control. It is designed to carry petrol sufficient for 150 miles, and will be fitted with both tube and electric ignition. The motor is geared to twenty-four miles an hour. The second car on order is practically an omnibus, for it is designed for the transportation of luggage, servants, loaders, etc. The motor is 22 to 24 horse-power, with both tube and electric ignition, and is placed under a bonnet in front of the dashboard instead of being underneath the footboard, as in the car now in use.

ELECTRICITY AND CANALS.—This subject is beginning to attract some attention. As an indication of the interest which is now being taken in the subject, reference may be made to the significant speech of Lord Dudley, the Parliamentary Secretary of the Board of Trade, at the dinner of the Leeds Chamber of Commerce the other night. The Board of Trade, he said, cordially sympathized with the desire of the Chamber that the internal waterways of the country should be fully developed. An enormous boon would be conferred on many manufacturers, especially in the Midland districts, by such a cheaper system of carriage as canals might afford. He hoped that before long this matter would be seriously taken in hand and pressed upon the attention of Parliament. To amalgamate the canal systems into trusts would necessitate a large sum of money, and, so far as he knew, there were only three ways in which it could be found—by private enterprise, by Treasury grant or loan, or by loans from the local authorities.

TELEPHONE ROW IN GLASGOW.—The Glasgow Corporation, which has introduced a municipal telephone system for the benefit of the citizens of the commercial capital of Scotland, has met with opposition from an unexpected quarter in extending its operations. At a meeting of the Town Council a lively discussion arose over a letter received from the directors of the Glasgow Royal Exchange refusing the corporation accommodation in the exchange buildings for the municipal telephones. Bailie Robertson said that if the exchange directors put the onus of the refusal on the National Telephone Company, it was for the latter to consider whether were consulting their own interests in refusing facilities to the corporation, from whom they had received so many privileges. As a way out of the difficulty, Lord Provost Chisholm pointed out that although the basement and top flats of the exchange were leased to the National Telephone Company, there was nothing to hinder the municipal telephones being introduced by a window to the intermediate floor. Further consideration of the matter was postponed. It would appear that the Exchange thinks the bother of one telephone service quite enough.

General News.

THE TELEPHONE.

NOGALES, ARIZ.—[illegible] Arizona, has completed a line from Jerome to Nogales, making a long-distance connection of 400 miles. A competing company is building from Prescott to Congress, and will connect with opposition companies building from Bisbee and Safford. Another private corporation is to build a telephone line up the Colorado from Yuma.

SANTA ROSA, CALIF.—The Pacific States Telephone & Telegraph Company is materially increasing its telephone equipment in Santa Rosa.

SAN FRANCISCO, CALIF.—Salinas, Calif., and Monterey will soon be connected by a new telephone line of heavy copper wire, which will become a part of the Pacific States Telephone & Telegraph Company's long distance system.

LOS ANGELES, CALIF.—A $25,000 bond has been filed in Los Angeles, Calif., by M. Adrian King for the possession of a telephone franchise under which he will be required to expend $25,000 within four months. He is also required to carry on the work, without delay until the entire system is completed.

MACON, GA.—Emil Dorn, of Chicago, has applied to the city of Macon for franchise to establish a telephone system.

CARROLLTON, GA.—The Gainsboro Telephone Company has begun the erection of a line to Roopville. Arrangements have also been completed for a local exchange at Dallas, Ga., in connection with the long distance service. During the coming summer it is said a local exchange will be put in at Tallapoosa in Haraloon County.

PLEASANT PLAINS, ILL.—Boyntown Telephone Company has increased its capital stock from $2,500 to $10,000.

CHICAGO, ILL.—The Chicago Telephone Adjustment Company, capital stock $2,500, has been incorporated by Wilton B. Judd, M. W. Shanahan and J. F. Esperson.

HARDIN, ILL.—A farmers' telephone company has been organized in Calhoun County, with headquarters at Belleview, Ill. H. C. Long is the president of the new company.

ATWOOD, ILL.—The Atwood Mutual Telephone Company, with a capital of $3,000, has been incorporated. The incorporators are C. B. Moore, H. H. Wildman and William D. Harshbarger.

ALTON, ILL.—Rural telephone lines are being built throughout the county around Alton, and extensions are being made in all the small towns. At Grafton a new telephone exchange is being established by the Central Union, and many other small towns in the vicinity of Alton are being connected up. The farmers say this telephone is invaluable to them.

ELGIN, ILL.—The Stromberg-Carlson Company, of Chicago, has furnished the apparatus for the new exchange at Elgin. It includes a switchboard of the lamp line indicator type, full multiple, with a present capacity of 800 subscribers' lines and an ultimate of 2400. A corresponding number of Stromberg-Carlson telephones is also being supplied. The exchange will soon be in operation.

LA PORTE, IND.—The La Porte Telephone Company has been reorganized, S. I. Kesselaer, the president and manager, selling his stock to W. W. Hanns, L. M. Kugler and J. V. Doreland.

MUNCIE, IND.—Municipal ownership sentiment is rife here and at Aurora. The people insist on the proposition being submitted at the spring elections. In the meantime municipal ownership leagues are being formed. Electric light and water are the utilities involved.

INDIANAPOLIS, IND.—Hon. S. P. Sheerin, president of the New Telephone Company, has just returned from a pleasure trip to Mexico. He thinks Mexico has great possibilities for the telephone. The great mineral wealth of the country and the agricultural opportunities and improvements through the aid of irrigation, and the large landed estates or holders is destined to make telephone communication a necessity.

EVANSVILLE, IND.—The city authorities are in a state of bewilderment over the telephone situation. The franchise of the Cumberland company, granted fifteen years ago, will expire in a few months, and now there is a clamor for a franchise from half a dozen companies. The Cumberland company will also be a bidder for a new franchise. The independent companies are knocking at the door and will make a strong effort to unhorse the local company. The matter of a franchise has been taken up by the people, and they are pretty equally divided on the question of having competition in the telephone business. In the meantime the Council is struggling with the several factions and the situation is not only interesting, but strenuous.

INDIANAPOLIS, IND.—Telephone enterprise took on a new spurt in this State during the past week, evidenced by the following new companies that filed articles of incorporation with the Secretary of State: The Lawrence Telephone Company, of Lawrence; capital, $3,500; directors, W. W. Hinman, R. S. Records and others. The Six Miles Telephone Company, of Charlottsville; capital, $2,100. The Kennedy & Nowland Telephone Company, of Markleville; capital, $3,000; President, Wm. Kennedy, of Markleville. The Falmouth Telephone Company; capital, $5,000. The Hope Telephone Company, of Hope; capital, $12,000, and the National Automatic Telephone & Telegraph Transmitter Company, of Valparaiso; capital, $10,000.

INDIANAPOLIS, IND.—During the recent annual convention of township assessors in this city much discussion was had on the subject of taxation of the telephone property in the State. Auditor Hart read a paper on "The State's Sources of Revenue." Mr. Hart advocated taxing telephone franchises and also exacting a certain per cent of the gross receipts of those in operation. Union B. Hunt, Secretary of State, read a paper on "The Assessment of Telephone Property." He said the law provided that the instruments and office property of telephone companies are to be assessed by the local assessors, all other property of the companies by the State Board of Tax Commissioners, which board is to find the true cash value of such property by adding to the mortgaged value of the aggregate shares of stock, or to the value of the capital, the aggregate amount of said mortgage or mortgages, and the result is deemed and treated as the true cash value of the property of said corporation. The telephone and telegraph property of the State is assessed at $4,000,000.

IOWA CITY, IA.—The Johnson County Telephone Company has increased its capital stock from $15,000 to $30,000.

NEW MARKET, IA.—The East River Farmers' Mutual Telephone Company has been organized here. J. B. Foster is president.

MINDEN, IA.—A [illegible] has been organized at this place, and a special election has been called for March 31 to vote on the franchise.

VILLISCA, IA.—At the [illegible] March 17 a proposition to grant a franchise to the Villisca Farmers' Mutual Telephone Exchange will be submitted to a vote of the people.

DES MOINES, IA.—The Senate has passed a bill granting to any community the right to vote a 5 per cent tax in aid of independent telephone companies. It is stated that there is some doubt of its passing the House.

IOWA CITY, IA.—The Iowa City & West Branch Telephone Company has recently been organized. The officers are: J. T. Struble, president; George Hunter, vice-president; James Murphy, secretary, and James Douglas, treasurer.

OAKLEY, KAN.—The Oakley Telephone Company, capital stock $1,000, has been incorporated.

HOPKINSVILLE, KY.—The annual meeting of the stockholders of the Cumberland Telephone Company was held here. An increase of 19,000 subscribers was made during the year, making the total number 76,000.

NEW ORLEANS, LA.—The Merrill & Leakville Telephone Company, of Merrill, has been incorporated by E. Rose, W. R. Rhinehart, Sam Pool, James Faulk, J. H. Tune and M. L. Batson; capital stock, $1,000.

EASTPORT, ME.—The Lakeside Telegraph & Telephone Company has recently been granted a franchise by the City of Eastport.

GRAND RAPIDS, MICH.—A new directory of the Citizens' Telephone Company of this city shows that there are 4121 telephones in service, a gain of 562 since the directory of last May was issued. The company now has 776 toll line points in the State and a total of 28,276 telephones, as against 27,607 six months ago. Within the past six months the company's net gains in the number of telephones in use at various points throughout the State have been as follows: 333 in Lansing, 160 in Traverse City, 76 in Lowell, 79 in Caledonia, 55 in Vermontville. In this city an impetus has been given to the business of the Citizens' company by the advances in rates announced for the first of the year by the Michigan Telephone Company, and since Dec. 1 last more than 500 orders for telephones have been booked.

CLEVELAND, MISS.—The Bolivar Telephone Company, of Cleveland, Miss., capital stock $10,000, has been incorporated by S. L. H. Graynes, J. G. Collier, W. P. Parks and others.

FAIRFAX, MO.—The Fairfax Telephone Exchange Company, with a capital of $5,000, has been incorporated by John Punsham, William A. Groesbeck, Nellie Morgan and others.

YORK, NEB.—The City Council has granted a twenty-year franchise to the Plattsmouth Telephone Company.

OMAHA, NEB.—The independent telephone companies of Nebraska are endeavoring to get in close touch with each other with the avowed object of fighting the Bell telephone. It is their intention to build connecting lines, and if possible, form a community of interest plan, which will embrace all independent companies in the State.

BOONTON, N. J.—The Boonton Telephone Company, Boonton, N. J., has been incorporated; capital, $5,000. Incorporators: Geo. W. Frutchey, Edwin A. Fisher, Frederick Gordon, Thos. J. Hillery, Edmund B. Morton, Robert Green, Frank H. Coe and Frank Wendt.

PATERSON, N. J.—It appears that the telephone exchange destroyed during the recent great fire at Paterson was the independent, and not the Bell, as first stated. The latter has been giving great service since the fire, the telephone naturally proving invaluable under such conditions.

ALBANY, N. Y.—The Midland-New York Telephone Company, New York, capital $25,000, has been incorporated. Directors: F. F. Culver, A. S. White and F. H. Lord, New York.

ALBANY, N. Y.—The Belmont Citizens' Telephone Company, Allegany County, capital $1,500, has been incorporated. Directors: W. P. Clark, J. P. Crosby and J. E. Middaugh, Belmont.

NEW YORK, N. Y.—In compliment to Prince Henry of Prussia, the New York Telephone Company has placed a number of telephones on the Emperor's yacht "Hohenzollern." The telephones are connected by direct lines with the city exchange system, and both local and long distance service is being furnished. The lines are kept in almost constant use.

NEW YORK, N. Y.—J. T. Sproull and John P. O'Brien have been elected directors of the Knickerbocker Telephone & Telegraph Company, succeeding William H. Eckert and W. Stanley Eckert. It is said that Henry S. Kearny, president of the Telephone, Telegraph & Cable Company of America, will succeed Colonel Eckert as president of the Knickerbocker Company.

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph Company has made a reduction of about 50 per cent. in rates for telephones in homes in Syracuse. The special metallic line, with a service within a one-mile radius of the central office of the company, which formerly cost $66, is now $48. The two-party metallic selective signal telephone, which formerly cost $51, is now $36. In addition to this reduction, the radius of service has been extended to two miles, cutting off the $5 a quarter mile additional charge, and making the special long distance metallic instrument within a radius of two miles of the central office in any direction now cost $48 instead of $66 and $20, or a total of $86. The company has also reduced the measured service business rate to $43, for the special metallic instrument with 800 calls, from $50, with but 500 calls; and the two-party business rate to $33, with 800 calls, from $40, with 500 calls. The rate for additional calls has been reduced from 5 to 2 cents.

BROOKLYN, N. Y.—An investigation is being made by officials in Brooklyn Borough into the affairs of the Orr Telephone Company, recently incorporated with a capital stock of $3,000,000. While the company's headquarters are in Buffalo, it has found investors all over the country, many of them in New York, Brooklyn and [illegible]. Its promoters have been operating so quietly that the general public has known little or nothing of their remarkable success in disposing of stock. Circulars have lately been sent out by the company with a view to raising $200,000 more. The circulars claim that the company has acquired or is about to acquire a franchise to operate a telephone service in Brooklyn. Deputy City Clerk James V. Sculley, in charge of the Brooklyn office, received one of these circulars inclosed in a letter from an anxious investor. So far as appears, the company has no franchise, but owns the Orr telephone receiver invented by a Buffalo person. The "receiving" part of the system seems to work all right.

GASTONIA, N. C.—The Gastonia Telephone Company is building a double metallic line to Lincolnton.

WILMINGTON, N. C.—It is reported that the Bell Company will extend its line to Carolina Beach next summer.

GREENSBORO, N. C.—The Southern Bell Telephone Company is seeking a franchise to put in a local exchange.

YADKINVILLE, N. C.—A telephone line from Yadkinville to Hamptonville, thence to Buck Shoals, is said to be assured.

ASHEVILLE, N. C.—A request from Dr. Emil Dorn, of Chicago, for a telephone franchise has been refused. A system is already in operation.

BERLIN, OHIO.—The Berlin Telephone Company, capital stock $1,350 has been incorporated.

TONTOGANY, OHIO.—The Mutual Telephone Company has been organized and will build a local exchange.

BATAVIA, OHIO.—The Bell Telephone Company will ask the Council of Bethel for a franchise in that village.

FAYETTE, OHIO.—The Fayette Telephone Company has increased its capital stock from $10,000 to $25,000, to provide for improvements.

CONNEAUT, OHIO.—The Conneaut Telephone Company is making extensive improvements to its exchange. A new board of increased capacity is being installed.

CHAGRIN FALLS, OHIO.—Chagrin Falls was snowbound recently, and the town was in darkness because the Chagrin Falls Electric Company could not secure fuel.

CINCINNATI, OHIO.—George W. Rapp & Sons, of this city, are preparing plans for an exchange building to be erected at Norwood by the City & Suburban Telegraph Association.

COLUMBUS, OHIO.—The Columbus Messenger & Signal Company has asked for a twenty-five-year franchise for the use of the streets for the purpose of constructing and maintaining a messenger and signal service.

WARREN, OHIO.—F. H. Stowe, for a number of years manager of the Ashtabula exchange of the Central Union Telephone Company, has accepted the position of general manager of the Columbia Telephone Company at Portland, Oregon.

BATAVIA, OHIO.—The Citizens Telephone Company, which was recently organized here, is using Stromberg-Carlson apparatus. It has 500 subscribers and contemplates extending its lines to Bethel, Ohio, and later on to Mount Washington.

POMEROY, OHIO.—The Coolville Home Telephone Company is building a line from Rock Springs to this place. Lines are also being built to Bottom and Reedville, and communication will thereby be opened with the entire eastern portion of the county.

DAYTON, OHIO.—The Acme Telephone Company, of Center Post Office, has been incorporated, with $8,000 capital stock, by G. T. Brown, N. W. Rinehart, G. E. Lees, E. M. Brumbaugh, and Enos Shellabarger. The company will build a farmers' community system.

EAST ROCHESTER, OHIO.—The Eastern Ohio Telephone Company, operating in East Rochester and vicinity, is arranging to make traffic arrangements with both the Stark County Telephone Company and the Columbiana County Telephone Company. Long distance service will be secured over both lines.

CINCINNATI, OHIO.—Preparations have begun for the removal of the office of the Long Distance Telephone Company to the office building of the City & Suburban Telegraph Association. The Long Distance people will occupy the entire fourth floor and will utilize a large room on the ground floor for offices and booths.

McCONNELLSVILLE, OHIO.—The McConnellsville Home Telephone Company is building a line from Rencock to Bristol to connect with a line to be built from McConnellsville to Reinersville. This will give direct connection from McConnellsville to Caldwell, as the Noble County Telephone Company has a line to Renrock.

ASHLAND, OHIO.—The Central Union Telephone Company has brought action in the Common Pleas Court to compel the Council of Ashland to grant the company a franchise for a local exchange. A number of the Councilmen are stockholders in the Star Telephone Company which operates in the town, and they refuse to act.

WARREN, OHIO.—The Warren City Council has passed an ordinance requiring the Warren & Niles Telephone Company, the Central Union Telephone Company, and the Western Union and Postal Telegraph companies to place their lines underground in the business portion of the city. The work must be completed by July 1, 1902.

EAST LIVERPOOL, OHIO.—Angered at the practice of the Bell Telephone Company of erecting poles and making changes without permission of the Council, the East Liverpool Council has adopted a resolution creating the office of city telephone inspector, and the telephone company has been notified that it must stop all work until it is willing to pay the salary of the inspector.

NORTH LIMA, OHIO.—The recently organized Beaver Telephone Company has failed to make long distance traffic arrangements with the Columbiana County Telephone Company, and it may decide to erect its main exchange at Columbiana instead of North Lima as originally proposed. It will probably build a number of toll lines and enter into competition with the Columbiana County Company.

SHREVE, OHIO.—The Shreve Council has declined to grant a franchise to the Ripley Township Telephone Company. The Millersburg, Wooster & Orrville Telephone Company has an exchange in Shreve, but the farmers of the surrounding country are dissatisfied with the rates and organized their own company. They propose to go into the courts for the privilege of operating an exchange in the town.

KENTON, OHIO.—The Kenton Home Telephone Company held its annual meeting a few days ago. Officers were chosen as follows: J. L. Moore, president; J. B. Seymour, vice-president; A. G. Wessling, secretary-treasurer. It was decided to put in new sections of switchboard to take care of the rapidly growing business and to entirely remodel the system. The cable capacity in the city will be increased and new lines will be built into the surrounding country.

HAMILTON, OHIO.—The City & Suburban Telegraph Association of Cincinnati has brought suit against the Hamilton Home Telephone Company and the Hamilton, Hughes & Monroe Telephone Company. It is claimed that the first-mentioned company is not the successor of the second mentioned company, and that it has no rights in the streets of Hamilton, and it claims that both companies are installing wires which will damage the system of the plaintiff.

CLYDE, OHIO.—The Clyde Telephone Company held its annual meeting a few days ago. Officers were elected as follows: H. V. Becker, president; Dermont E. Fuller, secretary-treasurer. During the year 1901 the company changed from a common return to the full metallic system; built about twenty miles of pole line and put up considerable cable in the village. The company has 310 subscribers and toll stations at Erlin, Vickery, Whitmore and Tork Station. Many farmers are asking for connections and the company will make numerous extensions to its farmers' system this year.

HAMILTON, OHIO.—The Hamilton Telephone Company has been incorporated by S. D. Fitton, Sr., F. W. Whitaker, O. M. Bake, F. M. Hughes, J. C. Slayback, W. W. Morrison and C. E. Greismer. The company succeeds the Hamilton, Hughes & Monroe Telephone Company, and it will take immediate steps to build an independent exchange in Hamilton, the only large city in Ohio, with the exception of Cincinnati, which has no independent exchange. The construction work will be in charge of D. E. Newman and W. W. Morrison, of Bryan, Ohio, who have built a large number of exchanges. Work of securing subscribers has been started, and within a week 100 were secured. It is guaranteed that the company will have 600 subscribers before patrons are asked to pay for service. The rates will be $18 per year for residences and $30 for business houses.

TOLEDO, OHIO.—The Toledo Home Telephone Company has pushed construction work throughout the winter and has practically completed the overhead and underground construction; something over 400,000 feet of cable having been laid. About April 1 the offices and new buildings will be completed. The switchboard will have a capacity of 17,000 connections, 5000 for East Toledo and the balance for the city proper. Between 5000 and 6000 subscribers have been secured, all of whom will have full metallic circuits and unlimited service. The company has copper wires running from Maumee into its office connecting Bowling Green, Fostoria, Findlay and Lima, and lines connect Ft. Wayne, Holland, Wauseon, Bryan, Delta, Swanton, Archbold, Fayette, Napoleon, Defiance, Sandusky, Fremont and other towns to the east and Michigan points to the north.

SHAWNEE, OKLA.—The Long Distance Telephone Company, capital $100,000, has been incorporated by James F. Nobles, of Shawnee; Eugene D. Simms, of Roff, I. T., and James L. Lombard, of Kansas City, as directors.

PENDLETON, ORE.—A co-operative telephone company has been organized by the farmers around Pendleton, with the intention of installing quite a large system.

PORTLAND, ORE.—S. L. Shuffleton has been granted a franchise for a lighting plant for a small section of Portland. The wires will all be put underground.

PORTLAND, ORE.—The Pacific States Telephone & Telegraph Company, at its recent stockholders' meeting held in Portland, authorized the expenditure of $2,100,000 for improvements of the system and extensions of lines.

MORGANTOWN, PA.—A local telephone company promoted by farmers and business men has been organized here.

LEAD, S. D.—The Black Hills Telephone Company has asked for a franchise to conduct its business in Lead and has agreed to put in a fire alarm system without cost to the city.

ALEXANDRIA, S. D.—Taylor Township Telephone Company, Alexandria, capital stock $3,700, has been incorporated by Magnus Johnson, John Schroeder, C. E. Twombley, W. M. Newell, Dean Beakman, Wm. Morrow and Edward Wenenda.

MILLTOWN, S. D.—The Milltown Telephone Company, capital $25,000, has been incorporated by J. B. Welch, G. E. Brown and W. J. Wooper.

LENNOX, S. D.—The Lennox Telephone Company, capital $5,000, has been incorporated by E. S. Heinrich, John Waldron, W. H. Gerick and W. J. Heinrich.

BON AIR, TENN.—The Gainsboro Telephone Company will, it is said, build a line to Ravens Croft, a coal mining point.

CENTERVILLE, TENN.—An effort has been started by I. B. Parker, former local manager of an exchange at Centerville to build a new and independent system.

NASHVILLE, TENN.—Two telephone companies are now seeking franchises in this city—the Tennessee Telephone & Telegraph Company and a company represented by Harvey Myers, J. S. Alsthrop and others.

TRINITY, TEX.—The W. A. Bell Telephone Company, capital stock $10,000, has been incorporated.

WICHITA FALLS, TEX.—The Texas Telephone Company has increased its capital stock from $12,000 to $24,000.

BALLINGER, TEX.—The Central Texas Telephone Company, capital $50,000, has been incorporated by L. C. Alexander, A. Schane, J. B. Wilmeth and R. A. Hall and W. A. Norman.

SALT LAKE CITY, UTAH.—According to the reports for 1901, on file in the office of the State Auditor of Idaho, there was 1154.15 miles of telegraph lines and 2,907.25 miles of telephone line in the State.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will at once commence to build a line to the great Thunder Mountain mining district. This line will run from Boise, via Idaho City, and will be a little over 150 miles in length. All towns on the new line will be connected.

MARTINSVILLE, VA.—A conditional order has been entered by the Town Council granting a franchise to the Martinsville Telephone Company. A committee was appointed to draft a suitable contract. D. L. Bowles is president of the company. The Town Council has rejected a proposition for municipal ownership of the local telephone system.

BLOOMER, WIS.—The Bloomer Telephone Company has been offered $6,000 for its system and exchange by Chicago parties.

MILWAUKEE, WIS.—The American District Telegraph Company will make general improvements on its system in this city.

WAUSAU, WIS.—Crossed electric wires damaged the switchboard of the telephone exchange to the extent of totally burning three sections of the large board.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has filed its annual report with the State Treasurer. The report shows that the value of its real estate exclusive of its lines is $261,686.83. The company operates 49,366½ miles of wire and owns 22,451 instruments. During the year ending Dec. 31, 1901, gross earnings amounted to $805,456.77, on which it pays a tax of 3 per cent, or $24,163.70.

MILWAUKEE, WIS.—Mr. Albert E. Smith, of this city, is back of a new telephone company, which has made application for a franchise. The ordinance requires the company to install 2000 telephones inside of five years; the police and fire departments are to have telephones for $25 a year and the privilege of stringing their wires on the poles of the company. The company also is to observe the two-mile underground conduit limit, the city, after twenty-five years, having the right to demand that the underground wire system be extended to all lines within the city limits.

ELECTRIC LIGHT AND POWER.

VALDES, ALASKA.—An electric lighting plant is being installed in the town of Valdes by Messrs. Love and Whitney, who have applied for a franchise for the use of the streets for a pole line.

TEMPE, ARIZ., has voted $30,000 for a new water service, and will probably add an electric lighting system.

SAN FRANCISCO, CALIF.—The Edison Electric Company recently received permission to construct an electric power transmission line from Colton to San Bernardino, Calif.

SAN FRANCISCO, CALIF.—The California Mine, Nevada County, Calif., is to be equipped with heavy machinery and operated by electric power, under the supervision of Manager George Levinsky.

SAN FRANCISCO, CALIF.—An electric power plant will be installed by F. P. Hurst, who has filed on a water right, and will transmit power to operate flour mills in Canby and Aurora, Oregon.

SAN FRANCISCO, CALIF.—The California Powder Works Company is constructing a new pulp factory at the Hercules plant. Electric power will be used to drive the machinery of the new installation.

SAN JOSE, CALIF.—The Electric Improvement Company, San Jose, recently petitioned the Board of Supervisors for a franchise for the establishment of an electric transmission line along the road to Santa Clara.

SAN FRANCISCO, CALIF.—The Winscott mine, owned by A. C. Mason, in the State of Washington, will be equipped with new machinery at a cost of $75,000, and operated by electric power. A large reservoir will be a feature of the hydraulic work.

SAN FRANCISCO, CALIF.—The Blue Lakes Manufacturing Company, which was recently incorporated by E. H. Jones, Isaac Culver and others, will install an electric light plant at Blue Lakes, Humboldt County, Calif., where they are erecting a shingle mill.

SAN FRANCISCO, CALIF.—The Department of the Interior, Office of Indian Affairs, has advertised for proposals, until March 27 for the construction of nine buildings and the necessary sewer, steam heating, water, and electric lighting systems therefor. The buildings will be erected in Arizona.

SAN FRANCISCO, CALIF.—The jute mills in San Quentin penitentiary, Calif., are now operated by electricity from the Bay Counties Power Company's transmission lines. It is claimed that, by the use of electric motors, there is a saving of 150 horse-power over steam and an annual saving in fuel, etc., of $7,000.

SAN FRANCISCO, CALIF.—Fifteen thousand acres of land were recently conveyed to Alex. F. Morrison, of San Francisco, the consideration being $375,000. The transfers were made for a syndicate who desired to control the land bordering on the headwaters of Coyote Creek on account of the valuable water rights involved.

SAN FRANCISCO, CALIF.—The South Yuba Water Company is reported to be making surveys for a transmission line to supply electricity in Grass Valley and Nevada City, Calif., in competition with the Bay Counties Power Company. It is proposed to locate the water-power electric generating station in Alta, twelve miles from Grass Valley.

SAN [illegible] Power Company is [illegible] will be installed on the Mereed River nine miles above Benton Mills, Calif. The engineer is N. C. Ray, of Coulterville. It will be necessary to construct a steel [illegible]

SAN FRANCISCO, CALIF.—Successful results have been obtained with small electric irrigating plants by farmers in Santa Clara County near Berryessa, Calif. The Standard Electric Company will supply current from its transmission lines for the operation of a 5-hp induction motor to run an irrigating pump on the ranch of F. H. Bean, and the service may be extended.

SAN FRANCISCO, CALIF.—The Keswick Electric Power Company, which is operating a Westinghouse transmission plant, located in Shingletown, Shasta County, Calif., expects to float bonds and install a duplicate of its plant on Mill Creek. There is ample water power for both electric stations. The Keswick Company intends to extend its transmission line to Red Bluff.

RED BLUFF, CALIF.—The Tehama Electric Light Company, Red Bluff, is rebuilding its steam power electric generating station, which was recently almost destroyed by fire. There is a transmission line about twelve miles in length which supplies the towns of Vina and Corning with electricity. Fred. Christie, the night engineer, was accidentally killed on the night of the fire.

SAN FRANCISCO, CALIF.—It is reported that San Francisco capitalists recently purchased the canal and water rights of Main River Water Company on the Stanislaus River in California. A large electric power transmission plant is projected by the new owners. The proposed site is on the main stream, near the beginning of the old miners' ditch, terminating near Hale's Mills, on the South Fork of the Stanislaus.

SAN FRANCISCO, CALIF.—A hydro-electric transmission plant will be installed on the Noaksack River in the State of Washington by P. B. Cornwall, one of the owners of the Bellingham Bay & B. C. Railway. The capacity of the plant will be 5000 horse-power, and the distance of transmission to Whatcom and the Bellingham Bay towns, about thirty miles. A short electric railway will be constructed through the mountains as a branch of the Bellingham Bay & B. C. Railway.

CALDWELL, IDAHO.—An 800-light electric plant will be installed in Caldwell by W. R. Sebree, who was recently granted a lighting franchise.

BOISE, IDAHO.—The Electric Power Company, of Boise, has been granted a franchise to run an electric light and power line through this city.

LEWISTON, IDAHO.—E. H. Libby and associates have come into the possession of the Lewiston Electric Light Company, of Lewiston. The price paid is reported at $500,000. The new stockholders elected the following board of directors: Henry Adams, W. H. Boweker and Elbert Wheeler, of Boston; W. F. Kettenback, W. W. Lepeer, E. H. Libby and S. H. Reed, of Lewiston.

ALTON, ILL.—A new electric lighting company, backed by prominent Alton business men, is being organized for the purpose of furnishing lights in the business district of the city. The new company will be for the mutual benefit of the stockholders, and will furnish light at a figure as near actual cost as can be done. Mr. Edmond Beall will organize the company. The patrons will be asked to sign a five years' contract to take light. It is expected to have the plant in operation within two months. An arrangement is being made with the Kinloch Telephone Company for the use of its poles. Incandescent lighting alone will be done; later arc lights may be furnished. The new company will be incorporated with $25,000 capital. An option for ground for the plant has already been procured.

KOKOMO, IND.—George J. Marrott, of Indianapolis, has purchased the electric light system of this city. T. C. McReynolds will continue as manager.

HOMER, LA.—A movement is now on foot to establish an electric plant and system of waterworks here at an early date.

MONROE CITY, MO.—Since the destruction of the electric light plant by fire some time ago the city has been in darkness, and the business men are protesting. The City Council has called a mass meeting to decide the advisability of calling an election to vote on the proposition of issuing bonds and putting in a first class plant owned by the city.

HELENA, MONT.—The Missouri River Power Company has completed a line for transmitting power from its dam and plant at the Missouri River to Butte. The length of this line is sixty-five miles, and it crosses the main range of the Rocky Mountains at an altitude of 7200 feet, and a spur of the main range at almost an equal height. At present the line conveys 12,000 horsepower, but it is intended to double the power by the construction of another dam.

SHELBY, N. C.—Since the closing of the municipal electric light plant, A. C. Miller and Chas. Eskridge have offered to furnish lights at $65 each. The aldermen have proposed to give $60 per light.

MADISONVILLE, OHIO.—The village has sold $25,000 5 per cent. 20-30-year optional water and electric light bonds.

CANTON, OHIO.—A proposition to issue $20,000 worth of electric light bonds for the purpose of improving the plant has carried.

ZANESVILLE, OHIO.—The City Council has granted a franchise to the Citizens Electric Light Company, on condition that a number of lights be supplied to the city free of charge and a plant be constructed within eighteen months.

SANDUSKY, OHIO.—At the recent annual meeting of stockholders of the Sandusky Gas & Electric Company officers were elected as follows: Barney Mahler, president; C. B. Wilcox, vice-president; A. L. Moss, treasurer, and F. W. Coen, secretary.

SHREVE, OHIO.—The Shreve Citizens Electric Light, Power & Heating Company held its first annual meeting a few days ago. Reports showed that the [illegible]

[illegible] franchise to the Greenville Electric Light & Power Company. The company [illegible] schedule except on moonlight nights. Commercial lighting is to be furnished at 15 cents per kilowatt.

PENDLETON, ORE.—An electric lighting plant is projected, in connection with a new paper mill in Pendleton by F. Wallers.

RICHMOND, VA.—Lane & Company will build a power-house at Warren on James River to supply power to a number of manufacturing plants.

EVERETT, WASH.—Electric lighting franchises have been asked for in Everett by the Snoqualmie Falls Power Company and J. A. Faulkner. The ordinance granting the latter franchise will call for work to commence within six months and to be completed two years later.

RACINE, WIS.—Articles of incorporation have been filed by the Wisconsin Heat, Power & Light Company. Martin Clancy, C. M. Dietrich, Jeus Jensen and Peter B. Nelson are the incorporators. The capital stock is $25,000. It is said that the company is ready to spend $175,000 in building the plant. A franchise will be asked of the Council. The company will be a competitor of the Milwaukee Electric Railway & Lighting Company.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has secured a franchise for an extension of its lines, also to extend their tracks in Ensley, Ala.

FLORENCE, ALA.—The question of extending a franchise for an electric light and railway system is being discussed. Promoters who obtained a franchise eight months ago now seek a renewal of same.

SAN BERNARDINO, CALIF.—The San Bernardino Traction Company has been granted a franchise for an electric railway line on Colton Avenue, in San Bernardino.

SAN FRANCISCO, CALIF.—Messrs. S. N. Griffith and W. H. McKenzies have been granted a franchise for a suburban car line for transporting passengers and freight to Fresno, Calif.

SAN FRANCISCO, CALIF.—The San Francisco & San Mateo Electric Railway Company has been granted a franchise for the construction of its line from Colma to the city limits of San Mateo, Calif.

SAN FRANCISCO, CALIF.—The Pacific Heights Electric Railway Company has been incorporated in Honolulu, H. I., to build an electric railway to Nunanu, Pali, by Charles S. Desky, J. B. Atherton, George P. Castle, F. M. Hatch and Joseph B. Pratt.

SAN FRANCISCO, CALIF.—The City Council of Helena, Mont., has been asked to grant electric light and street railway franchises to the Citizens' Electric Company, which was recently incorporated, with a capital stock of $100,000 by C. Yeagen, Peter Yeagen, J. F. Kurtz and F. J. Walters.

SAN FRANCISCO, CALIF.—A claim for a water right for electric power purposes has been filed by John Burson, who has also applied for a franchise to build an electric railway through Ventura County to Bakersfield, Calif. The stream from which the water is to be taken is the Big Sespe.

SAN FRANCISCO, CALIF.—The San Jose & Santa Clara Railway Company is changing over the Alum Rock Park branch to an electric line, and is installing additional generating machinery for its operation. The electric power equipment will consist of a three-cylinder 11x12 Westinghouse gasoline engine, to be operated by crude oil, direct connected to a Westinghouse generator. The distance from San Jose to Alum Rock is eight miles. The engine was ordered through C. C. Moore & Company, San Francisco.

LOS ANGELES, CALIF.—The contest for the franchise of Los Angeles Railway is creating much interest in San Francisco. The whole question is outlined by Attorney T. A. Gibson is as follows: "It is true that W. A. Clark has agreed to take an interest with the traction company in the construction of street railway systems in this city. When representations were made to Senator Clark that the Huntington-Hellman syndicate was planning to get a blanket-franchise for the city, and so force all rival lines to sell out, Senator Clark and some of his friends determined to acquire Los Angeles franchises and block the plans of the monopoly."

SAVANNAH, GA.—The Savannah Electric Company has recorded at Atlanta an issue of $3,500,000 5 per cent gold bonds to run for fifty years, and payable at Boston, Mass. The company is now constructing fifty-three miles of electric railway.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has increased its capital stock to $500,000.

KOKOMO, IND.—The Union Traction Company has located its power-house for its Kokomo & Indianapolis branch line in this city.

RICHMOND, IND.—The Richmond Interurban Railway Company has let the contract for its Centreville and Cambridge City extension.

LOGANSPORT, IND.—The Logansport & Kokomo Railway Company has been incorporated, with $500,000 capital stock. The incorporators are Messrs. Lau and Stoneman, of Detroit.

LEBANON, IND.—A thirty-year street railway franchise has been granted to the Indianapolis & Lebanon Traction Company. The consideration is a fee of $8,000, and the location of the power-house in this city.

VINCENNES, IND.—The Ft. Wayne Construction Company is suing to foreclose a lien for $23,000 on the local electric light plant. The Sechner company of St. Louis, and the Northern and Royal Trust companies, of Chicago, are made co-defendants.

KOKOMO, IND.—George J. Marott, of Indianapolis, has purchased the Kokomo street railway plant, and effected a consolidation with a view to building a line to connect this city with Logansport, where Mr. Marott owns the local street railway system.

TRENTON, N. J.—The United Railways Investment Company of San Francisco has been incorporated in New Jersey "to deal in securities," according to the application. The capital is $2,500, paid up.

BROOKLYN, N. Y.—The repair shops and car yards of the Brooklyn Rapid Transit Company were recently visited by a fire which destroyed ten elevated cars, with motors, etc., and did damage to the amount of about $200,000.

OSSINING, N. Y.—The Westchester Traction Company has taken full possession of the electric street-car line, at Ossining, and intends to put in a new electric plant at the power station, all new rolling stock, and to extend the line to Pleasantville and White Plains as soon as the weather will permit. The company has also purchased the plant of the Ossining Heat, Light & Power Company, and will put in an entirely new alternating-current plant, and be able to furnish power for motors all over town. The capital of the new organization is $300,000, and the directors are Thos. F. Barrett, New York; J. V. Lockhart, Ossining and Harry M. Shaw, East Orange.

BROOKLYN, N. Y.—J. Edward Swanstrom, president of the Borough of Brooklyn, sent to the Board of Rapid Transit Commissioners last week a long communication, requesting that the proposed rapid-transit extension to Brooklyn be made a four-track system instead of a two track system, and that, if the city could not afford so great a change, four tracks be laid at least as far as the Battery loop. He declared that already the travel to Brooklyn was so great that a two-track system would be unable to cope with it, and that, in view of the immense development which he anticipates for that borough, a two-track system would be worse than useless in the future. He called attention to the switching system, by which the Brooklyn trains would leave the Battery branch at Pine Street, and declared that a switching system would be a constant source of danger.

GREENVILLE, OHIO.—The Greenville Council has granted a 25-year franchise to the Dayton & Northern Traction Company.

MANSFIELD, OHIO.—The Norwalk, Greenwich & Mansfield Railway has applied for franchises in Mansfield and Richland counties.

BELLEFONTAINE, OHIO.—Right of way has been secured for an extension of the Dayton, Springfield & Urbana Railway from Urbana to Bellefontaine.

TROY, OHIO.—The Dayton, Covington & Piqua Railway Company, which is building a line to Piqua, will probably build a spur line from Pleasant Hill to Troy.

CONNEAUT, OHIO.—The Conneaut Council has granted a franchise through town to the Conneaut & Eastern Railway, a road which will complete a through electric railway from Erie to Cleveland.

TOLEDO, OHIO.—The Toledo & Southern Electric Railway Company has sold out to the Toledo, Columbus, Springfield & Cincinnati Railway Company. It is said the consideration was $100,000.

GREENVILLE, OHIO.—The Greenville, Versailles & Northern Traction Company has been incorporated, with $1,000 capital stock, by Jacob R. Strocker, Wm. G. Mergler, W. A. Brown, H. J. Yount and William Lutz.

MARION, OHIO.—Hon. David Joy, president of the Findlay & Marion Electric Railway, claims that all right of way for the line has been secured. The town of Carey has donated four acres of land and $5,000 for the location of the power plant in that place.

WEST UNION, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway Company may extend its road from Georgetown to this place. The road is to be changed to standard gauge and passenger cars are to be operated by electricity and freight cars by steam.

CLEVELAND, OHIO.—Mr. R. L. Palmer, formerly general manager of the Cleveland & Chagrin Falls Railway, is interested with other Cleveland people in the construction of a line in Florida to extend from Tampa to Sulphur Springs, Port Tampa, Clearwater, and St. Petersburg.

BELLEFONTAINE, OHIO.—It is stated that the Dayton, Springfield & Urbana Railway will build a large power-house at West Liberty. The company is preparing to build its extension to Bellefontaine, and if built, the new station will furnish power for a large portion of the road. Right of way has been secured for the extension.

CAMBRIDGE, OHIO.—A company is being organized here with $500,000 capital stock to build a line from Cambridge to Byesville, a distance of ten miles. It will take over the stock of the Consolidated Ice & Electric Company and utilize its power house. O. E. Miles is the engineer in charge of the work.

DELAWARE, OHIO.—The Delaware, Berkshire & Sunbury Railway Company has been incorporated, with $10,000 capital stock, by J. T. Adams, J. E. Bierbauer, E. F. Gwynn, J. M. Schooles and P. J. Enbanks. The company was organized by a number of farmers in Delaware County and the road will operate wholly within the county.

CANTON, OHIO.—The annual meeting of the Canton-Massillon Railway Company was held recently. Officers were elected as follows: W. A. Lynch, president; G. W. Bodinot, secretary; L. A. Loichot, treasurer, and Charles Currie, general manager. The election was merely a formality, as it is understood that a deal has been practically closed for the transfer of the property to Tucker, Anthony & Company, of Boston.

MT. VERNON, OHIO.—On Feb. 1 the Mt. Vernon Street Railway Company and the Mt. Vernon Electric Light Company passed into the hands of the Jackson-O'Neill syndicate. Hereafter all three properties will be operated under one management. J. W. O'Neill, of Topeka, Kan., is president of the new company, and C. E. Johnson, secretary-treasurer and general manager. The new company will improve the street car lines and lighting plant.

CLEVELAND, OHIO.—The Everett-Moore syndicate will probably dispose of the Canton-Massillon Railway which was purchased some time ago, and the Akron-Canton Railway, which is held under option, and which was to have been turned over when completed. The first mentioned property includes the city lines of Canton and Massillon, an interurban line between the two towns and a line from Massillon to Navarre. The deal has not yet been closed up, but it is under consideration by the bankers' committee in charge of the Everett-Moore affairs.

CINCINNATI, OHIO.—Annual meetings of the Cincinnati & Eastern Railway, Suburban Traction Company and Rapid Railway were held a few days ago. The directors of the three companies are the same. Officers: Cincinnati & Eastern, G. R. Scrugham, president and general manager; Lee H. Brooks, vice-president; J. M. Kennedy, secretary-treasurer. The officers of the Rapid Railway are the same as the above, and those of the Suburban Traction Company are: G. R. Scrugham, president and general manager; J. M. Kennedy, vice-president; Lee H. Brooks, secretary, and Guy W. Mallon, treasurer.

OTTAWA, ONT.—Mr. Henry Burkholder, of Chicago, Ill., has recently been in Winnipeg, Man., completing arrangements for the commencement of work on the Lac Du Bonnet electric power plant. He states that the company he represents is also pushing forward the scheme of an electric railway from Lac Du Bonnet to Winnipeg, a distance of fifty-eight miles, the cost of which is estimated at $20,000 a mile.

OTTAWA, ONT.—It is now said that the Niagara Falls & St. Catherines electric railroad is to be extended toward Toronto next spring.

OTTAWA, ONT.—The report of the Dominion Department of Railways, at Ottawa, for the year ended June 30, 1901, a return is made, for the first time in the history of Canada, officially at least, of the electric railways of the Dominion. These total 675 miles of track. The paid-up capital of the electric railway companies is $39,076,019; gross earnings, $5,768,283; working expenses, $3,435,163; net earnings, $2,333,120. The street railways report the following number of passengers carried during the year: Montreal, 45,833,652; Toronto, 37,620,583; Ottawa, 7,469,304; Quebec, 3,715,675; Hamilton, 3,693,677; Winnipeg, 3,196,489; Halifax, 2,968,811; St. John, 1,710,223.

NASHVILLE, TENN.—C. W. Ruth and Frank Haskell, Pittsburg capitalists, have been investigating the question of constructing an electric railway from Nashville to Gallatin, thirty miles, and to Mt. Pleasant, fifty-eight miles. A charter has been applied for. The road will traverse the new Tennessee phosphate beds.

JANESVILLE, WIS.—The Janesville Street Railway Company's car barn was burned recently.

WAUPACA, WIS.—The Waupaca Electric Light & Railway plant was recently damaged by fire to the extent of $2,000.

MARINETTE, WIS.—The consolidation of the Marinette and Menominee street railway and lighting companies has been practically effected. The deal was made by Marinette and Menominee capitalists, who now own the stock of both lines. The new company will immediately complete a belt line around both cities, add new rolling stock and make other improvements, at a cost of about $100,000. The ultimate intention is to operate the system by power derived from water power located two miles up the Menominee River. The officers of the company are: President, F. A. Spies, of Menominee; vice-president, A. C. Merryman, of Marinette; secretary, G. W. Hanley, of Marinette; treasurer, H. G. Brown, of Marinette; superintendent, Ed. Daniell, Menominee.

NEW INDUSTRIAL COMPANIES.

THE F. P. JONES ELECTRIC COMPANY, of Buffalo, has been incorporated; capital, $10,000. Directors: Ferdinand P. Jones, Arthur A. Franklin and Charles D. Blackhall, Buffalo.

THE TICONDEROGA GRAPHITE COMPANY, Ticonderoga, N. Y., has been incorporated; capital, $100,000. Directors: W. W. D. Jeffers and W. W. Jeffers, Ticonderoga; H. B. Moore, New York.

THE AUTOMOBILE.

THE OCTOMOBILE COMPANY was recently incorporated in San Francisco with a capital stock of $100,000. Directors: A. Keller, J. M. Peel, C. L. Tilden, J. A. Marsh and H. F. Peart.

FLAGSTAFF, ARIZ.—Mr. Oliver Lippincott, the Los Angeles artist, in his automobile "Toledo" has climbed Knob Hill, a 16 per cent grade, in six inches of snow, in a test before a committee of the new automobile company between Flagstaff and the Grand Canyon. The demonstration is considered one of the most successful and difficult ever given in this country.

AUTOMOBILE SHOW IN CHICAGO.—The Chicago automobile show will open at the Coliseum in that city, Saturday, March 1, and continue through the following week, closing March 8. This show will be under the joint auspices of the Chicago Automobile Club and National Association of Automobile Manufacturers. All the space in the Coliseum has been engaged.

THE AUTOMOBILE CLUB OF AMERICA will hold its annual dinner at the Waldorf-Astoria on March 7, when a number of prominent men are expected to speak. The indications are of a large attendance. The Banquet Committee comprises Messrs. J. M. Hill, chairman; S. H. Valentine, H. W. Hedge, J. C. McCoy, B. McGregor, H. K. Browning and A. H. Whiting.

THE CALIFORNIA MOBILE TRANSPORTATION COMPANY has been organized in San Jose, Calif. Col. W. J. Cotton, of Oakland, is president and general manager. The capital stock is $200,000. The company has a number of automobiles, which will be used to carry tourists on excursion trips. Connections will be made with the observation train, which the Southern Pacific Railroad Company will operate between San Francisco and Los Gatos.

OBITUARY.

MR. [illegible] QUIMBY.—Mr. [illegible], who died last week at Orange, N. J., was an [illegible] patent expert, who stood at the head of his profession in this country. He was born in Bangor, Me., on February 9, 1831. He was engaged in business with his father until 1860, when he invented the screw machine still used by the American Screw Company. He became superintendent of the plant of that company, and remained with it until 1866, when he branched out for himself, and opened an office as a patent expert. Among the notable cases Mr. Quimby was engaged in was the patent litigation between the Bell Telephone Company and the Western Union Telegraph Company. His specifications for the Mannesmann tube patents were bound and issued by the Patent Office as a model for the guidance of other applicants for patents. His private charities were numerous, and during his career he took out many patents for poor inventors who were unable to pay the necessary charges. His death was caused by an attack of malaria, brought on by overwork. He is survived by his wife, two sons, and four daughters.

PERSONAL.

MR. THOS. A. EDISON, we understand, was invited to breakfast with Prince Henry of Prussia on board the Imperial yacht "Hohenzollern" on Feb. 27.

MR. ROBERT McF. DOBLE, of San Francisco, is in British Columbia, engaged as consulting electrical engineer in the examination of hydro-electric projects for the City of Vancouver.

MR. FRED. W. C. BAILEY, consulting electrical engineer of Columbus, Ohio, has been in New York the past week in connection with the design and purchase of apparatus for some plants on which he is engaged.

MR. H. A. WOODS, who has long acted as chief electrician of the Independent Electric Light & Power Company's system in San Francisco, has been advanced to fill the vacancy occasioned by the resignation of Mr. R. S. Masson as superintendent. Mr. Woods was at one time connected with the San Gabriel Electric Company in Los Angeles, and was graduated from Stanford University.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the interests of the Westinghouse Electric & Manufacturing Company, Westinghouse, Church, Kerr & Company, and a number of other North American concerns in Chili, Peru, Bolivia and Ecuador, is now on a visit to the United States. He can be found at the offices of William E. Peck & Company, 100 William Street, New York City.

MR. ARTHUR F. STANLEY, one of the oldest and best known electrical manufacturers in New York City, has recently severed his connection with the firm of Stanley & Patterson, and has opened offices in the Havemeyer Building at 26 Cortland Street, where he proposes to handle leading electrical specialties. He has already returned from a western trip, on which he completed arrangements for representing the Warren Electric & Specialty Company. Mr. Stanley has a wide circle of friends and acquaintances in the industry and is receiving many evidences of their hearty support.

MR. JAS. R. CRAVATH, western editor of ELECTRICAL WORLD AND ENGINEER, lectured before the electrical engineering students of Lewis Institute, Chicago, the evening of Feb. 20, on High Voltage Transmission. The lecture was illustrated with demonstrations by the current of a 30,000-volt testing transformer, showing the effects obtained with high voltages and the points to be guarded against in the construction of high voltage lines. The lecture was, in fact, a resume, as far as the short time would permit, of current practice in the far West.

MR. G. MARCONI.—The March issue of *Success* opens with an interesting analysis of the life-work of Guglielmo Marconi, written by Herbert Wallace, a well-known authority on scientific matters who, for the past three years, has followed Mr. Marconi in his many undertakings. Mr. Wallace reveals to us the qualities that made the young inventor finally successful in flashing the message across the Atlantic Ocean without a wire, and shows that Mr. Marconi, during his many years of experiment, overcame obstacles that one might suppose would make the most optimistic and courageous give up.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agents for the Sangamo Electric Company, has just published a most complete meter catalogue, or book of information, dealing with the Gutmann integrating alternating current wattmeter. It will be sent upon application to those interested and is worth sending for.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Cleveland, Ohio, has recently completed its second factory for the manufacture of "Fostoria Inner Globes, Extra Quality," and incandescent lamp bulbs. This company claims the unique distinction of being the only lamp manufacturer which manufactures its own globes.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, reports that the insulating of wire and cable is quite an extensive business with it. The insulating and cable machines run along day and night and have done so since last summer. The daily output keeps the factory supplied while the surplus is supplied to the trade.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, is preparing to build two additions to its plant. One building two stories high [illegible] and another building two stories high and 125x48 feet will be used for storage purposes.

COAL HANDLING MACHINERY is the subject of a 12-page pamphlet issued by the C. W. Hunt Company, West New Brighton, Staten Island, N. Y., containing a brief description of the machinery of this class manufactured by this concern. The pamphlet is illustrated and will be perused with interest by those concerned in coal handling.

BUCKEYE LAMPS.—The Buckeye Electric Company, Cleveland, Ohio, reports a very prosperous business in Buckeye lamps during the past season, during which time it has added to its line of manufacture a complete line of special lamps. The new type Buckeye lamp has maintained its reputation and is stated to have kept abreast in the development of the incandescent lamp from the earliest times.

KELLOGG PHILADELPHIA OFFICE.—The Kellogg Switchboard & Supply Company, of Chicago, has opened a branch office in Room 204 Keystone Telephone Building, corner Second and Sansom Streets, Philadelphia, where a full line of samples will be on exhibition, and where any information regarding business matters generally connected with the company will receive prompt attention.

THE REYNOLDS ELECTRIC COMPANY, of 221-225 Fifth Avenue, Chicago, has recently added valuable improvements to its "flasher" which it claims have made it the simplest, most durable, most reliable and consequently the most satisfactory on the market. "The Improved Reynolds Flasher," as the company has named it, is being heartily welcomed by the trade everywhere, and no doubt will be a great success.

THE AMERICAN INSULATING MACHINERY COMPANY, 940 North Third Street, Philadelphia, Pa., has recently made a number of improvements in its winding machinery which have greatly increased its efficiency. These improvements are particularly noticeable in the flyer, the perfected type of which has been given a thorough trial by a number of large manufacturers and pronounced satisfactory in every way.

FINISHED CASTINGS WITHOUT MACHINE WORK.—The H. H. Franklin Manufacturing Company, Syracuse, New York, has a process of casting metals which avoids the necessity of subsequent machine work. In a pamphlet issued by the company some information concerning the work is told in the fewest number of words possible, a la Alfred Jingle. All interested in castings would do well to look into this company's work.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that the demand has become so great for its new Wesco dry battery, which it has recently placed on the market, that it is hardly able to fill orders for it. It goes so far as to claim that this battery has the highest voltage, greatest current discharge, most rapid recuperation and longest life of any such battery on the market. It is sending them out on trial on application.

THE UNION ELECTRICAL & SUPPLY COMPANY has been organized in Salt Lake City. This concern, which is co-operative in character, has been established by the Electrical Workers' Union, whose members have been on strike and could not come to any agreement with the contractors. The new concern has sent orders for material and supplies to start a business with. The president is H. Scheiber, and the secretary and treasurer, H. Johnston.

CLEVELAND ENGINEERING COMPANY has opened an office at 817 New England Building, Cleveland, Ohio, where it is prepared to furnish estimates and specifications, to superintend the installation and make final tests of plants for power transmission, for lighting, heating and ventilating, storage battery equipment and electric railways. It will also make efficiency tests on existing plants. The members of the concern are Messrs. H. W. Woodward and C. H. Benjamin.

MR. WILLIAM ROCHE, 42 Vesey Street, New York City, is receiving orders from all quarters of the globe for his "New Standard" flashlight. The most important feature of this useful article is its long life, and wherever used it has given satisfaction. The various other specialties made by Mr. Roche, namely, the auto-gas ignition outfits and electric gas lighter, are meeting with good demand, all of which is due to the use of the "New Standard" dry battery, so well known for its length of life.

AMERICA'S WINTER RESORTS is the title of "Four-Track Series," No. 5, just issued by the New York Central & Hudson River Railroad Company. It refers briefly to the various American winter resorts and gives all the information that a traveler wants concerning these places. It contains several excellent maps, covering the greater part of the world, and altogether is a very interesting addition to the "Four-Track Series" of folders. Mr. George H. Daniels, General Passenger Agent, will be glad to send a copy to any one on receipt of a two-cent stamp.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, Wis., has just completed and placed upon the market a complete line of drum controllers for printing presses, cranes, hoists, machine tools, etc. These controllers are built in several different types, one very novel design embracing control through both armature and field of the motor, as well as no-voltage and overload release. Descriptive bulletins have been published and are being distributed. The company reports that its business during the past year was double that of 1900 and that it is constantly increasing its facilities to keep up with the ever growing demand for its goods.

THE OSBURN FLEXIBLE CONDUIT COMPANY, of New York, is making rapid progress with the new buildings in the extension of its manufacturing plant in Hoboken, N. J. The new addition will more than double the present capacity, and is expected to be completed in a couple of months. The business that has come to this company for its product "Flexduct" has been most gratifying and has exceeded all expectations, but the company does not propose to be one of "delay in delivery" kind, and is making these additions to its plant to enable it to fill all orders promptly.

HAND TRAVELLING CRANES.—Messrs. Pawling & Harnischfeger, Milwaukee, Wis., describe and illustrate a line of hand travelling cranes in Bulletin No. 5, recently issued. These hand cranes are furnished in two types of trolleys, Type A being made to be operated from a floor through or by means of pendant chains, and are built in capacities from 3 to 10 tons; Type C trolleys are made for lifting loads varying from 10 to 40 tons, the operation of hoisting being effected by hand cranks. It should be noted in this connection that the manufacture of hand travelling cranes by this firm is a secondary feature of the business, the main portion of its output being electric travelling cranes.

TRANSFORMER EFFICIENCY.—The Pittsburg Transformer Company has issued a pamphlet entitled, "Ultimate Efficiency of Transformers," which will be found of much interest to users of transformers. The subject is considered, not, as is usual, from the standpoint of electrical and magnetic design, which are assumed to be correct, but with respect to the mechanical and other features. Under these heads are considered insulation, internal temperature, construction, workmanship and operation, the importance of which are pointed out as affecting ultimate efficiency, which is defined as the relation between earnings and total expense, including purchase price, during the entire life of a transformer.

SCRANTON ENGINEERS' CLUB.—At the annual meeting, on Jan. 23, 1902, of the Engineers' Club, Scranton, Pa., the following officers for the ensuing year were elected: President, H. H. Stoek; vice-president, B. F. La Rue, Professor of Civil Engineering in the International Correspondence Schools; secretary, A. E. Lister; treasurer, F. J. Platt; corresponding secretary, A. B. Dunning; librarian, H. M. Lane, Professor of Mechanical Engineering in the International Correspondence Schools; directors, W. M. Marple, C. C. Rose, and H. W. Rowley. President Stoek is the editor of *Mines and Minerals*, the well-known mining publication issued by the International Textbook Company, Scranton, Pa., proprietors of the International Correspondence Schools.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, Dayton, Ohio, has just issued two catalogues, one on the subject of power pumping machinery, and the other on Stilwell heaters. The former catalogue gives descriptions and many illustrations of triplex and duplex electric gas or gasoline pumps and combined water-wheels and pumps for general water supply, municipal water works, hydraulic elevator service, mine service, railway service, etc. The illustrations, which are mainly halftones, are very clear in detail, and several full-page views show actual installations of pumps. The Stilwell heaters are treated in the second catalogue in a very complete manner, and fully illustrated. Reproductions of testimonial letters from many users of these heaters are given at the back.

THE STUART-HOWLAND COMPANY, of Boston, reports a remarkable growth in all departments of its business. Its sales in the last year show an increase of 120 per cent over the previous year. In the street railway department it has been particularly prosperous, having furnished in the season of 1901, in addition to its general supply business, the entire overhead and pole equipment (excepting wire) for over 500 miles of new road. It now manufactures this complete line, and has already several large orders booked for delivery the coming spring. It carries a very complete stock of all kinds of electrical supplies except heavy machinery, and has now ten salesmen on the road. It has recently issued a 332-page, 8"x8" general electrical supply catalogue, handsomely bound in cloth, in which everything is listed alphabetically, and very generously illustrated. It is printed on 70-lb. coated, natural tint paper. Both print and illustrations are unusually distinct, and as practically everything is shown which contractors, supply dealers, street railways, telephone companies, central stations and isolated plants have to purchase, it must prove decidedly popular in the purchasing departments of the various branches of the electrical trade.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, is in receipt of a great many inquiries relative to cedar poles and the indications are that the business will be very brisk, and even greater than last year. The company entered the field about January of last year and secured from producers in the vicinity of Escanaba, Mich., a very large stock of white cedar poles, with an idea of furnishing them to telephone companies in connection with its switchboard and telephone business. It supplied a large number of poles for the independent plants at Jackson and Detroit, Mich., Columbus, Alliance and Canton, Ohio; Iowa, Indiana, Illinois and the Southwestern States also purchased a large proportion of the stock. It was, of course, an experiment for a telephone manufacturing company to take up a distinct branch such as the pole business, but the results were so satisfactory and worked in so well with its general business that it has decided to continue for another year. It is stated that poles have advanced this year, but the company is said to have quite a number of poles that were bought last year, and is able to make very attractive prices on them. The company has a very complete assortment of poles and in yards whose shipping facilities can not be equalled. They have several large yards on the C. & N. W. R. R., the Escanaba & Lake Superior Railroad, and the same on the D. S. S. & A. R. R., also a very large yard at Ontonagon, Mich, on the C., M. & St. P. R. R.

STORE WINDOW REFLECTORS.—Any merchant given to reflection recognizes that his show window display is as important an advertising medium as are the local papers in which he sets forth in printed form the merits of his goods, and he will as readily see the importance of having his display lighted up to best possible advantage, now that the artificial lighting of show windows at night has come to be a feature of the shopper's world. A lighting system which has come to the front as meeting every requirement of window lighting is that of Frink's special patent window reflector, which has been installed in the show windows of a large number of the finest stores in the country with the highest possible results. Among the stores more recently adopting same might be mentioned: Eastman Bros. & Bancroft, Portland, Me.; Edward Malley & Company, New Haven, Conn.; Geo. Muse, Atlanta, Ga.; Kauffman, Strauss & Company, Lexington, Ky.; W. R. Bennett Company, Omaha, Neb.; Parker, Lowe D. G. Company, Fort Worth, Tex., and the windows of Messrs. Burke & Company's Norfolk, Va., store, this firm having recently installed it in their Dallas, Richmond, Memphis and Nashville stores also. Messrs. Kaskel & Kaskel have installed it in the show windows, and also the show cases, of their fine, new Fifth Avenue store, New York, and Messrs. H. C. F. Koch & Company, New York, and Callender, McAuslan & Troup Company, Providence, R. I., have installed a modification of the same with fine effect in lighting up their art department.

EXHAUST STEAM HEATING.—The American District Steam Company, Lockport, N. Y., reports that great interest is being taken by electric companies in the subject of the utilization and sale of exhaust steam from engines, by means of the American District system of underground steam mains. The company is in receipt of twice the number of orders at this time of the year over any previous year, and also a large number of inquiries from electric companies in all parts of this country and abroad. The subject of direct and exhaust steam heating, it states, is being taken up by electric companies and the public generally. Electric companies find that by installing this system of underground mains they can secure a large amount of additional electric lighting and power in large buildings that formerly generated their own current, as they are then able to furnish such buildings with steam heat from the street mains and electrical energy from the central station. One of the largest heating plants that the American District Company has ever installed was built for this particular purpose. In order to secure the electric business in several large blocks, the electric company was compelled to furnish the steam for heating these buildings. Owing to the rapid increase of the electrical business and the installation of more boiler and engine power, the American Company considers it much more preferable, and a good deal cheaper, to utilize the exhaust steam in electric plants in the manner above outlined, than to develop some water power, which is liable to run dry part of the year, and require a steam plant in reserve. The company contemplates large additions to its manufacturing plant the coming season to take care of its increasing business.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 18, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

11,968. REISSUE—ELECTRIC CONTACT OR CURRENT TAKING DEVICE; E. Greil and E. Audiger, Paris, France. App. filed Aug. 9, 1901.

This patent and the two which follow cover different forms of contact in which one terminal consists of a bunch of metallic wires, or other finely divided metal, while the other terminal is a point, or points adapted to pass into the body of such material.

11,969. REISSUE—ELECTRIC CONTACT OR CURRENT TAKING DEVICE; E. Greil and E. Audiger, Paris, France. App. filed Aug. 9, 1901. (See No. 11,968.)

11,970. REISSUE—ELECTRIC CONTACT OR CURRENT TAKING DEVICE; E. Greil and E. Audiger, Paris, France. App. filed Aug. 9, 1901. (See No. 11,968.)

693,390. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Oct. 19, 1886. An electrolytic receiver comprising a cylinder-surface and a bath-reservoir, co-operating with a portion only of the surface.

693,394. SECTIONAL CONDUCTOR ELECTRIC RAILWAY; K. Hora, Pardubitz, Austria-Hungary. App. filed March 6, 1901. The naked conductor in a closed conduit is surrounded by metal rings at intervals which are lifted by a magnet, carried by the car, into contact with the roof of the conduit, to establish connection from the conductor, through the ring, the conduit roof, to the motor.

693,396. AUTOMATIC RAILWAY APPLIANCE; S. W. Huff, Baltimore, Md. App. filed Jan. 17, 1898. A depressor bar operated by the flange of the car wheel and being of such length that when once pressed down to close the circuit, there will always be a flange upon it to hold it down until the entire train has passed, thus preventing intermittent closures of the circuit.

693,398. CONDUIT BUSHING; H. Ill, Newark, N. J. App. filed Nov. 23, 1901. A bushing adapted to be clamped to the end of the conduit and engaged with the walls of the outlet box.

693,408. METHOD OF MANUFACTURING SUGAR; J. H. Lavollay and G. E. Bourgoin, Paris, France. App. filed May 19, 1900. (See Current News and Notes.)

693,410. SUSPENSION CLAMP FOR ELECTRIC CONDUCTORS; S. S. Leonard, Chicago, Ill. App. filed Oct. 12, 1901. A bracket having a seat and clamp for the suspension wire.

693,416. CIRCUIT BREAKER; F. A. Merrick and J. D. Forrer, Johnstown, Pa. App. filed Nov. 9, 1899. A chamber formed by bottom and side walls of refractory material contains fixed contacts with which a movable contact co-operates; a division plate is located in the chamber and the whole structure is surrounded by a magnetic field.

693,417. SELF-PLAYING MANDOLIN; A. I. Mitchell, Rumford Falls, Me. App. filed April 4, 1901. Separate magnets are used to fret and pick the strings, a single circuit closer operating both magnets simultaneously.

693,425. OVERFLOW ALARM; A. Nicolet, Newark, N. J. App. filed Aug. 20, 1901. Details.

693,453. SECONDARY BATTERY PLATE; W. L. Silvey, Dayton, Ohio. App. filed Jan. 10, 1901. A corrugated plate filled on both sides with the active material is rolled up into a plug and pressed into a cavity in the plate.

693,482. METALLURGICAL PROCESS; E. G. Acheson, Buffalo, N. Y. App. filed Oct. 14, 1899. (See Current News and Notes.)

693,491. ALTERNATING CURRENT MOTOR METER; H. Brockelt, Berlin, Germany. App. filed Aug. 17, 1900. Details.

693,495. CARBON FEEDING DEVICE; C. E. Chapin, Greenwich, and W. E. Patchin, Bridgeport, Conn. App. filed May 4, 1901. To control the feed

[illegible] contact with the side of the rod, thus creating or reducing friction thereon.

693,520. RAILWAY ELECTRIC SIGNALING APPARATUS; W. Hume, London, England. App. filed May 28, 1901. Details.

693,530. MULTIPLEX TELEGRAPH CIRCUIT; L. A. McCarthy, Brooklyn, N. Y. App. filed April 24, 1901. The system includes a main and an artificial line and a controlling instrument, the coils of which are inserted in the two lines, to automatically actuate a rheostat to maintain a balance of resistance on the two lines.

693,537. ALTERNATING CURRENT ELECTRIC METER; E. Batault, Geneva, Switzerland. App. filed March 15, 1901. A magnetic bridge is employed between the two branches of the shunt magnet by means of which a partial closing of the magnetic lines of force is obtained to diminish the number of lines which affect the armature.

693,542. AUTOMATIC SHUT-OFF FOR ELECTRIC PUMPS; J. H. Fox and C. M. Lowther, New York, N. Y. App. filed Dec. 4, 1901. The fluid pressure in an expansible coil controls an electric switch.

693,550. ELECTRICAL SWITCH MECHANISM; H. Krantz, Brooklyn, N. Y. App. filed May 8, 1901. Details of construction of the clips.

693,555. LIGHTNING CONDUCTOR; A. Lelong, Villers Poteries, Belgium. App. filed Nov. 1, 1901. The conductor comprises a wire connected at its upper end to a conducting head having a series of spikes and at its lower end to a spiral copper coil, also having spikes.

693,578. CONDUCTOR FOR ELECTROMAGNETIC INDUCTION APPARATUS; H. H. Wait, Chicago, Ill. App. filed Jan. 12, 1901. Armature conductors are made of two different cross sections, the portion having the smaller cross section resting in a groove of the armature, while the larger occupies the dead portion at the heads, the object being to make the armature proper smaller in circumference than heretofore.

693,579. WINDING FOR DYNAMO ELECTRIC MACHINES; H. H. Wait, Chicago, Ill. App. filed Jan. 12, 1901. A modification of the preceding.

693,597. APPARATUS FOR CONTROLLING ACTIONS AT A DISTANCE; J. Gardner, Fleetwood, Eng. App. filed Dec. 30, 1901. (See Current News and Notes.)

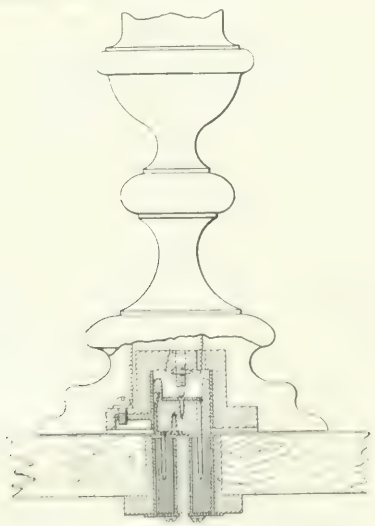
693,603. THIRD RAIL INSULATOR FOR ELECTRIC RAILWAYS; C. M. Hobbs, Baltimore, Md. App. filed July 24, 1901. The insulator is held between plates which have projecting tongues interlocking with dovetailed openings in the insulator.

693,605. TELEGRAPH; F. E. D'Humy, Boston, Mass. App. filed Oct. 14, 1901. The balance of the artificial line is automatically changed to suit the different conditions set up by the respective polarities of current, by which a perfect balance is maintained with either pole of the battery to line.

693,636. ELECTRIC SWITCH; H. P. Ball and L. Wintner, New York, N. Y. App. filed March 5, 1901. A small blade enters the clip ahead of the large blade and being connected with the latter through a spring, it leaves the clip suddenly, after the main blade has been pulled away.

693,650. AUTOMATIC SIGNAL APPARATUS FOR LIQUID HOLDING TANKS; J. E. Johnson, Brooklyn, N. Y. App. filed July 31, 1901. A float actuated circuit closer.

693,663. ELECTRIC ARC LAMP; S. M. Meyer, Brooklyn, N. Y. App. filed May 9, 1901. Details.



11,968.—Electric Contact or Current Taking Device.

693,676. STORAGE BATTERY SEPARATOR; G. M. Willis, Chicago, Ill. App. filed Aug. 10, 1901. The separator is made up of glass wool, stitched together with fibres of asbestos.

693,678. MACHINE FOR PRODUCTING CHLORIN GAS AND CAUSTIC SODA FROM COMMON SALT; G. M. Wilson, Sault Ste. Marie, Canada. App. filed Sept. 20, 1901. (See Current News and Notes.)

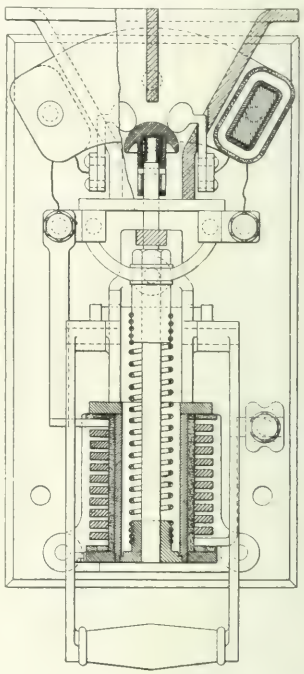
693,688. ELECTRIC METER; C. T. Claypoole, Sioux City, Ia. App. filed Jan. 6, 1902. In case the meter runs backward a fuse is automatically blown.

693,692. RESISTANCE COIL; A. C. Eastwood, Cleveland, Ohio. App. filed Sept. 26, 1901. The coils are wound around magnetic cores which are so placed that the magnetic field created by them will blow out any arc that may form between the buttons of the resistance.

693,705. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed July 12, 1901. Details.

693,706. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed Oct. 3, 1901. Details.

693,738. ELECTRIC LAMP SOCKET; J. D. Pierce, Philadelphia, Pa. App. filed Jan. 4, 1901. The shell which receives the neck of the lamp engages



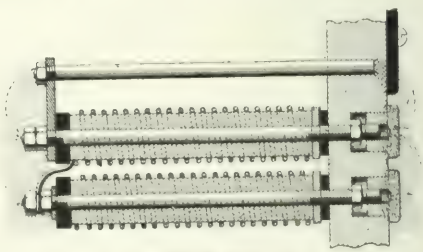
693,416.—Circuit Breaker.

with a porcelain disc by means of a lip which enters a notch in one edge of the disc, and a screw which passes through the disc and enters a flange on the base of the shell.

693,752. ELECTRIC COIL; W. Spencer, Jr., Schenectady, N. Y. App. filed Dec. 26, 1901. For purposes of ventilation the coil is made compound, an inner coil consisting of a series of windings spaced apart.

693,757. STORAGE BATTERY; W. Taylor, Philadelphia, Pa. App. filed July 28, 1900. The perforations in the plate have burrs extending in opposite directions and so shaped as to cause interlocking with the active material.

693,784. TRANSFER-BOARD FOR TELEPHONE OR TELEGRAPH CIRCUITS; A. B. Chance, Centralia, Mo. App. filed July 25, 1901. (See page 396.)



693,692.—Resistance Coil.

693,791. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, Ohio. App. filed Oct. 21, 1901. Details.

693,799. PULL SOCKET; H. Hubbell, Bridgeport, Conn. App. filed July 24, 1901. A pull chain passes into an opening in the side of the socket and around a segment which is moved in one direction by the chain and in the opposite by a string.

Electrical World and Engineer

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NEW YORK, SATURDAY, MARCH 8, 1902.

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THE LATEST WIRELESS FEAT.

Although the American Institute of Electrical Engineers made Mr. Marconi its guest of honor at the recent annual dinner, and acclaimed his feat in sending and receiving a telegraphic signal without wires across the Atlantic, there have been a great many persons who doubted the actuality of that feat. We have talked with some of them; while others are certainly engaged in editing our esteemed contemporaries in England, where their comments on Mr. Marconi have been of the most grudging and depreciatory character. In common with the daily newspapers, we now record achievements that make the Poldhu-St. Johns signaling quite insignificant, while this time Mr. Marconi has taken care to get records and witnesses. He is fully entitled to the heartiest congratulations, and we are glad to note that the Nestor of the science and art, Lord Kelvin, who first made submarine cabling feasible, is first to tender felicitations to the brilliant young inventor whose perseverence and grit have made the latest and greatest results possible. We have seen the attested records for ourselves. Mr. Marconi's word was enough for us, but it is something to have the documents which can be deposited in archives and national museums for the benefit of the incredulous and of posterity.

We publish, from the pen of Mr. Wilfrid Blaydes, a member of Mr. Marconi's staff, a report of the recent trip of the "Philadelphia," and we accompany his very interesting narrative by a reproduction of the signal received at 2099 miles—more than the Newfoundland record. The ease with which the whole thing was done is all that surprises us, and it compels us to expect greater results in the near future. In England, the Postmaster General may still dispute with Mr. Marconi his right to use any portion of the land. This is only in keeping with the policy that darkened the electric light, blocked the electric railway and strangled the telephone. But on the sea and on other shores Mr. Marconi and other workers in this great new field may surely look for kinder treatment. So far as the sea is concerned, it seems to us that the compass, the lighthouse and the wireless telegraph are the trinity of safe navigation.

"CAPTAINS OF INDUSTRY."

We were able to note briefly last week the breakfast given to Prince Henry of Prussia by twelve of the leading citizens of New York, at which a number of "captains of industry," "industrial notabilities" and "men of insight on the matter"—as Carlyle put it 50 years ago—were invited to meet the Prince. The idea had been submitted for approval to the German Emperor, who, with his usual quickness of perception, was prompt to approve so admirable a plan for bringing his brother in touch with those who conduct or who have helped to create the gigantic industries that are such a marked feature of American development. It is with pleasure that we call attention again to the prominence given to men connected with the electrical arts.

Before enlarging on this point we may note that there seems to be some little misunderstanding as to the invitations to this affair, these criticisms being based upon the list of acceptances. We happen to know, from inquiry, that about twice as many invitations went out as there were acceptances, and this result was inevitable, as a great many well-known men worthy of the honor were scattered all over the country and could not make the long trip to New York. But even of those who were there, the percentage of men of other distinction than that of wealth was remarkable, showing upon the part of the hosts a fine appreciation of the fitness of things, equaled only by the

quiet good taste that characterized the whole management. A printed list of 92 present, if analyzed roughly, shows only 24 "wealthy" men, and each of these stood for some great system of railroads, life insurance, etc. Of those representing industries distinctively there were 28, some rich, but often leaders because of their ability and energy. There were 10 educators, some of them leaders again in other groups; and no fewer than 30 inventors and engineers. In fact, this group ought to include some of the names in the other classes, but even as it stands in our rough analysis, it is the biggest batch of the lot.

To say nothing of men in the other groups interested in electrical work, we may note that of the 30 inventors and engineers, no fewer than 12 are distinctively electrical, and we should be justified in including one or two other names also; but the 12 are these: Edison, Thomson, Bell, Westinghouse, Brush, Weston, Sprague, Pupin, Hall, Acheson, Tesla, Steinmetz. This is assuredly a typical list, and a splendid compliment, but we should be warranted in claiming for is also from the other groups the names of Crocker, A. E. Brown, G. G. Ward and Vreeland—making 16 in all. Whatever may be thought of this proportion by those in other fields of work, electrical engineers can but contemplate it with pleasure.

Wires and Storms.

The recent storms have caused so much havoc among aerial circuits between the Alleghanies and the Atlantic seaboard that even now the telegraph and telephone circuits are not working at their full efficiency. The great centers of population, trade and government have been out of touch with each other, and it is not to be wondered at that there should be an agitation for putting all the wires underground. But the thing is easier said than done, and European instances have little weight in view of our "magnificent distances," some of which Prince Henry has been testing. That more wires between the cities could and should be put underground is true, but the floods have been out lately as well as the snows and winds; and on the whole, it would seem as though aerial wires had rather the best of it, as compared with those in ducts. Stronger construction than some of the newer telephone and telegraph circuits it would be hard to find; and when they succumb the weather is indeed exceptional. In spite of the clamor we do not expect to see much long-distance underground work attempted; but it is certainly worth the trial in some districts, and we hope that the Pennsylvania Railroad will carry out its reported intention of putting into conduits as many of its wires as possible between New York and Philadelphia.

A Notable Water Power System.

The detailed report of the operation of the Hartford Electric Light Company during the last decade, presented in the current issue, is exceptionally interesting and instructive. It displays in the most striking manner what can be done in a city of moderate size by a progressive and energetic management, and presents an excellent instance of a combined steam and water plant worked under sound and economical conditions. Within the past 10 years its load has increased nearly seven-fold, and its income has been correspondingly enlarged both in gross amount and net earnings. This conspicuous success is the more gratifying since it has been attained by broad methods and even daring innovations. The part in electrical pioneering which has been played by the Hartford plant is a very notable one, and it has reaped a far greater reward than comes to the ultra-conservative. Starting as a steam station it was the first American pl[illegible]ciate the value of modern methods in power transmis[illegible] to appr[illegible]
sion from water power, the first to order polyphase transmission apparatus; the first to experiment with enclosed arcs; if we mistake not the first central station to install 60-cycle rotary converters; the first to adopt the constant-current alternating-arc system; the first to adopt in this country the steam turbo-generator as a part of its regular equipment; and the first to commercially introduce the Nernst lamp! If some astute inventor steals the glow-worm's secret and puts it on the market, we would be willing to wager a reasonable amount that the Hartford Electric Light Company would install the first plant on the new system.

The use of water power at Hartford has been wise and successful. Ten years ago it put in a three-phase generator and synchronous motor to help out its steam plant, working over a 5000-volt line. To-day instead of being a steam station with a water power auxiliary, the tail is wagging the dog, and it is a water power transmission plant with a steam auxiliary. The management early grasped the fundamental fact that the economy of water power depends on the complete utilization of the power, and went to very large expense in reorganizing the plant with storage battery sub-stations so as fully to utilize their hydraulic resources. The business of the system has been continuously pushed forward until the whole available water has been taken up and steam has to be used in rather large amounts to take care of the surplus. Consequently, while water power plants have sometimes proved very costly to operate on account of the heavy fixed charges that have had to be borne by a comparatively small paying load, the Hartford station, with coal at a price that would enable it to compete on favorable terms with many hydraulic stations, has made its transmission from water power a paying proposition. And it has done this in spite of that fact that it has borne in this as in many things the brunt of considerable experimentation.

The growth of motor service in Hartford has been remarkably rapid. Both two-phase and direct-current motors are in use, as both systems are also in use for lights, and the company has not made that rather common mistake of adhering slavishly to one system because it happened to be the one first used. A part of its field is very compact, and in this the original three-wire system is in successful use; but when the need arose the management did not hesitate to put in alternating-current lights and motors wherever they would do the most good—an example which might profitably be followed by many others. Having available an alternating system of practicable frequency, the company was prepared to take up a novelty like the Nernst lamp without inconvenience. When the demand for this lamp becomes general, or when alternating arcs are substituted for other types, the Hartford Electric Light Company will be ready for business without a wholesale scrapping of apparatus. Its whole attitude has been one of shrewd foresight, and in its enormous increase of business it has but reaped the reward that was its due. Its experience ought to encourage the more general use of transmitted power and fearless innovation when innovation will pay. It is not every plant that has access to a cheap source of power, nor every one that realizes that water power is cheap only when it can be fully utilized. What a proper hydraulic development can do is powerfully in evidence in the work at Hartford, and what this, coupled with sound judgment and good management can do for the business of a plant, is written so that he who runs may read. It is real pleasure to be able to chronicle so notable an achievement.

Generator Heating Limits and the A. I. E. E. Standard.

A communication in our correspondence columns refers to a matter of considerable practical importance. The rating of a dynamo-electric machine is ordinarily limited by its temperature elevation. The temperature elevation that may safely be allowed depends upon the final temperature. The final temperature must not exceed a safe limit. Consequently, the load which a machine will carry in order to reach the assigned final temperature will be markedly greater when the machine is operated at a very low temperature in the arctic zone, than when operated on a summer day in a steam engine station near the tropics. But the commercial rating of the machine is assigned by the A. I. E. E. rule for a standard normal temperature of 25 degs C., with a temperature elevation of 50 degs. C. The safe load will

then be greater or less than the commercial rating, according to the local surrounding temperature. Some machines employ insulating materials which are not injured by a temperature of 150 degs. C., while other machines are liable to be injured by reaching a temperature of 100 degs. C. The safe load must, therefore, be considered for each type of construction, and each local temperature of surroundings.

To take a single supposititious case, a machine might be built which had a rating of 500 kw according to the A. I. E. E. rule of not exceeding 75 degs. C. in any part, when the temperature of surroundings is 25 degs. C. If the safe limiting temperature of the machine under load were, say, 100 degs. C., then the output of rating could be obtained if the engine room temperature were 50 degs. C., leaving, however, no margin for overloads. With a safe limiting temperature of 90 degs. C., the safe load of the machine would be less than the load rating unless the room temperature were lower than 40 degs. C.

The English Versus the Metric System.

On another page we print a curious communication from Mr. Charles T. Porter. For the benefit of our younger readers we will say that Mr. Porter is well-known in the history of the steam engine as the business partner of the gifted inventor, the late John H. Allen, in the development a generation ago of the high-speed steam engine. Mr. Porter, in the first place, is, we believe, incorrect in his statement that a bill is before Congress "which will make the use of the metric system compulsory in this country." The fact is that the bills in question seek to make the use of the metric system compulsory in United States Government departments and offices; but in this land of liberty no man can be restrained from either measuring or stating the height of his horse in "hands," or the area of his barn in "poles," as long as it shall please him so to do. In Germany there are still to be found a few who prefer to express lengths in terms of the defunct German inch, or "zoll," which was superseded by the metric system. The few are regarded as harmless victims of conservative idiosyncracy. If the Society of Mechanical Engineers is endeavoring to bar the way to the metric system, we must express extreme regret at such action; and in view of the testimony given at committee hearings in favor of the bill now before Congress by representatives of some of the largest engineering interests in the country, we doubt if adverse action on the part of the Society's governing body expresses the voice of a majority of its members. Of all classes of men, mechanical engineers have done most to develop civilization by the introduction of labor-saving devices. The metric system is merely a labor-saving device for dealing with magnitudes, just as our decimal system of coinage is a labor-saving device for effecting exchanges over its predecessor, the guinea-pound-shilling-penny-farthing system. Hence the anachronism of the deed. Unless history beguiles, there was a time in the days of Rome when the Arabic numerical notation was unknown, and all numerical computations had to be performed in Roman numerals. What must have been the labor involved in finding the product of two such numbers as 365 and 24 when those numbers were expressed as CCCLXV. and XXIV., respectively. There were regular rules for conducting the campaign. The saving of labor to the community effected by replacing the Roman by the Arabic numerals must have been enormous, and yet the change met, it is said, with vehement opposition among professional computers.

Mr. Porter's strange view is that the English system is preferable for the reason that it employs a variety of units, and he gives as an example the mile, yard, foot and inch, each of which is recommended for use in dealing with appropriate dimensions. So far as this argument claims any advantage over the use of the kilometer for roads, the meter for short distances and the centimeter and millimeter for smaller lengths, it seems only to recommend diversity and complexity of numerical ratios. Of the same order of distinctive use and procedure would be the denomination of all house lengths in feet, all church lengths in yards, all ship lengths in cables, all horse lengths in "hands," etc. How distinctive such a system might be made! As to the matter of the decimal point, sums of money are always expressed, in our decimal ssytem, in the largest suitable unit, commencing with mills and proceeding with decimal strides to billions If these numbers are written down there is always a danger of error from an accidental misplacement of the decimal point. A man who writes his income as ten thousand dollers, carried out to cents, is liable to make his income appear as a million dollars, by placing the decimal point at the end, and a similar liability to error occurs throughout the whole range of our decimal arithmetic. It is, however, an unwarranted reflection on the American mechanic's common sense and sense of proportion to imply that the decimal point would demoralize the workshop, and yet by some this objection has been urged as a crucial one.

Granting that the universal screw-thread is an Anglo-Saxon gift to the world, that thread does not require to be abandoned because the metric system is used. Metric-system Europe largely employs the Whitworth screw-thread and merely measures or expresses it in terms of the meter. As for the English inch, "which we have been at immense pains to obtain, with its endless possible bi-section," we all know that it is common among engineers to use decimals of a foot instead of inches, in leveling, and decimals of an inch instead of bisective fractions, in careful shop measurements. The metric system is a scientific system compared with the English system, because of its enormous relative simplicity. The sentiment, "Let other nations come to us. They have everything to gain by doing so," can hardly be commended. By the millions of men and women in the world who use the metric system exclusively, and who relinquished their own primitive units to adopt a uniform system, we hope that this sentiment may not be interpreted as jingoism, but rather as conservativeness enshrined. If our neighbors have a better system than ours, surely we have courage enough to admit the fact.

To our mind, the question of the general adoption of the metric system is entirely a practical one—a matter of dollars and cents—and a philosophical discussion such as that of Mr. Porter has nowadays merely an academic interest. We venture to say that all who have lived any length of time in a country employing the metric system have experienced some surprise at the facility with which they became accustomed to its use in daily life. In making purchases the liter, the kilogramme, the 50 grammes and the meter in a very short time take on an individuality quite equal to the corresponding English units; and the student very quickly finds the centimeter and millimeter adjusted to their linear value in his mind and to his eyes. Not the slightest difficulty would, we believe, be experienced by the American people in assimilating the metric system, while their gain through being able to easily interconnect the various units would be an enormous boon, and the benefit to our export trade incalculable.

In view of the striking fact that technical graduates are rapidly coming to dominate every department in every branch of technical industry, and that these through their thorough school training and their technical reading are not only entirely familiar with the metric system, but, almost to a man, in favor of its practical use, its general adoption in this country would be vastly facilitated. As the system would thus be welcomed by the present younger generation, and would be considered a great boon by the generations to come, the prejudices engendered by conditions existing in the past should not be permitted to obstruct the great reform. According to a report of the British Association advocating the adoption of the metric system by the British Government almost a majority of the House of Commons have pledged themselves in its favor. Since sentiment in favor of the system is rapidly growing in that country as in this, obstruction here is likely to have the sole result to deprive the United States of the credit of accomplishing the reform, which it will then obviously be compelled to embrace from commercial considerations.

Pennsylvania Railroad and Electricity.

The annual report of the Pennsylvania Railroad Company says with regard to electric traction in its tunnel under the Hudson River: "The board have long felt that your interests, as well as the convenience of the public, require the extension of your line into New York and the establishment of a centrally located passenger station in that city, through which the inconvenience and delays of the transfer by ferry will be avoided. The great cost of a bridge excluded that plan, unless all the railroad companies whose lines terminate on the west bank of the North River would join in the undertaking.

"The alternative was the construction of a tunnel line; but the difficulties incident to the operation by steam of a tunnel, at the depth and with the gradients required by the topographical conditions, seemed to make that method almost impracticable. Meanwhile, however, the successful operation of a number of tunnels in different parts of the world by electric power indicated that a satisfactory solution of the problem might be found in the construction of a line, to be operated by electricity, under the North River to a terminal station in New York, and thence under the East River to a connection with the Long Island Railroad.

"Preliminary investigations having favored its adoption, it was thought best to proceed at once to acquire ground for a station upon the location selected. This has been done and the greater part of the necessary property purchased at a reasonable price. The importance and cost of this work, however, and the fact that novel engineering questions were involved, made it the duty of your board, before proceeding further, to have the plans for construction, and, in fact, the whole subject, thoroughly studied by competent engineers. For this purpose a commission was created, consisting of five civil engineers eminent in their profession, namely: Colonel Charles W. Raymond, United States Army, chairman; Mr. Gustav Lindenthal, Mr. William H. Brown, chief engineer Pennsylvania Railroad Company; Mr. Charles M. Jacobs and Mr. Alfred Noble.

"This commission will supervise the preparation of all plans, and will have general control of the undertaking. The two members last named will have direct charge of the work, which has been divided into two sections, the North River section having been assigned to Mr. Jacobs, and the East River section to Mr. Noble. The study of the project has already progressed far enough to establish its entire practicability. The commission will have, in fact, a choice between several feasible plans. The cost of the work will be large, but your board are satisfied that the expenditure will be fully justified by the results obtained."

Telegraph Tournament.

The American Telegrapher's Tournament was held at Atlanta, Ga., on March 1, telegraphers from many parts of the United States being participants. Mr. Andrew Carnegie offered a gold medal for the speediest work, and sent the following message to the secretary of the tournament: "May the records be broken. '73' to all." Mr. Edison also took an interest in the event and sent the following letter:

"Although my business interests keep me well employed, I have decided to accept the honor you have conferred on me. I am much gratified to be a member of a committee composed of the honorable gentlemen whose names you mention. Trusting that the tournament will prove a success in every way, and with best wishes to the fraternity, I remain very truly yours, THOMAS A. EDISON."

Following were the results of the various contests: Transmission According to the Phillips Code—To the fastest sender for five minutes of matter by means of the code, a championship gold medal and $35. Won by F. M. McClintick, of Dallas, Texas; second prize, silver medal and $15, won by F. G. Matthews, of Atlanta.

Straight Morse Sending—To the fastest and most perfect sender for five minutes, a championship gold medal and $35. Won by E. E. Buckner, of Dallas, Texas; second prize, silver medal and $15, won by F. M. McClintick.

The *Atlanta Constitution* gold medal for the most rapid straight Morse sending, won by F. M. McClintick.

The *Atlanta Journal* gold medal, for the "cleanest" copy on a typewriter of five minutes, Phillips code, won by F. M. McClintick.

The message class event was won by H. V. Emanuel, of Philadelphia, receiving 50¼ messages in 30 minutes, breaking all records. The best previous record was 50 messages in 32 minutes 17 seconds. J. I. Hilliard, of Memphis, won the consolation prize for straight Morse sending. The Carnegie medal was won by McClintick, who established the world's record for sending.

Electrical Engineers of the Day.—XXXVI.

F. W. ROLLER.

Frank W. Roller, the son of a naval officer—now Commander J. E. Roller, U. S. N.—was born May 29, 1874, in New York City. His early education was received in the public schools of Boston, Mass., and Newark, N. J. From the high school of the latter place he entered the employ of the Sawyer-Man Electric Company in 1889, working first in the dynamo room, then on general wiring work, and finally in the laboratory at the time when experiments looking toward using carbonized silk threads for incandescent lamp filaments were being carried on. In 1890 he matriculated at Lehigh University, from which he was graduated four years later with the degree of mechanical engineer. At Lehigh Mr. Roller's scholarship and attainments entitled him to membership in the Tau-Beta-Pi Society, the college engineering society, an honor reserved for those who stand in the first fifth of their class. After graduation Mr. Roller entered into the employ of Mr. J. A. Machado, with whom he later formed the firm of Machedo & Roller, and entered into general electrical engineering work.

Upon the outbreak of the Spanish-American War Mr. Roller vol-



unteered his services to the Navy Department, and was commissioned a volunteer assistant engineer in the United States Navy, and was at once ordered to the U. S. S. "Nashville." Not long after going aboard the chief engineer of the vessel was ordered to the battleship "Indiana," and Mr. Roller was left to perform the duties of chief engineer until he received an honorable discharge from the service after the expiration of the war. The duties that devolved upon him were more special in character than in the case of a great majority of the vessels engaged in the Spanish-American War. This vessel was equipped in part with high-pressure water-tube boilers, and with quadruple expansion engines running at 300 r. p. m., both then innovations for a vessel of that size. In view of the very special nature of the machinery it was a high testimonial to the ability of the young officer that he was permitted to retain charge of the engineering department until the end of his service.

Upon his return to civil life Mr. Roller resumed his electrical engineering business, and took up in addition thereto much work in the line of mechanical energy. During late years he has devoted special attention to the matter of electrical measuring instruments, in which he has made several improvements and been awarded several patents. He has also done considerable work on small boilers and engines, and taken out patents on these and on an ingenious form of metallic packing.

Mr. Roller is a member of the American Institute of Electrical Engineers, the American Society of Naval Engineers and Franklin Institute.

Development of a Great Water Power System at Hartford, Conn.

By Alton D. Adams.

ELECTRICAL supply in Hartford, Conn., is notable for its rapid increase, the utilization of water power, and the system of transmission and distribution by which it is effected. The Hartford system includes three generating plants, two driven by water and one by steam, a sub-station of transformers and rotary converters in connection with the steam plant, a separate sub-station with transformers, rotary converters and a large storage battery, and two transformer stations for street lighting with series arcs.

The two water power plants are located on the Farmington River at points about three miles apart in the towns of Windsor and East Granby, respectively, one plant being approximately 10.5, and the other a little more than 11 miles in direct line from the steam station in Hartford. The Farmington River rises among the Berkshire Hills of Western Massachusetts, more than 50 miles above these electric power stations, and has a comparatively large drainage area. The flow of water in this stream, though subject to some variations, is large at all times of year, as may be seen from the electrical outputs of the water power stations, shown later on. The head of water available at the plant in East Granby is about 23 ft., and that at the station in Windsor 32 ft. The plant in Windsor is known as No. 1, and that in East Granby as No. 2, while the steam station in Hartford is spoken of as No. 3.

The earlier water power plant, or No. 1, is at a point called Rainbow, and the later, or No. 2, plant is near the village of Tariffville. At Rainbow the plant comprises a brick building with two Westinghouse generators, each belt connected to a horizontal turbine wheel. The capacity of each generator is 600 kw at 500 volts and 60 cycles, two-phase. This plant also contains four oil-cooled transformers of 300 kw capacity each, which raise the pressure of the energy from the generators to 10,000 volts and change it to three-phase. At Tariffville, the No. 2 station consists of a brick building in which are two Westinghouse generators, each direct connected to a horizontal turbine wheel. Each of these generators has a capacity of 750 kw at 500 volts, and their energy is raised to 10,000 volts, three-phase, by transformers. The combined capacity of generators in the two water power plants is thus 2700 kw. The steam power plant in Hartford, called No. 3 station, contains one 600-kw and one 400-kw generator, each driven by belt from an independent engine. The larger of these two generators delivers energy two-phase and 60-cycle at 2400 volts.

Besides the generators just named this station contains a 1500-kw alternator, direct connected to a steam turbine, all of Westinghouse make. This turbine alternator operates at 1200 r. p. m. and delivers energy at 2400 volts and 60 cycles, two-phase. With the 2500 kw of generating capacity at this steam plant, the water power stations give the system a rated dynamo output of 52000 kw at full load.

This turbine has been in actual operation long enough to sustain the statement of the builders and operators that it marks a distinct advancement in central station practice, and it may now be added that it has proved to be commercially successful. Its performance has been carefully noted under widely varying conditions, and while no official tests have yet been made, enough data have been gathered by the Hartford Company to satisfy it of the efficiency and economy of the installation.



Fig. 1. Interior of Station No. 3, Hartford, Conn.

It might be well to mention in this connection that the Hartford plant differs materially from turbine installations that have heretofore been made, both in this country and abroad. It has also the distinction of being the largest steam turbine plant in one integral part that has ever been built. The outfit weighs 175,000 lbs., including the generator, which is directly connected to the turbine, as shown in Figs. 3 and 4, and occupies a space 33 ft. 3 inches long and 6 ft. 9 inches wide. An examination of the illustrations of this outfit reveal the fact that the design and construction have been made to conform more to American ideas than the earlier machines of the same type. The turbine is entirely automatic in all its functions and requires very little attention. There are no rubbing surfaces and,

consequentiy, no internal lubrication is necessary, with the consequence that super-heated steam and surface condensers may be employed to the greatest advantage. The only real working part is the spindle revolving in its bearings, and as these bearings have been designed for minimum wear, the cost of repairs and renewal should be very small.

There is nothing remarkable in the design of generator used with the turbine, the principal modifications being those necessitated by the high speed at which the turbine operates, permitting a considerable reduction in weight and size, and making it possible to obviate crowding of pole pieces.

Besides the generators just mentioned at the steam power station there are also located there two rotary converters of 400 kw capacity each, four 375-kw, four 300-kw and four 200-kw transformers. At the battery sub-station on State Street are located two 250-kw and one 300-kw rotary converters, together with transformers of equivalent capacity, also a battery with 140 cells of 17,000 ampere-hours each. Two other sub-stations at opposite sides of the city contain constant-current transformers that supply series circuits for alternating arcs.

Each of the water power plants is connected by an independent line with the steam power station in Hartford. The energy developed by the water-driven generators, after being raised from 500 to 10,000 volts, is transmitted to the four 300-kw and the four 375-kw transformers at the steam power station, and there reduced to 2400 volts. A part of this energy from the water powers is further lowered in pressure by the four 200-kw transformers at the steam station.



FIG. 2.—SCHEME OF FEEDERS AND DISTRIBUTION.

which feed the two rotary converters of 400 kw each, there located These rotaries deliver direct current at approximately 220 volts to an underground, three-wire system that supplies consumers throughout the main business parts of the city.

Two-phase current at 60 cycles and 2400 volts passes from the larger transformers at the steam station to the switchboard there, and is thence distributed to the sub-stations and the suburbs of the city for lighting and motor service. The 2400-volt current is transformed at the battery station for the rotary converters there, which

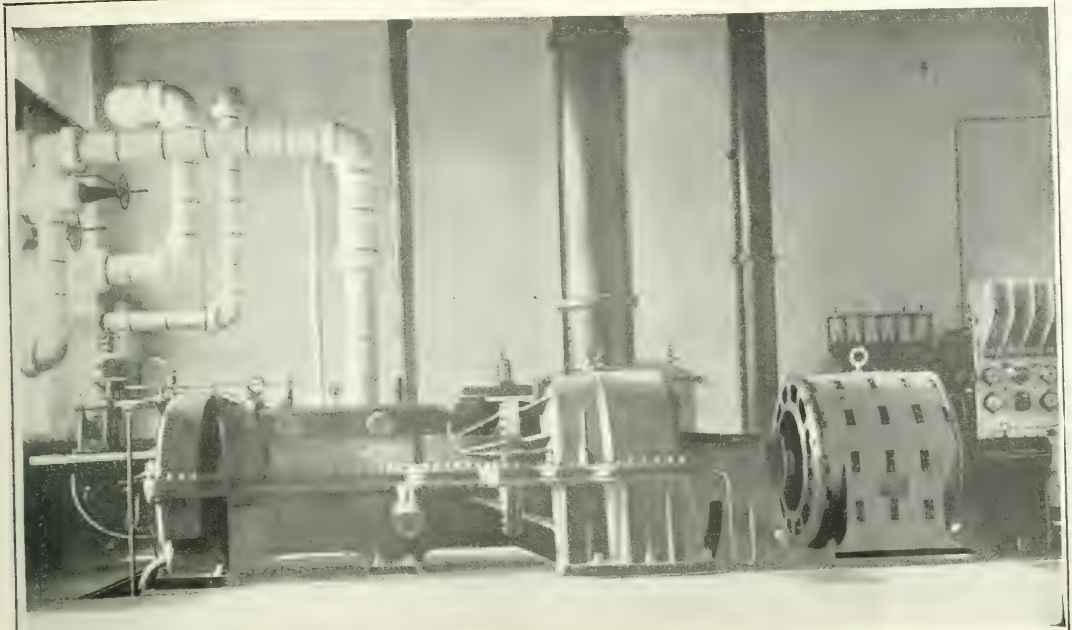


Fig. 3.—1500-kw Steam Turbine and Generator, Hartford.

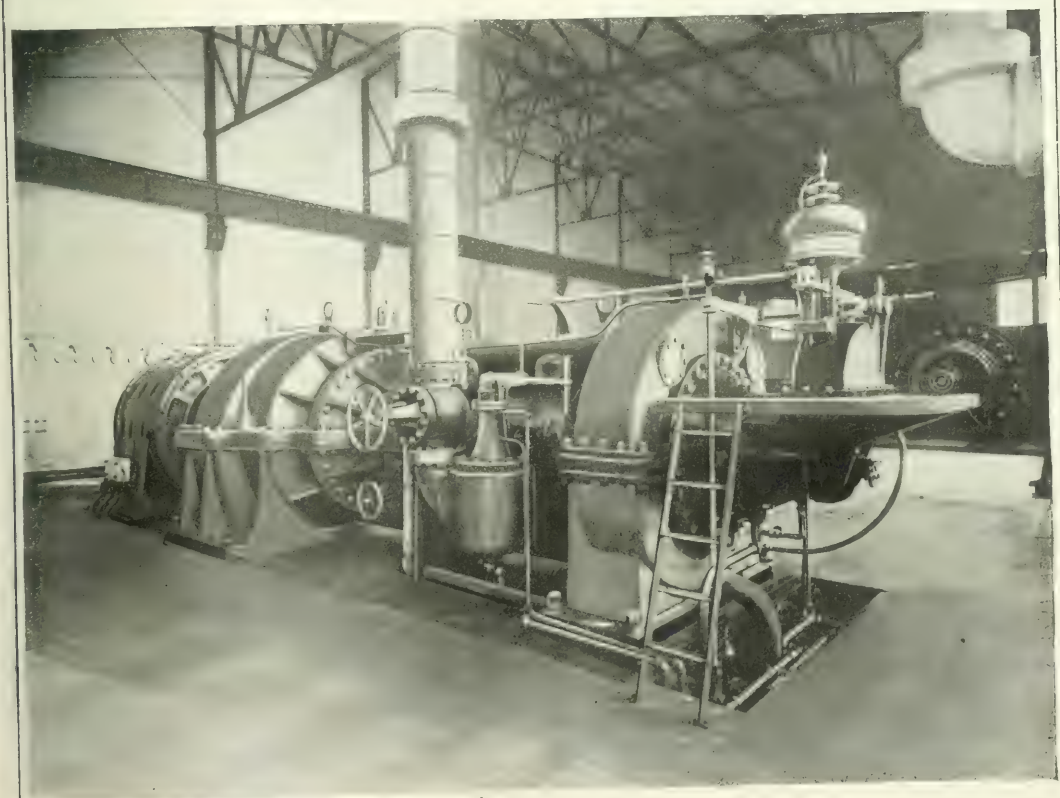


Fig. 4.—Another View of the 1500-kw Steam Turbine and Generator.

STEAM TURBINE GENERATOR, HARTFORD, CONN., PLANT

deliver direct current at approximately 220 volts to either the batteries or the three-wire underground system previously mentioned. At the two sub-stations devoted to the supply of alternating arcs on series circuits, the 2400-volt energy from the steam power station is passed through transformers that deliver constant current of 6.25 amperes. The 600, the 400 and the 1500-kw generator at the steam station deliver their energy at 2400 volts to the same switchboard that receives the current from the transformers connected with the water power plants.

It is thus possible to combine the outputs from water power and steam so that each may carry any desired portion of the total service load. The 400-kw generator at the steam station is of the double-current type, so that it can be used with its transformers to supply

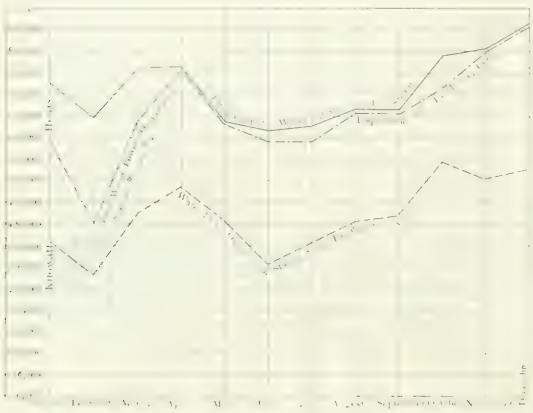


FIG. 5.—ENERGY OUTPUT CURVE.

either direct current at 220 volts or 60 cycle, 2400-volt alternating current. Energy from the water powers is absorbed by the batteries during periods of small load, and the batteries discharge into the outside conductors of the three-wire system in the usual way. The load of the Hartford plants is made up of arc and incandescent lamps and motors connected to the three-wire system, the same classes of service from the 2400-volt system through transformers of constant pressure, and series arc street lamps fed from constant-current transformers, which are also connected to the 2400-volt lines. Where motors are supplied with alternating current they are of the two-phase type, the two wires of each phase being brought to the motor. Arc and incandescent lamps are supplied from independent circuits representing each phase.

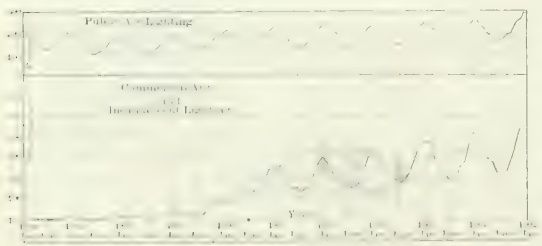


FIG. 6.—PERCENTAGE INCREASE OF RECEIPTS.

The Hartford plants are especially designed with a view to economy of both steam and water power. Too frequently systems that enjoy the advantage of water powers lack storage batteries, and thus lose large amounts of energy during the hours of small loads, which could be used to good advantage at periods of maximum demand. In this way much of the possible benefits of water power is lost.

Economy in the production of steam power at Hartford is sought by the use of the steam turbine above mentioned, by condensers with the engines, and three large cooling towers in which the water from condensers is subject to a mechanical draft of air while passing over layers of unglazed tiles. Fans for the production of this draft are driven by electric motors.

A large motor load has been secured for the Hartford system, and the battery capacity that would otherwise be necessary for the storage of energy from the water powers is thereby reduced. In October, 1901, the system had connected 68,725 incandescent and 1679 arc lamps. On Dec. 6 of the same year the number of motors supplied was 480, and their total rated horse-power 3476. This gives the unusually high average of 7.24 hp per motor, and indicates that the per cent of large motors to the total number is greater than in most cities. If these motors have an average efficiency of 74.6 per cent their kilowatt capacity is represented by the figures just given for horse-power, namely, 3476. Allowing 60 watts for each of the incandescent lamps, their total capacity amounts to 4123.5 kw. The arc lamps have a capacity of 471.6 kw, if each lamp consumes energy at the rate of 400 watts on an average.

The total of these figures is 8271 kw for the entire connected load. Of this total, motors make up the unusually large portion of 40.5

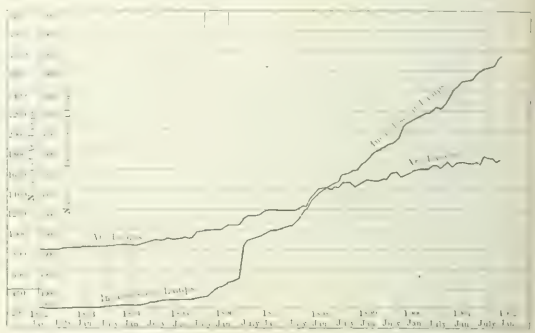


FIG. 7.—INCREASE IN LIGHTING SINCE 1892.

per cent. On Jan. 1, 1902, the numbers of arc lamps devoted to street lighting was 872, and 753 of these were on constant-current alternating circuits. Figures for a week-day load in several months of 1901 bring out some interesting relations between maximum, minimum, average and connected load, and the use of storage batteries in the system. On a week-day in January, 1901, the maximum load was 2720 kw, and the total energy output was 30,249 kw-hours. The average load for each of the 24 hours was, therefore, 1260 kw, or 46 per cent of the maximum load. On this same day the battery discharged at the rate of 260 kw at the peak of the load. In the early morning hours of this day the load on the system, apart from battery charging reached its minimum at 612 kw, or only 22.5 per cent of the maximum load.

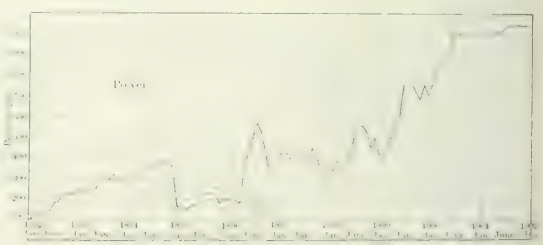


FIG. 8.—PERCENTAGE INCREASE OF RECEIPTS.

In July, 1901, the minimum load on a certain week day was 1390 kw, and the minimum load 250 kw, or 18 per cent of the former. The total output on this day was 25,105 kw-hours, so that the average load during the 24 hours was 1046 kw, or 75 per cent of the maximum load. For the day in question the maximum rate of battery discharge was 150 kw, but this did not occur at the period of greatest load on the system. In January the maximum load came on between 4 and 5 P. M., when lighting was the predominant factor, but in July the greatest demand on the system came in the latter part of the forenoon, and must have been made up in large part by requirements for electric power. By December, 1901, the maximum load reached 2838 kw, and the minimum load was 612 kw. The

greatest rate of battery discharge for the December day was 350 kw. In the month just named there were connected to the system 72,085 incandescent and 1824 arc lamps. Allowing 60 watts for the capacity of each incandescent and 400 watts for each arc, the total capacity of the former was 43,251 and of the latter 7296 kw. Adding these numbers to the 3476 kw of motor capacity found for Dec. 6, shows the approximate capacity of all connected lamps and motors in that month to have been 8530 kw. The maximum load of 2838 kw for the December day is only 33 per cent of the connected capacity just found. On this day the total output was 32,191 kw-hours, so that the average load during the 24 hours was 1342 kw. This average is 15 per cent of the total capacity of connected lamps and motors.

Extensive use of water power and its economical methods of distribution have contributed to effective competition on the part of the Hartford electric system. The price of gas in Hartford has been moderate for some years, and stood at $1 per 1000 cu. ft. in 1901. In spite of this fact electrical supply from the Hartford system has increased at an exceptionally rapid rate. In January, 1892, the public arc lamps supplied numbered 476, and 10 years later, in December, 1901, this number had increased to 853, or to 179 per cent of that in the earlier year. As is well known, street lighting offers much less opportunity for possible expansion than does commercial service. In January, 1892, the commercial arcs connected to the system numbered 308, and in December, 1901, the number was 971, or 315 per cent of that 10 years previous. Even commercial arc lighting has not the inherent capacity for expansion found in incandescent and

Numbers of arc and incandescent lamps connected to the system in January of each year.

Year.	Number of public arcs.	Number commercial arcs.	Number commercial incandescent.
1892.....	476	308	4,851
1893	494	312	4,879
1894	504	325	5,003
1895	537	380	7,070
1896.....	607	430	11,606
1897.....	642	547	26,671
1898.....	692	719	34,751
1899.....	730	768	42,938
1900.....	784	828	52,985
1901..	841	832	62,222
December, 1901.....	853	971	72,085

Prior to 1898 the number of public exceeded that of commercial arcs, but in that year commercial arcs shot ahead. The income from public arc lamps in the month of December, 1901, was greater by 42.3 per cent than the like income for the month of January, 1892. Commercial arc and incandescent lamps yielded an income in December, 1901, that was 5.035 times the like income in January, 1892. As to the income from sales of electric motive power in the month last named, the receipts from the same sort of service during De-

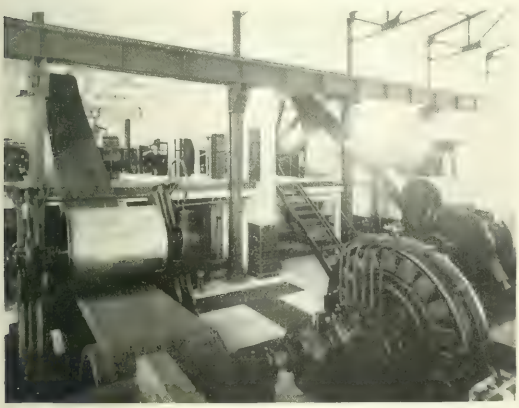


FIG. 9.—400 AND 600-KW GENERATORS.



FIG. 10.—SUB-STATION, BELDEN STREET.

power service. This is well illustrated by the case in hand. The Hartford system was operating 4851 incandescent lamps in January, 1892, and in December, 1901, the number of these lamps was 72,085, or 14.8 times that for the earlier year. From the foregoing it seems that the average yearly gain during the decade for arc street lamps was 7.9 per cent, for commercial arcs 31.5 per cent, and for incandescent lamps 148 per cent of the number connected to the system in January, 1892.

The moderate gains in the numbers of arc lamps have been made at a much more nearly uniform rate than that by which incandescent service has advanced. In January, 1896, the number of incandescent lamps connected to the system was 11,606, a gain of 139 per cent over the 4851 so connected in January, 1892. This gain during four years amounts to 34.7 per cent yearly of the number in 1892. From January, 1896, to December, 1901, the incandescent lamps added to the system were 1246 per cent of the number of these lamps in January, 1892. This addition amounts to an average yearly increase of 207 per cent of the number of incandescent lamps in the earliest year named. Unfortunately, it is not possible to present figures for the horse-power of motors connected to the Hartford system during the period under consideration. Other facts are at hand, however, which show that the rate of increase for electric power service was greater than that in either of the other lines.

Second only to the expansion of electrical supply from the Hartford plants has been the rise of their incomes. These incomes are here considered as to public arc lighting, commercial arc and incandescent lighting, and electric power.

cember, 1901, showed a gain of 945 per cent. The average yearly gain during the decade was thus 4.2 per cent for income from public arcs, 40.3 per cent for commercial lighting income, and 94.5 per cent for income from electric motive power, in the December months.

Water power has evidently been the most important physical factor in the rapid development of the Hartford electric system. During the entire period under consideration water power has supplied a very large though varying portion of the total energy output of the plants. Water power station No. 1, above described, was put into operation during November, 1891. The second water power, at No. 2 station, began to supply electrical energy in November, 1899.

Since the second water power station was started, only a small fraction of the delivered energy has been generated from coal, except at those times of year when the supply of water has been too small to meet the full demand. Fortunately, owing to the excellent engineering practiced by the company and the liberal policy of its management, it is possible to give the figures for the energy derived from water power, and the total output of the system in kw-hours. These figures are here presented for the kw-hours from water power, and for the entire output during each month of 1901. Considering the entire year, the energy output of the system was 8,577,699 kw-hours, and of this only 1,009,598 kw-hours were developed with steam power. It follows that the output from water power was 88.2 per cent of the total energy. If the available water power had remained constant at its higher values, little work would have been required of the steam equipment at any period of the year, and it is instructive to consider the records of the several months.

Energy output from water and steam power during the months of 1901.

Month.	Total kw-hours of output.	Kw-hours from water.	Kw-hours from steam.	Per cent of total from water.
January	748,096	588,100	159,996	78.6
February	642,762	292,500	350,262	45.5
March	758,537	633,400	125,137	83.5
April	759,581	615,900	144,031	80.9
May	635,421	630,800	4,621	99.2
June	616,407	583,900	32,507	94.7
July	625,530	589,800	35,730	94.2
August	666,898	656,500	10,398	98.4
September	660,213	654,000	6,213	99.0
October	790,521	665,600	124,921	84.1
November	805,837	804,901	936	99.8
December	866,946	852,700	14,246	98.4

The lowest ratio of output from water to the total electrical output for the month was that in February, when the water plants supplied only 45.5 per cent of the total energy, and the steam plant delivered 350,262 kw-hours. In November, on the other hand, 99.8 per cent of the total output from the system was developed by water power, and the steam plant supplied only 936 kw-hours.

During each of five months in 1901 more than 98 per cent of the total energy output was from water, yet in one month the steam plant was required to develop 54.5 per cent of the total energy. The largest monthly output from the steam plant, 350,262 kw-hours, was 4.16 times as great as the average monthly output of 84,133 kw-hours from steam power.

water power in the Hartford system, also illustrate the most inherent weakness, of such power, namely, the necessity of a relatively large steam plant that must be mostly idle during the greater part of the year. It is a most important consideration, however, that this requirement for steam plant is inherent in electric, water power systems as they usually are, rather than as they may be. Thus far

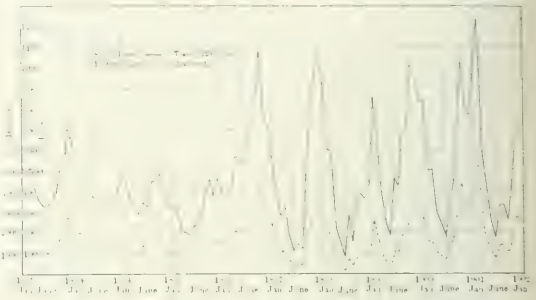


FIG. 12.—TONS CONSUMED AND AMOUNT PAID FOR COAL PER MONTH.

comparatively little has been done in the storage of water for systems of electrical supply. When this subject receives the attention it deserves, the surplus water that now runs freely to the ocean during some months of the year, will be impounded and later put to useful work in the scanty seasons.

The great advantage of water power to the Hartford Electric

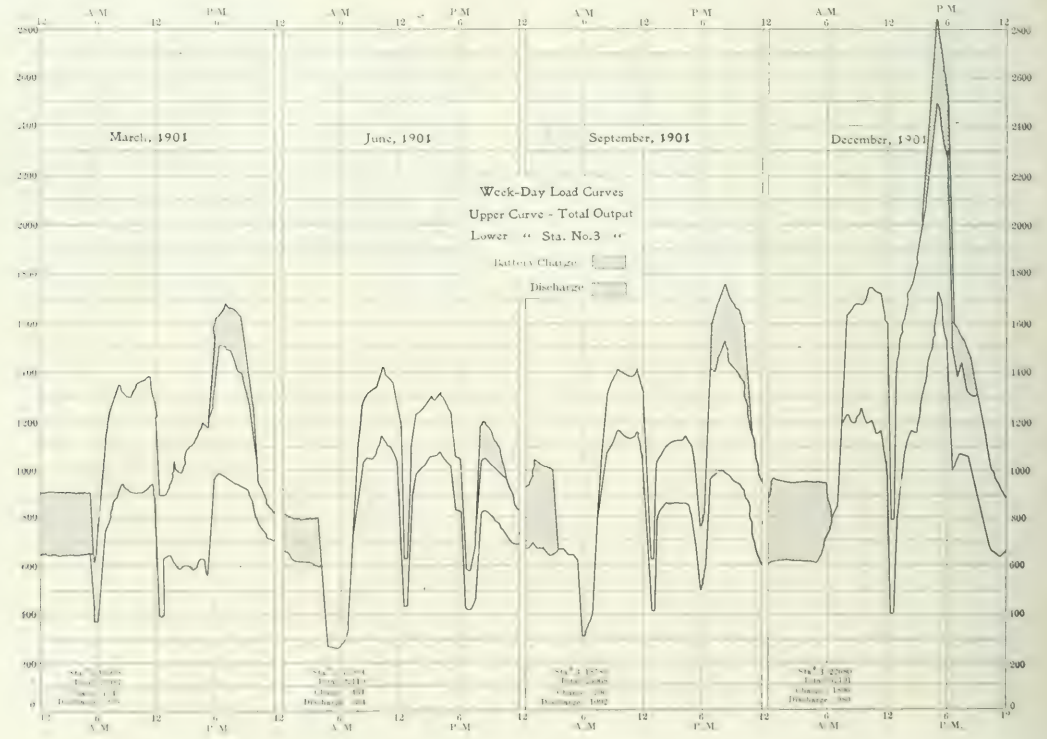


FIG. 11.—WEEK-DAY LOAD CURVES.

The greatest development of energy by water in any month was that in December of 852,700 kw-hours, and the least monthly development from this source was 292,500 kw-hours during February. This maximum output is 2.9 times the minimum, and 1.3 times the average monthly figure of 630,675 kw-hours from water power. These facts, while they bring out the very important position of

Light Company, and the important part it occupies in their system is further illustrated by figures for the tons of coal yearly consumed at their stations. To fully appreciate the force of these figures it is necessary to hold in mind that a large, though indeterminate, part of the coal yearly consumed is devoted to the public supply of steam heat, so that much coal is consumed when the output from water

power is at its highest point. An illustration of this may be seen in November, 1901, when the electrical energy delivered by the steam plant was only 936 kw-hours, but the coal consumption of the system amounted to 691 tons. So great has been the preponderance of water over steam power in the system that the increase above noted in connected electrical loads has had only a comparatively slight effect on the yearly amounts of coal consumed. This is well illustrated by figures for the years of 1892 and 1901 as to coal supply.



FIG. 13.—INTERIOR OF SUB STATION, WARD STREET.

In the earlier year the system consumed 5496.72 tons, and in the later 6306.4 tons of coal for all purposes.

Tons of coal consumed by the Hartford system during each year.

Year.	Tons of coal.	Year.	Tons of coal.
1892	5,496.72	1897	5,393.42
1893	5,120.86	1898	4,628.79
1894	4,634.16	1899	7,394.95
1895	3,727.56	1900	6,652.69
1896	7,711.18	1901	6,306.40

It thus appears that the consumption of coal was only 15 per cent greater in 1901 than in 1892. Meantime, however, as has already been



FIG. 14.—LIGHTNING ARRESTER IN TERMINAL HOUSE.

shown, the gain in income from public arc lamps was 42.3 per cent, from commercial arcs and incandescent lamps 403.5 per cent, and from electric motive power 945 per cent of the corresponding amounts in 1892.

The growth of electrical supply cannot be accurately measured by the capacity of connected lamps and motors, because the average yearly use of each connected unit has generally declined. Neither can money income serve as an accurate measure of electrical service, because, as a rule, prices have declined.

It is, therefore, of much interest in the present case to illustrate the expansion of the Hartford system by the figures for actual energy output. These figures are not available for the entire decade, but it is possible to present them for the last seven months of 1898 in comparison with the like months of 1901. The 616,407 kw-hours sent out by the Hartford system during June, 1901, were greater by 76



FIG. 15.—COOLING TOWERS FOR TURBINE, STATION NO. 3.

per cent than the output of 348,700 kw-hours during the corresponding month of 1898. In September, 1901, the kw-hours of output exceeded the output during the same month of the earlier year by 87 per cent. For the remaining months considered, the ratios of increase over the outputs in the earlier year range between the figures just given.

The fact that 88.2 per cent of the total energy output of the Hartford system, during the year 1901, was developed by water, in spite of the requirement of steam for 54.5 per cent of the total energy in a single month, carries its obvious lesson as to the value of water



FIG. 16.—JET CONDENSER, STATION NO. 3.

power in a system of electrical supply. This lesson is made plainer by the exceptional rate of development that has been maintained for electrical supply in Hartford, in spite of the active competition of a previously existing gas company with ample physical and financial equipment. At equal prices for similar service there can be little question as to the choice of the public between gas and electrical supply. Water powers are to-day much the most important of the

known factors by which the costs of electrical energy may be reduced.

Kilowatt-hours of output by months in 1898 and 1901.

Month.	1898. kw-hours.	1901. kw-hours.	Ratio energy in 1901 to that in 1898 Per cent.
May	355,522	635,421	178
June	348,700	616,407	176
July	335,724	625,530	186
August	373,019	666,898	178
September	352,196	660,213	187
October	424,151	790,521	186
November	435,305	805,837	185
December	491,391	860,092	176

Thanks are due to Mr. Austin C. Dunham, president; Mr. Robert W. Rollins, general manager, and to other officers of the Hartford Electric Light Company for the facts which their liberal policy has made it possible to set out in this article.

It is to be hoped, for the general good of electrical supply, that the precedent here set, as to publication of figures for actual energy outputs, will be followed for other systems. In this way a body of data of great value may be built up for American stations, similar to that already existing in England and on the Continent of Europe.

District Electrical Supply.

For some years past a practice has grown up on the Continent of Europe whereby, instead of there being a number of separate central stations in near-by towns, a large central generating plant furnishes the energy for all of the towns within a considerable territory. With the voltages now practicable, it is entirely feasible to supply in this manner a large territory, and one of the developments to be expected in the near future is a considerable extension of this practice in this country, involving in many cases the consolidation of the companies operating plants in neighboring towns.

An example of such a central plant is one recently erected by the Central Electric Company at Metuchen, N. J., for the supply of current to Metuchen, Highland Park, New Brunswick, Perth Amboy, Rahway, Woodbridge, Bound Brook and Dunellen. This company is a consolidation of the Middlesex Electric Company, Edison Electric Illuminating Company of New Brunswick, Raritan Electric Light & Power Company, of Perth Amboy; Rahway Electric Company, of Rahway, and Bound Brook Electric Light, Heat & Power Company, of Bound Brook.



FIG. 1.—METUCHEN PLANT.

The equipment of the generating stations replaced by the new central plant was as follows: Edison Electric Illuminating Company at New Brunswick, Edison bipolar machines belted from countershaft driven by belt from simple Corliss type engines. The Raritan Electric Light & Power Company's plant at Perth Amboy was equipped with 1100-volt single-phase alternators and American arc machines belted from a countershaft driven by belt from a simple high-speed engines. The apparatus at the Rahway Electric Company's plant at Rahway consisted of single-phase, 2200-volt, 125-cycle alternators and 500-volt railway generators, all belted from high-speed engines. The Bound Brook Electric Light & Power Company at Bound Brook was operating an 1100-volt, two-phase alternator, belt-driven from a Corliss engine. The location of all of these plants made it necessary to cart all coal used at a cost of 28 to 40 cents per ton, and in every case except at Bound Brook, to purchase water for boiler supply.

The main units in the engine room are two horizontal cross compound condensing engines, having cylinders 24 by 44 by 42, supplied by the Pennsylvania Iron Works Company, direct connected to 500-kw, three-phase, 60-cycle, 6600-volt Stanley generators. These engines are of the heavy duty railway type, having flywheels weighing 47 tons.



FIG. 2.—PERTH AMBOY SUB-STATION.

Steam is generated in two vertical water-tube boilers, supplied by the Clonbrook Steam Boiler Company, of 600 hp each, or of a capacity to evaporate 18,000 lbs. of water per hour into dry steam. Each boiler has a stack 60 inches in diameter by 75 ft. high, erected on the top of the boiler casing. There is a reserve space in the boiler room for a third similar unit, the foundation for which is already down.

The boiler water supply may be had from any one of the three sources—a spring-fed brook, three artesian wells about 100 ft. deep, and the regular city water works system. Water is first pumped into a large tank near the roof, which supplies a 1250-hp Webster vacuum feed water heater, and from the heater is pumped directly into the boilers. Either of the pumps may be used to feed the boilers or discharge into the tank, as the piping is in duplicate to the boilers. Coal is carried into the station from a siding of the Lehigh Valley Railroad up a trestle to a track over the coal storage space, which discharges close to the furnace doors. The engines are equipped with special piping which makes it possible in case of accident to one side, to operate the other either condensing or non-condensing, which greatly reduces the chances of a complete shut down. Two 50-kw, 125-volt Westinghouse generators are installed as exciters, each direct connected to a Ball & Wood tandem compound engine.

The engines are supplied with a complete oiling system, whereby all of the waste oil is brought to a central point and discharged into

an oil filter, which in turn discharges into a tank, from which the oil is pumped again into the receiving tank of the system.

The condenser is of the elevated central condensing type, supplied by Henry R. Worthington, who also supplied the compound circulating pump and the rotative dry vacuum pump. Condensing water is obtained from three brooks, which supply an artificial lake, and to which lake the discharge from hot well may be returned in case of scarcity of water. The piping is also arranged that water may be drawn from three artesian wells for condensing purposes, and although this source would not be sufficient in itself, the low temperature of the water obtained from these wells considerably reduces the surface water required.

The generators supply alternating current at the transmission pressure of 6600 volts. All of the high-tension switches on the switchboard, which was supplied by the Stanley Company, are of the oil type and of double the carrying capacity required for either the generators or circuits. The main switchboard now consists of two main generator panels and five circuit panels. The mains from one of the circuit panels lead to another part of the building to a set of Stanley three to two-phase step-down transformers having a ratio of 6600 to 2300 two-phase, at which pressure the current is distributed for local lighting. The high-tension leads from the other four panels are carried through lightning protection devices to sub-stations at New Brunswick, Perth Amboy, Rahway and Lincoln, which latter supplies the Bound Brook district. General Electric short-gap arresters with Stanley dischargers are used on all feeders.

The line is of the most substantial construction throughout, the insulators used being 10,000-volt Hemingray glass. The feeders vary in length from 4½ to 9½ miles, and are given two transpositions at respectively one-third and two-thirds of the distance covered by each particular feeder. All feeders are carried overhead their entire distance, except those to New Brunswick, which are carried on the stonework of a bridge over the Raritan River, then down through a triple-conductor, steel-armored submarine Okonite cable under the Delaware & Raritan Canal, which parallels the Raritan River at this point. On the opposite bank of the canal the line is carried underground through Okonite single-conductor lead-covered cable, each drawn in a separate conduit to the sub-station about 550 ft. distant. The whole underground and underwater system is provided with oil switches and is in duplicate, thus making it possible to carry the whole load on either set entirely independent of the other in case of accident.

The present installation of the New Brunswick sub-station includes one 100-kw set of step-down transformers for lighting, and one 200-kw, 240-volt Westinghouse rotary converter for supplying the Edison three-wire system, space, however, being reserved for double this equipment, which will probably be required in the very near future.

At the Perth Amboy sub-station there are at present installed two 100-kw Stanley step-down transformers, 6000-volt three-phase, to 2300 volts two-phase; and three General Electric constant-current transformers for street lighting, each having capacity of 50 6.6-ampere enclosed arc lamps, the primaries of which will take the current directly from the three-phase transmission, working three to two-phase, or straight single-phase, as desired. The three transformers now installed are connected in single-phase, but with the addition of the fourth one, the three to two-phase connection will be used, thereby obtaining a balance of the transmission independent of the number of transformers installed.

The equipment of the Rahway sub-station is similar to the one at Perth Amboy, but lacking the constant-current transformers, and with the addition of one 200-kw Westinghouse rotary converter, 550 volts, supplying current to the street railway company.

The present installation at the Lincoln sub-station comprises one 100-kw set of Stanley step-down transformers similar to the others, and three reactive-coil General Electric series regulators for the incandescent street lighting system.

The main generating plant at Metuchen was designed, as a whole, by Mr. Paul C. Oscanyan. The operating force of the company consists of Dudley Farrand, general manager; H. C. Richardson, general superintendent; S. D. Sprong, chief engineer; W. A. Belcher, superintendent Perth Amboy & Rahway divisions; R. P. Bache, superintendent Bound Brook division.

Canadian Electrical Association.

The Canadian Electrical Association will hold its next annual convention at Quebec on June 11, 12 and 13.

Progress on the Illinois Telephone and Telegraph Tunnel in Chicago.

One of the most daring financial and engineering undertakings of the decade is the underground tunnel system now being constructed under Chicago's principal business streets by the Illinois Telephone &



FIG. 1.—INTERSECTION SOUTH WATER AND STATE STREETS.

Telegraph Company, a corporation whose officers promise within a short time to give Chicago an independent telephone exchange in opposition to the Chicago Telephone Company. This tunnel, which is to serve the purpose of a conduit for wires, has already been excavated under more than 6 miles of streets, and it is expected to put it



under every street in the city where underground telephone wires will be needed. Trunk tunnels with branches will be run out from the business center to the various sides of the city. The tunnels are 40 ft. below the surface, and of concrete arch construction, as shown by

the accompanying photographs. The main or trunk tunnels are 14 ft. high and 12 ft. wide. The lateral or branch tunnels are 8 ft. high and 6 ft. wide. This gives sufficient room to not only hold all the telephone wires of the company and underground wires of other com-

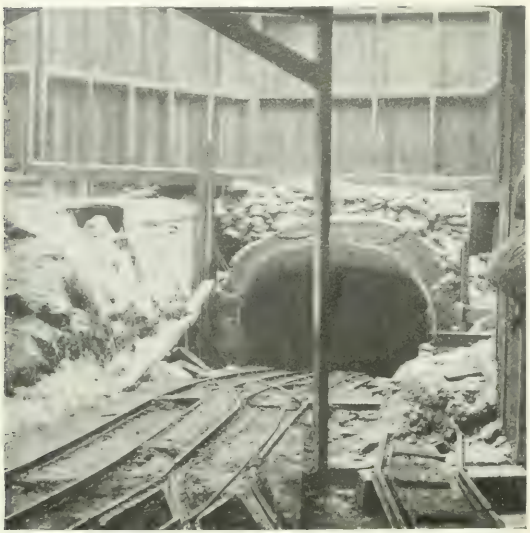


FIG. 3.—TUNNEL ENTRANCE CONGRESS STREET AND RIVER.

panies, but to provide for the operation of cars through the tunnel for hauling mails and handling freight. The first object, however, is to provide ample facilities for running underground wires for the new telephone service. All of the work has been done without interfering with the surface of the street. Shaft houses like the one shown in the accompanying illustration can be found at various places on the streets, and but for these and the loads of blue clay which come up occasionally to the surface there is no evidence on the surface that such extensive underground work is being carried on. In starting the work, entrance to the underground system was made through the shaft houses, and in some cases through basements. At the present time, however, work has advanced far enough so that instead of bringing dirt to the surface through the shaft houses and teaming it away from there, it is all hauled in dump cars by mules through the tunnel to the opening on the river at Congress Street, illustrated herewith. There it is dumped onto scows and towed away down the river. Compressed air pressure of 7 lbs. is kept on the tunnel during excavation. After the cement grouting has been put in 12 inches thick an air pressure of 24 lbs. is put on. At street intersections, one of which is shown, steel girders are put in to carry the weight. The intersections are arranged to permit the passage of cars or wires in any direction. It is stated that over $3,000,000 has been expended on tunnels and other work, with $7,000,000 more yet to go in.

The president of the Illinois Telephone & Telegraph Company is A. G. Wheeler, best known in the electrical field through his prominent connection with early underground trolley work. The company is backed by C. D. Simpson and F. H. Watkins, of Scranton, Pa.; J. B. Russell, of Wilkesbarre, Pa., and C. B. Eddy, of Almagordo, N. M. This is the Simpson-Watkins syndicate which has extensive fuel and railroad interests in Colorado and New Mexico, and in the anthracite coal region of Pennsylvania. J. B. Russel & Co. are fiscal agents of the company. All of the operations of the company have been carried on in an unostentatious manner, and little has been known of the work in financial or engineering circles, but it surpasses in magnitude of conception anything of a similar nature ever undertaken. Much criticism has, of course, been offered, but the officers of the company are confident that they are working on the right lines. If the plans all work out as contemplated, it will cause a general revolution of present ideas as to the limitations of telephone service.

This company, through its officers, controls the patents of the Strowger automatic telephone exchange switchboard, and expects to use the Strowger automatic system in the mammoth Chicago exchange. Work on the apparatus for this exchange is now in progress in the Chicago factory of the Strowger Company. It is announced that a telephone instrument will be placed in every responsible business office, and that charges will be made on a meter basis of 5 cents a call, except that all calls in excess of $85 a year will be free, making the maximum possible yearly rate $85. The progress of the company with its great undertaking along radical lines is, of course, being watched with the keenest interest not only in Chicago but by telephonists throughout the entire country.



FIG. 4.—STREET INTERSECTION OF TUNNEL.

The Heany Enclosed Arc Lamp.

By E. Trier.

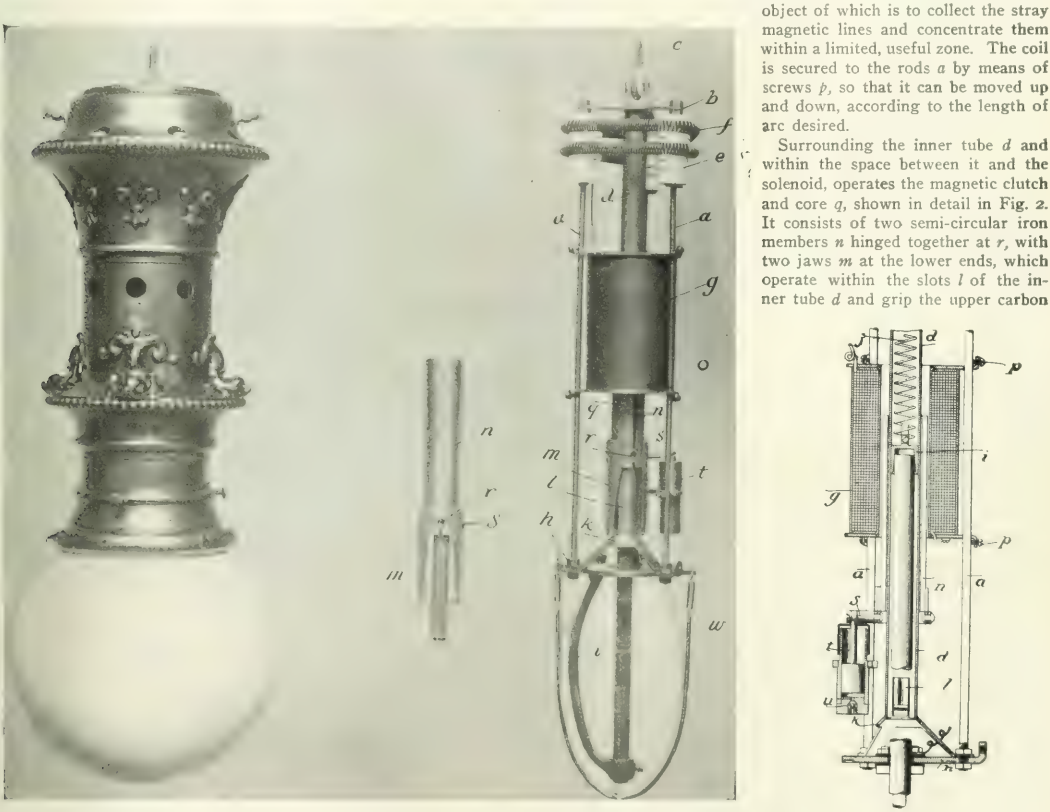
WHEN about 10 years ago a now prominent figure in the electrical profession made the prophesy that if inventors of arc lamps and arc lamp accessories would continue to work as diligently and prolifically as they did at that time, the United States Government would be compelled to either erect a separate structure or add another story to the present Patent Office Building for the accommodation of their products, most of his hearers considered the jest an unwarranted condemnation of conscientious efforts. This view has fortunately been borne out by later events, for in spite of the fact that arc lamp inventors have been accelerating their rate of production, space has always been found in the old Patent Office Building for the storage of their manuscripts and models. In obedience to the natural law of the survival of the fittest, seven distinct species have finally survived, the enclosed series and multiple lamps having within recent years largely replaced the open-arc lamps on direct as well as alternating circuits. In the words of Mr. Alton D. Adams, in a recent article on "Changes in Arc Lighting." "The several classes of arc lamps have come upon the scene one after another, and the effect of each type in displacing previous sorts has been due much more to possible economies of operation than to capacities for superior service, though this latter has not been lacking."

That such is the case is exemplified very forcibly by the lamp described below, which combines with economy of operation and capacity for superior service, simplicity of construction, low cost and small size. This lamp, which has successfully stood the severest commercial tests, and merits the praise which has been bestowed upon it on all sides, is the invention of J. Allen Heany, a young electrical engineer of Philadelphia.

Referring to the illustrations (Figs. 1 and 4), of this "wheelless" lamp, for there is not a single wheel in its mechanism, the supporting frame consists of three rods *a*. These rods are fastened at the top of the lamp to a stamped piece of brass *b*, which carries the hanger *c* and the brass tube *d*, containing the upper carbon. The rods also carry the porcelain knobs *e* supporting the resistance coil *f*, and after passing through the top and bottom plates of the solenoid coil *g* they are securely fastened to the base piece *h*. The brass tube *b* which contains the upper carbon holder *i*, the upper carbon and the flexible carbon holder contact *j* is secured to a conical cup *k* near the base of the lamp. The tube at its lower portion contains two slots *l* for the reception of the gripping jaws *m* of the clutch *q*, which close in on the upper carbon, and also serve the purpose of maintaining the core and clutch portion of the lamp in perfect alignment with the main portion of the lamp.

The solenoid coil *g* is wound with about ¾ lb. of No. 16 bare wire with asbestos cord between each two adjoining wires, and a sheet of asbestos between two successive layers. This makes it possible to short circuit the lamp and keep it in this condition for an indefinite period without fear of burning out the coil. In fact, damage could only be done to the coil by sending enough current through it to melt the wire. Around the coil is placed a shell of soft iron *o*, the object of which is to collect the stray magnetic lines and concentrate them within a limited, useful zone. The coil is secured to the rods *a* by means of screws *p*, so that it can be moved up and down, according to the length of arc desired.

Surrounding the inner tube *d* and within the space between it and the solenoid, operates the magnetic clutch and core *q*, shown in detail in Fig. 2. It consists of two semi-circular iron members *n* hinged together at *r*, with two jaws *m* at the lower ends, which operate within the slots *l* of the inner tube *d* and grip the upper carbon whenever the coil is energized. This makes like poles of the pieces *n*, which naturally repel each other, giving a very positive and powerful action. The energized coil tends to center the core, and in doing this raises the same somewhat, which establishes the arc. As will be seen, the lower portion of the jaws *m* are tapered, so that when they fall on the tapered piece *k* the carbon is immediately released and permitted to feed. A possible sticking action is thus prevented. Connected to the lug *s*, fastened to one of the jaws, is the dashpot *l*, which is so constructed as to cushion the upward movement of the core, without in any way hampering its downward movement. The details of this clutch, which responds to the slightest variation in the structure of the carbons and assures a very sensitive regulation, is best seen in Fig. 4, where the small sphere *u* acting as a valve is clearly shown.



FIGS. 1, 2, 3 AND 4.—ENCLOSED ARC LAMP.

To the base *h* of the lamp is connected the lower or negative carbon holder *v* and the simple globe support *w*, which consists merely of a wire supported by springs and having a loop at the bottom for the support of the inner globe. To more clearly comprehend the working of the lamp, it may be well to describe its action while in service. To assist in this we will first refer to the diagram of connections (Fig. 5). As will be seen, the current enters the solenoid coil *g*, which is grounded, follows the tube *d*, making contact with the upper carbon by means of spiral *j* and carbon holder *i*, then it passes through the lower carbon through the conductor *y* to the resistance coil *f* and out of the lamp.

When the current is turned on the solenoid coil is energized, pulling up the core and drawing the arc, the length of which depends upon the amount of resistance in series with the arc, the strength of the coil, the amount of iron in the core and the weight to be raised. The dashpot, described above, compels the core to move upward slowly and steadily. It only acts when the solenoid is acting on the core, when the lamp is started or when a complete feed takes place. After the arc is drawn to, say, a length of ¾ inch, with 90 volts at the arc, this dashpot effect ceases and the core is left to move downward freely, responding to any current variations almost instantaneously and maintaining a uniform arc.

The amperage consumption may be varied between the limits of two and six amperes, by sliding the solenoid coil up or down. By lowering the coil the current consumption will be greater and by raising the coil the current will be smaller. The higher the coil

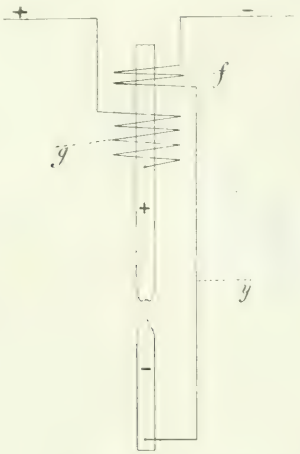


FIG. 5.—CONNECTIONS OF ENCLOSED ARC LAMP.

the greater will be the movement of the core as well as the length of the arc. It follows that with any given resistance in series with the arc, the shorter the arc the greater the current consumption, and vice versa.

The points of excellence claimed for the lamp may be enumerated as follows:

1. The lamp may be readily adjusted to take any desired current.
2. Any voltage, up to 102 volts, may be obtained at the arc, with 110 volts at the mains.
3. The lamp contains a minimum amount of resistance wire.
4. The core and clutch are combined. No mechanical clutch required.
5. The lamp is constructed entirely without wheels.
6. The lamp may remain on a dead short circuit for an indefinite period without injury to the lamp.
7. Most parts of the lamp are made of stampings.
8. No sliding contacts.
9. The lamp is easily recarboned.
10. Long hours of burning. With 7-16-inch carbons will burn 168½ hours.
11. Average feeding time every two hours.
12. Lamp to take 12-inch carbons is only 16 inches in length.
13. Lamp without casing weighs 3¼ lbs.
14. A minimum number of parts.
15. No carbon deposit on inner globe.
16. The lamp will accommodate itself to any reasonable rise or fall in the line voltage without a corresponding rise or fall in the amperage consumption.
17. The regulation is flexible and sensitive.

The lamp, which is now being placed on the market and has been in continued service at various places for a number of months, is made in several attractive styles, one of which is shown in Fig. 1, for continuous as well as alternating circuits.

The Electric Furnace in Industrial Chemistry.

THE last meeting of the American Institute of Electrical Engineers on Feb. 28 was devoted to the subject of "Electro-Chemistry," when several interesting papers were read.

Mr. Charles B. Jacobs, in a paper with the above title, briefly describes the several types of electric furnace used in industrial chemical operations and gives an account of some of the more important of these operations. He divides the industrial electric furnace into three general types, viz.: The reflecting arc furnace of the Moissan type, in which the heat of the arc is projected upon the charge by a reflecting surface; the direct-heating arc furnace in which the arc is surrounded by the material treated and imparts its heat directly to the charge; the incandescent furnace in which either the charge or the walls of the furnace form a part of the electric circuit, and by the resistance offered to the passage of the current produce the required heating effect. The two latter types are most frequently met with in commercial work.

Mr. Jacobs states that in furnaces constructed with linings of pure carbon blocks reinforced with some very poor conductor of heat, such as magnesia or chalk blocks, it is possible to obtain a temperature close to 4000 degs. C., at which temperature the purest carbon begins to vaporize. It is comparatively easy to operate commercially at temperatures ranging from 2500 to 3500 degs. C., and to raise a charge almost immediately to the required temperature.

Among the most striking of the new chemical combinations of the electric furnace are enumerated carbide of silicon, carbide of calcium and the silicides of the alkaline earth metals. The possibility has been demonstrated of using calcium carbide as a means of synthetically producing the valuable sediment of coal tar in a pure state and the compounds of the benzine series in general. In this manner a very pure sample of anthracene has been prepared by the Ampere Electro-Chemical Company, with which Mr. Jacobs is connected.

The carbides of the alkaline earth metals, being unsaturated compounds and capable of forming additional products, are of the highest interest. If one of these compounds be heated in the presence of some element having a stronger affinity for carbon than carbon has for itself, the bonds between the carbons will open and the new and stronger element will attach itself to the carbons of the carbide to form a saturated compound. Nitrogen, for instance, if passed through heated carbide of barium under the proper conditions will, at a certain critical temperature, combine with the carbide and form a cyanide of barium. The Ampere Company has taken advantage of this property in the production of cyanide of sodium and potassium, barium carbide being used as the absorber of hydrogen derived from the atmosphere and as the carrier of the cyanogen, which is subsequently converted by ordinary chemical means into sodium or potassium salt, the barium being used over again in the production of more barium cyanide.

Mr. Jacobs states that the silicides of the alkaline earth metals, viz., calcium, barium and strontium, were discovered by the Ampere Electro-Chemical Company in July, 1899. These compounds are formed in the electric furnace under conditions similar to those maintained in the manufacture of the alkaline earth carbides, although at a somewhat higher temperature. They possess a distinctly crystalline structure and oxidize slowly in the air at ordinary temperatures. Like the carbides, they decompose with water, but yield instead of acetylene, hydrogen in a pure state, which is evolved without explosion. Barium silicide seems to be rather the most important on account of its greater activity and the positive nature of all its properties. Strontium would answer as well for most purposes, but is more expensive and difficult to obtain. As a hydrogen producer, barium silicides probably offers the cheapest and most efficient source of pure hydrogen in commercial quantities. All of the silicides are strong reducing agents for both organic and inorganic compounds. Barium silicide has been used for the production of indigo, and seems to offer many advantages over certain reagents which it can replace. Various other uses of these silicides are

pointed out. Reference is made to the production of corundum from an amorphous alumina, such as bauxite or other aluminum compound, by a process invented by the Ampere Electro-Chemical Company, and now being operated by the Norton Emery Wheel Company.

It is stated that there are a number of instances in which it is advantageous to introduce the electric furnace to replace the ordinary means of bringing about chemical reactions that take place at high temperatures, and such substitution is, as a rule, merely a problem of economic engineering. The Readman process of the manufacture of phosphorus by the electric furnace is briefly described, and it is stated that by a process invented and developed by the American Electro-Chemical Company, barytes are treated in the electric furnace and from 97 to 99 per cent of the available barytes sulphate is converted into soluble form. An account of this process was printed in these columns in a recent issue.

Mr. Jacobs considers that probably no field offers so many important commercial problems as the chemistry of the gaseous elements, and referring to the importance of the atmosphere as a source of nitrogen compounds for the production of fertilizers, he states that it remained for Mr. Charles S. Bradley to introduce the energy necessary to bring about the combination of the oxygen and nitrogen in a commercial quantity. The work carried on jointly by Messrs. Bradley and Lovejoy has carried the problem of the fixation of the atmospheric nitrogen from the realm of experiment and placed it on a basis of commercial development. It is stated that in the combination of oxygen and nitrogen a number of extremely high-tension arcs are brought into intimate contact with carefully dried air, but the details of the process are not given; the results so far obtained have demonstrated on a practical scale great economy in the manufacture of nitric acid, and the nitrates and also nitrous acid and the nitrites, which makes possible the cheap production of all the commercial products which can be chemically derived from these compounds. In conclusion, Mr. Jacobs says that the electric furnace has offered a very plausible explanation of the occurrence of our natural gas, petroleums and bitumens, while the formation of graphite and corundum has thrown still further light on some of the phenomena and products of the various geological changes.

ELECTROLYTIC CONDUCTION WITHOUT ELECTRODES.

Mr. Carl Hering presented three papers, of which one treated of electrolytic circuits without electrodes. As it has always been found necessary to use electrodes in passing continuous currents through electrolytes, it has been claimed by some that electrodes must necessarily form a part of every electric circuit containing an electrolyte, or, in other words, that electrolytic conduction without electrodes is impossible. Some even go so far as to define electrolytic conduction by the action at the electrodes, and, according to such a definition, there would be no electrolytic conduction (as distinguished from metallic conduction), if no electrodes are used. The use of electrodes probably arises from the fact that it is the simplest means of connecting an electrolyte in circuit with a dynamo or source of current, or with measuring instruments. In view of the antagonistic theories concerning electrolytic conduction, it is of interest to know whether electrolytic conduction without electrodes is possible, and, if so, whether it is the same as when electrodes are used, assuming, of course, that any new products which may be formed at the electrodes are separated from the electrolyte under discussion by means of porous diaphragms.

The paper after giving a brief account of the state of the art, describes with the aid of a diagrammatic illustration a generator which enables the current which it generates to circulate in a complete circuit containing nothing but electrolytes, thus enabling this question to be investigated. The generator consists simply of a unipolar machine with a short circuited armature, which armature circuit consists entirely of electrolytes.

In such a circuit it seems that there could be nothing more than what the chemists call mere substitution, that is, a mere exchange of atoms or groups of atoms, as distinguished from a setting free of something or a reduction or oxidation. It does not seem possible that there can be any such true decomposition or setting free of something, without electrodes, and if this is correct, there would be no prospect of using such a method commercially for decomposition without electrodes, in order to get rid of some objections arising with the use of electrodes, as has been suggested by others. The questions discussed in the paper is, therefore, largely of theoretical interest. A proper settlement of the theoretical questions would, however, frequently be of use in practice.

POINT OF CUT-OFF IN A BATTERY DISCHARGE.

A second paper by Mr. Hering is on the limit of e. m. f. in storage battery discharge. In discharging a battery the voltage falls more or less gradually, and it is, therefore, often difficult to see just when the discharge should be considered ended, that is, what the proper point of "cut-off" of the discharge is. It is left to the experimenter, and is a purely arbitrary point. Sometimes it is quite important to have this point definitely fixed. This is the case, for instance, when batteries of different voltages are to be compared with each other, or when the discharges of the same battery at different rates are to be compared. After briefly referring to a number of cases in which this final voltage is determined by existing circumstances, the author describes two methods by which a definite point of "cut-off" can be found, thus eliminating the differences arising from arbitrary selections of the point of cut off.

The first of these applies to batteries which are to be used on constant potential circuits; that is, those in which all the voltage above the final must be absorbed by dead resistances. In such cases draw the voltage curve for a constant-current discharge, the abscissas being time, then find the point on the final bend of the curve at which a tangent cuts the axis of the abscissas at just twice the distance of the abscissa for that point. This is determined by trial, but is a very simple operation, requiring but one or two trials.

The second method, which applies to all cases, is simply to discharge the battery at constant power in watts instead of at constant current as usual, or at constant external resistance. The current must then, of course, be increased as the voltage falls, in order that the product shall always be constant. During the end of the discharge, when the voltage begins to fall more rapidly, the current will have to be increased quite rapidly, and a point will then very soon be reached when the battery is no longer able to give the current necessary to maintain the watts constant. This is, then, the end of the discharge, and is a very definite and fixed point found directly while the test is made and not afterwards. It leaves nothing to be determined arbitrarily by the experimenter, and is as fair for one battery as for another. A curve for such a discharge, of course, becomes a right angle. The paper shows these curves and gives also the volt curve and the ampere curve for such a discharge at constant watts.

LIQUID POTENTIOMETER, DETERMINING ELECTROLYTIC RESISTANCE WITH DIRECT-CURRENT INSTRUMENTS.

The third paper by Mr. Hering demonstrates that the potentiometer principle may also be used with certain precautions, with a column of an electrolyte in place of the usual potentiometer wire. It then affords a simple means of measuring the resistance of electrolytes with nothing but ordinary direct-current instruments. The apparatus is described and illustrated, and the precautions which are necessary in order to use it successfully are described. It consists essentially of a long trough of known cross-section, filled with electrolyte. Electrodes are introduced at the ends, and are separated from the rest of the trough by means of porous partitions. A current is passed through this column of liquid from an outside source, and there will then be a regular drop of potential in the column of the liquid, as in a potentiometer wire. Two electrodes, preferably of gold, but under no circumstances of platinum, are connected to a second battery, the voltage of which is known. The electrodes are in circuit in the column of the liquid, and are moved together or apart until any convenient galvanoscope in their circuit shows that no current flows. It is necessary, however, to approach the zero position from both sides to avoid finding false zero positions. At the proper zero position the current in that local circuit should change direction when the gold electrodes are moved a little farther apart and then a little closer together. The distance between them is then measured and the fall of potential in the column over that distance will then be equal to that of the local battery. From Ohm's law the resistance of the electrolyte between those gold electrodes can then be calculated, knowing the main current which flows through the whole column.

The theory of the action seems to be based on the condenser action of the auxiliary battery, as the deflections when the zero point is nearly reached are more in the nature of momentary currents like those for a condenser, as distinguished from continuous currents like those in the Wheatstone bridge method.

A paper read by Professor W. R. Whitney dealt with the class of substances known as colloids. He considers the difference between colloids in suspension and ordinary solutions. Whenever any substance, which is by nature insoluble in water is produced in water in

a very fine state of division, a permanent suspension or so-called colloidal solution will result if electrolytes be absent. This fine state of sub-division should exist (as it probably does) in all cases where insoluble substance is produced chemically *in situ*, for it is produced molecule by molecule. It should also exist where vapors condense in the water, as occur with subaqueous electric arcs between metal electrodes. The question is then discussed why such suspensions are not identical with solutions. The author concludes that if colloidal solutions or substances are made up of statically charged particles, the fact that they are precipitated by electrolytes, together with the quantitative relationships of this precipitation and the seeming probability that a part of the electrolyte is rendered insoluble in the process, make the connection of this phenomenon with the electrolytic association theory, a most natural one.

ELECTROLYTIC RECOVERY OF COPPER FROM LOW-GRADE ORES.

In a paper with the above title Mr. N. S. Keith described an electrolytic process of recovering copper from low-grade ores containing from ½ to 5 per cent of copper. The works are now being erected for the application of this process to the recovering of copper from the ores of a mine a few miles from New York City, containing about 2 per cent of copper to the ton.

The rock is broken in a crusher to the size of about ¾ to 1 inch cubes and smaller, after which it is dried by forcing heated air or furnace gas through the body of the crushings. It is then passed through a set of crushing rolls, which further reduce the size of the pieces to that of peas and beans, and smaller even, to sand and dust. Other operations then pulverize the rock so that it will all pass through the meshes of a No. 30 wire cloth having 900 holes to the square inch.

The next step consists in roasting the dust to expel the sulphur and oxidize the copper, which takes place continuously as the rock comes from the pulverizers, in mechanical furnaces fired by coal in seven fireplaces arranged along its side. From the discharge end the roasted rock is fed to leaching tanks.

In order to economize in the use of acid, there is mixed with the rock as it passes into the furnace some powdered ores preferably carrying at least a small percentage of copper, which serve to supply sulphur to be oxidized and unite with the lime in the ore to produce $CaSO_4$, while the copper therein is also recovered. The solvent consists of dilute sulphuric acid, the amount of the latter varying from 5 to 15 per cent of the water in the solution. The solvent is drawn off from the bottom of the leaching tanks, running through a filter bottom in a stream of perfectly clear greenish blue liquid. The first solvent run in during the filling of the tank takes up nearly all of the copper and runs out at the bottom fully saturated $CuSO_4$. As fresh additions of the solvent pass through, they carry decreasing quantities of copper until all of it has been taken up.

The solvent flows to deposition vats, which are so set at different elevations above the floor that the electrolyte runs by gravity from one to the next, and so on through the series to the end. Each vat has its electrodes connected in multiple, and the several vats of electrodes are connected in a series of 128, exactly as in the case of the large storage batteries. In order, however, to ensure a retrogressive decrease of the current at the electrodes of each vat after the first of the series, the number of electrodes is increased progressively from the first to the last of the series. For example, the density of the current may be 15 to 20 amperes per square foot of cathode surface in the first vat, and 3 amperes per square foot in the last vat. The evolution of the free oxygen at the anode keeps up a free mixing movement of the electrolyte in addition to the movement due to the flow through the vats. During the electrolysis there is a counter e. m. f. of 1-6 volt in each of the vat series.

As there are 128 vats and the generator is operated at approximately 240 volts, the total e. m. f. is 1.87 per cell, thus giving .27 volt for the resistance of the conductors, etc. The anodes and cathodes are of sheet lead. As soon as the copper deposit reaches a thickness of thin cardboard on the lead, it is stripped off and the two copper sheets thus produced have suitable connections riveted to them, and they are rehung as cathodes in some of the vats, where they remain a sufficient length of time to receive a thickness needful to market.

THE ELECTRO-CHEMICAL INDUSTRIES.

Professor Samuel Sheldon, in a paper with the above title, gives a general view of the present condition of the electro-chemistry industries. Aside from the manufacture of storage and primary batteries and electro-plating, it is stated that the carrying on of the industries considered requires over 200,000 hp, of which about 90 per cent is obtained from water power. An authority is quoted to the effect that the limit of cost per horse-power per year is from $5 to $50. At Niagara the price to large consumers is about $17, and power is delivered in Buffalo for about $30. The paper does not admit of abstract within the space here available, and, therefore, merely the heads will be enumerated.

Under the electro-deposition of metal there are taken up plating of gold, silver, nickel and brass, copper refining, parting of gold and silver, extraction of gold and extraction of nickel. In this section current density, circulation and dissociants are also considered. Under inorganic products the processes are described for producing alkalies and bleach, sodium, aluminum, sponge lead, potassium, ozone and nitric acid. Under the head of organic electrolytic products are iodoform, chloroform, bromoform, camphor, vanilin and artificial rubber. Under furnace products are calcium carbide, carborundum, artificial graphite, barium hydrate, barium cyanide, phosphorous, corundum and silicides. Under miscellaneous are considered electrolytic condensers, the electric rectifier and electrolytic interrupters.

American Street Railway Association.

At the meeting of the executive committee of the American Street Railway Association at Detroit it was decided that Wednesday, Thursday and Friday, Oct. 8, 9 and 10, 1902, be adopted as the meeting dates, with a reservation that Thursday, Oct. 9, be set apart especially for the exhibition of supplies, and that no regular proceedings be held on that day. The time for holding the annual banquet was also fixed upon as the evening of Friday, Oct. 10, 1902, at the Cadillac, which hotel was also selected as the headquarters of the association. The committee was unanimously of the opinion that the topics and papers to be read should hereafter be assigned directly to members of the association, and not to special officers of the different corporations. Seven subjects were selected, and the following designations made:

1. "Registration of Transfers," Cincinnati Traction Company, of Cincinnati, Ohio.
2. "Benefit Associations," Metropolitan Street Railway Company, of New York.
3. "Discipline of Employes by the Merit System," Metropolitan Street Railway Company, of Kansas City, Mo.
4. "Transportation of Light Express and Parcels," Detroit United Railway Company, of Detroit, Mich.
5. "Steam Turbines and Rotary Engines," Boston Elevated Railroad Company, of Boston, Mass.
6. "Signals for Urban and Interurban Railways," Union Traction Company, of Anderson, Ind.
7. "Settlement of Damage Claims," Chicago City Railroad Company, of Chicago, Ill.

The secretary was directed to write members urging the attendance of their representatives under such instructions that their presence in the convention hall at the discussions should be obligatory.

After the business meetings of the committee were concluded, Mr. Hutchins, of the Detroit United Railway Company, acted the part of host to the visiting members of the committee at a delightful dinner at the Detroit Club, and afterward during a pleasurable visit to the Yontodago Club.

The Light Guard armory hall selected for the meetings has ample space for the exhibits and meetings of the association, and is within easy riding distance of the Cadillac and other leading hotels of Detroit. It is understood that the local committee is arranging very pleasurable social features for the entertainment of the visiting delegates in October, and, as Detroit is a very attractive city, particularly in October, ample opportunity will be given for many excursions.

The Nice Observatory.

A cable dispatch from Paris of March 1 to a New York daily newspaper reports as follows: A curious lawsuit is pending between the Nice Observatory and a local electric tram car company using the Thomson-Houston system. The observatory authorities say that the electric instruments in their magnetic department were so much disturbed by the electricity of the tram cars that they were obliged to transport all the instruments to another observatory on Mount Mounier, at a lost of $20,000. They contend that the company ought to pay the cost, and the company is fighting the case.

The English Versus the Metric System.

By Chas. T. Porter.

A BILL is now before Congress, and is in danger of becoming a law, which will make the use of the metric system of measurement compulsory in this country. The Society of Mechanical Engineers is issuing an appeal to its members to exert their influence individually with representatives in Congress to prevent the passage of this bill. At this juncture it seems important to present to engineers generally the point here made, which appears to me to go to the root of the matter. The bill is advocated on two grounds: First, that the metric is the only scientific system, and, second, that it is generally adopted, and uniformity in this respect is of the first importance. I have already, in an article in *Locomotive Engineering*, published in its issue of July, 1897, pointed out the absurdity of this scientific pretension; showing that system of measurement to be only the decimal system, with a single arbitrary unit, different from the units employed by us, and to which single mode of division the metric system labors under the disadvantage of being limited.

I now propose to show further, that the English system, employing several units, commensurable with each other, adapted to different uses, and each divided by continual bisection, while making no pretension in that way, is in reality in the highest sense scientific or philosophical; and this by reason of a feature which is wanting in the metric system, and the want of which renders that system unphilosophical, unnatural and inconvenient for the purpose of mechanical measurement.

We employ four units of linear measurement—the mile, the yard, the foot and the inch. Each one of these units has its individuality and a distinctive name. The same is true of the parts obtained by continual bisection. Each of these also has its individuality and distinctive name.

The problem always is, How can the idea of any distance or dimension be formed in the mind and conveyed to other minds with the greatest distinctness? The answer is obvious. We must employ the largest available unit of measurement, and supplement this, as required, by smaller units, employing the largest available division formed by continual bisection. When the reality cannot be expressed in this way, then, and not till then, must we resort to the decimal system of division, the value of which, in this limited field, is beyond all estimation.

This mode of expression brings the distance or dimension before the mind with a definiteness which cannot even be approximated in any other way. This advantage is possessed by the English system of measurement, and is retained by it to the utmost useful limit. Thus, we do not say 17,600 yards, but 10 miles; we do not say 120 inches, but 10 ft. And so universally. By employing the largest suitable unit, we see the distance or the dimension as a vivid reality. We are enabled also to apprehend more clearly the relation to one another of the different members of any construction. We reach correct proportions more readily, are less liable to errors either of design or figuring, and are more likely to detect errors if these are fallen into.

This system is in accord with the divisions of the circle, and of time, which are universally employed. In the former we have three units—the degree, the minute and the second. In the latter we have centuries, years, months, weeks, days, hours, minutes and seconds. Each one of these units also has its individuality and its distinctive name. Here, too, we always employ the largest of these units that is applicable, and by this means, as is obvious to every one, the angle, or the interval of time is properly expressed to us. Any other mode of expression would be ridiculous. The decimal system is not resorted to, until we need it, to express divisions of the second, either the second of arc or the second of time.

This principle of employing the largest available unit is recognized by the French, in adopting the kilometer (1000 metres) as the unit for land measurement, and the meter as the unit for civil engineering work. Indeed, the French civil engineers have rather an advantage over our men, the meter being a larger unit than the yard.

But for the uses of the mechanical engineer all is reversed. Here the metric system bids defiance to this principle, and in place of the largest it substitutes the smallest unit, the millimeter (0.001 of the meter) nearly 0.04 inch, and all mechanical measurements are expressed in terms of this unit. Where we would write 10 inches, the metric expression would be 254 mm., approximately, as the two measurements cannot be expressed exactly each in terms of the other. Four feet eight and one-half inches is an illustration of our system of employing the largest unit, supplemented as already described. The definiteness of each item will be observed. The metric equivalent is 1434 mm.

This system, in its application to mechanical measurements, presents a dreary monotony of abstract figures, while the draughtsman is in a state of constant anxiety lest he misplace his decimal point. All this results from the fundamental error of employing the decimal system in a field to which it is not adapted.

It should be observed that, while our own decimal system is in decimals of an inch, we employ it in micrometer measurements only. Sometimes, however, for convenience, writing in decimals the fractions obtained by continual bisection.

It will be seen that the philosophical superiority of the English system lies in the fact, that figures express realities of distance or dimension with a definiteness that in the metric system cannot be approached. This is the secret of its greater convenience for mechanical measurements.

But uniformity! Everything, we are told, must be sacrificed to uniformity. I do not know why uniformity is of so much more consequence to us than it is to other people, that for it we must sacrifice what is priceless. Let other nations come to us. They have everything to gain by doing so.

There is also another view. English-speaking people have established the gauge system, about which other nations know nothing except what we have taught them. We have been at immense pains to obtain the ideal inch, with its divisions on the natural system of continual bisection, and its multiples, and their combinations, with the utmost exactness, as concrete realities. These are in universal use with us. All our mechanical construction is adapted to them. The universal screw-thread system, another Anglo-Saxon gift to the world, is founded upon them. All this also we are to be compelled to throw away. This would involve a loss and confusion, beyond all power to estimate.

This, however, is nothing compared to the abandonment of the philosophical principle, on which our system of mechanical construction rests. How little do our legislators imagine what it is they are meddling with.

Is there not power enough in the English-speaking people to defend for their own mechanical engineers the invaluable principle of employing the largest unit of measurement, and, moreover, to make its application as universal for constructive work, as it is for everything else, for the civil engineer, for geographical measurement, for the circle and for time?

Cables and Wireless Telegraphy.

In the course of his annual report the figures of which are noted elsewhere, President Ward of the Commercial Cable Company, says: "The shareholders of the company will no doubt expect some expression of opinion from the officials of the company in respect to wireless telegraphy. While we do not intend to belittle the credit due to Mr. Marconi for the advancement he has made in that field, we have every confidence in the ability of submarine cables to maintain their commercial supremacy in competition with wireless telegraphy, even should it ever extend beyond its present experimental stage as regards transatlantic or other long-distance transmissions.

"Our shareholders must not overlook the fact that it has taken the Commercial Cable, and its land line system (Postal Company) some 17 or 18 years to perfect their organization for the distribution and collection of telegrams throughout the United States and the rest of the world. Assuming that the Marconi system should become perfected so that it could really compete in a commercial sense, and commercial requirements are very exacting, it is fair to say that it would take as many years to put the Marconi system in a position as would enable it to serve the public.

"Messages are now transmitted across the Atlantic and answers received in two and three minutes. A message experiencing a delay of 10 or 15 minutes means the defeat of the object of the sender. A most important point is the fact that 95 per cent of the Atlantic messages are expressed in code or cipher language, the words or ciphers having no connected meaning. The words or cipher groups frequently only differ from each other in single letters, yet they have widely different meanings, and an error in the transmission of one of their letters might have disastrous consequences. These are some of the commercial exactions or demands made upon the telegraphs.

"No one has yet even pretended that the speed with which messages may be transmitted by wireless apparatus even approaches the speed of the aerial or submarine wire, and among submarine wires those of the Commercial Cable Company stand pre-eminent, not only for speed, but for accuracy and reliability of communication."

Mr. Marconi's Latest Achievement in Ocean Wireless Telegraphy.

By W[illegible]



G. Marconi.
(*From an unpublished photograph.*)

BUT a few weeks have elapsed since the [illegible] by the report that Mr. Marconi had succeeded in receiving near St. Johns, Newfoundland, telegraphic signals transmitted through space from Cornwall, England. Already, however, the energetic inventor is once more to the front with yet a new record of marvelous accomplishment. He has followed up the feat of Signal Hill by a series of achievements on board the U. S. M. S. "Philadelphia," beside which the former will seem to many but a *tour de force*. Some account of these will doubtless be of interest to the readers of Electrical World and Engineer.

Mr. Marconi only reached London on his return from his last visit to the States on the 26th of January. In the interval between this date and the 22d of February, when he again sailed for New York, besides transacting a large amount of business in London, he paid visits to several of his stations, and in particular spent four days in overhauling and testing the transatlantic plant at Poldhu, Cornwall. He there arranged the exact conditions which he wished to rule during the sending of signals and messages to him at stated hours throughout his then forthcoming voyage on the "Philadelphia." The nature of those conditions I am, of course, not at liberty to reveal. The letter "S" being the easiest letter in the Morse code to transmit is habitually used by Mr. Marconi for his initial tests in connection with any experiments which he may be undertaking for the first time, and for which, naturally, he wishes to secure conditions as favorable as possible. The signal letter to be transmitted was, therefore, S, as in the case of the Newfoundland test. The plan adopted was that it should be sent for an hour at a time—with five minutes' rest after each ten minutes of sending—at fixed intervals from Saturday afternoon, Feb. 22, up to Saturday night, March 1. Also, however, upon this occasion, messages were to be dispatched at the rate of one message to each hour's sending of the "S" signals. In the case of the Newfoundland land test, it will be remembered that only the latter were sent.

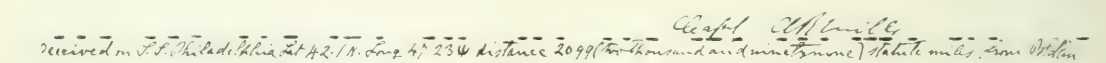
Upon the ship an aerial height of about 150 ft. had been obtained by the lashing of a stout spar to the head of a mast, and a quadruple aerial was used. The receiving apparatus had been conveniently sheltered in a deckhouse aft. Mr. Marconi's stateroom adjoined the instrument room, as, indeed, it was necessary that it should, in view of the hours, sometimes 2, 3 and 4 A. M., at which he required to be at his receivers. The apparatus was tested in the morning of the 22d while the ship still lay at her pier in Southampton docks, and the signals from Poldhu seemed quite unaffected by the fact that they were then traversing a distance much of which lay overland.

It was late in the afternoon of Feb. 22 when the "Philadelphia," having taken on board the mails at Cherbourg, started on her westward journey. Using an ordinary duplicate aerial, some communications took place in the ordinary way with the Marconi Channel stations at Nilton, Isle of Wight, and the Lizard, but it was not until we had reached a point 250 miles west of the Lizard that the big power experiments seriously commenced. From the first, it was seen that there was no doubt whatever about their success. The sensitiveness of the adjustments with which the best results were obtained increased only slowly, and for the first thousand miles, Mr. Marconi found that he had no need to use any adjustment whatever of special sensitiveness.

I remember very well the excitement with which we all assembled to watch the signals come for the first time over a thousand miles. We were not long left to wonder what the result would be, however, for immediately the connection was made, the "S" signals came ticking off on the tape as strong and regular and clear as I have heard them at 30 miles. I should mention that most of the messages received were of a private character, referring principally to conditions in the transmitting house at Poldhu. I subjoin, however, a copy of five messages to which no such remark applies, together with the dates and distances at which they were received on board the "Philadelphia":

Date.	Distance. (Statute Miles.)	Remarks.
Feb. 23.	250	Stiff southwest breeze, fairly heavy swell.
Feb. 23.	500	All in order. Sign.: Do you understand? (This in code.)
Feb. 24.	1032	Fine here. Thanks for message. (Sent previous day.)
Feb. 25.	1163	May every blessing attend you and your party.
Feb. 25.	1551	All in order. Sign.: Do you understand?

This was the last message received, though good "S" signals were received with a somewhat sensitive adjustment, which the rolling of the ship made it difficult to maintain, up to 2099 miles on Feb. 26. All the messages were followed by the code signature of the Poldhu station, and upon every occasion Mr. Marconi, mindful of the scepticism with which his Newfoundland results were received in certain quarters, made a point of receiving the signals and messages in the presence of independent witnesses, and throughout he used also the ordinary tape receiver for the purpose. The tape records were duly attested in each case by Captain Mills, his chief officer, Captain Marsden, or others of the ship's officers. We may, therefore, sup-



Fac Simile of Tape Record of Signal Received at Distance of 2099 Miles

(*The tape bears the witnessing signature of Captain Mills, S. S. "Philadelphia."*)

pose that this time the scepticism to which I have alluded will find little to feed upon.

The net results of these tests which have so completely borne out Mr. Marconi's calculations are in themselves sufficiently stupendous, without there being any need to look forward to the day, now very near at hand, however, when they will receive their crown and completion in the commercial establishment of transatlantic wireless telegraphy between stations in America and Europe. It should be remembered, too, that they have been obtained with, at Poldhu, a purely temporary installation so far as aerial capacity is concerned. I think I shall be correct in fact if I say that the electrical energy which has sufficed to send legible signals over a distance of 2099 miles—a distance somewhat greater, by the way, than that covered in the Newfoundland test—is not much more than one-tenth of the supply which Mr. Marconi will have available as soon as the work of tower erection now in progress at Poldhu is completed, as it may be expected to be within a very short time. As Mr. Marconi has now demonstrated that the limit of the distance over which his system can work is conditioned only by the amount of power available, the curvature of the earth being apparently immaterial, the extra thousand miles is not a consideration which need present much difficulty to those who are interested in transatlantic wireless communication.

Incidentally, I may conclude by remarking, his work on the "Philadelphia" has afforded a quite admirable illustration of the nicety of Mr. Marconi's "tuning" devices. The "Umbria," which followed the "Philadelphia" across the ocean at the distance of only a day's steam, failed to receive a single one of the signals, which yet were all the time flashing over her to Mr. Marconi's (differently tuned) receiver.

Stealing Electrical Energy.

The Ohio Senate has passed a bill providing for a penalty of from $50 to $100 fine, or from one to three years imprisonment for stealing electrical energy by tapping wires or by any other means.

Marconi-Canadian Transatlantic Rates.

A special dispatch from Quebec of Feb. 27 says: Ten cents a word for ordinary transatlantic telegraphic messages, with a press rate of 5 cents a word, is the rate to be enjoyed by Canadians in the near future in virtue of the recent arrangement made by the Dominion Government with Signor Marconi. The details of the contract have just been made public. The Government will contribute $80,000 toward the erection of a station in Nova Scotia, according to plans and specifications prepared by Marconi himself. Should the station cost more than that amount the additional expenditure will be borne by the company. The company agrees that the rates to be charged for messages between Canada and Great Britain shall not exceed in any case the rates charged for similar messages between Great Britain and any other parts of North America. If the company's operations are successful, it undertakes to transmit general messages at rates which shall be fully 60 per cent less than the rates now charged for cablegrams between Canada and Great Britain. In other words, whereas the rate for general messages is at present 25 cents, the company will charge not more than 10 cents a word. The company, as far as possible, will use Canadian machinery, material and labor in the construction of the station in Nova Scotia.

The Canadian Government undertakes that all messages received by the company, or intended for transmission by the company, shall be sent over Government telegraph lines now existing, or which may hereafter be constructed or operated by the Government, at rates not higher than those charged to others for ordinary commercial messages.

If the Government desires to use the Marconi system as a means of communicating with any of the lighthouses or life-saving stations on the coast or between the mainland and any island within the jurisdiction of Canada, it is free to erect such stations as it may require. In such cases the company must furnish all machinery needed for such stations at a fair and reasonable price, and free from any charge for patent rights or royalties. It is agreed that there is to be no discrimination on Marconi's part in favor of the United States.

New Telephone Patents.

The issue of Feb. 25 contains but three telephone patents, one relating to a sanitary shield for transmitter mouthpieces, the other two to switchboard systems. It is questionable whether it is worth while to patent such devices as the sanitary shield invented by M. Jean B. Tauveron, of New York. For one thing very few people would bother to use such a device, for another it would undoubtedly impair the efficiency of talking, and for still another it would be very easy to provide, were such a precaution considered really necessary, a much simpler and more effective shield to be thrown away after each conversation, such as a paper cup or funnel shaped exactly to fit the mouthpiece, which would be thoroughly "sanitary," and at the same time have absolutely no effect on the quality of the talking. The necessity for such a device has never really made itself felt, however, despite occasional scare articles in the daily papers. Granted that the idea of using a much-used public telephone is disagreeable to the squeamish-minded, there are hundreds of daily experiences in a big city equally disagreeable or more so, and it has never been proved that the public telephone is a real source of danger. In fact, such investigation as has been made has shown the contrary.

Mr. Fauveron's shield consists, as shown in the drawing, of a support of pasteboard with folding flaps to fit over the mouthpiece. The diaphragm or shield is of thin moisture-proof paper pasted to a support and having an extension or strip which forms a wrapper for the support and shield, enabling a sealed package to be made of the appliance by means of the mucilage indicated at the rounded end. The small figure shows the shield made up i na sealed package, which may be carried in the pocket without soiling of the shield proper. In this way, too, the user is sure of getting a fresh and uncontaminated shield.

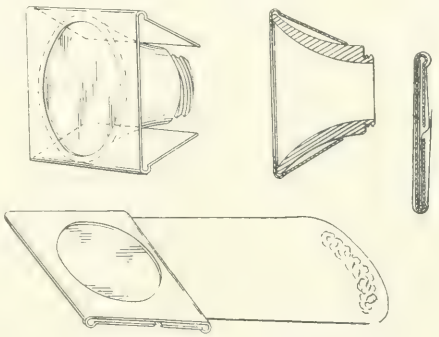


FIG. I.—SANITARY SHIELD FOR TRANSMITTERS.

Two patents of a more ambitious character are granted to Mr. William S. Paca, of Erie, Pa., assignor of three-fourths to Messrs. Peter H. Adams and John Z. Miller, of the same place. The object of Mr. Paca's invention, which he describes in two specifications adapted to different methods of exchange signaling, is the provision in a telephone exchange of a second switchboard, auxiliary to the main multiple switchboard, for the purpose of handling overflow traffic at extra busy times. The idea is almost as old as the multiple switchboard itself, has been tried in practice—though not exactly according to Mr. Paca's method—and has been found wanting, and it has disadvantages much more obvious and more numerous than any possible advantages.

Mr. Paca's plan is pretty clearly indicated by the preamble to his specification, as follows: "Necessarily during the busy portions of the day the operators at multiple sections have great difficulty in answering the calls promptly, as at such times there are frequently several calls in such sections at the same time, and the operator is then obliged to answer the calls and make the necessary connections one at a time, which necessarily causes considerable delay to some of the subscribers so calling the exchange; and to overcome this difficulty it is frequently necessary to decrease the number of connections in particular sections of the board, as the calls at such sections during the busy part of the day are so frequent that the operator at such

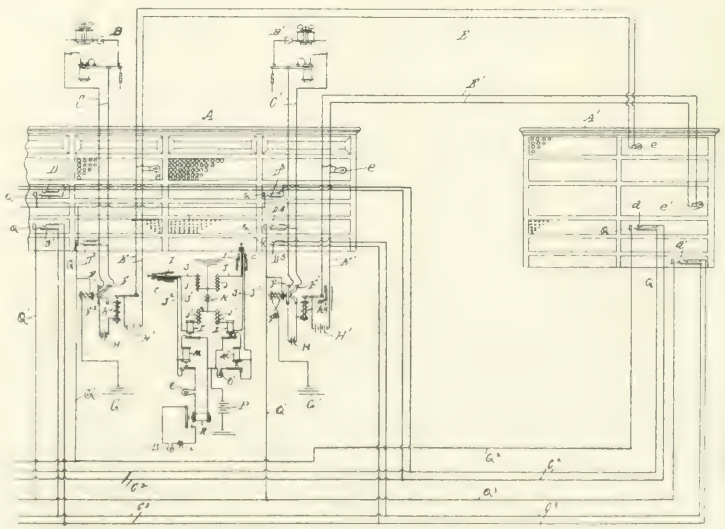


FIG. 2.—PACA'S TELEPHONE SWITCHBOARD SYSTEM.

section cannot answer them promptly, and in some cases two operators are placed at one section to overcome this difficulty. I entirely overcome this difficulty by means of an auxiliary switchboard, which is so connected up with the main switchboard that one or two operators at the auxiliary board can at any time promptly assist the operators at busy sections of the main board, so as to avoid delay in promptly answering calls thereto, and when desired—as, for example, at night, when there are comparatively few calls—one or more operators at the auxiliary board can promptly answer all calls coming into the exchange."

Fig. 2 illustrates the invention applied to common battery working, *A* being the main switchboard and *A'* the auxiliary board, which is apparently intended to be non-multiple, but in an exchange of more than a few hundred subscribers would necessarily have to be multiple, as the line signals and jacks could not be put near enough together to enable connections at the auxiliary board to be made directly between line jack and line jack. Moreover, in small exchanges the trouble which this device seeks to remedy does not exist, and in large exchanges the adoption of the system would practically result in two multiple boards in tandem, each subscriber's line having a line signal and answering jack in each and a multiple circuit in each; all so that the operator at the second board might take up a connection if the call were not immediately answered at the first.

In Fig. 2, station *B*, line *C*, besides its regular jacks and connections in the main multiple board *A*, is bridged to jack *d* in the auxiliary board *A'*, and has a line signal *e'* in board *A'* bridged on to the local circuit of its main line signal *e* in board *A*. Similarly, station *B'* has jack *d'* and signal *e'* in board *A'* bridged on to its regulation equipment in main switchboard *A*. The remainder of the apparatus shown in Fig. 2 is in the main that used in standard common battery practice and needs no description. Cord circuits similar to those shown at *A* would naturally be needed at *A'*. According to this system a call from a sub-station would light the lamps at both boards, and presumably the operators at both boards would endeavor to answer every call, with a resulting amount of confusion that may be imagined.

The whole idea underlying this invention is wrong. The inventor has set out to break a butterfly on a wheel or to build an elephant trap to catch a mouse. In the first place, Mr. Paca, when he says that at busy times "the operator is obliged to answer the calls and make the necessary connections one at a time," does the expert telephone operator great injustice. She thinks nothing of handling several connections at once during busy times. Then the supervisor, able to cut in and help at any position at any moment when an operator is temporarily overloaded, and the intermediate distributing board provide far better remedies for the difficulty Mr. Paca has set out to cure than his scheme of an extra signal and jack at a separate board. The auxiliary board would not only largely increase the cost and operating expenses of an exchange, but it would introduce troubles in operating far worse than those it is designed to remedy. The responsibility for attending to calls would be divided, the main and auxiliary operaotrs would inevitably often meet on a subscriber's line, the auxiliary operators would get many calls they could not handle unless the whole exchange equipment were duplicated at the auxiliary board and in turn would become overloaded themselves. In short, the scheme is one which, however attractive it may look on paper, meets with many practical objections when it comes to actual operation.

American Institute of Electrical Engineers.

At the 162d meeting of the Institute, held at 12 West Thirty-first Street, New York City, Feb. 28, 100 members and guests were present, with President Steinmetz in the chair. The following papers were read: 1. "The Electro-Chemical Industries," by Dr. Samuel Sheldon, of Brooklyn. 2. "The Electric Furnace in Industrial Chemistry," by Mr. Charles B. Jacobs, of New York. 3. "Electrolytic Recovery of Copper from Low-Grade Ores," by Dr. Nathaniel S. Keith, of New York. 4. "Colloids," by Mr. W. R. Whitney, of Boston. 5. "Liquid Potentiometer; Determining Electrolytic Resistance with Direct-Current Instruments." 6. "Point of Cut-off in a Battery Discharge." 7. "Electrolytic Conduction Without Electrodes," by Mr. Carl Hering, of Philadelphia.

These papers were discussed by the different authors, also by Messrs. C. J. Reed and E. P. Thompson. They are abstracted elsewhere in this issue.

CURRENT NEWS AND NOTES.

LEHIGH SCHOLARSHIPS.—Among eight scholarships to be competed for at the annual examinations in June of Lehigh University, are one in electrical engineering, and another in mechanical engineering, to the value of $150 each.

JAPANESE INDUSTRIAL EXHIBITION.—A national industrial exhibition under the auspices of the Japanese Government will be held at Osaka in 1903, and foreign manufacturers are invited to exhibit. Foreign exhibitors will be granted special protection with respect to patents.

CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—It has been decided to change the meeting place of the next annual convention of the Association of Railway Telegraph Superintendents from Boston to Chicago. The meeting will take place on June 18 next. The Association was organized in Chicago in 1882, and has not held an annual meeting there since.

ELECTRICITY ON THE MANHATTAN.—It is announced that up to this time there have been delivered and placed in service on the Second Avenue Elevated line, in New York City, six electric trains of full length. The operation of these trains has been quite satisfactory, and there can be no question of the complete success of electric traction. Installation of machinery in the power house is going steadily forward, progress in this matter keeping pace with the increasing number of trains available for service. The third rail is being laid on other lines of the system, but as this is a comparatively easy matter no effort is being made to rush it to completion. Everything depends on delivery of equipment, and in this fair progress is being made.

DATA ON SHOCKS.—A cable dispatch from London of March 1 says: The cause of temperance has suffered a cruel blow by a disclosure made in a paper on "Electric Shocks," which was read by Mr. F. F. Aspinwall before the Institution of Electrical Engineers. Mr. Aspinwall has been carefully investigating the subject for some years, and collecting all available data of instances of people being "shocked" by an electric current. He comes to the conclusion that a severe shock, strong enough to kill a man if sober, will probably not kill a man if he is drunk. This is due probably to the relaxed conditions of the nerve system. If the man has been working hard enough to throw him into a perspiration he has a good chance of escaping with his life from an otherwise fatal shock. People in bad health are much more sensitive to electric influences, while persons of weak intellect can stand stronger shocks than those of normal intelligence. Sleep also renders a person able to stand electric shocks, which if he were awake would be strong enough to cause death.

INDUCTION MOTOR WITHOUT IDLE CURRENT.—A patent issued Feb. 25 to Ernst Danielson, of Westeras, Sweden, describes an induction motor combination designed to eliminate the defect of induction motors in loading up a line with idle current. A direct-current exciter is mounted on the same shaft with the rotor of the induction motor. The motor is started as usual with a starting resistance in the rotor, and after it has gotten up to speed a double-throw switch cuts out the starting resisance and throws the armature circuit of the exciter into series with the rotor winding, thus causing the motor to act as a synchronous motor. By suitable adjustment of the exciting current by means of a rheostat in the field of the direct-current exciter, the phase relations of the current and the e. m. f. of the motor can be regulated within quite wide limits and made equal to zero or leading or lagging at will. When the exciting circuit is thrown on the rotor, one terminal of the exciter becomes connected to one collector ring and the other terminal to both of the other collector rings, the result being that the current strength in the coils belonging to one phase will be twice that in each of the others, which is stated to accurately correspond to the distribution of current maintained at certain moments when the coils are traversed by three-phase currents.

ANOTHER RURAL THIRD-RAIL ROAD.—Right of way is being acquired by the promoters for a third-rail road from Hudson to Poughkeepsie, passing through Red Hook and Rhinebeck and in Poughkeepsie crossing Main Street overhead. The project also embraces a railway to some point near the city of New York. Much of the right of way has already been secured. A corps of surveyors is now in the field. The third-rail trolley line from Hudson to Albany is paying, and lines are either in operation or being built from Albany to Utica, to Syracuse, to Rochester, to Buffalo and to Cleveland. Benjamin H. H. Brevoort, of Poughkeepsie, is the chief engineer of the road, and he and his assistants have been running lines since September last. Two lines have been run between Hudson and Poughkeepsie. Southward the line is proposed to run near Vassar College and then through the country to a point near Hopewell, and from there to Carmel over the old Boston and Montreal roadbed. There is every indication that this road will be built and that it will be equipped for both freight and passenger service.

APPARATUS FOR PREVENTING COLLISIONS AT SEA.—In a patent issued Feb. 25 to Nicolas Gherassimoff, of St. Petersburg, Russia, a curious arrangement is proposed for preventing collisions at sea. The object of the arrangement is to ensure against collision between the ship and any moving or stationary body situated in the path of the ship, either at the surface or at a depth less than the draught of the ship, and also to give warning of shoals. Electrically propelling bodies or "feelers" move in advance of and at substantially the same rate of speed as the ship, and at such a depth under water as to come in contact with any obstruction at a depth less than the draught of the ship. There are three of these "feelers," one of which moves in a line with the keel and the other two in paths to the right and left of this line, respectively. The three electric cables controlling the feelers are united at a point such that this point and the position of the three feelers are at the corners of a square; a cable from the junction point is connected with indicating apparatus aboard ship. The "feelers" are given motion by an electric current generated on the ship, and are provided with mechanism connected with indicating apparatus aboard ship to indicate the deviation in one direction of the two outside feeders and the deviation in either direction of the third or leading feeler. Each feeler is supplied with a luminous floating signal carried by a buoy at the surface of the water. The indications aboard ship denote also whether a feeler has come into contact with a floating obstruction or is over a shoal.

INDUCTION MOTOR STARTING APPARATUS.—Among the patents granted Feb. 25 is one to K. A. Lindstrom, of Sommarrs, Sweden, which relates to a new starting system for induction motors. The two usual methods of starting induction motors are by varying the primary e. m. f., or using a starting resistance in the secondary circuit. An objection to the former method is stated to be that a great current strength is required in starting and a small torque is obtained in proportion to the current. While the second method combines the advantage of a great torque in comparison to the current strength, yet the use of a starting apparatus is necessitated, which, owing to sparking or chemical influences Mr. Lindstrom considers is subject to considerable wear and is easily destroyed. The Lindstrom patent provides for use in starting of an inductive resistance having a small ohmic resistance and provided with a magnetic core, the hysteresis losses of which are great in comparison to the losses due to eddy currents in the same. As illustrated, the apparatus for a star rotor winding consists of three coils having a common point and wound on three cores so arranged to have a common magnetic circuit. In one form shown, the three cores form the spokes of a ring casting. The core windings are connected together at one end, the other ends leading to switches. In starting up the rotor windings are connected by collector rings and brushes to the three terminals of the windings of the core. After the motor has gotten up to speed the starting device is cut out and the rotor windings are short circuited on themselves. The specifications give a mathematical demonstration to show that with a properly designed magnetic core and windings of the kind described, the current taken in starting by the primary of the motor will not materially exceed that required for the motor for its normal running at full speed and for the same torque. In order to obtain with small weight great hysteresis losses in the core and, therefore, small shifting of phase, a material such as steel or gray cast-iron is used, the coefficient of hysteresis of which is great; and in order to obtain small loss by eddy current the core is minutely sub-divided.

Letters to the Editors.

Generator Heating Limits and the A. I. E. E. Standard.

To the Editors of Electrical World and Engineer:

Sirs.—A misconception not at all of rare occurrence appears to exist as to the rating of generating machinery under the standards recommended by the committee of the American Institute of Electrical Engineers. This misconception cannot by any means be said to be confined to a few ignoramuses, for some very large contracts have been placed by experienced engineers and filled by equally experienced manufacturing companies on a wrong basis, due simply to a misconception or to carelessness as to what the A. I. E. E. standard actually is and how it should be applied in practice. In some cases the mistake has cost thousands of dollars.

The misconception on which these mistakes in ordinary generators have been based is that the maximum allowable rise in temperature in the A. I. E. E. recommendations (which is 50 degs. C.) is one that will prevent a generator from reaching an unsafe temperature in all conditions that can arise in an engine room in very hot weather. To be sure, no one in these days expects to design an engine room so that ordinarily the temperature is so high that 50 degs. C. added to it would burn out a generator; but with the thermometer outside reaching 100 degs. F. and high pressure steam in the engine room, it takes more than ordinary precautions in power house design to keep the generator temperature down to a safe amount at full load with a rise of 50 degs. C. in the generator coils above the surrounding air, unless considerable floor space is used per kilowatt of power station capacity.

This is a point that has not been taken into consideration in the cases referred to, the order being simply given for a generator of so many kilowatts capacity, A. I. E. E. standard. The result is either a burn out if the generator is run fully loaded or a reduction in the capacity of the generator in the hottest weather. In the case of railway generators this means a reduction of generator capacity just when riding is most popular and when people take to the cars to keep cool. In a lighting machine the discrepancy between rated and actual safe load in hot weather would not be so important because the heaviest loads come in midwinter.

The conclusion is that the A. I. E. E. standard of allowable temperature rise was chosen to fit average conditions and should not be blindly adhered to when abnormal conditions are likely to exist in operation, as in crowded engine rooms near high-pressure steam cylinders and piping.

Philadelphia, Pa. Jas. L. Barr.

Measuring Three-Phase Circuits.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the letter of Mr. Stratton in your issue of Feb. 22, if the watts input of an induction motor are measured by two wattmeters connected in the way the wattmeters are connected up in Mr. Stratton's diagram, the readings of both instruments are not the same unless the power factor of the whole system is unity. The power factor of the motor on which Mr. Stratton made his test is



FIG. 1.—MEASURING THREE-PHASE CIRCUITS.

88.8 per cent, but it is a bad fallacy to reason the way he has done.

He has the pressure coils of his wattmeters connected between the *outside* wires, and he, therefore, does not measure the watts in an individual leg. If he had connected his pressure coils between the outside terminals and the neutral, then he would have received very

different results, viz., the watts in each leg would have been the same.

Referring to the accompanying diagram, the power is $I E \cos 30$ degs. if the load is non-inductive. If inductive, the power is $I E \cos$ [illegible] or $I E \cos 30$ degs. [illegible], the power factor being [illegible].

BOSTON, MASS. S. L. LONG.

To the Editors of Electrical World and Engineer:

Sirs.—Perhaps the simplest way to explain to Mr. Stratton why he obtained the results given in his letter of Feb. 22 will be to explain the theory of two-wattmeter, three-phase measurements.

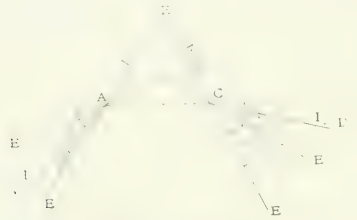


FIG. 2.—MEASURING THREE-PHASE CIRCUITS.

The total power in a three-phase balance system can be measured by means of two wattmeters, each connected with the current coil in one of the lines and the potential coil between these lines and the third. Since the e .m. f. in the potential coil is displaced in phase from the current in the line, it is evident that each wattmeter does not give the power of each individual phase. It is easily demonstrated, however, that the sum of the two readings regardless of the phase relation of current represents the total power in the three-phase system.

Let in Fig. 1 the phase of the current be represented by line $A B$, lagging by the angle ϕ behind the e. m. f.; $C D$ the current in the other phase lagging the same angle behind its e. m. f., and let these two currents be used in the current coils of the two wattmeters having the potential coils connected across $E A$ and $E C$, respectively. The power measured by the first wattmeter will then be $I_1 \times E \times \sqrt{3} \times \cos (30 - \phi)$. The power read in wattmeter No. 2 will be $I_2 E \sqrt{3} \cos (30 + \varphi)$, where I_1 and I_2 are represented by $A B$ and $C D$, respectively. In a balanced system I_1 is equal to I_2; E is the e. m. f. per phase, so that the line voltage is $E \times \sqrt{3}$, and consequently the sum of the two wattmeter readings will be $E \times \sqrt{3} \times I \times \cos (30 - \phi) + E \times \sqrt{3} \times I \times \cos (30 + \phi)$.

By solving this equation we find the total power to be $\sqrt{3} \times E \times I \times \cos \phi$, which is the sum of the power in each of the three phases with the current lagging an angle ϕ behind the e. m. f. This proves that this method of connecting two wattmeters gives the total power

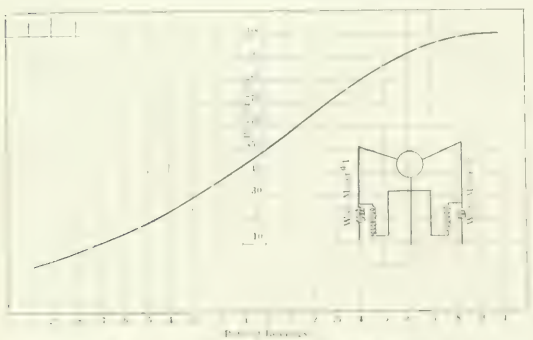


FIG. 3.—MEASURING THREE PHASE CIRCUITS.

in the three-phase circuit, regardless of the phase relation of currents. The ratio between the two wattmeter readings

$$\frac{\cos (30 - \phi)}{\cos (30 + \phi)} = \frac{1}{3} \cdot \frac{\cos \phi + \sin \phi}{\cos \phi - \sin \phi}$$

Substituting different values of ϕ in this equation we find the relation between ratio of wattmeter readings for different degrees lag of current and different power factors. This is plotted in Fig. 3.

In the particular case referred to in Mr. Stratton's letter, where one meter reads 3600 and the other 8000, the ratio is .46 and, consequently, the power factor, according to the curve, is 84.5.

SCHENECTADY, N. Y. E. J. B.

To the Editors of Electrical World and Engineer:

Sirs.—In regard to the problem encountered by Mr. Stratton in testing a three-phase induction motor, an account of which appeared

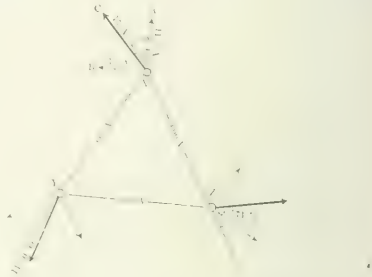


FIG. 4.—MEASURING THREE-PHASE CIRCUITS.

in the issue of your paper for Feb. 22, permit me to offer the following solution:

Assuming the total watts supplied to the induction motor to be $8000 + 3600 = 11{,}600$, the e. m. f. per phase 6000, and current per lead 15 amperes, the following calculations would be made:

Power factor $= \cos \phi = \frac{11{,}600}{15 \sqrt{3}\ 600}$	$= .745$
Angle of lag $= \phi$	$= 41^\circ.50$
Wattless factor $= \sin \phi$	$= .667$
Power component of current	$= 11.2$
Wattless component of current	$= 10.0$

Referring now to the diagram, it will be seen that a wattmeter having its current coil in lead Y, and its pressure coil across between this lead and lead X would register

$$I E \cos \phi_y = 15 \times 600 \times .0787 = -8800$$

While a wattmeter with current coil in Z and pressure coil across $X Z$ would register

$$I E \cos \phi_z = 15 \times 600 \times .3118 = +2800$$

It is evident that so long as the angle ϕ_y remains less than 90 degs., the record of the wattmeter at Y will continue to be positive in value, and that the wattmeter at Z will give a positive reading up to that angle of lag which causes ϕ_z to become 90 degs. This latter condition will be reached when φ, the lag of the current in each lead wire behind the e. m. f. between that lead and the neutral point, becomes (90 degs. — 30 degs.) = 60 degs., at which time the power factor of the *system* will be $\cos 60$ degs. = .50, but that of wattmeter at Y, if the term "power factor" can be used here, will be $\cos 30$ degs. $= \frac{1}{2} \sqrt{3}$, and of the wattmeter at Z $\cos \varphi = 0$.

In other words, an individual wattmeter does not read negative till after its "power factor" has decreased to 0, but one wattmeter of a three-phase system will read negative when the power factor of the *system* is below .50.

In the case cited by Mr. Stratton, though the "power factor" of one wattmeter was below .50, that of the system, was above .50, and hence neither wattmeter recorded a negative value.

There seems to be some discrepancy in the ratio of watts recorded by the individual meters and the current flowing in the system.

If we assume the readings of the individual wattmeters to be

$W_y = 8{,}000$, $W_z = 3{,}600$, then

$\tan \phi = 1.3 \frac{4{,}400}{11{,}600}$	$= .657$
Power factor $= \cos \phi$	$= .8355$
Wattless factor $= \sin \phi$	$= .5495$
Apparent watts $= \frac{11{,}000}{.8355}$	$= 13{,}000$
Power component current	$= 11.2$
Wattless component current	$= 7.35$
Primary current	$= 13.4$

Assuming this last value of current to be correct, and making cor-

*See ELECTRICAL WORLD AND ENGINEER, November 23, 1901.

responding substitutions in the diagram the record of wattmeter at Y would be

$$I E \cos\varphi = 13.4 \times 600 \times \cos 35^\circ 20' = + 8000$$

and at Z would be

$$I E \cos\varphi = 13.4 \times 600 \times \cos 83^\circ 20' = + 3600$$

These are the values of watts recorded. Assuming them to be correct the remarks concerning the condition for obtaining a negative reading upon one meter apply equally as forcibly as before, since the power factor of the system is above .50.

ITHACA, N. Y. A. S. McALLISTER.

To the Editors of Electrical World and Engineer.

Sirs.—The writer has noticed the peculiar results Mr. Stratton obtained in testing his three-phase induction motors, and believes the matter can be easily explained.

Mr. Stratton obtains the power factors apparently from the following formulæ:

$W_1 = I E_{13} \cos\varphi$, and $W_2 = I_2 E_{23} \cos\varphi_2$, where W_1 and W_2 are the readings of the two wattmeters. This is not correct. For the two-wattmeter method on a three-phase system the formulæ are:

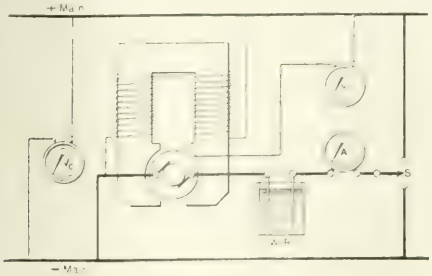
$W_1 = I_1 E_{13} \cos(\varphi_1 - 30^\circ)$ and $W_2 = I_2 E_{23} \cos(\varphi_2 + 30^\circ)$, where W_1 will be the higher reading instrument.

MONTREAL, CANADA. CHARLES BRANDEIS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS MOTORS AND TRANSFORMERS

Testing of Motor Losses.—SUMPNER.—A paper read before the Birmingham section of the (Brit.) Inst. of Elec. Eng. He discusses three different methods which have the common feature that they are acceleration methods in so far as from the way in which a machine slows down under the retarding torque due to frictional and other losses, the magnitudes of these losses are deduced. In the first method the only apparatus required are an ordinary watch, a good speed indicator, and some means of applying to the machine a small measured retarding torque either mechanically or electrically. The time is taken in which the machine slows down from a given speed m to n, as read by the speed indicator; the loss of kinetic energy of the revolving mass in $a\,(m^2 - n^2)$, when a is a constant depending on the moment of inertia of the rotor. If the retarding torque is altered while the values m and n are the same, a can be determined. The retarding torque may now be altered by varying the excitation of the machine, and in other ways, so that the torque due to hysteresis and eddy currents can be separated from that due to friction. Moreover, the torque at different speeds can be determined. The mathematical formulas are given. The limit of accuracy is determined by the speed indicator. The second method described applies to large alternators working in parallel. The synchronizing apparatus can be used as the speed indicator by making use of the principle of beats. If the machines are running in synchronism, and power be shut off from one machine and its armature circuit opened the synchronizing apparatus will show more and more rapid beats. If the number b of beats occurring in a time t is counted, from the moment of opening the armature circuit, then $Tt^2 \div b$ is a constant quantity for any particular machine, where T is the retarding torque caused by the losses. The third method applies to a direct-current shunt machine, or an alternator provided with an exciter on the same shaft, or any machine which is run up to speed by means of a belted shunt motor. The method consists, as shown in the adjoining diagram, of using a suitable low-voltage voltmeter



TESTING OF MOTOR LOSSES.

to measure the difference between the voltage of the field magnet coils and the induced e. m. f. in the armature. The field magnet is permanently connected to constant potential mains, the armature being connected across the mains through a switch and starting resistance, the switch end of the armature being also connected to the corresponding main through a voltmeter provided with a key. When the desired speed is attained the armature switch is opened and the voltmeter key is closed. The reading of the voltmeter is a direct measure of the change of speed. The method then merely consists in observing the time interval taken for the voltmeter to change its deflection between two given values. When this method is applicable the speed readings can be very accurately taken. The only novelty in the suggestion of using a voltmeter as speed indicator arises from the special way in which it is connected. Instead of joining it up across the armature so as to indicate the total speed of the machine, it is connected so as to measure the difference between the constant voltage corresponding with the normal speed and the actual voltage due to the reduced speed. It is thus possible to use a sensitive voltmeter capable of indicating by a considerable deflection small changes in speed. This is a great advantage, for in this acceleration methods the time measurements can be much more accurately taken than the speed indications. Besides, it is desirable to make the measurements for a small percentage change in the speed. An account is given of tests in which this method was used.—Lond. *Elec.*, Feb. 7.

German Manufacturing Plant.—E. K. SCOTT.—An illustrated article on a recent visit to the Schuckert works. In the large machines the armature windings are not soldered to the commutators but are screwed to them. In several large machines the writer noticed a long, narrow slot, which was cut down the middle segment of the commutator so that the air could freely circulate from inside to outside. Great care is taken to bring the pole faces close together, and the pole tips are machined off to a sharp edge.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

Alternating-Current Machinery for High and Low-Speed Frequencies.—BEHREND.—The first part of an illustrated article, in which he begins with a discussion of 60-cycle alternators. When driven by a slow-speed steam engine at 120 to 75 revolutions, it must have 60 or 96 poles, respectively. It is advantageous to place this large number of poles directly on the flywheel. The main difficulty is to devise a construction which gives, with a small amount of material, a stiff but narrow armature. The efficiency of such slow-speed, 60-cycle generators is very high and the heating very low.—*Elec. Rev.*, Feb. 15.

Speed Regulation of Direct-Current Motors.—SCHULZ.—A brief general discussion of the different methods by which the speed of a direct-current motor can be changed. The article does not seem to contain anything new.—*Elek. Anz.*, Jan. 26.

POWER

REFERENCE.

Air Brakes.—An illustrated article on the electric control of air brakes.—*Elek. Anz.*, Jan. 30, Feb. 2.

TRACTION

Third Rail.—GUARINI.—A brief article on several third-rail installations in various countries. Recently the service on the Milan Varese line in Italy has commenced. The length of the line is not given. At present the ordinary service of steam trains has not been interrupted, but to these have been added 14 electric trains, i. e., seven in each direction, of 2 cars and 168 seats each. Direct current at 600 volts is used. Its motive power is supplied at present by a steam central station, but it will soon be furnished by a hydraulic installation.—Lond. *Elec. Rev.*, Feb. 7.

REFERENCE.

Lorain Surface Contact System.—A long illustrated description of the experimental line of the Wolverhampton municipal tramway, on which the surface contact system of the Lorain Steel Co. will be tried.—Lond. *Elec. Eng.*, Feb. 7.

Installations. Systems and Appliances.

Charging for Electrical Energy.—Esson.—A long reply to the critics of his former article. He carefully distinguishes between company and municipal undertakings. The aim in selecting a system of charigng by a company must be a commercial one—to make profits. The only result of the maximum demand system is to give long-hour consumers their electricity cheaper, but this, a flat rate with discounts, will answer equally well. Discounts, however, should be based not on the amount of electricity consumed, but should be given in respect of the class of customers supplied. Experience has taught what discount should be given to each of the few classes between which it is found necessary to differentiate. The flat rate system with such discounts amounts in practice to the maximum demand system without the maximum demand indicator. If, however, some indication of the maximum demand is advisable, the simplest is to take the number of lamps fixed as this indication; but "obviously it would be much better if the basis of the charge were not the number of lamps fixed, but the maximum number of lamps simultaneously in use, and this is where a recording indicator comes in. An automatic assessment from time to time of the number of lamps alight, frees the demand system from all difficulties. While the method of charging should be a matter of profits for a company, it should be a matter of principles for a municipal undertaking. He upholds his former proposition that in order to meet the standing charges of the electrical undertaking—the cost of getting ready the supply—a municipal tax should be levied on all the residents within the area served, the compulsory area to begin with, and the extended area as the undertaking expands.—Lond. *Elec.*, Feb. 7.

South London Electric Plant.—An illustrated description of this plant. The single-phase alternating-current system is used. There are 5 steam-driven, 3000-volt alternators, of together 3300 kw capacity. There are six feeders, supplying independent networks. Each of these high-pressure networks feeds a number of transformers in street boxes, and each of these again supplies a small local and independent low-pressure network. The high pressure feeders are all drawn into earthenware ducts, in which an ample number of spare ways has been provided. The low-pressure mains are laid in bitumen on the solid system. The lamp connection is equivalent to 58,000 lamps of 8 cp, and there are a few motors in use. The general supply is given on the two-wire system at 220 volts. Energy for lighting is charged for at the flat rate of 10.5 cents per unit, and for power at 4 cents per unit.—Lond. *Elec. Rev.*, Feb. 7.

Wires, Wiring and Conduits.

Direct-Current Distribution Mains.—Ward.—An illustrated paper read before the Glasgow Section of the Inst. of Elec. Eng., giving "practical notes on continuous-current distributing mains." He says that while mains break down owing to faults in manufacture, and to mechanical injury, yet there is no form of destruction so difficult to contend with as the action of electrolysis, which commences where it is insufficiently guarded against, at the moment that the mains are made alive. The continual heaping up of moisture at the negative conductor, where exposed, tends to lower the insulation resistance between that conductor and earth, and especially in cases where the middle or neutral conductor on a three-wire system is deliberately earthed, minute currents tend to pass from the neutral conductor through the earth and on to the negative conductor, resulting in electrolysis. He discusses the construction of end boxes and earth plates, and the question of fusing feeders and networks. He describes at length the elaborate system which has been in use in Glasgow with the endeavor not only to keep the distributing system joined up throughout, but also to fuse as effectively as possible. From the point of view of central station efficiency he thinks that a triple concentric system can be maintained in a nearer state of perfection than a system consisting of single conductors, for the reason that, as a rule, any defect in insulation between the conductors rendering the main immediately useless necessitates repairs without delay, whereas with a system of single conductors small leaks may remain undetected for a considerable time, and have very destructive electrolytic effects upon the whole system. This applies especially to large systems, when it becomes practically an impossibility to take frequent insulation tests of each section of the system. He recommends the adoption of a triple concentric system with an insulating outer sheathing, laid on the solid system, in cast-iron or stout wooden troughs.—Lond. *Elec.*, Jan. 24, 31.

Some editorial notes are given on this paper. The advantages gained by fusing both feeders and distributors at Glasgow, are thought to have been gained at the expense of simplicity of apparatus. As typical of a large network in which no fuses are used, Manchester is noticed, where Wordingham's pillar distributors form a practical and effective means of disconnecting at street corners and dividing or isolating the network generally. By this system, however, a fault in one section will have a much more serious effect on the remainder of the network than with a well-dimensioned system of fuses in the network boxes. It is thought that Ward is unnecessarily alarmed regarding electrolysis. The lead covering of the cables on any network, whether continuous or alternating, high-pressure or low-pressure, should be connected through, and there should be no interruptions in its continuity. This done, there should be no danger from electrolysis. Even in solid systems in which lead-covered cables are used, the metallic continuity should not be interrupted.—Lond. *Elec.*, Jan. 31.

Fuse Wires.—Murdock.—A communication giving an account of experiments in which he determined the effect on the time of fusing, of altering the length of a fuse wire, the current being kept constant. The wire was held in terminals capable of being set at given distance apart, and the current kept constant by means of a lamp and water resistance. The results show the importance of making a fuse wire exceed a certain definite length in order that the time of fusing may be a minimum for a given current. No. 24 lead-tin fuse wire was used, the current was 13.3 amperes. For a length of 8 inches the time of fusion was 3 seconds; for 2 inches, 6.5 seconds; for 1 inch, 12.5 seconds; for 0.75 inch, 92 seconds; for 0.63 inch, no fusion. He then compared the time of fusion for vertical and horizontal fuse wire, No. 24 lead tin wire being used, the current being 13.4 amperes. For a length of 1 inch the time of fusion was 8 seconds for the vertical wire, and 11.5 seconds for the horizontal wire; for a length of 4 inches the time was 3.2 and 2.5 seconds, respectively. In the case of the vertical wire there is almost no visible heating, although horizontal wires of equal length glow brightly before fusing. The wires invariably break at the point of maximum tension. He claims that fuses should be designed so that for a given fusing current the time of fusing will be practically a minimum.—Lond. *Elec.*, Feb. 7.

Electro-Physics and Magnetism.

Heat Energy.—Swinburne.—An abstract of a Brit. Phys. Soc paper on "The factors of heat." He remarks that while it is generally customary to split energy into an intensity factor and a quantity factor, this is not usual with heat. He builds up a system of dividing heat into factors upon the strict model of electrical energy, i. e., he assumes a heat quantity-factor analogous to electricity (coulombs), and a heat intensity factor analogous to electric potential (volts). The first he calls "posot," the latter "tasis." Tasis is of the dimensions of the square root of temperature. "Conductivity of posot follows Ohm's law, and the capacity of a body for posot is constant." In the discussion which followed, Everett, Bryan, Donnan and Gray thought the proposed changes involve loss of simplicity without compensating advantages. Donnan said that the entropy function is good enough for developing a consequent science of thermo-dynamics. There is also a long editorial in which it is pointed out that the temperature and the heat capacity are the natural fundamental factors of heat. Heat is sui generis among all the forms of energy; the operations of all forms of energy other than heat involve the irreversible transformation of some of the energy into heat, while on the other hand, even irreversible processes of heat transference do not dissipate heat energy into any other form of energy from which it cannot return to the condition of heat. Heat is "the scrap-heap of the universe's energy."—Lond. *Elec.*, Jan. 31.

Nickel Amalgam.—Wuensche.—An account of an investigation of the magnetic behavior of nickel amalgams. He is strongly of the opinion that in the case of nickel amalgam a chemical combination of nickel and mercury must be assumed, as it shows an extraordinarily low magnetization. Sometimes amalgams containing little nickel

are found to be more magnetic than amalgams containing much nickel.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

Crystallization Under Electrostatic Stress.—Heyl.—An account of experiments based upon the thought that if crystals were allowed to form from solutions subjected to strong and intermittent electrostatic stress, the crysals might, when large enough to be observed, bear some birthmarks which might be interesting or possibly valuable. A change in the interfacial angles seemed the most likely effect, and an alteration of density was deemed possible. These effects were looked for, and a salt sensitive to slight mechanical disturbances, mercuric iodide, was used as an indicator; but no effect was found. This negative result may be thus stated: Any molecular forces called into play in a solution under electrostatic stress are not comparable with the forces of crystalline attraction.—*Phys. Rev.,* Feb.

Kerr Effect.—Schmidt.—An account of an experimental investigation. The liquids which exhibit the Kerr effect may be divided into two classes, corresponding respectively to positive uniaxial crystals and to negative uniaxial crystals. The intensity of the electro-optic effect of the dielectric, i. e., the difference of the retardations of the ordinary and extraordinary rays, reduced to unit thickness of dielectric, is proportional to the square of the difference of potential and to the electro-optic constant. He has studied a number of liquids, including carbon bisulphide, chloroform, amyl compounds, benzol compounds, a number of alcohols and water, the liquid in the condenser of reference being "cumol" free from "terpene." Two remarkable results were obtained. One of these is the intermediate value obtained in the case of water, which in other electrical qualities is very irregular. The other is the enormous double refraction of nitro-benzol, viz., 60 times that of carbon bisulphide, which hitherto passed for the substance showing the greatest Kerr effect.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

Atmospheric Electricity.—Linke.—An article on the influence of ascending and descending currents of air upon the course of the atmospheric potential. According to modern researches, the earth has a negative charge. The atmosphere contains more positive than negative ions in the lower strata, but in the upper strata they are about equal in number and much more numerous. Any conductor, such as a drop of water, moving upwards in the atmospheric field, must acquire a free negative charge, whereas it must become positive on descending. When a number of drops coalesce, the charges and volumes are simply added, but the capacity of the resultant drop only grows with the cube root of the volume. Ascending clouds in which this process takes place may, therefore, produce a high negative potential, more highly negative than that of the earth even, and may thus produce a reversal of the ordinary potential gradient. He quotes a balloon observation in which a stratum of mist had a positive charge at an elevation of 1000 meters, and a negative charge when it reached an elevation of 1800 meters. A lightning flash at high levels enables the layer to assume the surrounding potential, and a sudden fall would then lead to another discharge.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

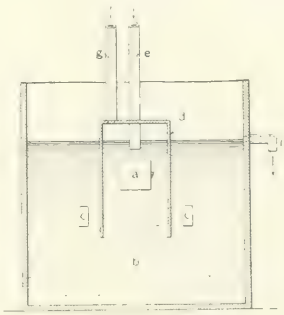
Dielectrics Subjected to High Potentials.—Shearer.—A long account of some experiments on the behavior of dielectrics when subjected to high potentials. He concludes that all the observed changes may be readily accounted for without reference to anything other than heat and the slight distortions due to an unsymmetrical distribution of charge. It seems that the production of changes of form and dimensions in matter by purely electrostatic strain is extremely improbable.—*Phys. Rev.,* Feb.

Literature.

Vacuum Discharges.—Lehmann.—An account of a long investigation of the discharges through very large and wide tubes. He used a tube composed of two air-pump bells cemented together, thus obtaining a space 65 cm. long and 32 cm. broad.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

Electro-Chemistry and Batteries.

Bell Process for the Production of Alkalies and Chlorine.—J. B. C. Kershaw.—An illustrated article on this new commercial process, the characteristic feature of which is the absence of a diaphragm and the separation of the anode and cathode parts of the electrolyte by means of gravity. The anode is surrounded by a "bell" ("glocke"), which gives the process its name. The adjoining diagram is a diagrammatical section of the cell, in which *a* is the anode, *c* the cathodes, *d* the bell, and *e* and *g* the feed and gas exit pipes, respectively, to the anodic compartment. The cell is filled with brine. In the anodic department chlorine is formed, in the cathodic compartment caustic alkali. The separating zones between the two parts of the electrolyte tends to rise upwards in the bell while the electrolysis proceeds, and would finally reach the anode. To prevent this, fresh brine solution is admitted through the pipe *e* into



SECTION OF GRAVITY CELL.

the anode compartment either continuously or at short intervals of time. At the same time the caustic alkali solution leaves the cathode compartment through the overflow pipe *f*. The admission of brine solution through *e* is regulated so that the speed with which the anode liquid passes downwards, equals that with which the alkali tends to pass upwards (which is closely related to the coulombs passed through the cell). In this way it is possible to maintain constant the level of the zone where the anode and cathode liquids meet, without in any way destroying the line of demarcation. The advantages claimed for this type of cell, as compared with the other forms in actual use at the present time, are: A current efficiency of 85 to 90 per cent, and a cathode liquid containing 100 to 150 grams caustic alkali per liter, without the use of mercury or of diaphragms, a greatly increased life of the carbon anodes, with decreased cost of operation and increased purity of the chlorine produced. A reduction in the working costs of the cell and process, owing to very simple nature of the cell and its method of operation. Ordinary thick lamp carbons are used as anodes, and are stated to have a life of 1¾ to 2 years. He has received the following official information regarding the cost of operation from the Austrian firm which operates the process commercially after having worked it out during the years 1893 to 1899. The capital outlay upon a plant utilizing current from four 600-hp generators, and producing 14,000 kgr., 90 per cent caustic potash and 21,600 kgr. bleaching powder per day is $750,000, the working capital $50,000; hence total capital $800,000. The total working costs per day are $1,857. Taking the current values for caustic potash and bleaching powder, the margin between actual costs and sales values of the daily products works out to $1,185, a sum more than ample to cover all manufacturing contingencies incidental to the conduct of the process. If caustic soda is made instead of caustic potash in the same plant, 9200 kg. caustic soda (72 per cent oxide of sodium) and 21,600 kgr. bleaching powder are produced per day, the total working cost per day is $1,074; but taking current prices for the products, the margin between daily actual costs and sales value works out at only $170. This is the reason why the owners of plants have preferred to decompose potassium chloride rather than the sodium salt. The market for caustic potash is, however, a restricted one. The bell process is in operation at one Austrian and three German, plants, the total number of bells in operation at the end of 1901 being given as 24,000. "It is noteworthy that it is by careful attention to the feed of the electrolyte to the anode compartment of the cell that a type of cell which failed in the hands of the Electro-Chemical Company at St. Helens, Lancashire, in 1899, has been converted into a practical industrial success."—Lond. *Elec.,* Feb. 7.

Ionization, Ionic Velocities and Atomic Sizes.—Sutherland.—A highly theoretical paper in which he discusses several "gaps" in the electrolytic theory of ions. He first deals with the cause of ionizations, and says that exceptionally high dielectric capacity, high-power of ionization, and marked tendency to molecular association, are three effects traceable to the same cause, which he proposes to call the

latent or potential valency of certain atoms. He suggests using certain well-known musical signs, the sharp, the flat and the natural signs, for distinguishing the two kinds of electrons from another and from the "neutron." By means of this notation he shows how the high dielectric capacity, molecular association, and ionization in water may be explained as consequences of the latent or potential valency of oxygen. A radical with electric charges, yet not an ion, because its charges are equal and opposite, he proposes to call a stion; the neutron and stion differ as do the electron and the ion; the neutron and electron are the molecule and atom of electricity, the stion and the ion are atoms of matter with associated electrons. Those substances which fail to conform to Maxwell's relation between dielectric capacity and index of refraction, when the dielectric capacity is measured electrostatically, fail because they contain stions which are doublets of exceptionally large electric moment. The second part of the paper deals with the question why Ostwald's law (the relation between dilution and degree of ionization) which was found to be true for over 200 weak organic acids dissolved in water, fails completely for ordinary binary electrolytes. He thinks that Ostwald's formula applies to weak acids because many of these are known to polymerize. Acetic acid is probably diacetic acid, and when dissolved in water is partly dissociated into mono-acetic acid, which is practically all ionized. This law for acetic acid is probably the expression for equilibrium between diacetic acid and the products of its dissociation, namely, mono-acetic acid. A similar explanation will apply to all his cases of weak acids. This is different with ordinar binary electrolytes; but he emphasizes that it is first necessary to have an experimental investigation of dielectric capacity in solutions, before we can determine ionization satisfactorily. "The complete theory of the ionization of the binary electrolytes, in aqueous solutions is more complicated even than it has been hitherto supposed to be." The third part of the paper deals with ionic velocities and absolute sizes of atoms. He deduces the ionic velocities from the other physical properties of the atoms, and shows the possibility of using them as a definite means of calculating the absolute sizes of the atoms. For the radius of the Li atom he gets 0.000000002 cm. The process of calculating the size of a molecule from its observed ionic velocity might prove helpful in the case of large organic ions such as physiologists have to deal with, for the molecular weight could be estimated from the size when other recognized methods of determining it fail. Incidentally, he mentions that the high mobilities of the H and OH ions may be explained as being due to the fact that these are the ions of water itself, and that these two ions have their real ionic velocities largely increased by a sort of Grotthus chain action, whereby an H or an OH instead of passing through the space of a water molecule, which is in front of it, simply combines with part of the molecule and liberates the other part at the other side, so that the same effect is produced as if the ion had traversed the space of the molecule with a higher velocity than the true ionic velocity.—*Phil. Mag.*, Feb.

Dissolution of Metals.—AUREN and PALMAER.—An abstract of a paper in which they say that the law of mass action cannot be applied to calculate the velocity of dissolution of zinc in acids, as the values so calculated do not agree with the experimental results. They consider that the dissolution is purely electrolytic, and occurs solely as a result of local currents. To this is due the slow velocity of dissolution of pure metals. On this assumption an expression is deduced for the rate of dissolution of a metal in acids of any concentration, the expression, however, involving an unknown quantity, the resistance capacity. This may, however, be deduced from one set of determinations and the velocity of dissolution under other conditions then calculated. The values so obtained were found to agree well with those determined experimentally. The temperature coefficient between 10 degs. and 50 degs. was found to be in general about 1.5 to 2 per cent per degree. This is far smaller than the usual temperature coefficient of a chemical reaction, but is approximately that of the increase of e. m. f., a result in accord with the theoretical views.—Lond. *Elec. Eng.*, Feb. 7.

Lead Storage Battery.—An account of tests of a new lead storage battery devised by Ricks. The feature is that the active material—lead peroxide and spongy lead—is absolutely detached from the metallic lead plates which collect and conduct the current. There is no attempt made to cause the one to adhere to the other, and, therefore, the usual trouble caused by the peroxide working loose, does not occur. The foundation for the active material is a non-conductive plate, such as ebonite or celluloid, with which it is possible to secure firm union, and which at the same time is less rigid and heavy than the usual lead grid. The active material in granular form is cemented and pressed on to the plate on both sides, and it is stated, adheres so firmly that it can scarcely be detached without breaking the plate. The lead-conducting plate is very thin, and is pressed by springs against the outer face of the active material, so as to be in intimate contact with a part of its surface. Holes are cut in the lead plate to facilitate the circulation of the electrolyte. The length of the plate is so great that it serves for a positive electrode in one cell, and a negative electrode in the next, the lead being bent over, and, therefore, does not need to be soldered or burnt between adjacent cells. The tests included several small batteries. In the first the active material was spread to a thickness of 0.17 inch on celluloid plate 0.02 inch thick, and measuring 7.7 by 6.3 inches. The lead-conducting plate was 0.02 inch thick, the total weight of cell was 4 lbs., and 30 ampere-hours were obtained in six hours at an average e. m. f. of 1.9 volts, giving 57 watt-hours, i. e., 14 watt-hours per pound of cell. Another cell of different dimensions and weighing 15.76 lbs. gave at the rate of 6 to 7 amperes, 130.6 ampere-hours at 1.8 volts average, equal to 245 watt-hours, or 15.6 watt-hours per pounds. In two other cells even 19.5 watt-hours per pound and 20.8 watt-hours per pound were obtained. (These results regarding watt-hour capacity are exceedingly good for a lead cell.)—*Centralblatt f. Accum.;* abstracted in Lond. *Eng'ing*, Feb. 7.

REFERENCES.

Rotation of Electrolytes in Magnetic Fields.—DRUDE.—Some notes on experiments made by Urbasch, who has shown that an electrolyte placed in a suitable magnetic field, shows rotation phenomena, when chemical processes or diffusion takes place in it. The present author points out that in order that these phenomena take place, it is essentially that at the same time an electric current flows in the electrolyte.—*Zeit. f. Elektrochemie*, Jan. 30.

Ions and Electrons.—GARRARD.—The first part of a general summary on "Recent development of the atomic theory and its connection with light and electricity."—Lond. *Elec. Rev.*, Feb. 7.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Earth Telephony.—DUCRETET.—A description of a "Remarkable and somewhat mysterious new ssytem of telephoning without wires." He describes it as an extension of the geo-telegraphic experiments made in 1876 by Bourbouze. The transmitter consists of a microphone in circuit with a battery and two earth plates a few yards apart, with a hollow space formed by thick masonry between them. At the receiving end there is a vertical shaft, partly of cast iron, communicating with the catacombs of Paris. A metallic sphere, 8 cm. in diameter, lines on the dry soil of the catacombs and is attached to an insulated wire leading up through the shaft. This wire is attached to one terminal of an ordinary telephone whose other terminal is attached to the cast-iron shaft. Under these conditions anything spoken into the microphone, is exactly reproduced in the telephone, and without the secondary noises which are heard in ordinary wire telephony. It follows that the interrupted earthing conductor must somehow separate the outward and return currents, and thus form a complete circuit. The author does not state the distance between the stations, but mentions having succeeded in worknig an electric call bell at the receiving station on the same system. All action ceases when the sphere is lifted off the ground, and is restored on lowering it again. Further experiments are being made at different distances and with various earthing devices."—*Comptes Rendus*, Jan. 13; abstracted in Lond. *Elec.*, Feb. 7.

Wireless Telegraphy.—BRAUN.—An illustrated lecture on his system of wireless telegraphy, which has been noticed before in the Digest. He discusses chiefly his transmitter, and especially that arrangement in which the poles of an air-gap are connected to the inner plates of two condensers, while the outer plates are connected together by an inductive circuit, and besides are connected, one to the transmitting wire, the other to earth. This latter connection to earth was formerly thought to be necessary, but may be replaced by a wire of a length equal to the transmitting wire. This arrangement gives strong, pure, undamped oscillations. He proves experimentally that the waves are pure and increase their amplitude gradually by means of resonance.—*Phys. Zeit.*, Jan. 1.

Wireless Telephony in France.—An illustrated note on experiments made by Maiche. The results of the tests with an improvised apparatus and a current of .003 ampere at 8 volts, is given as fol-

lows: "At 1500 meters conversation was transmitted as distinctly as by the best ordinary telephony system; at 4 kilometers speech was still very distinct, but seeming to have arrived at the limit of perceptible intensity; at 7 kilometers, vibrations of the telephone plate sufficiently distinct to allow of Morse signals being transmitted with the utmost regularity. The transmitting apparatus used by Maiche consists, besides the source of electricity, of an improvised microphone and an induction coil wound in a special way. In the case of transmission of Morse signals, a key and vibrator are substituted for the microphone. In both cases the receiver was a sensitive telephone. The connection to earth consisted sometimes of two electrodes immersed in water, and sometimes of electrodes embedded in damp earth. The two electrodes at each station were connected by an insulated wire, which formed a basis on which was connected, according as required, the receiver or the transmitter."—Lond. *Elec. Rev.*, Feb. 7.

REFERENCES.

Telephone Exchange.—The first part of a well illustrated description of the National Telephone Company's new Battersea exchange. It has a lamp signal switchboard, working on the Kellog central battery system, the only one of its kind at present in Europe. It embodies a central station system of the latest type, but on somewhat different lines to the Western Electric Company's system.—Lond. *Elec.*, Feb. 7.

Underground Telephone Wires.—An illustrated description of an air-tight conduit, devised by Morten and Kenney, for placing telephone wires underground.—*Tel. Mag.*, Jan.

Miscellaneous.

Machine Tools.—Bathurst.—The conclusion of his illustrated serial on machine tools at the Glasgow exhibition, with special reference to the requirements of dynamo and motor manufactures. He deals with side-planing machines and key-way cutting machines. In conclusion he says that even when the works of the English manufacturer are equipped with the best labor-saving, most accurate and most efficient types of machine tools, there is still a great disadvantage to overcome. His experience is that "generally speaking, a greater interest and intelligence is manifested by the American workman over that shown by his English confrere, because the American workshop is not so bound down by trade unionism to keep the individual output of the best man in the shop down to the level of the man of mediocre calibre." He recommends encouraging piece work in preference to time work.—Lond. *Elec. Rev.*, Jan. 31.

Tide Indicator.—Schermerhorn.—A paper, read before the Eng. Club, of Philadelphia, in which he describes an electrical tide indicator. The rise and fall of the water level is used to complete electric circuits which, through the intervention of electromagnets, communicate the motion to the indicator arm and device by which the required information concerning the height and character of the tide is displayed to the public. An ingenious device shows whether the tide is rising or falling. The apparatus is in use.—*Proceed. Engin. Club of Phila.*, Jan.

Light Treatment.—Bang.—An article on a new electric arc lamp for therapeutical treatment. The therapeutically active rays are the blue, violet and ultra-violet rays. He has obtained a practical lamp by using instead of carbon for the electrodes, metals of suitable spectral properties, as, for instance, iron, the spectrum of which is very rich in the desired rays. He cools the electrodes by water, either by making them hollow and letting a current of water pass through, or by making larger lamps and placing them in water. The bactericidal power of the rays given out by this lamp is said to be very great.—*Jour. Phys. Therapeutics;* Lond. *Elec. Rev.*, Jan. 17.

REFERENCES.

Celestial Explosions.—Maxim.—An illustrated article on celestial explosions and their relation to electrical phenomena.—*Elec. Age*, Jan.

Science Abstracts.—The index to Vol. 4, 1901, contains a list of 133 scientific and technical journals, with the price and the name of the publishers.—*Science Abstracts*, 1901, Index.

Twenty Years of Electrical Development.—A general illustrated review by Child of the development of electrical industries from 1882 to 1902; also illustrated articles, by Elihu Thomson and Weeks, on electric lighting 20 years ago and since; by Stanley, on the beginnings of alternating-current engineering; by Sprague, on some personal reminiscences on electric railways; by Lockwood, on telephony 20 years ago and to-day; by H. A. Reed, reminiscences of an old-time telegrapher.—*Elec. Rev.*, Feb. 15.

New Books.

Compressed Air. Its Production, Uses and Applications. By Gardner D. Hiscox, M. E. New York: Norman W. Henley & Co. 822 pages, 40 tables and 545 illustrations. Price, $5.

The purpose of the author in the preparation of this work has been to provide a comprehensive manual for the engineer who is concerned with the use of compressed air in any of its many applications as found in modern engineering practice. To this end the subject is treated historically, theoretically and practically. The theoretical treatment comprises the usual discussion of the laws of isothermal and adiabatic expansion and compression with the thermodynamics of the various operations involved, together with tables, diagrams, formulæ, etc.

The practical side of the treatment comprises extended discussion of the applications of air in the useful arts in all forms from a high vacuum to its liquid form. The transmission of power by air, air compressors, air motors, air tools of various kinds, the air blast, railway appliances, refrigerating machines, etc., etc., are treated in extended form and illustrated freely with excellent diagrams and cuts.

Scattered through the work are found some 40 tables of the physical properties of air as required in its various applications in engineering work. A list of the patents on compressed air from 1875 to date is also included.

Taken as a whole, the work seems well adapted to fulfill its purposes. It represents the results of long experience and contact with the subject and the accumulation of many years' study of the useful applications of compressed air. The illustrations are especially plentiful, and while few of them seem to have been made for the book primarily, yet they serve to illustrate the subject in a very satisfactory manner.

In the general discussion of the subject will be found a large amount of information put in such form as to readily serve the purposes of the engineer and student. The size of the book and the diversity of topics treated shows well the extent to which air enters as a useful factor in modern engineering and manufacturing enterprise.

Excellent as is the make-up of the book generally it is to be regretted that the publishers saw fit to face the title page with a full-page advertisement of pneumatic hose. The introduction of advertisements in technical treatises is, leaving aside other aspects, unfair to the author, for the reader may connect a favorable reference in the text with the paid advertising notice appearing elsewhere in the book, and those manufacturers who have not responded favorably to solicitations from the advertising agent would be apt to place an unwarranted construction on any passage dealing unfavorably with a point or points involved in his apparatus.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of the Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

International Association of Municipal Electricians. Next meeting, September, 1902.

National Association of Manufacturers. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Mili-

TARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

Illuminations for Prince Henry at the Opera.

Among the entertainments given to Prince Henry of Prussia during his stay in New York last week was a gala performance at the Metropolitan Opera House, which was on an unprecedented scale of magnificence, with prices in keeping, the charge for a single seat in the orchestra being $30. To justify such prices, Mr. Maurice Grau not only felt constrained to put on all his operatic stars in one night, but to go in for elaborate decorations, and to supplement these by illuminations of a very unusual and expensive character. Outside the Opera House, some excellent effects were obtained, with eagles, streamers, shields, etc., in incandescent lamps, and high above all the Emperor's new yacht "Meteor" outlined in white light. But it was inside that the Opera House wore its most striking and original aspect. Aside from the decorations to the approaches and the royal box, the whole auditorium was draped in smilax from the floor to the dome, and set in this around the various tier fronts, were innumerable big bouquets of choice flowers. It was, however, upon the dome and the proscenium that the extra lighting effects were chiefly concentrated, and there, thanks to the marvelous manner in which the "Elblight" system lends itself to rapid structural work, Mr. Spaulding, the manager of the National Electric Improvement Company, was able to do a really startling piece of spectacular work —as daring as it was successful. The contract taken by Mr. Spaulding called for 8500 lamps in all, and there were literally no signs visible of this stupendous job from the auditorium before the Sunday preceding the Tuesday of the performance. Special arrangements for current had also to be made, the service given by the New York Edison Company representing fully 1500 amperes. The lamps used were all 4 cp, 20 watts, and all of them stabbed into the "Elblight" cables.

The huge dome had an open canopy of smilax, and back of this were long "Elblight" spans of cable carrying green and white lamps, the strings running from the central electrolier out in every direction to the four walls. The building, it will not be forgotten, covers a whole big city block. Here there were no fewer than 1500 lamps, and the effect was, indeed, beautiful. But the piece de resistance was the proscenium, with its arch, sides, drop curtain and all. This proscenium is one of the largest in the world, and the whole front and width, some 60 or 70 ft. square, was a mass of green smilax in front of the regular drop curtains. Closely associated with the green drapery were "Elblight" cables again, carrying no fewer than 6000 lamps, of which 4500 were in the movable curtain, the lamps all being either green or white. By an ingenious system of tackles, the curtain could be raised and lowered as though it were a permanent part of the proscenium fittings, and this was no joke, for it weighed one ton, and, of course, required several men to raise and lower it from the flies. All told, the weight of the curtain and its adjuncts at the sides and on top of the proscenium arch weighed not less than three tons. In order to be sure of smooth operation and to obtain distinct effects, Mr. Spaulding installed telephonic connection between the proscenium and the ceiling, so that orders could be given and carried out instantaneously at the respective switchboards.

It will, we think, be admitted that for a large and swift installation this will take the record. Those of our readers who were at the famous Institute-Marconi dinner will recall the brilliant effects obtained there by Mr. Spaulding, and will readily appreciate that here they were intensified manifold. All who saw them on the gala night were delighted, and they remained until the following Thursday to please successive audiences, when the whole paraphernalia was stripped down as rapidly and as easily as it had been installed. The word "easily" is used in a relative sense, however, for it is not conceivable that with any other appliances the work could have been carried out. The incidental trimming of the approaches to the royal box and the corridors, with some hundreds more of lamps in the same manner, deserves mention, but alongside the other achievement was taken very much as an insignificant matter of course.

New Electric Heaters and Rheostats.

The McGuire Manufacturing Company, of Chicago, has added an electrical department to its plant, for the manufacture of rheostats and heaters. The resistance used is a composition of carbon and graphite. Electricians have long looked upon this material with favor for resistance, but the difficulty of associating the carbon with metallic connections has never been overcome so far, as to give satisfactory results. Carbon connections are used, which make a perfect contact and a uniform resistance not affected by age, temperature or dampness. A much larger radiating surface is obtained, thereby causing a much greater dissipation of heat. This greater radiating surface allows the carrying of an unusually large overload. There is no oxidation from any cause, and fusing from overload is entirely obviated, while no expansion, sagging, or loosening of parts takes place to cause short circuit. There is also claimed for this construction perfect insulation between the box and the resistance material, preventing leaking through the insulation when moist, thus completely avoiding the causes of grounding.

The McGuire Company states that before buying the patents covering these features, it assured itself by a most thorough investigation. The apparatus is already in use in the plants of some of the largest electrical concerns in the country, among them some who have been handling the ordinary rheostats in the commercial way for years. The new Tribune Building, of Chicago, and its printing presses, will be equipped with these rheostats. The services of the patentee of the apparatus, Mr. Max C. Krueger, have been retained by the McGuire Company. Mr. Krueger is an engineer of experience in electrical lines, and a graduate of the Polytechnic College of Berlin. He served his apprenticeship with the Siemens & Halske Company, of Berlin, later working for the same company in London and then in Chicago.

A Simple Receptacle.

The accompanying illustrations show the "P—K" Fielding moulding receptacle, manufactured by the H. T. Paiste Company, Philadelphia, Pa. It is of the Edison type, and measures 3 inches long,



FIGS. 1 AND 2.—RECEPTACLE PARTS.

2 inches wide and 2½ inches high over all. As shown in Fig. 2, it is intended for use on mouldings. All that is necessary to be done to apply it is to saw off a short length of the moulding cover, remove the insulation from the wires and connect the receptacle. The cap (Fig. 1), after being screwed down, holds the receptacle firmly in

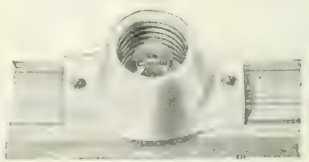


FIG. 3.—RECEPTACLE COMPLETE.

place. The cap itself forms the base, as seen in Fig. 3, which shows the receptacle complete, in place.

The easy access and application of this device are its principal advantages, besides its compactness. It is made of glazed porcelain, and altogether is a very handy accessory.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was obtainable with comparative freedom, the closing quotations being 3½@4 per cent for 30 to 90 days, 4@4½ per cent for four, five and six months. The stock market throughout the week was dull and heavy, and the public continued to buy investments, while bonds were strong. Large interests, however, supported prices, and bears seemed timid about attacking the market. The steel stocks were strong and had good support. Many inactive railroad specialties and cheap stocks of the same class were the objects of manipulation, and were marked up as to price. The traction stocks were stronger, there being considerable manipulation in Brooklyn Rapid Transit with renewed talk regarding the possibility of closer relations between the company and the Pennsylvania for control of the Manhattan interest. Amalgamated Copper was rallied on the shorts. Brooklyn Rapid Transit closed at 64, being a net gain of 2¼ points, 101,950 shares of stock being sold. General Electric made a big jump and closed with a net gain of 7 points, the extreme quotations being 290, the lowest, and 298, the highest; 9850 shares of this stock changed hands. Metropolitan Street Railway closed with some weakness at 168¾, a net advance of ⅛ point; the stock fluctuated within narrow limits all through the week, the highest figure reached being 170¼ and the lowest 167½. The sales were 24,425. Western Union remains unchanged at 90½, the sales being only 1390. Westinghouse Electric, common, closed at 178, a net gain of 4 points, and do. 1st pfd. at 182, a net gain of 2 points. Following are the closing quotations of March 4:

NEW YORK.

	Feb. 28	Mar. 4.		Feb. 25.	Mar. 4.
American Tel. & Cable	—	—	General Electric	293	296
American Dist. Tel	—	—	General Carriage	⅞	1⅛
Brooklyn Rapid Transit	64½	63⅜	Hudson River Tel.	—	—
Ches. & Pot. Telephone	—	—	Metropolitan Street Ry.	168¼	167⅛
Commercial Cable	—	—	N. E. Elec. Veh. Tran.	½	½
Electric Boat	28½	28½	N. Y. Elec. Veh. Tran.	13½	13⅜
Electric Boat pfd.	45	45	N. Y. & N. J. Tel.	—	—
Electric Lead Reduc'n	1⅝	1⅞	Tel. & Tel. Co. America	—	—
Electric Vehicle	1¾	1¾	Western Union Tel.	90¾	90¼
Electric Vehicle pfd.	4½	4	West. U. & M. Co.	177	178
			West. E. & M. Co. pfd.	180	180

BOSTON.

	Feb. 28	Mar. 4.		Feb. 25.	Mar. 4.
Am. Tel. & Tel.	137	136	Mass. Telephone	2	2
Cumberland Telephone	—	—	New England Telephone	140½	140
Edison Elec. Illum.	—	—	Western House Elec.	87½	90*
Erie Telephone	—	—	Westinghouse Elec. pfd.	—	90
General Electric pfd.	292½	293			

PHILADELPHIA.

	Feb. 28	Mar. 4		Feb. 25.	Mar. 4
American Railways	64	64	Lehigh Valley	100	100
Electric Storage Battery	—	—	Philadelphia Electric	4¼	5⅛
Elec. Storage Batt'y pfd.	—	—	Pa. Electric Vehicle	—	—
Elec. Co. of America	6¼	6	Phila. Rapid Transit pfd.	3	3

CHICAGO

	Feb. 28	Mar. 4		Feb. 25.	Mar. 4
Central Union Telephone	—	—	General Carriage pfd.	83½	84
Chicago Edison	137	137	Metropolitan Elevated	37½	39
Chicago City Ry.	216	216	North Chicago	134	134
Chicago Telep. Co.	—	—	Union Traction pfd.	—	50
National Carbon	—	—			

*Asked.

PHILADELPHIA TROLLEYS.—The directors of the Union Traction Company, of Philadelphia, recommend the stockholders of the company to accept the offer of John Mack and his associates, now an unincorporated group, but later to be organized into the Consolidated Traction Company with a capital stock of $30,000,000, to lease the Union Traction Company for 999 years on the following terms: The new company to guarantee $1.50 per share for the first and second years, $2 per share on the third and fourth years, $2.50 per share on the fifth and sixth years and $3 per share for the seventh year, and for the other 992 years of the lease. The new company also to pay all fixed charges of the underlying companies, rentals, interest and taxes of every kind. The stockholders of the Union Traction Company to have the right to subscribe for 150,000 shares of the stock of the new company or one share for each four shares of their present holdings. The fixed charges of the new company for the first year will be nearly $8,000,000; license taxes, $1,029,963; fixed charges, $5,704,265; rental of Union Traction Company, $900,000; obtaining charter of new company, $75,000, to which must be added the tax on the $3,000,000 to be called on the new company's stock, or $5 a share. A collateral trust loan of $1,500,000 will be made by the Union Traction Company to take up the floating indebtedness of the company and pay all bills, so that the new company can start on July 1 without any floating obligation. This trust loan will be made by depositing some of the treasury stock of the Union Traction Company. The interest on this loan is to be paid by the new company until the loan is canceled. Just where John M. Mack and his associates were to profit by the transaction is elucidated by the statement that Mr. Mack and his associates have the right to subscribe to 450,000 shares of the new company's stock. These rights may be worth from $3 to $5 a share, so that, assuming the latter figure, Mr. Mack, without receiving one penny from the new company for the franchises, will be able to net for himself and associates $2,250,000.

COMMERCIAL CABLE.—The annual report shows gross $3,371,063, and expenses, $1,111,166; net, $2,259,897. After deducting bond interest and dividends of 8 per cent, the balance is $409,537. The previous surplus was $221,066, and after deducting $500,000 for the reserve fund, the present surplus is $130,603. The above gross is for the cable, with net from the land lines, while the expenses are for cable lines only. The general reserve fund now is $4,421,208, and the insurance fund $689,809. In addition to the Azores cable, etc., there were added to the land system 307 miles of poles, 14,966 miles of wire, and 96 new offices. The board of directors elected is as follows: John W. Mackay, James Gordon Bennett, Right Honorable Lord Strathcona and Mount Royal, G. C. M. G.; Gardiner G. Howland, Charles R. Hosmer, Colonel William Jay, Thomas Skinner, George G. Ward, Clarence H. Mackay, Sir William C. Van Horne, Albert B. Chandler, Edward C. Platt, Dumont Clarke. Dr. W. Seward Webb and Edwin Hawley were added to the board, which was increased from 13 to 15 members. The officers elected at the meeting of the board of directors are: John W. Mackay, president; Geo. G. Ward, vice-president and general manager; Charles R. Hosmer, vice-president; Albert B. Chandler, vice-president; Clarence H. Mackay, vice-president; Edward C. Platt, treasurer; Charles E. Merritt, assistant treasurer; Albert Beck, secretary, and John O. Stevens, assistant secretary.

SAN FRANCISCO TROLLEYS.—The plan that the syndicate headed by Brown Brothers & Co. is underwriting contemplates the purchase of the Market Street Railway and other lines in San Francisco. A corporation, called the United Railways Investment Company, of San Francisco, will issue $15,000,000 5 per cent cumulative preferred and $5,000,000 common stock. It will own the bonds, preferred and common stocks of the United Railroads of San Francisco, the stock and bonds of which will be $20,000,000. The latter company will furnish $1,600,000 cash for betterments and improvements, and will reserve stock to take up minority stock of lines, the control of which has been already acquired. The combined system has a mileage of 229. It earned last year $5,125,282 gross and $2,083,155 net.

DISTRICT TELEGRAPHS.—The American District Telegraph & Messenger Company was incorporated in Trenton, N. J., last week, with an authorized capital of $50,000 to operate lines of telegraph, a messenger service, and a system of electrical call boxes in New Jersey, New York, Pennsylvania and Delaware. The incorporators are: F. L. Blendinger, of Rutherford; C. S. Shivler, of Brooklyn, and J C. Willever, of Millburn. The office of the company is at 76 Montgomery Street, Jersey City, and J. B. Bertholf, manager of the Western Union Telegraph Company's system in Jersey City, is the agent.

COLUMBUS (GA.) WATER POWER.—The annual meeting of the Chattahoochee Falls Company, owners of the Clapps factory property, just above Columbus, Ga., was held recently. The following officers were elected: President, George J. Baldwin, of Savannah, who is president of the Columbus Railroad Company; secretary and treasurer, A. A. Wilbur. L. H. Chappell remains general manager of the company. The company owns a splendid water power, and it is the the intention of the present stockholders to develop it as early as possible.

THE CANADIAN GENERAL ELECTRIC COMPANY, of Toronto, Ont., is about to issue $1,000,000 additional capital in common stock. This will make the capital of the company $3,000,000, of which $300,000 is preferred. Only about half a million of the new stock will be issued at present. The increase is to provide for the rapidly growing business of the company.

CONNECTICUT WATER POWERS.—Winsted (Conn.) dispatches state that the New Milford Power Company has increased its capital to $1,000,000, and is buying up all the water privileges on the Housatonic River.

STATEN ISLAND.—Three of the Staten Island trolley roads have been put in the hands of a receiver, it being the intention to bring them under one management in the reorganization.

CAMDEN & TRENTON RAILWAY.—One million seven hundred and fifty thousand dollars capital stock of the Camden & Trenton Railway Company, par $10, has been issued, and the old stock, par $100, stricken off. The company's bond issues consist of $750,000 first mortgage gold 5s, due Nov. 1, 1929, and $1,750,000 first general mortgage gold 5s, due July, 1, 1931. Of the latter issue, $400,000 are outstanding; $750,000 are reserved to retire the above $750,000 issue at maturity and the balance are reserved for any possible future extensions of the railway system within the cities of Trenton and Camden. The line of the Camden & Trenton Railway Company extends from the terminus of the Camden & Suburban Railway Company, to the city of Trenton, N. J., a distance of about 32 miles. The Camden & Trenton Railway connects at Trenton with the line of the Trenton & New Brunswick Railroad Company, affording connecting at New Brunswick over the Middlesex & Somerset and North Jersey Traction companies with all New York City ferries. In addition to the operation of the railroad, the Camden & Trenton Railway Company supplies electric light in cities and towns along its line.

UNITED RAILWAYS & ELECTRIC COMPANY.—At the annual meeting of the United Railways & Electric Company, of Baltimore, Md., the following officers were elected: President, John M. Hood; vice-president, George R. Webb; second vice-president and general manager, William A. House; secretary and treasurer, H. C. McJilton; auditor, N. E. Stubbs. The number of directors was increased from 9 to 11, and Messrs. H. C. Black, Alexander Brown, Francis E. Waters and J. M. Hood were newly elected. The annual report shows: Gross earnings, $4,718,295; operating expenses, $2,493,175; net earnings, $2,525,120; fixed charges, interest and taxes, $2,493,001; surplus, $32,118.

NEW YORK TRANSPORTATION.—Bunnell & Buchanan have issued a circular in which they say that the United States Express Company has closed a contract with the New York Transportation Company for the delivery of all express matter above Fifty-ninth Street. Passenger business has increased so much that it has been found necessary to open new stations in and about New York City and branches have been established at Buffalo and Newport. It is stated on good authority that net earnings for the quarter ending December 31, 1901, were over $40,000, which indicates that net earnings will be increased by $150,000 annually, making them 4 per cent on the stock.

CHICAGO EDISON STOCK INCREASE.—The directors of the Chicago Edison Company have decided to increase its stock by 6900 shares of $100 par value, the proceeds to be devoted to extensions and improvements. This will make a 10 per cent increase on the present outstanding capital of $6,900,000. The authorized capital is $10,000,000. The stock will be offered for subscription at par to stockholders of record April 22, 1902.

PENNSYLVANIA ELECTRIC VEHICLE.—A report from Philadelphia says: "The Electric Storage Battery Company, of Philadelphia, has practically acquired control of the Pennsylvania Electric Vehicle Company through the purchase of its stock."

DIVIDEND.—The directors of the Westinghouse Electric & Manufacturing Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable April 1.

Commercial Intelligence.

THE WEEK IN TRADE.—In spite of the unfavorable weather conditions in many large sections of the country, current demand has been maintained at maximum, while spring business continued in large volume. The best reports as to spring trade come from the large jobbing centers of the East, West and Northwest. The Southwest continues to report somewhat unsatisfactory conditions. The immensity of consumption and the increased call from the rest of the world for supplies, constitutes the most remarkable evidence of the continued strength of demand and the abounding prosperity of the country as a whole. Bank clearings and railroad earnings show that, despite the rather poor reports from the South and Southwest, the business of the country, as a whole,, is still in excess of that of a year ago. Iron and steel are quieter on the surface, but consumption remains undiminished. Finished products show no diminution of demand, and the scarcity of steel is still the feature leading to predictions that the imports of this material will be very heavy. Short supplies of coke are complained of in the West, and furnaces are being banked for this reason, but the output of pig iron was larger last week than for some time past. Structural mills are filled with orders, most of them being five months' demand, and the same is true of other products, orders for which extend well up to the close of the year. Among the other metals, copper displayed some strength during the week, but the prices remained unchanged. The closing quotations were: Lake, 12⅜c. to 12½c.; electrolytic, 12¼c. to 12⅜c., and casting, 12⅛c. to 12⅜c. The business failures for the week, as reported by *Bradstreet's*, numbered 204, as against 228 the previous week, and 177 the same week last year.

JANUARY EXPORTS.—The export figures for the month of January and the seven months ending with January, 1902, just completed by the Treasury Bureau of Statistics, show an improvement in the outward movement of manufactures. In the month of January, 1902, the exports of manufactures amounted to $34,412,992, against $32,654,035 in January, 1901, and are the largest shown in any January, except 1900, when the total was $35,586,940. Compared with January, 1901, it will be seen that the figures show a gain of nearly $2,000,000 in the exports of manufactures. For the seven months ending with January the exports of manufactures are about $13,000,000 less than those for the corresponding period of the fiscal year, 1901. Indeed, manufactures for the month of January show greater evidence of activity in the export trade than any other class of our exports, being the only great class of exports which shows an increase in January, 1902, over January, 1901. Agricultural exports in January, 1902, fall $8,000,000 below those of January last year, while products of the mines, forests and fisheries are in January, 1902, slightly below those of January, 1901; while manufactures, as above indicated, are nearly $2,000,000 greater than those of January, 1901. In the three great articles in which manufactures had shown a decline during the past year—illuminating oil, copper manufacturers, and manufactures of iron and steel—there is a decided improvement, especially in illuminating oil and copper. In copper manufactures, the exports of January are valued at $3,965,622, against $3,790,364 in January of last year. The quantity exported has very largely increased, the total number of pounds of copper ingots alone (which form the bulk of copper manufactures) being in January, 1902, 32,085,041 lbs., against 22,270,030 lbs. in January, 1901, and 28,389,422 in January, 1900. For the seven months, however, the exports of copper manufactures are still about $9,000,000 below those of the corresponding seven months of the preceding fiscal year. The quantity of copper exported has greatly increased, though the value shows but a comparatively slight increase. The only item of importance in the list of manufactures exported which still shows a reduction is that of iron and steel, which falls in January, about $1,500,000 below the figures of January, 1901, being in January, 1902, $8,088,958, against $9,610,552 in January, 1901, and $10,218,628 in January, 1900. For the seven months the total exports of iron and steel manufactures were valued at $57,290,128, against $73,616,467 for the seven months ending with January, 1901, and $66,504,611 for the corresponding seven months of the fiscal year, 1900.

McKEESPORT TIN PLATE COMPANY, a new concern putting up works at Port Vue, near McKeesport, Pa., will have a very large plant, which will be operated throughout by electric motors, excepting the hot and cold mills. The output is to be between 1200 and 1500 boxes a day. There will be two electric generators of 150 kw each, driven by Harrisburg Ideal engine. The main building, containing 10 hot mills, will have two 15-ton electric traveling cranes, and the cold rolling and annealing building will also have two 15-ton electric traveling cranes, all four being furnished by the Whiting Foundry & Equipment Company, of Chicago. The plant will be under the direction of Mr. E. R. Crawford and Mr. J. E. Lauck, well known tinplate manufacturers.

THE BUFFALO FORGE COMPANY, of Buffalo, N. Y., is building a large and interesting fan to be used for mine ventilation by the Modoc Coal Mining Company, of Gloucester, Ohio. This fan has a 250-inch housing of the three-quarter type, and is constructed throughout of steel plate rigidly stiffened and braced. The blast wheel or rotating element is of special design. It is to be driven by a direct-connected horizontal engine at a speed of about 150 r. p. m. The fan will deliver 125,000 cu. ft. of air per minute at ordinary working speed.

WESTERN ELECTRIC CAPITAL INCREASED.—Directors of the Western Electric Company have voted to issue $2,000,000 of stock at par to stockholders in proportion to their holdings. Each holder of four shares will receive one new one at par. The stockholders authorized an increase in the stock from $8,000,000 to $15,000,000 at the last annual meeting to be issued as the directors chose from time to time for improvements and extensions.

LOS ANGELES OFFICE FOR THE S. K. C. SYSTEM.—Messrs. John Martin & Co., Pacific Coast representatives of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., have opened an office in the Douglas Building, Third and Spring streets, Los Angeles. They already have offices at San Francisco and Seattle, Wash., and have taken contracts for some of the largest power transmissions on the Pacific Slope.

GENERAL ELECTRIC NEW POWER PLANT.—Plans are reported to have been completed for a new power plant, to be erected by the General Electric Company in Schenectady, at a cost of $200,000. The station will be an extension of the one now in use, and will have an output of from 4000 to 6000 kw.

VARIOUS BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, 39-41 Cortlandt Street, New York City, reports recent receipt of orders for some 30,000 hp of engines to be installed for electrical purposes in various plants throughout the country. Foreign orders include a 17½-inch by 32½-inch by 27-inch cross compound engine, which will be shipped to Tokio on the order of the American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama. The Union Light, Heat & Power Company, of Covington, has called for two tandem compound engines. The Armstrong Electric Company, of Kittaning, Pa., is to be furnished with a tandem compound engine, 13 inches by 22½ inches by 21 inches. The Indianapolis Street Railway Company is to be forwarded a 32-inch by 60-inch by 60-inch cross compound engine for an extension of its plant. This is the second order received from the same source. The Canton Gas & Electric Company, of Canton, Ohio, is to be supplied with a 15¼-inch by 16-inch simple engine. The Central Union Depot & Railway Company, of Cincinnati, Ohio, has ordered three engines of simple type, 18¾-inch by 21-inch, 16½-inch by 18-inch and 11-inch by 14-inch. The United States Government has called for one 11-inch by 12-inch simple engine for the Kansas City Post Office. The Waterloo Gas & Electric Company, of Waterloo, Iowa, is to have a 12-inch by 22-inch by 16-inch cross compound, and a 16½-inch by 30-inch by 24-inch engine of the same type. The Cincinnati & Eastern Railway, of Cincinnati, Ohio, has ordered two tandems 18¼-inch by 26-inch by 33-inch. The Arrot Building, Pittsburg, is to be equipped with one 12-inch by 16-inch engine, and one 14¼ by 18-inch machine, both simple type. The National Soldiers' Home at Dayton, Ohio, is to be shipped a 21-inch by 22-inch simple engine. The Lunkenheimer Company, of Cincinnati, Ohio, has ordered a cross compound engine 14-inch by 22½-inch by 21-inch. The Muskegon Traction & Light Company, of Muskegon, Mich., is to be furnished with two 15½-inch by 28-inch by 30-inch cross compound engines, also one 18¾-inch by 36-inch by 30-inch of same type. The Lake Shore Electric Railway Company has ordered four engines each 18-inch by 32½-inch by 33-inch cross compound for installation in its new shops at Collingswood, Ohio. The Steubenville Traction Company, of Steubenville, Ohio, will be supplied with a simple type engine, 16½-inch by 18-inch. The Suburban Traction Company, of Cincinnati, Ohio, is to have two 22-inch by 40-inch by 36-inch tandems, and one 7¾-inch by 12-inch simple engine. The Edison Electric Illuminating Company, of Cumberland, Md., has requisitioned for a 20-inch by 22-inch simple engine. The Bureau of Public Lighting at Allegheny, Pa., is to be supplied with two 20-inch by 36-inch by 36-inch cross compound engines, one 16-inch by 28½-inch by 18-inch cross compound, and one 7½-inch by 12-inch by 12-inch vertical cross compound. The Buckeye Company is about to erect a new pattern shop which will represent a floor space of 1000 sq. ft.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Feb. 26: Antwerp—23 pkgs. material, $1,195; 1 pkg. machinery, $45. Argentine Republic—1 pkg. machinery, $74; 127 pkgs. material, $6,071; 3 pkgs. material, $150. Bilboa—2 pkgs. material, $100. British Poss. in Africa—8 pkgs. material, $993. British E. Indies—131 pkgs. material, $8,858. British Guiana—8 pkgs. material, $75. Bradford—46 pkgs. machinery, $15,395. Brazil—41 pkgs. material, $3,176; 22 pkgs. copper wire, $4,517; 23 pkgs. material, $1,084; 4 pkgs. material, $67. British Australia—52 pkgs. wire, $1,262; 19 pkgs. material, $1,440. British West Indies—26 pkgs. material, $632. Cuba—98 pkgs. material, $2,109. Chili—102 pkgs. material, $673; 1 pkg. cable, $140. Egypt—1 pkg. material, $90. French West Indies—1 pkg. material, $19. Genoa—29 pkgs. material, $7,450. Glasgow—4 pkgs. electric cable, $921; 5 pkgs. material, $1,000. Havre—3 pkgs. material, $900; 30 pkgs. material, $1,132. Hamburg—1 pkg. machinery, $45; 79 pkgs. material, $3,308. Huddersfield—20 pkgs. copper wire, $6,200. Ipswich—2 pkgs. copper wire, $100. Liverpool—70 pkgs. machinery, $11,230; 37 pkgs. material, $1,698; 242 pkgs. copper material, $13,500; 4 pkgs. motors, $1,630; 60 pkgs. copper wire, $5,842. London—388 pkgs. machinery, $38,319; 142 pkgs. material, $5,976; 25 pkgs. manufactures of copper, $625; 121 pkgs. copper wire, $12,896; 28 pkgs. electric cable, $8,840. Market Harborough—3 pkgs. wire, $225. Mexico—98 pkgs. machinery, $25,688; 7 pkgs. material, $54. Manchester—216 pkgs. machinery, $41,728. Norfolk—3 pkgs. material, $65. Newcastle—8 pkgs. machinery, $495; 12 pkgs. wire, $600; 1 pkg. material, $16. Naples—7 pkgs. material, $500; 134,989 lbs. copper, $18,898. New Zealand—10 pkgs. material, $391; 6 pkgs. wire, $224; 1 pkg. machinery, $10. Peru—22 pkgs. material, $726. Rotterdam—1 pkg. material, $50. Southampton—12 pkgs. material, $423; 153 pkgs. machinery, $39,709. Strassburg—5 pkgs. machinery, $462. United States of Columbia—10 pkgs. material, $302. Venezuela—12 pkgs. material, $332; 10 pkgs. copper wire, $216.

CONTRACTS FOR SHAW CRANES.—Manning, Maxwell & Moore, of 85-89 Liberty Street, New York City, report receipt of a number of substantial contracts for Shaw electric cranes. The Harrisburg Pipe & Tube Bending Company, of Harrisburg, Pa., has requisitioned for one 50-ton special steel casting crane, two standard cranes of 15-ton capacity each, also a 10-ton crane. These cranes are to be operated by 105-hp, 55-hp and 40-hp electric motors, respectively. The equipments are intended to be installed in the new steel casting and rolling mill plants of the Harrisburg Company. The new billet mill and steel casting plant about to be erected by the American Tube & Stamping Company, of Bridgeport, Conn., is also to be equipped with Shaw cranes. The contract calls for one special machine of 50-ton capacity and four standard cranes of 10-ton capacity each. The motors to drive the 50-ton crane will be of 105 hp, while the 10-ton machines are to be operated by 40-hp motors. The Vermont Marble Company, of Proctor, Vt., has ordered two 10-ton cranes for their new marble cutting works. The motors will be of 40 hp each. The value of these contracts aggregates over $60,000.

CROCKER-WHEELER GENERATORS.—Recent orders for the engine type generators of the above company have again given assurance of the high regard in which these machines are held by manufacturers all over the country. Among others the following companies have recently placed orders for these machines: Pittsburg Reduction Company, New Kensington, Pa., one 200 kw; National Mining Company, Sygan, Pa., two 200 kw; Lake Shore & Michigan Southern Railroad, Collingwood shops, Ohio, one 400 kw; Federal Lead Company, Alton, Ill., two 150 kw; Farrand Organ Company, Detroit, Mich., one 100 kw; Snellenberg & Co., Philadelphia, four 200 kw, one 100 kw: Harrisburg Pipe & Pipe Bending Company, Harrisburg, Pa., one 200 kw; American Bridge Company, New York, one 300 kw; Allis-Chalmers Company, Milwaukee, Wis., one 300 kw; Hawley & Hoops, New York, one 75 kw; Hall of Records, New York, two 150 kw, one 100 kw, one 50 kw.

ENGINES FOR N. Y. SUBWAY ROAD.—The Allis-Chalmers Company has contracted to furnish six additional engines of a maximum of 12,000 hp each, to be completed as soon as possible, for the New York Underground Electric road. These engines are to be duplicates of six engines now under contract, and will complete the power necessary to drive the machinery of the underground road, when completed. The full amount of the contract is $1,305,000, the price for each engine being $108,750, making the cost of the six engines now ordered amount to $652,500. The contract for the first six engines carried with it an option to increase the number to eight within two months from the signing of the contract at the same price, and to increase the order to the full complement of twelve. The six engines that are already contracted for are to be completed for delivery in 18 months from last October.

LINK-BELT ORDERS.—The Link-Belt Engineering Company, 49 Dey Street, New York City, have recently secured a contract from the Delaware, Lackawanna & Western Railroad for a locomotive coaling station to be installed at Hoboken, N. J. The capacity of the plant will be about 2000 tons. The equipment is to be operated by a 20-hp Crocker-Wheeler motor. The United Coke & Gas Company has requisitioned for a coaling bridge for handling coal from barges to storage, and from there to the retorts at its Camden, N. J., plant. The motors to drive same are to be two in number, of 30 hp each, Westinghouse induction type. The power is to be transmitted to the various shafts by means of the Renold silent chain, which is exclusively manufactured by the Link-Belt Company. The machinery will be built at the Nicetown plant of the Link-Belt Company.

BIDS FOR ST. LOUIS FAIR BUILDINGS.—Director of Works Taylor has advertised for bids on the Electricity and Machinery Building of the World's Fair. The architects estimate of the cost of construction is $400,000. Eight days will be allowed the contractors to figure on the work of erection. The conditions require a deposit of $10,000 and a penalty of $500 for each day of delay, together with a bond of one-third of the contract price.

THE VILTER MANUFACTURING COMPANY, builders of refrigerating and ice making machinery, Corliss engines, etc., of Milwaukee, Wis., has recently closed contracts with the following parties: Port Arthur Rice & Irrigation Company, Port Arthur, Texas, two 22 by 42 Corliss engines; Morris Paper Company, Morris, Ill., one 18 by 36 Corliss engine.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., has bought the plant of the O. S. Platt Manufacturing Company, of Bridgeport, Conn. The manufacture of the switches will be under the direction of C. C. Morgan.

ST. LOUIS WORLD'S FAIR.—The contract between the St. Louis World's Fair and the Westinghouse Electric & Manufacturing Company has been confirmed. Details of the big plant have already been given in these pages.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company held its annual meeting recently in Portland, Ore., and a very favorable showing was made. The company authorized the expenditure of about $2,100,000 for improvements and extensions of the lines, etc.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company recently decided to enforce the order issued some time ago requiring all of its operators to submit to vaccination. Manager Glass has informed the Board of Health that arrangements have been made to have all of the telephone girls in San Francisco vaccinated at the rate of 100 a week.

SAN FRANCISCO, CALIF.—The Automatic Direct Line Telephone Company, which has been incorporated, with San Francisco as the place of business, purposes to construct and operate a telephone and telegraph line from its office in the city to Ocean View. The directors are: C. F. Runyon, Julius Fay, J. A. Stulz, A. K. Andriano and Robert Capelle. The capital stock is $250,000; subscribed [illegible].

LEWISTOWN, IDAHO.—The Lewistown & Grassrange Telephone Company, of Lewistown, has been incorporated. The capital stock is $10,000. J. H. Charters, A. W. Ware and E. Brassey are incorporators.

BOISE, IDAHO.—The Rocky Mountain Bell Telephone Company is building an extra line between Boise and Nampa, and material is on the ground for a line between Blackfoot and Hailey, Idaho, thus completing the Salt Lake-Boise connection. An exchange with 53 new subscribers has been put in at Harrison in the Cœur d'Alene region, Idaho, and connections will be made with the rest of the interstate system.

OREGON, ILL.—The Ogle County Telephone Company has been granted a franchise in Forreston.

ABINGDON, ILL.—The Mutual Telephone Company, of Abingdon, has increased its capital from $2,500 to $10,000.

BENSON, ILL.—The Benson Telephone Company, capital $10,000, has been incorporated by S. L. Peterson, R. H. Parks and J. E. Eckhart.

PANA, ILL.—The Pana and Christian County Telephone Company has been incorporated with a capital of $15,000 by J. R. Chapman, Chas. R. Harris and Thomas Harrison, Jr.

NASHVILLE, IND.—The Nashville Telephone system has passed into the hands of the Morgantown Telephone Company.

SYRACUSE, IND.—The Syracuse Home Telephone Company, capital $25,000, has been incorporated by J. F. B. Kauffman, G. D. Lunt, of Goshen, Ind.; A. A. Rasor and Wm. Self and others, of Syracuse, Ind.

UTICA, IA.—The Union Telephone Company, capital $50,000, has been incorporated by F. J. Teal and others.

EAGLE GROVE, IA.—The Northwestern Telephone Company will build a line from La Porte to Eagle Center in the spring.

SHENANDOAH, IA.—The Oak Grove Telephone line has been organized. Allen Davison is president, and Wm. Grimes, secretary.

DOWS, IA.—Fifty farmers of Ingham Township, Franklin County, have organized a telephone company and incorporated under the laws of Iowa.

BOUTON, IA.—The Globe Telephone Company, of Bouton, capital $5,000, has been incorporated. J. C. Bryon is president; Chas. Hansen, vice-president; T. E. Scott, secretary, and J. J. Cannon, treasurer.

JEWELL, IA.—The Council passed an ordinance granting the Jewell Telephone Company a franchise to construct a telephone exchange, which will take effect after being submitted to and approved by the people at the coming election.

MACEDONIA, IA.—The Carson Telephone Company is making an effort to gain entrance to this city, but the City Council does not seem disposed to grant the desired franchise. The town already has two companies, the Nebraska and the Tabor.

KEOKUK, IA.—The Denmark Independent Telephone Company and the Wever Telephone Company have been incorporated. Franchises have been granted by the Board of Supervisors to both companies, one to build lines from Fort Madison to Denmark and the other from Fort Madison to Wever.

WATERVILLE, ME.—The application of the Dirigo Telephone Company for the right to erect poles and install its service for connection with its trunk lines to Portland and north and west via Farmington, was granted by the board of Aldermen.

DOWAGIAC, MICH.—The City Council has granted to M. E. Foote and W. T. Heddon, a twenty-year franchise to establish an independent telephone system in this city.

MINNEAPOLIS, MINN.—Suit has been brought by the Northwestern Telephone Company against the Twin City Telephone Company to compel the latter to remove all its aerial wires which are under the wires of the Northwestern Company at about 40 cents of crossing in this city.

NEVADA, MO.—A local stock company will build an independent telephone system from Montevello to Vergil Springs.

BOZEMAN, MONT.—The West Gallatin Telephone Company has been organized. E. Broox Martin was elected president.

BILLINGS, MONT.—A fight is on between the Rocky Mountain Bell and the Montana & Wyoming Telephone companies. The former, which controls the local system at Billings, recently cut off connections with the Wyoming-Montana Company, so that the patrons of the latter line can not talk with the Billings people. The Wyoming-Montana company has applied for a franchise in Billings.

STELLA, NEB.—The Stella Telephone Company, capital stock $10,000, has been incorporated by [illegible]

RATON, NEW MEXICO.—The City Council of Raton, New Mexico, has been requested to grant Geo. J. Spear a telephone franchise.

BLOOMFIELD, OHIO.—A telephone line from Bloomfield to Smithfield will be constructed in the near future.

LISBON, OHIO.—The North Georgetown Telephone Company, of Columbiana County was incorporated, with a capital stock of $5,000.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Company will build a line to Pipeville connecting up a number of people in that community.

CRIDERSVILLE, OHIO.—The Cridersville Telephone Company is preparing to extend its lines into the country connecting up many farmers in this vicinity.

WESTON, OHIO.—The Weston Mutual Telephone Company is about to establish a new central office. A 100-drop switchboard has been ordered and the lines are to be extended.

CIRCLEVILLE, OHIO.—The Circleville Citizens' Telephone Company is building lines to Laurelville, Adelphi, Stringtown, Tarlton and other towns in the county. Service will be given to farmers on the lines at $12 per year.

GENEVA, OHIO.—At a recent meeting of the Madison Telephone Company, E. U. Hyde was elected secretary of the company in place of E. Parker, who resigned. The company is preparing to make important improvements to the Geneva exchange.

MT. VERNON, OHIO.—Business men of this place have signed a protest and have agreed to not pay higher rates than at present to either of the companies doing business here. The Bell company is about to increase its rates from $15 to $36 per year.

CINCINNATI, OHIO.—It is officially announced that the Columbus, Ohio, Citizens' Telephone Company has passed out of the control of the Everett-Moore syndicate into the hands of Columbus capitalists. Capital, $300,000. The lines will be extended.

GREENVILLE, OHIO.—The Southern Ohio Independent Telephone Association, has been organized at Greenville, Ohio, by about fifty or sixty home and independent telephone companies. The purpose is to protect the independent companies and fight the Bell company.

CINCINNATI, OHIO.—Stockholders of the City & Suburban Telegraph Association have elected the following directors: Charles P. Taft, Charles Kilgour, John Kilgour, Henry Hanna, Wm. A. Blanchard, George Bullock and C. J. French, the last mentioned of Boston. The board will organize later.

SPRINGFIELD, OHIO.—H. P. Miller, district manager for the Central Union Telephone Company, has established his headquarters in Springfield. The local system is to be thoroughly overhauled and new long-distance instruments are to be installed throughout. After March 1 the residence rates are to be increased $1 per month.

MARIETTA, OHIO.—The Marietta Telephone Company has elected officers as follows: A. L. Gracey, president; A. C. Davis, secretary-treasurer; F. P. Moaps, general manager. The company is planning to enlarge the plant in order to take care of increased business. Free service has been inaugurated with Parkersburg, W. Va.

YOUNGSTOWN, OHIO.—Citizens of both Green and Poland townships are organizing to follow the example of citizens of Beaver township who have incorporated. The Beaver Telephone Company has secured over 200 subscribers to its service. It is the intention to have the three companies affiliated and interchange service, all using the same long-distance service.

CLEVELAND, OHIO.—It is authoritatively announced that negotiations for the purchase of the Detroit property of the Federal Telephone Company have reached a point where actual sale may be effected within a few days. It is claimed that the sale of this property could be made without in any way affecting the remaining telephone properties owned by the Everett-Moore syndicate and that its sale would simplify matters to a considerable degree.

CADIZ, OHIO.—The Harrison County Telephone Company has completed lines to connect with Sistersville and a number of oil towns in that section of West Virginia, as well as with Woodsfield, Somerton and other Monroe County towns. Lines to Freeport, Moorefield, Piedmont, Smyrna, Antrim, Londonderry, Cambridge, Zanesville, Coshocton, New Rumsley and Scio are either completed or under construction. Important extensions to the exchange will have to be made to take care of the large increase in subscribers.

CLEVELAND, OHIO.—It is the intention to increase the list of subscribers of the Cuyahoga Telephone Company from 9,000 to 12,000, and it is believed this can be accomplished in a short time by placing solicitors in the field. Because of the embarrassment of the Everett-Moore syndicate, nothing of the kind has been done for several months, and construction work has been at a standstill. The company already has switchboard and conduit facilities for 12,000 telephones. The Columbus exchange is badly in need of additional equipment. Work has been at a standstill for many months and over 1000 orders for new telephones are on the books. The same conditions exist in the majority of the exchanges controlled by the Federal company, and it is claimed that if required improvements are made at once, the earning capacity of the system will be doubled within a year. The uncompleted Detroit plant will undoubtedly be sold, but it is probable that the Dayton exchange will be completed and retained by the syndicate.

PLEASANTON, OHIO.—Mr. C. M. Pierce, of the Pierce Telephone Company, which was recently organized, gives some interesting details regarding the plans of the associated interests. Six months ago there was not a telephone in the vicinity, but to-day nearly 1000 farmers in this and adjacent counties are in telephonic communication with co-operative exchanges. The method employed by this concern, which is one of the several of similar nature, is to select a central point, purchase a switchboard, employ a switchboard tender, etc., and get the farmers in the surrounding neighborhood to build lines to the switchboard. No line is permitted to have fewer than nine telephones, nor more than fifteen, the person owning the switchboard making a contract, usually for ten years, with the owners of each line connecting therewith to give switchboard service for $2.15 a month. The exchanges are connected with one another, free service being given between them. On the payment of a very reasonable toll, con-

nection can be had with Columbus, Cleveland and other large cities by long-distance lines. The cost of each share in the company is from $20 to $30, including the building of the line, cost of telephone ($2), switchboard fees, etc.

GRAND RAPIDS, OHIO.—This town is the center of a mutual telephone system which is something unique. The village and vicinity for a distance of twenty-five miles in every direction, including the towns of Weston, Tontogany, West Hope, McClure, Grelton, Malinta and Holgate are connected by a system of telephones that is well-nigh complete. A majority of the farmers in this section are members of the association. The membership numbers nearly 500, and is increasing rapidly. Each line is composed of from eight to ten members. All lines going to a village purchase and support a small central board. Each town is connected by a wire from one central to another. A subscriber has free use of any line composing the entire system by paying his pro rata in the support of the individual line and the central. The transfer from one line to another or through neighboring towns to its residents is done by mutual courtesy. Every line of eight to ten members has its by-laws, president, vice-president, secretary-treasurer, four directors and a trustee. From $15 to $20 includes actual cost to each subscriber for his telephone, which is the best long-distance instrument made. This sum further includes his interest or share of expense for a central, the wires, cross arms, etc., which make up the line. By an actual experience the cost of supporting a central for day and night operating averages from 15 to 30 cents per month. At Tontogany the United States Telephone Company is preparing to connect with the exchange, thus giving the system long-distance connections. At Grand Rapids, the new Home Telephone Company has established a toll station, thus giving the community outward communication over foreign lines. The Toledo Home Telephone Company which is building a new exchange in Toledo, is also preparing to make connections with the mutual system.

OTTAWA, ONT.—A combined move is to be made, on behalf of the various municipalities of the province of Ontario, to limit the powers of the Bell Telephone Company, of Canada, in regard to rates and other matters. A circular has been issued setting out fully the position of the telephone company, and urging that legislation be sought at the present session of the Dominion Parliament to compel the company to supply telephone service to all who apply for same, and whose premises are on a line of supply of the company, in the same way as municipal councils who supply water, gas or electric light are required to furnish it. The municipalities are informed that the company will apply, at this session of Parliament, for power to increase capital stock, and that this fact affords an opportunity to have passed the new legislation sought for by the municipalities.

PLATTE, S. D.—The Platte Telephone Company, capital $2,000, has been incorporated by T. E. Andrews, B. H. Brady, Geo. R. Ellsworth, J. W. Gray and F. C. Smith.

SHERIDAN, WYO.—The Powder River Telephone Company filed articles of incorporation, with a capital stock of $10,000. This company will operate in Johnson County principally.

CODY, WYO.—Two telephone companies are building to Cody, and both are attempting to secure an exclusive franchise from the town. They are the Red Lodge Telephone Company and the Big Horn County Telephone Company. The latter asks for a twenty-year exclusive franchise, and the former asks for a fifteen-year exclusive franchise.

ELECTRIC LIGHT AND POWER.

SACRAMENTO, CALIF.—The city of Sacramento, Calif., is considering plans for the installation of a municipal lighting system.

PETALUMA, CALIF.—The Petaluma Power & Water Company's plant in Petaluma, may be purchased by the municipality. The company's price is $218,000. The City Trustees expect to call a bond election.

SAN FRANCISCO, CALIF.—The Barbee Mining Mill, Silver Reef, Utah, controlled by the company of which Mr. T. L. Brundage is president, will be enlarged and improved this season. An electric power plant will be installed.

SAN FRANCISCO, CALIF.—The Pomona & Ontario Light & Fuel Company, which was recently incorporated in California, will operate in the above-named towns for the purposes of manufacturing and distributing gas and electricity for light and heat.

SAN FRANCISCO, CALIF.—An electric light and power plant will be installed by A. D. Frame, who has accepted the franchise granted him by the authorities of Baker City, Oregon. The water power electric station will be located on Eagle Creek.

SAN FRANCISCO, CALIF.—It is reported that the Fresno Gas & Electric Company has been purchased by John Martin and other capitalists interested in the California Central & Electric Company. It is their policy to buy up electric and gas plants and operate them in connection with the large companies which they control.

SAN FRANCISCO, CALIF.—The Consolidated Light & Power Company, which is allied to the Standard Electric Company, of California, will hold a meeting in San Francisco on March 17, for the purpose of authorizing an issue of bonds to the amount of $200,000. The funds thus raised will be used to extend and improve the distributing system for the Standard Electric Company's current in Santa Clara County and other points south of San Francisco.

MONTREAL, CAN.—The report submitted at the annual meeting of the Lachine Rapids Hydraulic & Land Company, held at Montreal recently showed that during the year ended Dec. 31 last, the company earned $190,000, from which the sum of $37,000 being deducted for bond interest, bad debts, etc. left a net profit of $153,000. The semi-annual dividends paid were 3 and 3½ per cent, made in June and December respectively, and amounted to $112,046. The increase in the company's business during the year was as follows: Incandescent lamps, 16,318; alternating arcs, 116; horse-power of motors connected, 563. Guided by past experience, the directors have decided that it is necessary to acquire further property upon which to erect a fireproof transforming station, switchboard room, etc., and for this purpose land has been purchased already.

GEORGETOWN, COLO.—Application has been made to the Georgetown Council for a franchise by the Seaton Mountain Electric Company, of Idaho Springs, Colo. This is a retaliatory measure because of the Georgetown plant selling electricity to the Cascade company, of Idaho Springs, which reduced the prices for lights 25 per cent under the older company, and in addition gave a discount of 60 per cent. The people of Idaho Springs have been enjoying free lights since Oct. 1, with no sign of a settlement. The two companies have fought hard for the business in the Springs, with a stand-off between them.

INDIANAPOLIS, IND.—E. E. Rine, an Indianapolis electrician, has invented an incandescent lamp by which the degree of illumination may be varied.

LAWRENCEBURG, IND.—The City Council has leased the new electric light plant erected by Messrs. Fox and McKim. The lease contains a clause providing for purchase and the applying of certain payments on the purchase price.

DULUTH, MINN.—The electric lighting and power plant of the Commercial Light & Power Company of this city has been sold under foreclosure proceedings to the Duluth General Electric Company. The price was $107,408.92. The Duluth General Electric is a reorganized company, formed by the bondholders of the old company.

WHITE SULPHUR SPRINGS, MONT.—A municipal electric lighting plant, to be installed in connection with the water works system, is proposed in White Sulphur Springs, Mont. Mayor Temwell will investigate the details of an electric plant and report to the City Council.

ALBUQUERQUE, N. MEX.—The new addition to the electric lighting plant of Albuquerque will enable the company to light the surrounding mines and camps, as well as improve the city service.

ALBANY, N. Y.—The Oneonta Light & Power Company, of Oneonta, Otsego County, has been incorporated with a capital of $175,000.

HALIFAX, N. S.—The People's Heat & Light Company, of Halifax, which is talked of as likely to be taken over and operated by the Halifax Electric Tramway Company, which also does an electric lighting business, is capitalized at $700,000 and has a bond issue to that amount. This company did not meet the interest on its bonds when the last payment fell due, on Oct. 1, 1901, and the holders agreed to wait for a year before taking any action.

MIAMISBURG, OHIO.—N. J. Cartow, W. A. Mays, C. Weber and others have asked for a franchise for a lighting, power and water works plant.

CHILLICOTHE, OHIO.—Unless the Chillicothe Gas, Light & Water Company accepts the Council's terms for lighting service, the people will vote next month on the question of a municipal plant.

CANTON, OHIO.—The Central Heat & Power Company has accepted the franchise recently granted and will built its plant at once. P. J. Bernower, V. L. Ney, and L. C. Wise are proprietors.

ZANESVILLE, OHIO.—The City Council has granted a franchise to the Citizens' Electric Light Company, conditional upon supplying a number of free lights to the city and the construction of the plant within eighteen months.

OTTAWA, ONT.—At the annual meeting of the shareholders of the Cataract Power Company, of Hamilton, Ont., it was decided to increase the capital stock of the company by an addition of $50,000, for the purpose of extending the Radial Railway from Burlington to Oakville. Operations on the extension will likely be commenced as soon as the stock is subscribed.

OTTAWA, ONT.—There is likely to be keen competition between two rival groups for a charter giving authority to generate electricity, or hydraulic power, for lighting, heating and other purposes, and to construct and operate an electric railway from Niagara Falls to Toronto. Notice of application to the Dominion Parliament has been given by one of the syndicates under the title of the Canadian Power Company and the rival corporation is to be called the Dominion Power Company.

EUGENE, ORE.—An electric lighting plant to supply Eugene is projected by J. L. Chambers, who has asked the City Council for a lighting franchise.

NEPHI, UTAH.—The towns of Fountain Green and Nephi, Utah, situated eighteen miles apart, are likely to co-operate in the construction of an electric lighting system that will supply both towns.

MILWAUKEE, WIS.—At a meeting of the board of directors of the Milwaukee Electric Railway & Light Company, held Feb. 20, for organization, the following officers were elected for the ensuing year: John I. Beggs, president and general manager; Wm. Nelson Cromwell, first vice-president; Charles W. Wetmore, second vice-president; George R. Sheldon, treasurer; Charles A. Spofford, secretary; George O. Wheatcroft, assistant secretary and assistant treasurer at Milwaukee. The same gentlemen were elected to the corresponding officers for the Milwaukee Light, Heat & Traction Company.

MILWAUKEE, WIS.—Local fire underwriters have petitioned the city to establish a city electrical inspection department. It is claimed that a great many fires have been caused by defective electric light wires. The local Board of Fire Underwriters has an electrical inspector.

THE ELECTRIC RAILWAY.

LOS ANGELES, CALIF.—The Pasadena & Los Angeles Electric Railway [illegible] Pasadena.

SANTA PAULA, CALIF.—The Santa Paula Electric Railway [illegible] from Santa Paula to Ventura.

SAN FRANCISCO, CALIF.—Bids will be received in Bakersfield, Calif., up [illegible] P. M. on April 7 for the street railway franchise applied for by Messrs.

Verider and La Coste. They asked for a 50-year franchise and to use electricity [illegible]

SAN FRANCISCO, CALIF.—It is reported that the purchasers of the Market Street Railway Company, San Francisco, will expend $2,500,000 in extending the San Francisco & San Mateo Electric Railway line from San Mateo to San Jose. The line is not yet completed to San Mateo, but it probably will be during the present year.

DANBURY, CONN.—The Westchester Traction Company of New York has acquired the Danbury & Harlem Railway, a partly completed road running from Danbury to Goldens Bridge, N. Y., where it connects with the New York & Harlem road. The Westchester company is to complete the road and extend it to White Plains and to the Hudson River.

INDIANAPOLIS, IND.—Minority stockholders in the Indianapolis & Greenfield Rapid Transit Company have sued for a receivership and accounting. The complaint alleges gross fraud, and that the defendants, now in control, ignored their rights; that they awarded contracts of construction to the Kirkpatrick Construction Company at enormous prices and then accepted the work when not completed according to specifications; that they have failed to make any report of the earnings, and that they have illegally and without right retained for themselves $150,000 in second mortgage bonds and $120,000 in stock, which together with the $100,000 in stock originally owned they then controlled the affairs of the company. It is also alleged that this stock was obtained through fraudulent representations. The plaintiffs ask for a receiver, an accounting and $40,000 damages, and that the court declare null and void the $150,000 second mortgage bonds and the $120,000 stock now in defendant's hands. The suit was a great surprise to the community and a big legal battle is imminent.

DETROIT, MICH.—At a meeting of the directors of the Detroit United Railway, held Feb. 22, the usual quarterly dividend of 1 per cent. was declared. It is understood that the stockholders of the company are not responding very favorably to the proposal of the Cleveland bankers' committee of depositing their stock for sale at $70. The general impression is that the stock should bring a considerably higher figure.

STEUBENVILLE, OHIO.—It is stated that the Steubenville & Mingo Traction Company proposes to construct a new line between Steubenville and Mingo over the county pike.

CIRCLEVILLE, OHIO.—The Circleville Council has advertised for bids for electric railways over four routes in the town. The franchises are wanted by the Scioto Valley Traction Company.

ASHLAND, OHIO.—T. Y. McCrea, of the Mansfield, Savannah & Wellington Railway, has asked the Ashland Council for a franchise for a spur line which the company proposes to build into the town.

YOUNGSTOWN, OHIO.—A. A. Anderson, of the Mahoning Valley Railway Company, has purchased a site near Lansingville which is taken to indicate that the company will erect its much talked about power station at that point.

CONNEAUT, OHIO.—The Pennsylvania & Ohio Railway has increased its capital stock from $600,000 to $700,000. The charter was amended to permit the building of a line to Jefferson, work on which will start as soon as possible.

MANSFIELD, OHIO.—The Mansfield, Savannah & Wellington Railway has been granted an extension of franchise to Nov. 1, 1902, in which to commence work within the town. The company has about sixteen miles of road graded and the work will be pushed as soon as weather permits.

CANTON, OHIO.—The Stark Electric Railway Company has been granted an extension to Jan. 1, 1903, in which to build its line in Canton. The company has already spent $250,000 in construction work. Rails are being laid between Alliance and Sebring, and the power-house near Alliance is nearing completion.

MT. VERNON, OHIO.—Stockholders of the Mt. Vernon Electric Light Company and the Mt. Vernon Electric Railway Company met a few days ago. The resignation of D. K. Bird as secretary and manager of both companies was accepted and C. E. Johnson, of Middletown, Conn., was elected to succeed him. J. W. O'Neil, of Topeka, Kan., was elected president of both companies, and E. Q. Jackson, of Middletown, Conn., treasurer. It is the intention to consolidate both companies under one organization, to be known as the Ohio Light & Railway Company. A large power-house will probably be erected.

OTTAWA, ONT.—The largest electric railway project yet launched in Canada was sanctioned by the Railway Committee of the Ontario Legislature, when the Cornwall and Toronto bill, providing for the building of a line along the lake front from Cornwall to Toronto, came up for consideration. The company includes A. J. Jewell and G. E. Smith, of Boston, and H. N. Smith, of Salem, Mass.; Sir R. J. Cartwright, Minister of Trade for Canada, and others. It proposes to build a trunk line 350 miles long, including one from Brockville to Ottawa and branches at various points, as far as thirty miles back from the main line. The Railway Committee was assured that it was a solid concern, with plans for the spending of $8,000,000.

PITTSBURG, PA.—A big surprise is the announcement that the Philadelphia company which controls the city's heat, light and traction service, had bought the elevated railroad franchises secured by Thomas Bigelow, the Olivers and Richard Quay at the last session of the Legislature. The news came out in a letter to Recorder Joseph Brown from President Reed and Vice-President Callery, of the Philadelphia company, who asked that a commission be appointed to consider the question of constructing one or more roads to relieve the congested traffic in the city. The letter says that something must be done at once, and with this object in view the company bought the elevated railroad franchises.

SEATTLE, WASH.—The Seattle Electric Company has purchased the line of the Seattle Central Street Railway Company.

JANESVILLE, WIS.—The Janesville Street Railway Company has prepared plans for [illegible] to replace the barns recently destroyed by fire.

LA CROSSE, WIS.—An electric road from La Crosse to Viroqua may be built during the coming summer. C. J. Smith, of Viroqua, is one of the principal promoters.

CHIPPEWA FALLS, WIS.—The Chippewa Valley Electric Railway Company is considering various improvements, including a large storage battery plant at the power station near Magenta. The company contemplates extending its line in several directions.

CHILTON, WIS.—It is reported that Fond du Lac and Chicago capitalists are about to build an electric railway from Chilton to Fond du Lac, taking in the small towns along the shore of Lake Winnebago. The promoters have an option on the electric light plant in this city.

KENOSHA, WIS.—It is reported that a new street railway franchise ordinance will be sent to the City Council. The ordinance will be presented by the Kenosha Street Railway Company, now holding a grant in the city, but it will probably be presented under the name of the Chicago & Milwaukee Electric Railway Company.

THE AUTOMOBILE.

CHICAGO AUTOMOBILE SHOW.—The automobile show at Chicago opened at the Coliseum Saturday afternoon, March 1, to continue one week. Although at the opening time many exhibits were not in place there was sufficient to show that the electric vehicle would be well represented, and that the electrical part of the gasoline engine is receiving considerable attention. Speed tests this year are on a testing platform, as no good track is available.

NATIONAL AUTOMOBILE CLUB.—A telegram from Chicago of March 4 says: "Delegates from eight of the leading motor vehicle organizations of the East and the West at the Coliseum to-day, completed the formation of a national body to be called the American Automobile Association. The organization will be governed by a board of directors, composed of the president, first vice-president, and treasurer, ex-officio, with the seven other directors. Each club will have as many votes in the association as it has active, associate and life members, and will pay $10 initiation fee and $3 annually as dues for each of its members. There will be annual meetings of the association in the spring, alternating between the East and West. Officers were chosen from the eight alter- sending delegates to the convention as follows: Winthrop E. Scarritt, Automobile Club of America, President; F. C. Donald, Chicago Automobile Club, First Vice-President; W. W. Grant, Long Island Automobile Club, Second Vice-President; W. G. Morris, Automobile Club of Philadelphia, Third Vice-President; Jefferson Seligman, Automobile Club of America, Treasurer; S. M. Butter, Secretary of Automobile Club of America, Secretary; F. G. Wells and A. E. Pardington, Long Island Automobile Club; A. R. Shattuck, Automobile Club of America; W. J. Stewart, New Jersey Automobile Club; F. C. Lewin, Automobile Club of Philadelphia, and Dr. Chase, Automobile Club of Rhode Island.

NEW INDUSTRIAL COMPANIES.

THE INTERNATIONAL WIRELESS TELEPHONE COMPANY is to be formed in Muncie, Ind., to exploit the system invented by A. L. Bolen, of that city.

THE DeFOREST WIRELESS TELEGRAPH COMPANY, of Kittery, Me., capital $3,000,000, has been incorporated by E. L. Chaney, Kittery, Me., and M. W. Baldwin, Boston, Mass.

THE AUTOMOBILE STORAGE & TRADING COMPANY, of Albany, capital $25,000, has been incorporated. Directors: F. G. Robinson, R. M. Robinson and K. F. Robinson, of Albany.

THE AMSTUTZ-OSBORN COMPANY, of Jersey City has been incorporated to manufacture electrical supplies; capital, $100,000. Incorporators: H. C. Osborn, H. B. Stough and P. J. Morgan.

THE ALPHADUCT MANUFACTURING COMPANY, of New York (electrical supplies), capital $50,000, has been incorporated. Directors: Courtney Hyde, Russell Dart, Jr., E. D. Speer, New York.

THE LOZIER MOTOR COMPANY, of New York, has been incorporated, with a capital stock of $500,000. The principal office is in Plattsburg. The directors are: Frank E. Smith, of New York City, and George S. Weed, Thomas B. Cotter, Walter W. Gregg and Charles A. Emise, of Plattsburg.

LEGAL.

SUBMARINE BOAT FIGHT.—The Holland Submarine Torpedo Boat Company has instituted another action against the Lake Torpedo Company at Bridgeport, Conn., and the plant of the latter company was attached to satisfy the claim of damages of $50,000. The case is returnable April 1. Operations were suspended at the Lake plant in consequence of the damage suit. The action is based upon the allegation that the Lake company has libelled the Holland company by the alleged malicious publication of a circular setting forth the merits of the Lake type of submarine craft in a manner which is averred to be damaging to the business of the Holland company. Included in the property attached is the only Lake submarine torpedo boat in existence, which the company was constructing for demonstration purposes before the Navy Department at Washington next month. The boat is practically completed and would have been launched within a few days. The Lake company says that the action was brought by the Holland company to prevent the demonstration of the Lake boat at Washington. In its bill of complaint the Holland company asserts that it has contracts with the United States Government for the construction of five submarine torpedo boats, seven for the British Government, and that it is negotiating with Powers in Europe, Asia and South America for other contracts, and that the publication by the Lake company of a "confidential circular" has materially injured its reputation and credit.

PERSONAL.

LORD KELVIN has cabled to Mr. Marconi his "hearty congratulations" upon his latest success in receiving messages at 1500 miles at sea, and signals at 2099 miles.

MR. JACOB CLOOS, consulting engineer, has opened up offices at 1001 Pabst Building, Milwaukee, Wis. Mr. Cloos is very active in engineering several large electric power and light installations.

MR. LUTHER STIERINGER, after a prolonged convalescence following his work at the Pan-American, has gone south to Florida and will study the Charleston Exposition en route. He will be gone a couple of months.

MR. THOS. A. EDISON, after postponing his departure South until after the reception of Prince Henry in New York, has left for Florida, where he will spend some weeks resting and enjoying a good time on his plantation.

PROF. F. R. HUTTON, dean of the faculty of applied science of Columbia University, is to lecture before the Automobile Club of America on March 11, his subject being "The Fundamental Principles Underlying the Design of Automobiles."

MR. A. S. CLIFT, electrical engineer with Siemens Bros., Limited, in England, and formerly with the Crocker-Wheeler Company in this country has an interesting article in *Cassier's Magazine* for March on the telpherage system and its importance.

MR. R. G. WILLIAMS.—A cable dispatch from London of March 1 says: Rupert Greville Williams, the inventor of the telepantograph, by which sketches can be sent by telegraph, committed suicide at Heywood, in Lancashire, on that day. He was 46 years of age.

MR. P. W. DAVIES, operating secretary of the British Traction Company, is in this country and has been making his headquarters at the office of the *Street Railway Journal*. He intends to take back some electric railway engineers with him to operate roads owned by the corporation.

MR. THOS. D. WATSON, for the past seven years associated with Messrs. J. Jones & Son, New York, has recently severed his connection with this firm and accepted a position with Mr. William Roche, the manufacturer of New Standard dry batteries and specialties. Mr. Watson has charge of the sales department.

M. MAURICE LEBLANC, of Hutin & Leblanc, of patent fame, is at present in this country and was at the meeting of the Institute on Friday, Feb. 28, when President Steinmetz welcomed him in the name of that body, on motion of Mr. J. W. Lieb, Jr., and expressed the pleasure of the members at his presence among them.

MR. S. L. G. KNOX, engineer in charge of the drafting department of the General Electric Company at Schenectady, and chairman of the Committee on Mechanical Design, has accepted the position of chief engineer and manager of the Bucyrus Company of South Milwaukee, Wis. Mr. Knox is an associate member of the A. I. E. E.

JUDGE J. M. THOMAS.—Reports have been in circulation that Judge Thomas had ceased his connection with independent telephony. This appears, however, to be quite without foundation. A friend of his who is in a position to speak authoritatively states that Judge Thomas has not left the independent ranks and has no intention of doing so. He has retired from the presidency of the New York company, but that has little significance, as he has simply yielded the position to one who is an expert in telephone construction work; but continues as a director. As a matter of fact, he is now at work on more comprehensive plans for the development of independent telephone lines throughout the country than ever before attempted and working harder than ever to build up the movement.

OBITUARY.

MR. LEONARD LEWISOHN.—The sudden death is announced from London, England, of Mr. Leonard Lewisohn, of Lewisohn Bros., one of the leaders in the copper industry. Their business had of late, as copper selling agents, all been transferred to the United Metal Selling Company. He was a native of Hamburg, Germany, and fifty-four years old, and came to this country when sixteen as an agent for his father in the feather business. He had accumulated a large fortune, and was liberal in his charities, etc.

MR. JEROME WHEELOCK.—At Worcester, Mass., on Feb. 26, Jerome Wheelock, inventor of the Wheelock engine, fell dead on the street of heart disease. He was nearly sixty-eight years of age. He was born in Grafton June 20, 1834. He was a practical mechanic from boyhood, gradually working himself up to an engineer's position. He then invented a cylinder packing, and while engaged in its manufacture, invented the valves that were the chief feature of his engine. He manufactured his machine many years and sold a great many. His inventions were patented all over the world. He retired from active business several years ago. He is survived by two sons.

Trade Notes.

THE BANNER ELECTRIC COMPANY, Youngstown, Ohio, reports that it is exceedingly busy.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S Cleveland office has been made a district office with considerably larger territory than heretofore. C. S. Powell is manager.

THE CINCINNATI PLANER COMPANY, of Cincinnati, Ohio, again finds it necessary to increase its facilities and is now letting the contract for a new addition, a one-story brick structure with basement, to be used exclusively for erecting purposes.

MESSRS. CHARLES E. STAMP & COMPANY, New England Building, Cleveland, Ohio, have been appointed sales agents for the Milwaukee Electric Company for the district of Northeastern Ohio. E. H. Monasmith is in charge of the electrical department.

BULLOCK ILLUSTRATED CALENDAR.—The March calendar of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, contains a medallion picture of Sir Charles Wheatstone. On the back of the card is given a brief outline of Sir Charles' lifework.

THE STANDARD UNDERGROUND CABLE COMPANY has removed its Boston offices to the Converse Building, 101 Milk Street, where it now has more commodious and more centrally located quarters. Mr. W. B. Sausman is manager of the New England sales department.

THE AMERICAN VULCANIZED FIBRE COMPANY, 1017 Market Street, Wilmington, Del., announces that it has taken charge of the sales and purchasing departments of the American Hard Fibre Company, of Newark, Del., and the Kartavert Manufacturing Company, of Wilmington.

THE SHELBY ELECTRIC COMPANY.—Mr. Fish, secretary of the Shelby Electric Company, Shelby, Ohio, reports that his company's business during the month of January last was one of the best for any one month in the company's history. The plant is running night and day, so great is the demand for its special coil filament lamps.

DRY BATTERIES AND NOVELTIES.—Mr. G. C. Thornton announces that his business of manufacturing electric dry batteries and novelties has been transferred to the Thornton Electric Works, Incorporated, 3 East Fourteenth Street, New York. The officers of the company are W. F. Thornton, president; Charles E. Brower, vice-president, and G. C. Thornton, secretary and treasurer.

"NOARK" FUSES.—The H. W. Johns-Manville Company has just issued some printed matter descriptive of its "Noark" enclosed indicating fuse devices. The company proposes to produce a complete line of bulletins relative to enclosed fuse devices. Bulletins 6, 7, 9 and 10 are devoted to fuse and fuse blocks for different voltages, and contain much other information on the general subject.

COLUMBIA TELEPHONE SUPPLY COMPANY.—The amount of stock required to induce the Columbia Telephone Supply Company to locate in Ottawa, Ohio, has been subscribed, and it is believed the deal will be closed at once. Plans have been prepared for a two-story brick factory building 200x75 feet, and it is proposed to employ 100 men at the start. James G. Nolan and Fred. J. Mason, Chicago, are at the head of the company.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is prepared to send upon application a circular fully describing the loud ringing extension bell which it is selling. This bell is especially desirable for telephone service where the instruments are placed in factories and other noisy places. They are mounted on hard wood bases with nickel plated trimmings which make them adaptable for use in offices where a bell of neat appearance is desired.

FREE POSTAL CARDS.—The Cutter Company, of Philadelphia, has hit upon a scheme to attract attention to its products, which bids fair to become popular. It is distributing half a million postal cards among its customers. Each postal card bears a small illustration of some of the apparatus manufactured by it, either flush switches, instruments or circuit breakers, in the corner, together with some catchy phrase in very small type, thus leaving plenty of space on the card for other use. A card which has reached us refers to the excellence of the Keystone instruments.

THE CARPENTER ENCLOSED RESISTANCE COMPANY, New York, reports that its business has grown so rapidly during the past few weeks that it has been obliged to install new machinery, etc., and acquire additional manufacturing space. Orders received during the month of February were double those of January, and four times the business of December. The company states that its enclosed type resistances, reversing printing press and crane controllers, resistance units and field controllers for large dynamos, are giving the best of satisfaction. Increased orders are coming in from old as well as new customers.

EMERSON MOTORS.—The Emerson Electric Manufacturing Company is sending circulars out to the trade making a very favorable proposition, with a view to extending the use of its motors. It offers to send to any electrical dealer or central station of financial responsibility in the United States, one sample each of such types of its 1902 desk and ceiling fan motors as may be designated, these samples to be returned after 30 days' trial, at the company's expense, if for any reason it should be desirable to do so. The Emerson company keeps a large stock of its entire line at St. Louis, and also at its Eastern branch office in New York City.

HAZARD INSULATED WIRES.—The Hazard Manufacturing Company, of Wilkesbarre, Pa., supplied some of its rubber covered wire for the telephone system on the Pan-American grounds. The following report on its work will be noted with interest: "The independent telephone system which was operated on the Exposition grounds was installed by the Stromberg-Carlson Company. This system, together with the fire alarm system, worked perfectly and the telephone system in particular deserves particular mention. The network of wires run for telephone service paralleled in the same water-soaked wooden ducts, heavy current conductors carrying alternating current, potentialed anywhere between 104 and 1800. The service given was excellent and such could not have been true if these wires and insulation had not been of good material and workmanship."

GENERAL ELECTRIC BULLETINS.—Direct-current motors forms the subject of Bulletins No. 4275-6 of the General Electric Company. One of the bulletins is on the CE motor built for slow speeds in sizes ranging from 2 to 15 horse-power, and in moderate speeds from 3 to 20 horse-power. The second bulletin is on small direct-current motors of the type CA, ranging in sizes from ⅓ to 2-horse-power, and wound for 115, 230 and 500 volts. Both bulletins are profusely illustrated and show applications of the two types of motor to a number of machine tools. Bulletin No. 4277 relates to type C, form D, circuit-breaker. This was formerly known as type CB circuit-breaker, and made only for use on direct currents. The new type is now manufactured for alternating current work also. Bulletin 4278 is on horizontal edgewise ammeters designed primarily for alternating currents. Other recent publications of the General Electric Company are a circular on the radial fan motor described and illus-

trated in these columns Feb. 22 last. In this type the fan is placed in a horizontal position and so revolved as to draw air from above and force it against a reflecting surface directly beneath the fan, thus causing a gentle breeze to proceed horizontally in all directions. Another circular is on snap switches, and a third on an apparatus for blue printing with enclosed arc lamps.

THE ELECTRIC FOUNTAIN COMPANY OF AMERICA.—The Darlington Electric Fountain & Supply Company, of Philadelphia, has been reorganized and incorporated under the laws of Delaware as the Electric Fountain Company of America, the new company taking over the entire business which has been built up by Frederick W. Darlington, the president, whose familiarity with the fountain business is well known. It has been largely due to his skill and energy that the electric fountain has the position as an attraction that it now holds. Besides the design and construction of illuminated and other types of fountains, the large factory which the company intends to build will have a sufficient capacity for the supplying of all kinds of specialties in hydraulic apparatus, such as fire nozzles, automatic valves, etc. It is understood that the company not only has options on several patents in the fountain line, but that Mr. Darlington is now at work upon several ingenious improvements. Among these may be mentioned an attachment whereby musical effects can be produced in combination with those of light and water. The company is already on a good financial footing and it intends to erect in the near future the manufacturing plant which will be necessary for carrying on its business. Among those of other consulting engineers, the services of Mr. Luther Stieringer have been secured, and his reputation as an expert designer of artistic effects guarantees all work with which he is in any way connected. The offices of the Electric Fountain Company of America are in Philadelphia.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEBRUARY 25, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

693,841. CURRENT REGULATOR FOR ELECTRIC TRANSFORMERS; F. R. M. Cutcheon, St. Paul, Minn. App. filed Oct. 12, 1901. A primary coil is wound on the yoke of a U-shaped core and the secondary coil on the prongs of said core. An adjustable armature or bar working in the field of the secondary coil serves to magnetically short circuit said field and, by adjustment, vary the strength of the coil. The secondary coil is wound in sections spaced apart and connected in series. If, for example, a transformer is for five lamps and only three lamps are in circuit, the limits of motion of the armature is so adjusted as to only influence the secondary circuits of the three lamps.

693,855. APPARATUS FOR PREVENTING COLLISIONS AT SEA; Nicolas Gherassimoff, St. Petersburg, Russia. App. filed June 20, 1899. (See Current News and Notes.)

693,863. AUTOMATIC REGULATOR FOR STORAGE BATTERY SYSTEMS OF DISTRIBUTION; C. H. Holderreith, Brooklyn, N. Y. App. filed June 21, 1901. The end cells are switched in and out of circuit automatically by means of a motor operating the switches; two circuit controlling magnets direct the current through the motor in opposite directions, and are normally prevented from operation by being energized.

693,864. ATTACHMENT PLUG; C. F. Howes, Cambridge, Mass. App. filed April 28, 1900. Details of construction whereby a simple form of plug is obtained.

693,889. TELEPHONE EXCHANGE SWITCHBOARD SYSTEM; W. S. Paca, Erie, Pa. App. filed March 15, 1901. (See page 443.)

693,890. TELEPHONE EXCHANGE SYSTEM; W. S. Paca, Erie, Pa. App. filed March 15, 1901. (See page 443.)

693,916. CONDUIT FOR ELECTRIC WIRES; E. D. & H. N. Speer, New York, N. Y. App. filed Oct. 25, 1901. The conduit is made up of an inner flexible tube wound with a layer of fireproof cord; and this layer surrounded by another layer of fireproof material.

693,918. PROCESS OF FORMING BODIES BY ELECTRODEPOSITION; Carl Steinweg, Ludenscheid, Germany. App. filed July 1, 1901.

693,935. SAFETY ATTACHMENT FOR CARS; C. A. Willard, St. Louis, Mo. App. filed June 22, 1901. A guard is thrust rearward from the end of the car to prevent persons from walking around the rear end of the car and into danger of being run down on the adjoining track.

693,944. STREET RAILWAY SWITCH; W. J. Bell, Los Angeles, Calif. App. filed Dec. 14, 1901. The system of levers is normally under spring tension and the car automatically closes a circuit through a magnet which release the system and allows it to throw the switch, the switch being afterwards re-set, mechanically, by the car.

693,988. TROLLEY FOR ELECTRIC CARS; E. W. Taylor, Spokane, Wash. App. filed Dec. 26, 1900. The trolley has both lower and upper contact, between which the wire is embraced and upon which wire the trolley can swing laterally, as a pivot in passing forks, or branches of the wire, at switches.

693,995. ELECTRIC SWITCH; T. H. Brady, New Britain, Conn. App. filed Dec. 7, 1900. The invention consists of male and female bent sheet metal [illegible]

694,018. ELECTRIC HEATING DEVICE; E. Kastner, Berlin, Germany. App. filed June 17, 1901. An electric heater is enclosed in a tube which is adapted to be thrust into a liquid for heating the same.

694,020. TROLLEY POLE SUPPORT; F. H. Lippincott, Philadelphia, Pa. App. filed July 16, 1900. A retracting mechanism for lowering the pole is tripped into operation when the pole rises above the wire.

694,041. SANITARY SHIELD FOR TELEPHONE TRANSFORMERS; J. B. Tauveron, New York, N. Y. App. filed May 18, 1901. (See page 443.)

694,075. ELECTRIC MOTOR; F. A. Pocock and C. W. Kennedy, Philadelphia, Pa. App. filed July 29, 1897. An automobile motor in which the field magnet is connected to one wheel and the armature to the other, with interposed gearing for giving both wheels a rotation in the same direction.

694,089. ZINC ELEMENT FOR PRIMARY BATTERIES; H. J. Brewer, New York, N. Y. App. filed Nov. 18, 1901. The stem supporting the zinc element is attached to the latter by means of an insulating sleeve which permits of the attachment of a new zinc to the old stem, thus effecting an economy in the use of zinc.

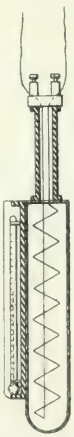
694,092. ALTERNATING ELECTRIC CURRENT INDUCTION MACHINE; Ernst Danielson, Westeras, Sweden. App. filed June 11, 1901. (See Current News and Notes.)

694,105. DEVICE FOR STARTING ALTERNATING ELECTRIC CURRENT INDUCTION MOTORS; Karl A. Lindstrom, Sommarro, Sweden. App. filed Dec. 29, 1899. (See Current News and Notes.)

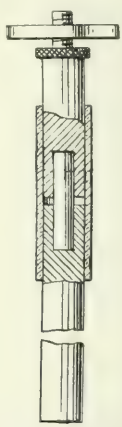
694,152. TROLLEY STAND; H. Holland, Detroit, Mich. App. filed Aug. 28, 1901. The trolley base is fitted with rollers which run freely upon a circular horizontal plate having unwardly turned confining flanges.

694,158. AUTOMATIC CONTROL SYSTEM FOR ELEVATORS; B. N. Jones, East Orange, N. J. App. filed April 30, 1901. A push button system by means of which the passenger can send the car to any desired floor, and which includes an automatic lock preventing the operation of any push button after one has been set.

694,190. ARC LIGHTING SYSTEM FOR ALTERNATING CURRENTS; L. and A. Privat, Oak Park, Ill. App. filed June 10, 1899. Alternating arc lamps in the secondary circuit of the transformers are cut out automatically by means of a shunt around the primary coil, which is closed by the expansion of a body of mercury.



694,018.—Electric Heating Device.



694,089.—Zinc Element for Primary Batteries.



694,220.—Former for Filaments for Incandescent Electric Lamps.

694,218. TROLLEY; J. S. Van Leer, St. Louis, Mo. App. filed May 9, 1901. An arrangement of guard plates preventing the wheel from leaving the wire.

694,220. FORMER FOR FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; G. C. Webster, Warren, Ohio. App. filed Dec. 30, 1901. A shaping implement having two opposite spiral grooves leading downward from its upper end, into which the filaments are deposited preparatory to baking.

694,239. THERMO-ELECTRIC ALARM; H. Black, New York, N. Y. App. filed May 18, 1901. A block of fusible material normally confines a spring contact under tension.

694,293. DYNAMO ELECTRIC MACHINE OR MOTOR; W. R. V. Marshall, Paisley, Scotland. App. filed Nov. 6, 1901. The pole faces are made up of plates of iron or steel with intervening non-magnetic spaces for the purpose of checking the reaction of the armature.

694,311. ELECTRIC CIGAR LIGHTER; J. M. Althouse, Reading, Pa. App. filed June 26, 1901. Details.

694,317. ELECTRIC TRACTION ROAD; L. Dion, Boston, Mass. App. filed June 22, 1901. A flexible conductor in connection with the main conductor passes into a closed tubular chamber and is supported at each end thereof. Between its points of support it is looped and connected with an armature which can be lifted by a magnet on the car into contact with buttons in the roadway.

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CARD INDEX OF CONTENTS.

For the benefit of such readers as may care to file weekly for reference a list of contents of this journal, we shall reprint in each issue, commencing with the present one, a list of contents of the preceding issue. The list will be printed of such a size that when cut out it may be pasted on the standard library card, which cards can be obtained at almost any stationery store. At times when the contents as printed on this page would require more space than the dimensions of a card will permit, it will be shortened for reprinting by omitting less important references to the text. The list will be printed in the advertising portion of the paper to avoid clipping the reading text, and its location may vary, owing to the exigencies of "make-up," from week to week.

THE NEW YORK CENTRAL.

After a brisk little discussion, the stages in which are elsewhere noted, Mayor Low has accepted in behalf of the city the Apgar bill now before the New York Legislature fixing May 1, 1905, as the date after which it will become unlawful to use steam in the Park Avenue terminal tunnel. This is surely liberal allowance enough. If the railroad company were in dead earnest about the thing the change could easily be made long before that time. We should have preferred to see a much earlier date fixed, believing that there would be no unreasonableness in such pressure; but Mayor Low is evidently anxious to be fair and to have the reform shape in with the other transportation improvements now being effected in the city. For three years more, then, those who have to pass through the tunnel must endure the inconveniences of that dirty and dismal smoke sewer, and make the best they can of it. It seems a great pity that this must be so, and that electricity was not resorted to long ago. There may be mitigations of the evils of steam, but the only real cure is to stop using it.

In making its plea for more time, in the letter signed by eight of its directors, the New York Central Company makes a curious statement to the effect that it is advised that electricity cannot handle its trains yet satisfactorily. We quote the passage elsewhere. It might be true in regard to through trains, but seeing that the whole question is the handling of trains when they reach the tunnel, we are puzzled to discover what such a statement has to do with the case. On the face of it, it looks like a disingenuous plea for delay, but we should be slow to suggest that in view of the solemn pledge otherwise given by the eight directors. Meantime, it would be interesting to know who the electrical engineer is—if there really be one—who advises the company that electricity cannot handle easily every one of its trains—local, through, etc.—in the tunnel, or even in the suburban area. We take it upon ourselves to assert flatly, without any fear of contradiction, that Messrs. Arnold and Sprague never gave any such advice. So far as the public is aware, no one else has ever been called upon for an opinion professionally; and even the extent to which the reference to these two engineers has gone is more or less indirect, or a matter of doubt. Mr. Arnold has certainly done some work for the company, and he is an outspoken advocate of the adoption of electricity for traction. The New York Central owe it to the electrical profession at least, to give up the name of the electrical engineer, who, according to them, is literally "fouling his own nest." We hear the view freely expressed in electrical circles that the company have never had any such advice from any electrical engineer whose professional opinion is worth 10 cents.

Atmospheric Conductive Strata.

Elsewhere we print an interesting communication from Dr. Kennelly on the subject of conducting atmospheric strata, and the influence of the same with respect to wireless telegraphy. From the earliest days of wireless telegraphy the manner in which etheric waves of the Hertzian order are transmitted through the atmosphere has been a subject of lively interest. By some it was held that unless a portion of the terminal antennæ projected above a plane tangent to the earth midway between stations, transmission was impossible, and some experiments made in Belgium to test this assumption were held to have verified it. One result of the recent brilliant experiments of Marconi has been effectually to dispose of theories which considered the height of antennæ a definite function of the distance between stations. Dr. Kennelly points out that reasonable grounds exist for the assumption that in transoceanic wireless telegraphy the waves in their course are reflected, on the one hand, by the electrical conducting surface of the ocean, and on the other hand by the surfaces of upper atmospheric strata, which latter, by virtue of their rarefaction, approach sea water in conductivity. The deduction from this view is, therefore, that the curvature of the earth plays no important part in transoceanic wireless telegraphy, that the propagation of the signaling waves is cylindrical, and that the attenuation of the effective waves is in simple proportion to the distance traversed by the waves.

The figures given of the conductivity of rarefied strata are most interesting in view of the claims that have been put forth as to the possibility of utilizing the upper strata of the atmosphere for the economic transmission of electrical energy in large quantities. Such claims have been vague as to the height of elevated transmission termini—in fact, merely specifying that they should extend into the rarefied atmosphere. According to figures given by Dr. Kennelly as deduced from data determined by Professor J. J. Thomson, at a height of from 45 to 55 miles above the surface of the earth, the conductivity of the atmosphere for low-frequency alternating currents is about 600,000 times less than the conductivity of copper. As to the conductivity of atmospheric strata at an altitude of but a few miles, we do not think its value would be of an order to cause the engineers of a Himalayan transmission project to fear that measurable shunts of energy would occur across high-voltage pole-line conductors. Indeed, one of the mountainous regions of the world would furnish an ideal field for a test of the upper-strata transmission of power theory; for if not successful there, we could hardly hope to attain a sufficient altitude for the transmission termini in habitable regions of the earth.

The Wattmeter on Induction Motors.

We printed last week a group of communications on metering three-phase currents which, together with those of Messrs. Taylor and Brandeis printed in this issue, will well repay examination on the part of many of our readers. In the early days of the system the whole matter was very imperfectly understood, and more than one station manager was brought to the verge of nervous prostration in trying to extract coherent readings from his wattmeters. Without going in detail into the concrete case discussed by our correspondent, the fundamental thing to remember in dealing with three-phase circuits is that the several currents must be measured in connection with their allied voltages if a correct reading is to be obtained. One would not think of trying to meter an alternating-current circuit by taking the current belonging to one customer and combining it with the voltage on the lines of another customer. Yet this is substantially the thing which often happens in carelessly connecting to three-phase circuits. In one case that came to our notice, an induction motor of about 5 hp was connected to a meter by using the current in one branch and the voltage across the two other branches. All was well until the bills were rendered—then the customer smiled happily and said nothing, and the station manager groaned in spirit and was sad. At last the truth came out, and to this day the manager has not been able to convince the customer that he is not the victim of soulless corporate greed in the sudden increase of his bills. The safest course to follow in the average station not extensive enough to have a meter expert is to put the installation of meters into the hands of one intelligent man and direct him to study thoroughly the directions given by the manufacturers and to paste their connection diagram for three-phase circuits into his hat and follow in slavishly tracing out every connection until he is sure that his wiring and the diagram exactly correspond. Properly connected the wattmeters will tell the truth to a close percentage, and if they give an unexpectedly low result on induction motors it is well to suspend sentence on the meters until one is quite sure that the motors are carrying a disproportionately large real load. The wattmeter does not punish a bad power factor, and it behooves those who furnish electric power to keep close track of the character of the motors on their circuits, and either to exclude the bad ones or to use a system of charging that will take account of unreasonably large demands for current.

The Power of Incandescent Lamps.

Just at the present stage of events, there seems to be a reopening of the old question as to the extent of sub-division which is desirable in practical illumination. Almost from the beginning of the art the usual unit in incandescent lamps has been 16 cp. This figure was very naturally adopted from the ordinary legal requirements for gas, and as a matter of fact it seems to answer well for most requirements. But once given a convenient method of sub-dividing the electric light, the advantage to be gained by distribution in small units became at once a pertinent subject of study. So long as the requirement in illuminating a given space is based upon a fixed minimum intensity of illumination, sub-division has very obvious advantages. For evidently upon this specification, that distribution requires the least energy which exceeds the required minimum at the fewest points, and by the least amount of these points. Hence assuming that incandescent lamps do not change materially in efficiency as the size of the unit varies, lamps of small capacity will evidently give the best economic result so far as energy required is concerned. The compensating factors are the extra cost of wiring and of lamp replacement when the number of lamps is increased. Abroad, the result of experience has been the very extensive use of 8-cp lamps. The brilliant results attained by Mr. Stieringer at Buffalo last year with this same unit has demonstrated its economic importance. It is very doubtful whether any better effect would have been produced by an equal number of 16-cp lamps.

But the advance of electrical engineering has introduced new factors into this problem. While it is easy to produce an excellent 10-cp or 8-cp lamp at 110 to 120 volts, the task becomes difficult at 220 volts or more, and the advent of these higher pressures in the working conductors has tended to encourage the use of units even larger than 16 cp in order to obtain a durable lamp at a good efficiency. Still more recently the Nernst lamp has appeared, and all the experiments seem to point to the desirability of using units of 100 cp or more to gain the full advantage of the new construction. This situation at once raises a question of relative efficiency in practical use. In the illumination of a given space one has to judge by results, and if for the purpose in hand 100 10-cp incandescent lamps could give the same useful illumination as 20 100-cp Nernst lamps, then the two kinds of lamp could be on an economic parity irrespective of all nice questions involving watts per candle-power. The same dilemma

may be met in comparing incandescents with enclosed arcs, or in general any two classes of lights differing greatly in their capacity for convenient sub-division. Under at least conceivable circumstances a more complete sub-division may more than compensate for lower electrical efficiency.

On the other hand, the more powerful lights have in certain cases a material advantage. Wherever a large amount of light is needed at any one point a single large lamp is generally more efficient than several small ones. It seems to us that the possession of illuminants of great efficiency, but only moderate capacity for sub-division ought to encourage the indirect methods of illumination. Most of these modern powerful sources of light are of great intrinsic brilliancy as well as of great efficiency, and when used in the ordinary way have to be heavily shaded to reduce the glare. In indirect lighting they can be used bare, and the loss of the diffuse reflection will be hardly more considerable than that incurred by proper shading. Even incandescent lamps large or small generally require shading of some sort. It thus becomes quite possible for arcs, Nernst lamps or the like, to compete with even the most perfectly distributed incandescents in virtue of lighting mainly by diffusion. As a practical matter it would seem as if the incandescent lamps of very moderate candle-power, say, 8 or 10, could retain a stronger hold on the art, against competition, than those of larger capacity. The 16-cp lamp has too firm a position to be easily shaken out, and those of 20 to 32 cp are occasionally useful, but the inroads of competition are likely to be first felt in the large candle-powers, particularly if lighting by concealed lamps gains increased popularity.

Electro-Chemical Industries.

The papers read at the last meeting of the American Institute of Electrical Engineers form an important contribution to the literature of electro-chemistry. We may mention here that through a printer's error, the abstracts of these papers printed in our issue of last week, appeared under a misleading head, through the substitution for the general title, "Electro-Chemistry," the title of one of the papers. There are at present two main groups of electro-chemical industries, namely, the electro-chemical and the electro-thermal. A few industrial processes are, however, intermediate, and form connecting links between these two divisions. While some few electro-chemical industries, such as electroplating, are nearly a century old, most of them are of very recent date. The modern industries require cheap electric power in nearly all cases, and, consequently, they naturally develop around waterfalls. No flat country like Holland can expect to foster large electro-chemical industries. Such industries naturally belong to countries of ups and downs. Two distinct fields of usefulness are developed in electro-chemical and electro-thermal industries. One is the production of already existing commercial chemical products, such as alkalis, aluminum and graphite, at reduced cost. The other is the production of new substances, or substances that cannot be obtained in any other way, such as carbides and silicides. Niagara Falls now produces both these classes of products.

A most interesting industry and one which may have important developments in its future, is the production of nitric acid from the atmosphere. It has long been known that the free oxygen and nitrogen of the air are capable of uniting at a sufficiently high temperature. Fortunately for all animal life, the temperature of their combination is very high, otherwise any spark, lightning flash, lighted tobacco pipe or conflagration might set the nitrogen of the air on fire and burn down the atmosphere. This is only another way of saying that the oxygen in the air has probably been produced from a pre-existing atmosphere of carbonic acid gas diluted with the nitrogen, by the accumulated activity of vegetation carried on through millions of years. On this view the carbon originally united with the oxygen in our atmosphere would make a layer of coal about 50 centimeters thick, all over the earth's surface, including ocean basins. By exposing dry air to a sufficiently high temperature obtained through the use of a number of arc lamps, the air is brought to the burning point at Niagara Falls, producing nitric acid, and thus nitrogen compounds, at apparently reduced cost. The presence of nitrogen as a constituent of plant tissues is necessary to animals who depend entirely upon plants for their nitrogen. Lightning flashes in the air and bacteria in the earth, living on the roots of plants, seem to be the only natural agents for restoring nitrogen to the soil after the plants or crops have been carried away. Any artificial method which can compete with bacteria from a commercial standpoint is capable of great development.

Taking up the several papers more specifically, it is interesting to notice that Professor Sheldon's paper mentions five organic substances that may be produced electrolytically. The paper of Mr. Jacobs, on the electric furnace in industrial chemistry, is mainly chemical, and it is interesting to see such papers read before the American Institute of Electrical Engineers. It describes the production of a number of substances, among them the silicides of barium, calcium and strontium. Calcium silicide when thrown into water has the convenient property of producing hydrogen; just as calcium carbide has of producing acetylene. One pounds of calcium silicide is stated to be capable of cooling 18.73 cu, ft. of hydrogen at standard temperature and pressure, or about one-tenth of its own weight of the gas. Barium silicide, possessing similar properties, is, however, recommended for this purpose. This electro-thermically prepared material may have a future field of usefulness in aeronautics, as, for example, in the filling of military balloons.

Dr. Keith's paper on the electrolytic recovery of copper from low-grade ores was confined to a consideration of the electrolytic treatment of a low-grade copper ore containing about 2 per cent of the metal. He alludes to 1½ per cent as being a minimum limit of richness at which it might be possible to extract metal profitably under otherwise favorable conditions. The process described is essentially one of crushing, roasting, leaching and electrolization, the copper being finally deposited on the cathodes in the electrolytic tanks. It is curious to notice that scientific metallurgical processes for the extraction of metals from their ores are tending to large operations on extensive deposits of regular low-grade ores, as distinguished from the work of the individual gold miner who only attempts to work with the cradle upon rich local deposits. The Rand in the Transvaal is a good example of the successful treatment of a large deposit of low-grade ore upon a large scale.

Mr. Carl Hering's paper on electrolytic conduction without electrodes, suggests a particular form of unipolar dynamo adapted to produce a unidirectional current in a tube of electrolyte closed upon itself, so as to form a purely electrolytic circuit without electrodes. It would be interesting to have such an apparatus constructed and tried; although it would be very remarkable if the c. m. f. in the circuit failed to produce electrolytic effects and ionic transfer. In fact, if it did fail to set up the expected electrolytic effects, it would be necessary to revise existing theories of electrolysis in order to call for an explanation. These theories, in the medium between the electrodes not in their immediate vicinity, prescribe actions due to the local electromotive intensity, and these actions should take place, whether there are electrodes or not, provided that the electromotive intensity is furnished.

The New York Central and Electric Traction.

An interesting "passage of arms" has occurred between Mayor Low and the New York Central Railroad in regard to the adoption of electric traction for the tunnel. The Mayor gave his indorsement to a bill seeking to set a date within which the company should abandon steam, whereupon eight of the directors of the road signed a letter to him, asking him to waive this point, pledging the company to change the motive power for suburban trains at the earliest possible moment. As to other traffic, however, the company's letter said: "If it were practicable to do this there would be no call for such legislation, for this company is as anxious as the public to operate all its trains through the tunnel by electric power. In the present stage of the electric art, however, we are advised that this is not practicable as to our heavy through trains, which carry distant as distinguished from local traffic. This part of the problem is made difficult by the exceptional and complex conditions prevailing at our terminal and by the very large scale upon which the traffic has to be carried on." This remark has set the electrical public wondering as to what it means, first as to what the advice was, and next who gave it; while another element of curiosity is as to the alleged difference in the tunnel of the two classes of traffic. So far as electrical engineers can see, the only difference is in the weight of the trains, and that is no obstacle, as the trains hauled electrically through the Baltimore tunnel are as heavy as anything the New York Central can show. The only well-known men whose names have come up in this connection are Messrs. F. J. Sprague and B. J. Arnold, and a well informed "Electrical Engineer," writing to the *New York Evening Post*, says:

"Irrespective of any general statements they may have made in the past, both of these engineers, and especially the latter, have recently given utterance to views which may be taken as defining their status and belief. Only two weeks ago they appeared before the Railway Committee at Albany and gave testimony for the railroad company upon this very question. Mr. Arnold's evidence was mainly about the time which would be required to get an electric system in operation, and he gave as his conclusion three years as a fair limit to put into a bill for the installation to be well under way. Mr. Sprague gave somewhat more extended testimony, and stated that in view of the character and size of the units which would be required, three years would be a fair limit for getting the suburban service into operation and making progress on the balance In reply to questions by Mr. Wainwright, he specifically stated that in his opinion all the terminal service should be electrically operated, and that the central station units should be planned with regard to the necessities of entire electrical operation within a resonable distance from the Forty-second Street station. The same engineer, only a month ago, in a letter to a daily paper, in reply to one by Mr. Westinghouse, stated that every train movement at the Grand Central terminus could be effectively and safely made electrically, and that engineers were ready to contract to do it.

"In view of these facts it would appear distinctly improbable that these technical advisers have reported to the New York Central Railroad that the operation of all trains—that is, through as well as suburban—cannot be safely undertaken electrically, in so far as the city of New York has any concern. That concern is the operation of all trains within what may be called the "danger zone," not the operation only of suburban trains electrically, because, by a new arrangement of tracks requiring an underground tunnel, no other power is possible for them.

"There is one possible explanation of the statement in the Central's letter, which is, that they have been advised that the through, that is, long-distance electrical operation of their main trains, is not yet practicable."

It is to be added that Mayor Low this week has accepted the Apgar bill which fixes May 1, 1905, as the date when it shall become unlawful to use steam in the tunnel.

Electrical Engineers of the Day—XXXVII.

Samuel Sheldon.

Samuel Sheldon was born in Middlebury, Vt., March 8, 1862, and was fitted for college in the public schools of his native town. In 1883 he was graduated from Middlebury College, receiving the degree of B. A., and during the following academic year of 1884-85 he occupied the position of instructor in mathematics in that institution.

A strong desire to acquire a more thorough theoretical knowledge of physics and electricity and a more accurate and systematic training in original research and investigation than could at that time be had in this country, prompted him to enter the University of Wuerzburg, Germany, where he spent the years 1885-87, as assistant in physics to the distinguished physicist Kohlrausch, and was associated with the latter in his celebrated determination of the ohm. At the conclusion of his work in the German University, in 1887, the degree of Ph.D. was conferred upon him. His old college at Middlebury, in recognition of his scientific attainments, honored him with the degree of A. M. in 1886. Returning to America he became assistant in physics at Harvard University, where he remained until the fall of 1889, when he was called to the chair of Physics and Electrical Engineering at the Polytechnic Institute, of Brooklyn, which position he still occupies.

Here an opportunity was afforded him to utilize the constructive and inventive faculties which had been strongly developed in his youth, namely, in creating and equipping a physical and engineering department and laboratory out of practically nothing. Many a creditable department has been developed, and many a spacious laboratory has been equipped in our modern colleges and schools under the beneficent wing of a generous endowment fund, but these were not the conditions under which Dr. Sheldon has worked for the past 12



years. With no available endowment and with only such funds as could be spared from the earnings of a self-supporting institution, he has, all things considered, inaugurated and developed one of the most creditable courses in electrical engineering, supplemented with laboratory and shop practice, to be found in any of our technical schools and colleges. What Dr. Sheldon lacked in apparatus and material equipment he made up for in originality of ideas and methods of presentation of facts to his students.

During his connection with the Polytechnic Institute, Dr. Sheldon has carried on an extensive practice as a consulting electrical engineer. His keen perception, accurate reasoning and clear and concise opinions inspire his clients and those who seek his advice with extreme confidence. He frequently is called upon to give expert testimony in State and Federal courts.

As a classroom teacher and demonstrator, Dr. Sheldon possesses those qualities which cause his listeners to be perfectly unmindful of the lapse of time. His humorous tendencies are well developed, while his powers of accurate description are manifested in the highest degree. As a contributor to the scientific and engineering press, Dr. Sheldon is widely known. His work on "Dynamo Electric Machinery" is his most notable production, and has been adopted in nearly all the leading technical schools and colleges of this country, as a standard text-book. A complete list of his scientific contributions would occupy more space than is here available, but they cover a multiplicity of subjects of great practical interest to the electrical engineer and student in applied science. He has been active and prominent for some years in the American Institute of Electrical Engineers, and is now a vice-president.



FIG. 8.—CANAL AND AQUEDUCT BETWEEN VILLADA AND FERNANDEZ LEAL

The Transmission System of the Compania Explotadora De San Ildefonso of the City of Mexico—I.

BY STEPHEN Q. HAYES.

THE Compania Explotadora de San Ildefonso operates a remarkable transmission system, supplying current for lighting and power purposes to the City of Mexico. The most striking fact about this transmission system is that the usual arrangement of a single generating station furnishing power to a number of sub-stations is here reversed, and a number of generating stations supply power to a single sub-station.

Along the banks of two mountain streams, the Monte Alto and the Tlalnepantla, that tumble down the eastern slopes of the Mexican Sierras, just without the City of Mexico, are installed a number of small generating plants at various points. The streams rise in the mountains, closing at the west the Valley of Mexico, and flow side by side in a westerly direction, one of them finally turning to the north and the second toward the northeast, as shown on the map (Fig. 1). On the Monte Alto are two power stations, one at Villada, and one at Fernandez Leal. On the Tlalnepantla are three, Alameda, Chiluca, Madin. The nearest is 10 miles from the receiving station at La Veronica in the suburbs of the City of Mexico.

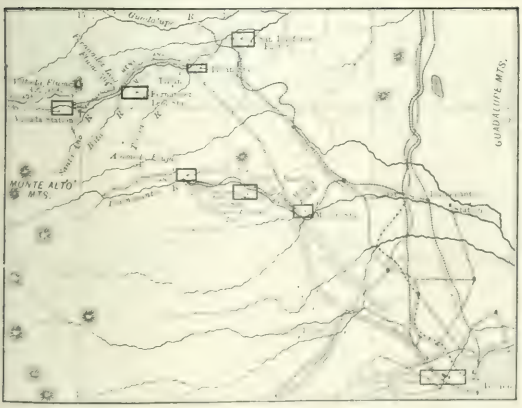


FIG. 1.—MAP OF THE VALLEY OF MEXICO.

This peculiar arrangement of stations is the result of a successful plan to utilize the natural fall of water along each of the rivers, by placing the generating stations at those points where the water power is most available, and the arrangement has given rise to a number of novel problems in high voltage transmission work. These have been successfully met, and their solutions present many interesting features, to be described later in detail.

In the rough, mountainous country here existing it is no easy undertaking to carry a water supply to the various power stations, when the waterways, as projected, are of considerable length—2 to 8 miles—and must at times cross ravines, pierce hillocks, but still follow the generally uneven and deviating slope of the ground. For the greater part of their length they are canals dug in a volcanic tufa so hard that, in several places where it was pierced by tunneling, no lining was needed to prevent leakage. Of course, the volcanic surface is not everywhere uniform. At a few points it is a pudding-stone of such porosity as to require a lining to make it water-tight. The upper part of the Villada Canal is in a clayey soil, and the sides are retained by a wall of masonry.

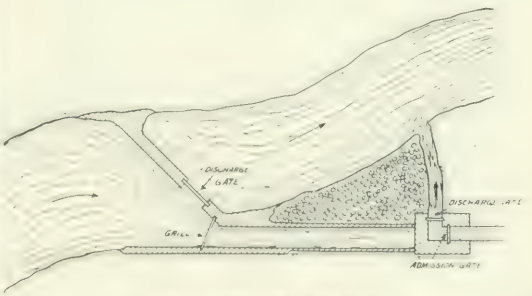


FIG. 2.—[illegible] OF THE CANAL

The engineering difficulties encountered in the construction work were numerous. Across small ravines aqueducts were built of masonry supported by I-beams arranged in pairs and resting upon pillars either of stone or substantial ironwork, an arch of corrugated sheet iron from one inside I-beam to another supporting the bed of

the waterway. The most noteworthy bit of construction work was the crossing of a tributary valley of the Rio Alto, too wide for an aqueduct, by a large siphon tube of steel. This is inverted in position and dipping into the valley reaches from one canal to another. It is 750 ft. long and 200 ft. deep, and is shown in Fig. 9. The piping is supported on a substantial masonry bridge and anchored at either end in blocks of masonry. The water descends to the power stations through a steel pipe almost 4 ft. in diameter. Several views show this piping, or flume, lying on the rough, uneven hillside. Wherever the piping takes a bend it is, of course, anchored in blocks of masonry.

The Villada Canal begins at a dam across the Monte Alto high up in the mountains. The mouth of the canal is protected by a strong grill against the entrance at flood tide of tree trunks and other debris. A second grill of finer mesh picks up any floating objects that may have passed the first one. After winding for several miles through a country, the uneveness of which is well shown in Fig. 8, the Villada Canal comes to the brow of a steep hill above the power station (Fig. 6). A settling reservoir of generous dimensions receives the water, and communicates by a canal with a second stor-



FIG. 3.—PIPE LINE TO ALAMEDA STATION.

age reservoir from which the flume passes down the hill to the power station. Leaving the Villada power house, the canal empties into the river, some feet above the dam intended to turn the water into the next canal, which feeds the Fernandez Leal power house, five miles below Villada. This canal, after meandering down the easiest slope, finally opens upon a little plateau, where the construction of a settling basin and water reservoir presented little difficulty.

Along the Tlalnepantla River are canals of much the same general character as those along the Monte Alto. Fig. 4 shows the basin at the top of the Alameda Hill. It also gives a good idea of the volcanic pudding-stone in which a part of the waterway system lies.

As all of the water powers are comparatively small, it was impossible to install at any one point a plant large enough to furnish the required amount of power. Moreover, owing to the distance between the points of maximum fall along the streams, it was better and cheaper to install a generating plant at each one, using a number of small generators (225 kw each), rather than to build a canal long enough to use the entire hydraulic head at one point, although the latter plan presented the possibility of using a few large generators rather than the 19 small ones which go to make up a total of 4225 kw comprising the present installation.

Not the least of the advantages to be gained by the use of these small generators is the facility with which they can be transported in a rather wild and mountainous district. Of scarcely less importance than the consideration of portability, is that of immunity from shut downs. This could easily be secured by making all of the machines of the same capacity, so that a fewer number of repair parts would insure against the shutting down of a plant, so far from the factory where the machinery is built. This idea has been closely followed out in the entire installation. The generators and raising transformers are all of the same capacity—225 kw. The various switchboard panels are, as far as possible, duplicates of each other, and may, if desired, be used at any of the generating stations, and not necessarily at the one for which they were originally built. Extra fuses and similar parts liable to be destroyed are kept in stock in the City of Mexico, so that it is not necessary to send to the builders of the original equipment, the Westinghouse Company, at Pittsburg, for repair parts.

GENERATING STATIONS.

Fig. 11 shows the general arrangement of the various stations with respect to each other, and is what may be called a "single-wire diagram" of this polyphase installation. Each circuit, whether consisting of two, three or four wires, is shown as a single line, and only the general layout of the various apparatus appears, all other details being omitted to avoid confusion. The interesting points about the layout are more clearly indicated in some of the later diagrams,



FIG. 4.—TANK AT ALAMEDA.

which show details and practically all of the connections at the important points.

As previously stated, along the Monte Alto River there are two generating stations at Villada and Fernandez Leal; on the Tlalnepantla River three generating stations at La Alameda, Chiluca and Madin. In Fig. 11 the number of generators in each station is indicated by circles marked *G*, and the banks of raising transformers are shown by circles marked *T*.

In all of these five stations the generators are 225-kw, Westinghouse two-phase alternators, delivering 280 amperes per terminal at 440 volts, and 50 cycles. They are all direct connected to Piccard and Pictet waterwheels running at 430 r. p. m.

On page 468 is a brief synopsis of the apparatus at each station, beginning with the station of largest output.

There are 19 generators with an aggregate output of 4225 kw; 22 raising transformers with a total capacity of 4950 kw, and 10 exciters of an output a little less than 200 kw, making a total of nearly 10,000 kw in generating and transforming machinery.

At first sight it may seem odd to have 4950 kw installed in transformers and only 4225 kw in generators, but it must be borne in mind that the generators are installed in units of 225 kw each, while trans-



FIG. 9.—INVERTED SIPHON ON MONTE ALTO LINE.



FIG. 5.—VIEW OF ALAMEDA FROM TANK.



FIG. 10.—EXTERIOR OF ALAMEDA POWER HOUSE.

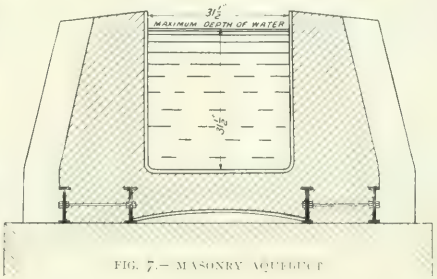


FIG. 7.—MASONRY AQUEDUCT.



FIG. 6.—EXTERIOR OF VILLADA STATION.

formers are grouped for transforming from two-phase to three-phase with an output of 450 kw for each pair.

While speaking of this ratio of the generator output to the transformer output, it would be well to compare the generator capacity with the exciter capacity. The exciters in each station have about 4 per cent of the output of all the generators. As alternating-current generators of this size require approximately but 2 per cent of their output for field excitation, it will be seen that in each station one exciter is capable of taking care of the field currents of all the machines, the second exciter being held in reserve.

VILLADA.

5	225-	kw,	440-volt	generators.
6	225-	kw, 440-22,000	"	raising transformers.
2	22[illegible]	kw.	125 "	exciters.

FERNANDEZ LEAL.

Same as Villada.

LA ALAMEDA.

4	225-	kw.	440-volt	generators.
4	225-	kw, 440-22,000	"	raising transformers.
2	22[illegible]	kw,	125 "	exciters.

CHILUCA.

3	225-	kw,	440-volt	generators.
4	225-	kw, 440-22,000	"	raising transformers.
2	15	kw.	125 "	exciters.

MADIN.

2	225	kw,	440-volt	generators.
2	225	kw, 440-22,000	"	raising transformers.
2	11[illegible]	kw.	125 "	exciters.

By referring again to the diagram (Fig. 11) it will be noticed that

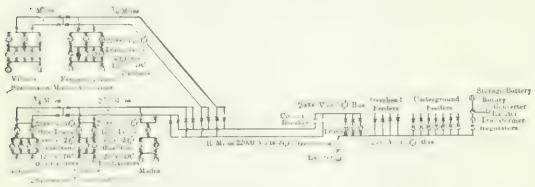


FIG. 11.—GENERAL DIAGRAM OF SYSTEM.

the 22,000-volt lines from the raising transformers in the stations along the Monte Alto River can be thrown on either or both of two sets of transmission lines running to Madin, and similarly, that the stations along the Tlalnepantla River can be connected to either or both of the two lines along that river. At Madin these four transmission lines come to one high-tension switchboard (Fig. 12), where they can be connected to either or both of two three-phase, 20,000-volt lines leading from Madin to the City of Mexico. The duplication of these transmission lines allows any one to be disconnected for inspection or repair without shutting down the plant.

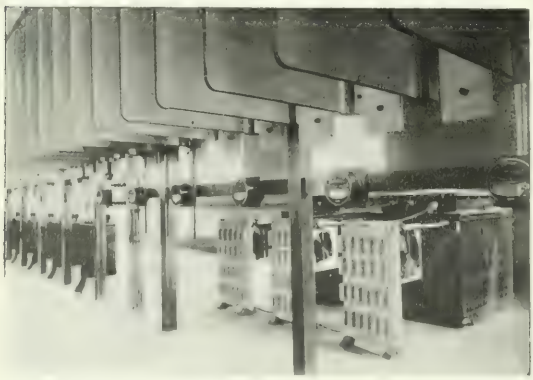


FIG. 12.—HIGH-TENSION ROOM AT MADIN.

On their arrival at the La Veronica receiving station, the lines pass through two three-pole, 20,000-volt, 150-ampere reverse-current circuit breakers, to 20,000-volt, three-phase bus-bars. Fed from these bus-bars are three sets of lowering transformers that reduce the pressure from 20,000 volts to 2600 volts, and are connected on the low-tension side to 2600-volt, three-phase bus-bars.

During the dry season of the year, lasting about 100 days, the amount of available water power is not sufficient to supply the demands of this distributing station, and, therefore, a 375-kw, 2600-volt, three-phase, 50-cycle, steam-driven generator has been installed. Provision has been made for two more steam-driven units to run in multiple on the same bus-bars as the lowering transformers. In other words, they are run in synchronism with 19 waterwheel-driven generators, the nearest being 10 miles away and the farthest 22. The generator now in place is attached by a flexible coupling to a steam engine running at 177 r. p. m., normal rating 500 hp, maximum rating 700 hp. Four Babcock-Wilcox boilers furnish steam at 140 lbs. pressure. A storage battery, rotary converter and lowering transformers for the rotary are also installed in this station.

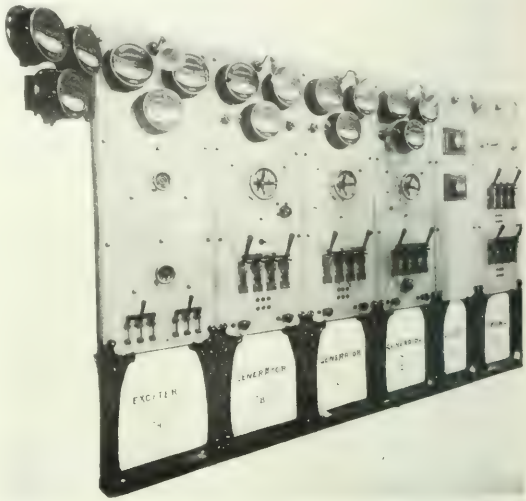


FIG. 13.—FRONT VIEW OF CHILUCA SWITCHBOARD.

During the period of heavy load the battery helps out by discharging into the rotary, which converts the direct current thus supplied to an alternating one and feeds back through its transformers to the three bus-bars and out over the three-phase feeders. This rotary is, of course, in multiple with all of the other apparatus of the system.

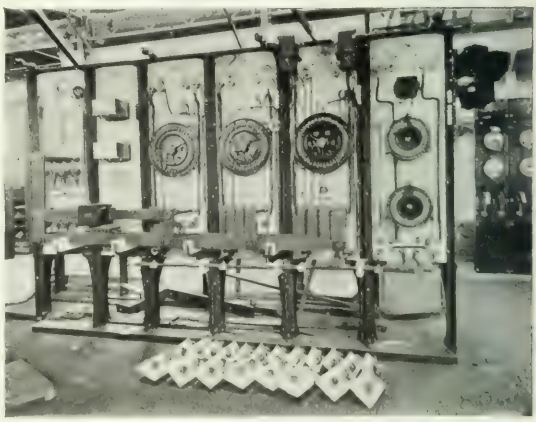


FIG. 14.—REAR VIEW OF CHILUCA SWITCHBOARD.

The switchboards of the system were installed in 1898, and have been in continuous service for the last three years, and have given

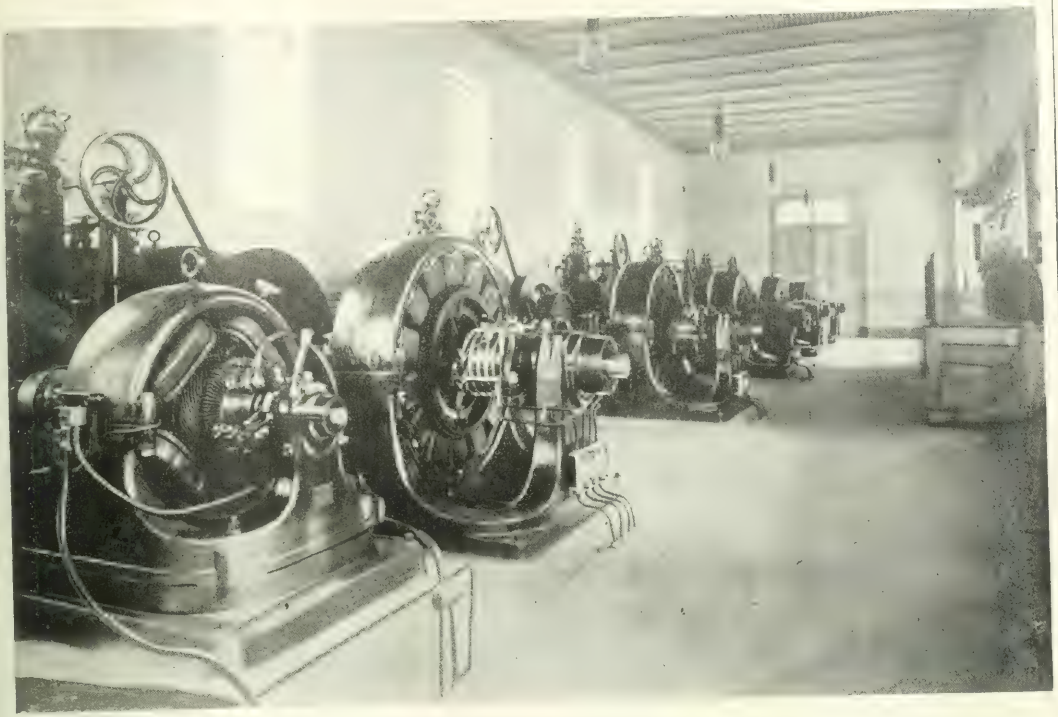


FIG. 18.—INTERIOR OF VILLADA STATION.

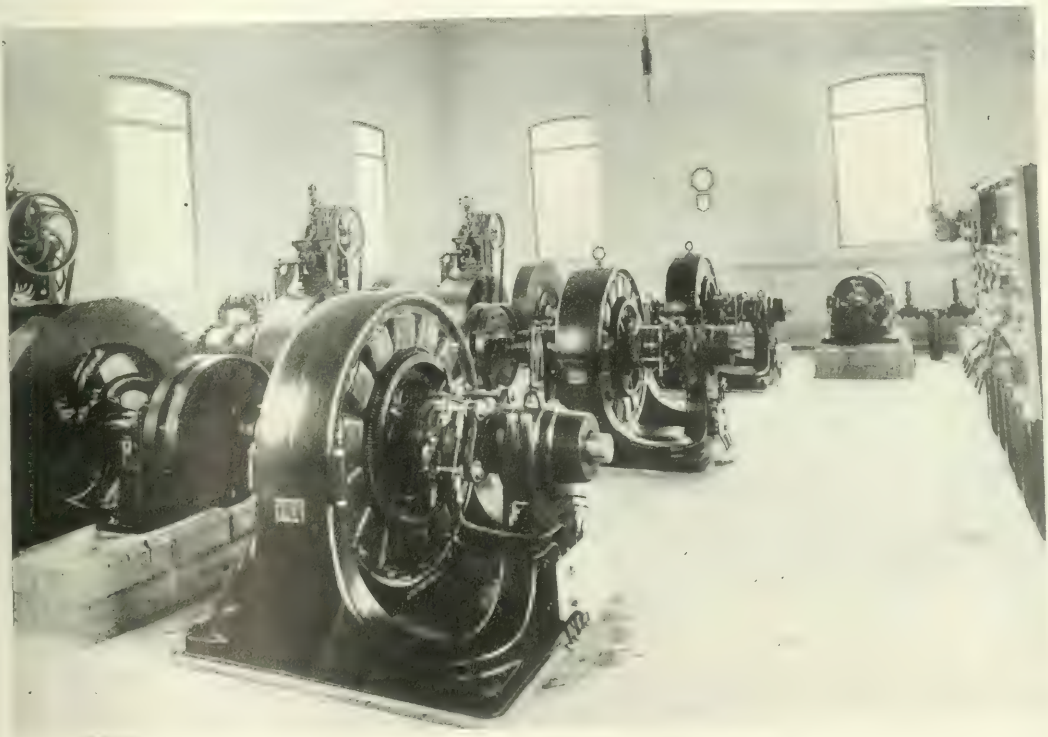


FIG. 15.—INTERIOR OF CHILUCA STATION, SHOWING GENERATORS.

entire satisfaction. As the switchboards are nearly identical—for they were built with the idea of having the panels duplicates of each other as far as possible—the plant at Chiluca, which is typical of the others, will be described, and afterwards it will be pointed out in what respects the others differ from this one.

Fig. 13 shows the front and Fig. 14 the rear of the low-tension switchboard installed in the Chiluca generating station. Fig. 15 and Fig. 16 show the interior of the station. At Chiluca two 15-kw, 125-volt exciters are controlled by panel *A*, the one on the extreme left-hand end; three 225-kw, 440-volt generators are controlled by panels *B*, *C* and *D*. There is a load panel *E*, and two banks for raising transformers, each consisting of two 225-kw transformers, are controlled by two four-pole switches on panel *F*, the one on the extreme right.

Figs. 13 and 14 show very clearly the type of switchboards, the number of instruments, etc. As the wiring diagram indicated the connections of all these instruments, it is unnecessary to go into details concerning this switchboard. There are a few points, however, which might be noticed with some particularity.

On the load panel are mounted one pilot lamp and two 1500-ampere, 450-volt, Niagara type indicating wattmeters. These meters have their current coils fed from the secondaries of 1500 5-ampere series transformers placed over the main bus-bars (See Fig. 14), and which have their voltage coils connected directly to the same bars. These two meters indicate the total output of the station, and if during light load, i. e., with only one machine running, that machine should tend to run as a motor fed from the line, these wattmeters would immediately indicate the trouble by running backwards. Another advantage of these indicating wattmeters is that a comparison of their readings with the result obtained by multiplying the sum of the ammeter readings by the voltmeter reading, which gives the apparent output, will give the power factor of the system.

This power factor depends, among other things, on the field excitation of the machine, and for a given load the other conditions being constant, there is one definite field charge that will give the highest power factor. By adjusting the field rheostat and watching the main alternating-current ammeters, a point will be found where, for a given output, the reading of these ammeters will be a minimum and consequently the power factor of the generator a maximum. This proper field current will be indicated on the direct-current field ammeter, and afterwards the station attendant will know that for a given output a particular field current will give the best results and can set his rheostat accordingly.

On the feeder panel the outfit comprises one pilot lamp, two synchronizing lamps and plugs, with two six-point voltmeter receptacles and two four-pole, quick-break, 600-ampere switches. As the function of the synchronizing lamps and voltmeter receptacles on a feeder panel may not be apparent at once, it will be necessary to refer to Fig. 17, which shows the diagram of connections of the Chiluca generating station in greater detail than shown in Fig. 11.

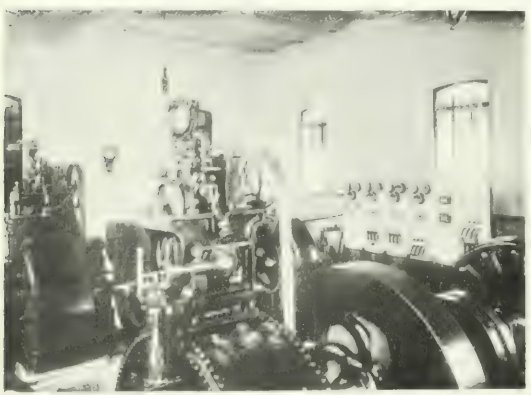


FIG. 16.—INTERIOR OF CHILUCA STATION, SHOWING EXCITER.

Let us suppose that the 22,000-volt transmission lines passing the Chiluca station were alive, i. e., that the plant at La Alameda was running. Before the Chiluca plant can be thrown in multiple with it, it is necessary to synchronize the plant as a whole with the transmission line. This is done by first closing the high-tension fused circuit breakers that connect the line with the 22,000-volt, three-phase bus-bars from the transformers, then close the circuit breakers which cannect one bank, say, the right-hand one, to these three-phase bus-bars, and the transformers will then act as lowering transformers, reducing the voltage from 22,000 volts, three-phase to 440 volts, two-phase. If none of the generators has been started the four-pole switch on the low-tension side of the transformers can be closed, thus placing the bus-bars in synchronism with the line and the generators can then be brought up to speed separately and synchronized with the bus-bars.

If, however, some of the machines are already connected to the bus-bars, then it is necessary to put the ground detector plug in the

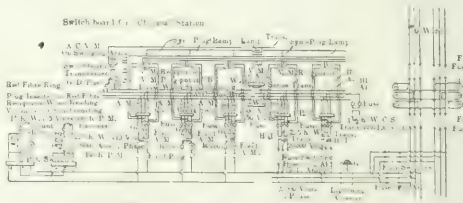


FIG. 17.—DIAGRAM OF CONNECTIONS AT CHILUCA.

red fiber receptacle (shown solid in Fig. 17), which connects one side of the ground detector transformer to bus *A*, the other side being connected at the double contact push button to bus A_2. The voltmeter plug is then put in the right-hand position of the six-point voltmeter receptacle connected to the transformer switch. This compares directly by means of the alternating-current voltmeters on the swinging arm, the voltage on the bus-bars and that on the low-tension side of the transformers; or, in other words, the voltages on the two different sides of the four-pole transformer switch. If it is not the same the station voltage is altered—by adjusting the exciter rheostat, which changes all of the generator voltages at once—until they do correspond. The synchronizing plug corresponding to that bank of lowering transformers, is put in, which places the synchronizing lamp on the front of the board in series with an extra one on the rear; that is, across like terminals of the synchronizer and ground-detector transformers. At the instant of synchronism the lamps are dark, and the main transformer switch is closed. It takes about 12 seconds to synchronize a station with the line before connecting in.

This diagram (Fig. 17) also shows the high-tension connections in the line from La Alameda, and it will be noticed that the operator at Chiluca has control of the lines from La Alameda which are joined in multiple at this point. If power is coming over the left-hand line from La Alameda, the operator at Chiluca can transfer it to the right-hand line, or vice versa, or again he can connect it to both lines or cut it off completely. In these lines from La Alameda are six series transformers in the 22,000-volt circuits feeding six ammeters which indicate at a glance whether one line or the other, or both lines, from La Alameda are in use and how much current they are carrying. In this way it is possible to determine that line to which the Chiluca station should be best connected to avoid overloading either line.

While speaking of this question of loading the lines, it might be interesting to call attention to some calculations which were made in the beginning relative to the ohmic drop in the lines. At that time the distance between wires and the relative location of the lines was not known, so that it was impossible to figure out the inductive drop. The figures for the ohmic drop were calculated from the length and size of the wire used and the current carried, on the assumption that full-load current at 90 per cent power factor was carried on one of the two transmission lines at 22,000 volts, the other line being idle.

	Miles.	Wire. No.	Amperes.	Volts drop.
Villada Fernandez Leal	5	0	32.0	340
Fernandez Leal-Madin	6.875	6	65.8	910
La Alameda-Chiluca	3.75	6	26.3	205
Chiluca-Madin	2.5	6	40	235
Madin-Mexico	10	3	125	1280

These figures for the drop in the lines were used as a basis for determining the proper loops to bring out from the high-tension sides of the raising transformers in order to obtain the proper line voltage with 440 volts on the low-tension side. While, of course, it was im-

practicable to bring out loops for these exact drops and still have the transformers interchangeable, these voltages were approximated to and the exact voltage obtained by slightly altering the primary voltage (that of the station bus-bars) by field regulation.

To return again to the low-tension part of this diagram, there is one point to which it will be well to call particular attention as a procedure opposed to Westinghouse standard practice, but put in at customers' request—supplying fuses for the connection between the generators and the alternating-current bus-bars.

The objection to the use of fuses between alternators and bus-bars is that they are not needed for the protection of the machine, and that they are liable to blow at a most inconvenient time—the moment of synchronization. The Westinghouse alternators are built with such armature reaction that even on a dead short circuit they will not generate sufficient current to damage themselves, and for this reason, fuses or other automatic protection are not needed. Moreover, at the instant of synchronizing, if the two machines are not exactly in phase when thrown together, there may be a rather heavy interchange of current from the leading to the lagging machine, which will immediately pull the two machines into step without damage to either, unless the circuit is opened by the blowing of a fuse. Therefore, the use of fuses at this point is unnecessary, but as stated before, they were installed at the customers' request. The remainder of the low-tension diagram will readily be understood.

The installation at Madin differs from that at Chiluca in having only two generating panels, and in having exciter ammeters and load wattmeters of smaller capacity; but it has in addition panels for the line wattmeters. That at La Alameda has one more generator panel and larger exciter ammeters and load wattmeters. The Villada station, shown in Fig. 18, and Fernandez Leal, which are duplicates of each other, are provided with five generator panels, larger exciter ammeters and load wattmeters than Chiluca, and an additional bank of raising transformers controlled by a four-pole switch, placed on the load panel below the wattmeters.

Single-Phase Permutator with Revolving Brushes.

BY P. LETHEULE.

MM. ROUGE AND FAZET have designed an interesting apparatus for the purpose of charging automobile storage batteries from a single-phase distributing system, which may be considered to be a combination of the well-known principles of the single-phase converter with the principle of a new class of rectifiers, which may be termed reaction rectifiers. Their fundamental principle is as follows:

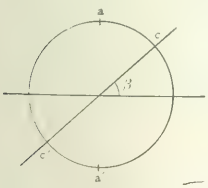


FIG. 1.—DIAGRAM ILLUSTRATING PRINCIPLE.

Let us consider a two-pole Gramme ring armature, provided with a commutator and placed in a magnetic medium permitting an equally good flux path in all directions. Assuming an alternating difference of potential to be applied between commutator segments a and a' (Fig. 1), then

$$V = E_A \sin \omega t$$

The value of the difference of potential between two diametrically opposed segments, c, c', corresponding to a given value of angle β is known to be

$$E \sin \beta$$

If we now assume two brushes revolving on the commutator surface with synchronous speed, and so adjusted that β exactly equals ωt, then

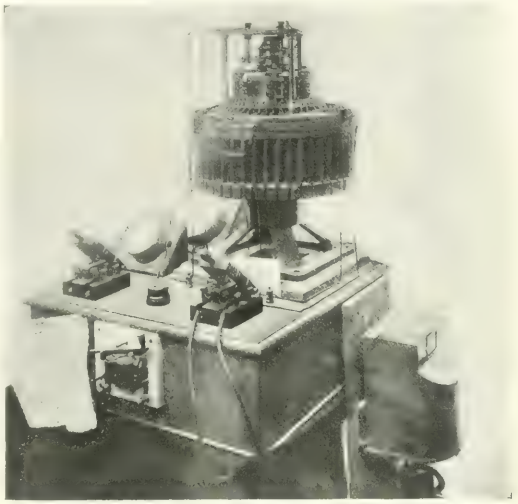
$$e = E_A \sin \omega t \cdot \sin \omega t = \tfrac{1}{2} E_A (1 - \cos 2 \omega t).$$

The no-load difference of potential thus appears as the superposition of a constant potential difference of $\frac{1}{2} E_A$, and of an alternating potential difference $\frac{1}{2} E_A \cos 2 \omega t$, that is, of frequency of 2ω and an amplitude of $\frac{1}{2} E_A$.

The working conditions under load may be determined, according to the nature of the receiving circuit, by application of the usual formulas to the alternating component, taking account of the inductance of the system.

A permutator of this class recently exhibited at the Grand Palais du Champs Elysees by MM. Rouge and Fazet, and shown in Fig. 2, was designed and built as follows. The external part consists of a fixed four-pole ring armature, series wound, with 45 coils of 10 turns each, laid in slots on the outside periphery of the ring (Fig. 3), the inside periphery of the same ring being used for closing the magnetic circuit of the reaction rectifier.

Inside the commutator ring is a steel inductor running synchronously, which is shaped like a Gramme ring for the purpose of offering to magnetic leakage a permeability equal in all directions (Fig. 3). Being moved directly by a derivation of the main flux, this ring can revolve the brushes at a constant phase angle, since it does not depend on the interposition of any m. m. f. due either to the alternating or the direct current of the machine.


FIG. 2.—30-AMPERE, 90-VOLT SINGLE-PHASE PERMUTATOR.

For the purpose of starting as well as improving the rectifying actions of the transformer, the inventors connect (Fig. 5) two conveniently placed points of the armature, C E, by means of a non-inductive resistance, D, the single-phase terminals being A and B.

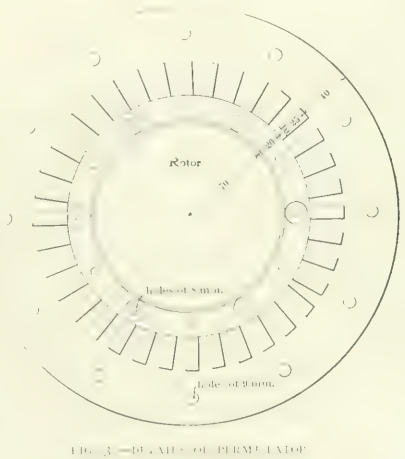


FIG. 3.—DETAILS OF PERMUTATOR.

This produces a sort of revolving field, which, although very imperfect, yet is sufficient to enable the dead points to be passed by the moving part. If the field of the machine were a regular revolving field, there would always be a value of the angle of brushes allowing a commutation to be obtained. With a single alternating field equivalent, according to Fresnel's law, to two magnetic component fields revolving in opposite directions, it was to be feared that the component field of opposite directions with regard to the rotation of

brushes might produce an objectionable sparking. Tests, however, have shown that, at least running light, a perfect commutation can be obtained without any sparking. For running equally well under

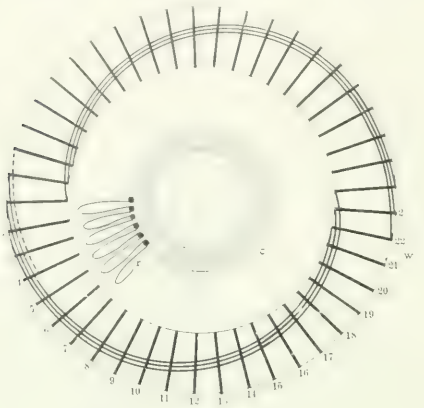


FIG. 4.—SCHEME OF WINDING.

load the inventors have designed an ingenious way of decomposing the commutations into two distinct operations.

As every pole has two sets of brushes running in multiple, each set is alternately used for carrying the largest part of the current, the other set being used for commutating; that is, for changing the coil. This result is obtained as shown in Fig. 2.

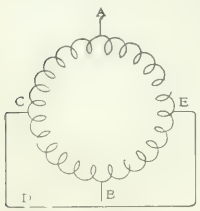


FIG. 5.—CONNECTIONS TO WINDING.

The commutator of the machine now practically used consists of 90 segments, corresponding to a 45-coil armature; but instead of being all direct connected to the windings, every second segment of the commutator has a direct connection to the winding, the remaining segments being connected to the preceding ones relatively to the direction of rotation of brushes by means of a resistance r of a high value. (Fig. 4.) In this illustration w represents the end connections of the windings, c the commutator and r the resistance.

Automobilism in England.

Automobile clubs are now established all over the United Kingdom, mostly in affiliation with the Central Automobile Club of Great Britain and Ireland, which is now agitating for the removal of the restrictions placed on motor vehicles by the act of 1896, which removed earlier absurd regulations, such as that no mechanical vehicle should proceed along the public road at a speed of more than four miles an hour, and that each one must be preceded by a man with a red flag.

In a long letter addressed to the press and signed by the presidents of the councils of the French, Swiss, Belgian and Austrian automobile clubs, and also by all the chief British automobilists, cogent reasons are put forward for an amendment of the act which prevents an automobile being worked at a speed of more than 12 miles an hour, even on a straight road free from traffic. The protest points out that the systematic prosecutions and heavy fines imposed for constant breaches of this law are damaging an industry whose importance can be inferred from the fact that in October last, probably the quietest month in the year, $227,205 left the country for France, Germany and the United States for the purchase of automobiles.

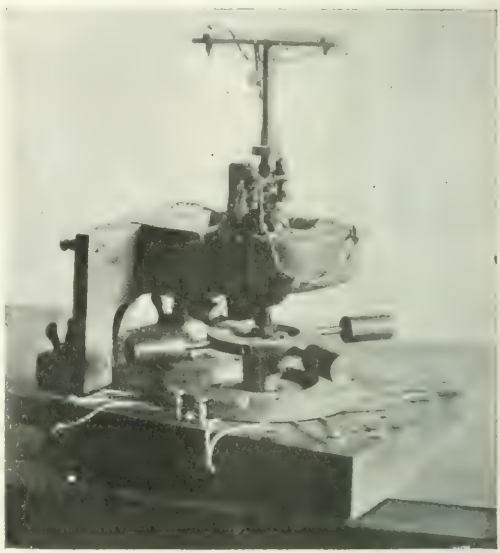
English manufacturers are also protesting against these restrictions, which, they say, hamper the automobile manufacturing industry at the present time, owing to the prejudice against automobiles, the systematic prosecutions and the heavy fines imposed for breaches of the 12-mile-an-hour limit, thus damaging an industry which is encouraged in almost every other country, so that a source of employment for thousands of men is checked, and English automobilists are still ordering, to a great extent, machines from abroad.

A Device for Synchronizing Motors.

BY PROF. WILLIAM DUANE.

IN certain kinds of multiplex and printing telegraphs and in the picture telegraph, it is necessary to have two brushes, type wheels or drums, at each of two stations, revolving synchronously. The purpose of the device described below is to synchronize two electric motors under the following conditions: Firstly, there shall be but two wires, or one wire and earth return between the two stations. Secondly, this circuit shall be utilized for synchronizing purposes during a small fraction only of the time required for each revolution of the motors. Thirdly, the power transmitted over the line shall be very small compared with the power required to drive the motors. The scheme for synchronizing the motors may be divided into two parts—a regulator for each motor, by which it can be made to run at any desired speed, and by which this speed is kept practically constant; and a device by which when the motors are running at nearly the same rate, the speed of one or both of them is automatically varied so as to keep them always synchronized with each other.

The regulating device may be understood from the accompanying illustration, which is reproduced from a photograph of a machine constructed for experimental purposes. The motor is suspended in such



SYNCHRONIZING DEVICE.

a way that the axis of its armature is vertical. The lower end of the axle is sharpened, and rests upon a steel plate just below the flywheel, but not seen in the picture. This is to furnish a firm support and a bearing with very little friction for the rotating parts. The motor's commutator is just above the armature. The axle above the commutator is hollow. Two insulated wires are soldered to two opposite segments of the commutator, and pass up through the hollow axle and out at a hole near the top. The hole is on the far side of the axle and not seen in the illustration. One of these wires is carried to the outer left-hand end of the cross bar (which is non-conducting) and soldered to a nut firmly fastened there. In this nut turns a thumbscrew, which carries a platinum point at its lower end. The other wire is soldered to a metal pin passed horizontally through the cross bar near the axle. The pin passes through a hole in the upper end of a movable conducting arm seen in the illustration hanging down near the axle. The arm carries a weight two-thirds of its length from the top, and at its end a small platinum plate.

When the armature revolves, owing to the centrifugal force the arm swings outward, and if a sufficient speed is reached, brings the platinum plate into contact with the platinum tip of the thumbscrew. This short circuits the armature and prevents further increase of speed. If the speed decreases, the platinum plate falls away from the thumbscrew and breaks the short circuit. Thus a speed is maintained

which is just about sufficient to bring the plate into contact with the point. The speed of the motor can be varied by screwing the thumb-screw up or down. Two wires similar to those described above are seen in the illustration running to a pin and nut at the other end of the cross bar, and a second short-circuiting arm could be used on this side, too. This double short circuit, however, was found to be superfluous. The motor represented was originally designed as a small series-wound electro-plating dynamo, and when running as a motor the armature revolves in the clock-wise direction, as seen from above.

The speed of this machine remains constant to within one part in 200; further, if stopped, left for a while, and started again on some future day, it will run with the same speed as before to within one part in 200, provided no very large change is made in the e. m. f. or resistance of the motor circuit. A large change in either of these quantities, however, will alter the speed slightly. For instance, an increase in the current supplied the motor from .8 to 1.4 amperes, increases the speed by about 2 per cent. The fact that this change in speed takes place is due probably to the jarring of the platinum contact. There is very little or no sparking when the contact is broken, and it does not appear to be necessary to keep the platinum surfaces clean. As a matter of fact, these particular pieces of platinum have not been cleaned since the machine was constructed.

The synchronizing device is as follows: Two motors similar to that represented are placed at the two stations, respectively, and regulated to run at approximately the same speed. The axle of each motor is joined to the line wire by means of a metal rod passed up through the center of a fixed commutator seen in the illustration just below the flywheel. One end of this rod is soldered to the steel-bearing plate upon which the axle rests, and the other is connected by a wire with one of the small binding posts on the wooden base of the machine and thence to the line. In this line circuit is inserted a battery of sufficient strength to work a high-resistance relay. A metal brush fastened to the flywheel revolves with it, and touches in succession the insulated segments of the fixed commutator.

Let us call one of the motors A and the other B. One segment of A's fixed commutator is divided into two halves insulated from each other. One-half of the corresponding segment of B's commutator is cut away and the space filled by insulating matter. Let a be the half of the divided segment that A's brush touches first in its revolution, and a' the second half, and let b be the corresponding segment in B's commutator. The segment b is connected directly to the earth or the return wire, and a and a' are connected through two coils of a double relay, respectively, to the earth or the same return wire. This double relay is so constructed and joined up that a current from a through the coil joined to it pulls a small lever arm over and short circuits part of the resistance of A's motor circuit, and a current from a' through its coil pulls the same lever arm back again, breaking the short circuit. Suppose that A has been regulated so as to run slightly slower than B. If they are started running, A gradually falls behind B until, when B's brush touches b, A's brush touches a. This completes the circuit through a's coil of the relay, the lever arm is drawn over and the portion of A's motor circuit is short circuited. A's speed then increases as explained above, and A gradually gains on B until when B's brush touches b, A's brush touches a'. This completes the circuit through a''s coil of the relay, the lever arm is pulled back and the short circuit broken. A is now running slightly slower than B, and the above process is repeated. This keeps the motors running nearly in phase with each other. One motor will gain on the other slightly and then fall behind, but in the case actually tried the difference in phase did not exceed one-fiftieth of a complete revolution.

The advantages of this method of synchronizing motors are that, as stated above, a very small current sent over the wire, namely, enough to work a sensitive relay, is sufficient to maintain synchronism, and since the wires are used for this purpose during a small part of the time only, they may be used for telegraphing almost all the time. Further, if one of the motors is stopped for any reason and started again, they will get into synchronism automatically, and will run together in only one relative position with regard to each other; i. e., so that when B's brush is on segment b A's brush is on segments a, a'.

The commutator in the machine represented in the picture was designed for multiplex telegraphy. It has 18 segments in addition to that used for the synchronizing device. A key placed in a circuit joining any of these segments to the earth or return wire, will operate a relay similarly placed in a circuit connecting the corresponding segment in the other machine with the same return. In this way 18 distinct circuits have been operated simultaneously over a single wire and return, running the length of the university campus, and containing a resistance of 500 ohms. Only one battery was required to operate these 18 circuits and the synchronizing device. Whether the above described scheme will work over a very long line or not remains still to be investigated.

Hale Physical Laboratory, University of Colorado.

On the Elevation of the Electrically-Conducting Strata of the Earth's Atmosphere.

By A. E. Kennelly.

According to the measurements of Professor J. J. Thomson ("Recent Researches in Electricity and Magnetism," p. 101), air at a pressure of 1-100 mm. of mercury has a conductivity for alternating currents approximately equal to that of a 25 per cent aqueous solution of sulphuric acid. The latter is known to be roughly 1 mho-per-centimeter, so that a centimeter cube would have a resistance of about one ohm. Consequently, air at ordinary temperatures, and at a rarefaction 76,000 times greater than that at sea level, has a conductivity some 20 times greater than that of ocean water, although about 600,000 times less than that of copper.

If we apply the ordinary formula for finding the elevation corresponding to a given air-rarefaction, we find that if the air had a uniform temperature of 0 deg. C., the height of this stratum of air with a rarefaction of 76,000, would be

18.39 log 76,000 kilometers above the sea.
or 89.77 kilometers,
or 55.77 miles.

If the air had a uniform temperature of —50 degs. C. this elevation would be reduced 18.3 per cent, or to 73.3 kilometers (45.5 miles). The temperature of the earth's atmosphere has only been measured within a range of a very few kilometers above the surface of the sea, and consequently the materials are not at hand for any precise calculation of the height of electrically conducting strata. It may be safe to infer, however, that at an elevation of about 80 kilometers, or 50 miles, a rarefaction exists which, at ordinary temperatures, accompanies a conductivity to low-frequency alternating currents about 20 times as great as that of ocean water.

There is well-known evidence that the waves of wireless telegraphy, propagated through the ether and atmosphere over the surface of the ocean, are reflected by that electrically-conducting surface. On waves that are transmitted but a few miles the upper conducting strata of the atmosphere may have but little influence. On waves that are transmitted, however, to distances that are large by comparison with 50 miles, it seems likely that the waves may also find an upper reflecting surface in the conducting rarefied strata of the air. It seems reasonable to infer that electromagnetic disturbances emitted from a wireless sending antennæ spread horizontally outwards, and also upwards, until the conducting strata of the atmosphere are encountered, after which the waves will move horizontally outwards in a 50-mile layer between the electrically-reflecting surface of the ocean beneath, and an electrically-reflecting surface, or successive series of surfaces, in the rarefied air above.

If this reasoning is correct, the curvature of the earth plays no significant part in the phenomena, and beyond a radius of, say, 100 miles from the transmitter, the waves are propagated with uniform attenuation cylindrically, as though in two-dimensional space. The problem of long-distance wireless wave transmission would then be reduced to the relatively simple condition of propagation in a plane, beyond a certain radius from the transmitting station. Outside this radius the voluminal energy of the waves would diminish in simple proportion to the distance, neglecting absorption losses at the upper and lower reflecting surfaces, so that at twice the distance the energy per square meter of wave front would be halved. In the absence of such an upper reflecting surface, the attenuation would be considerably greater. As soon as long-distance wireless waves come under the sway of accurate measurement, we may hope to find, from the observed attenuations, data for computing the electrical conditions of the upper atmosphere. If the attenuation is found to be nearly in simple proportion to the distance, it would seem that the existence of the upper reflecting-surface could be regarded as demonstrated.

Rating of Wattmeters for Three-Phase Systems.

By Charles Brandeis.

THE most common way of measuring the energy in a three-phase circuit is with two wattmeters connected as shown in Fig. 1, in which W_1 and W_2 represent the two wattmeters.

In a perfectly balanced three-phase system at 100 per cent power factor these two wattmeters will read alike, i. e., each will record exactly one-half the total load. As soon, however, as the power factor drops below this value they become divergent in their readings until 50 per cent power factor (or the current lag equals 60 degs.) is reached. At this point W_1 will read the total energy and $W_2 = 0$. Below 50 per cent power factor the wattmeter W_2 will again indicate certain values, but they are negative, i. e., to get the total load the value of W_2 must be deducted from the value of W_1. On the other hand, above 50 per cent power factor the sum of the two readings will give the total load.

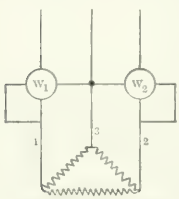


FIG. 1.—DIAGRAM OF CONNECTIONS.

It is, of course, desirable to rate the wattmeters as low as possible, for if they be too large it is not possible to read accurately when the load is small, say, at ¼ full load. Nevertheless, they must be large enough to allow for the inductive loads. To facilitate determining the correct ratings of indicating and recording wattmeters the curves given in Fig. 2 will be found useful.

While the total load curve only shows values up to 100 watts, it is applicable to any other load, the values being in proportion. It will be seen that W_1 reaches its highest reading value at about 85 per cent power factor, and that this value is approximately 58 watts for every 100 watts non-inductive load capacity of the generator or generators. Hence, if the maximum non-inductive load of a generator be multiplied by 0.58, the result gives the highest reading obtainable for W_1 on that circuit. This, however, by no means indicates the rating of the instrument, since wattmeters must be rated as to their non-inductive load capacities. To obtain the *rating* of the instrument we must divide the highest possible reading at the lowest probable power factor by the latter. This may be directly obtained from the W_1 rating curve. Thus if it be assumed in a certain case that the power factor of the generator may drop as low, but will not be lower than 80 per cent, then the rating of the instrument should be $\frac{71.5}{100}$ or .715 times the maximum non-inductive load capacity of the generator.

The wattmeter W_2, on the other hand, as will be seen from the curves, will reach its maximum value at 100 per cent power factor,

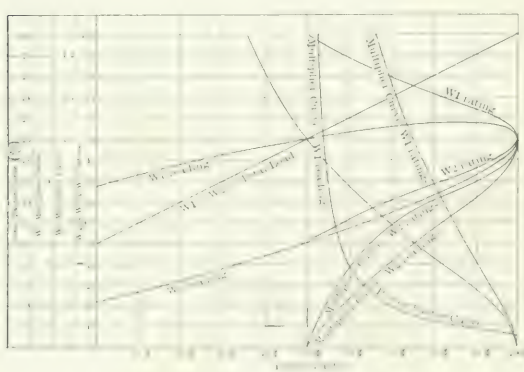


FIG. 2.—CURVES OF WATTMETER RATINGS.

and will, therefore, never record more than 50 per cent of the maximum non-inductive load capacity, and hence the rating may be the latter value.

For determining the correct ratings of wattmeters for motor or other inductive loads we proceed differently. It will be seen that W_1 has always a certain fixed relation to the corresponding total load $(W + W_2)$ for the corresponding power factors. Hence, we have a multiplier curve for W_1 readings, which is obtained by working out $\frac{W_1}{W_1 + W_2}$ for the corresponding power factor values. Similarly, we obtain the multiplier curve for W_1 ratings by dividing the values of the first mentioned multiplier curve by the corresponding power factor value. Similar curves are obtained for W_2. The application of these curves is best illustrated by an example.

Let us assume we have several three-phase induction motors on a circuit which require a maximum of 100 kw, and it is known that at this load the power factor will not be less than 85 per cent and not higher than 90 per cent. We find for 85 per cent power factor the value of the W_1 reading multiplier curve to be .68. Hence the highest reading for W_1 will be 68 kw. The rating of the instrument will be $100 \times .8 = 80$ kw. We find similarly the highest reading for W_2 will be 36 kw at 90 per cent power factor, and its rating 40 kw.

Thus in this case we could take two wattmeters, one of 80 kw, the other of 40 kw capacity. But it must be borne in mind that when the instruments are inserted directly into the circuit, as in Fig. 1, the same current passes through them both, therefore precaution must be taken that W_2 has ample current-carrying capacity. Thus we could take for W_2 a similar instrument as for W_1, but with a different scale. This may involve, however, an instrument of special make. The case is otherwise when the instruments are operated by means of current transformers, and this precaution is not required.

The W_1 and W_2 watts reading curves are obtained from the formula:

$$\tan \varphi = \sqrt{3}\left(\frac{W_1}{W_1} - \frac{W_2}{W_1 + W_2}\right) \text{ where } \cos\phi = \text{power factor.}$$

While this formula may not generally be known, it is not new, and it is probably well, therefore, to show here how it is deduced:

$$W_1 = C_1 E_{13} \cos(\phi_1 - 30^\circ)$$
$$W_2 = C_2 E_{23} \cos(\phi + 30^\circ)$$

Where C_1 and C_2 = the currents,
E_{13} and E_{23} = line pressure,
ϕ_1 and ϕ_2 are the angles of lag of the circuit currents.

In a balanced three-phase system, where

$$C_1 = C_2, E_{13} = E_{23}, \text{ and } \phi_1 = \phi_2$$

we obtain

$$\frac{W_1 - W_2}{W_1 + W_2} = \frac{\cos(\phi - 30^\circ) - \cos(\phi + 30^\circ)}{\cos(\phi - 30^\circ) + \cos(\phi + 30^\circ)}$$
$$= \frac{\sin\phi}{1.73\cos\phi}$$
$$\text{whence } \tan\phi = 1.73\left(\frac{W_1 - W_2}{W_1 + W_2}\right)$$

It will be seen that W_1 and W_2 bear a certain definite relation to each other according to the power factor. Hence, we can draw the power factor curve, which will enable one to find the value of the power factor of a system by means of two wattmeters only, without ammeters and voltmeters. Thus, for example, when W_1 reads 60 kw and W_2 reads 30 kw, $\frac{W_1}{W_2} = 2$, which value on the curve gives the power factor 86 per cent.

New Telephone Patents.

The issue of March 4 contains two telephone patents, both relating to switchboard systems and one based on a novel idea, which, however, is unfortunately, of doubtful practical application to actual working conditions on a large scale. This invention aims to supply an automatic signal which shall notify the operator when a line that was busy when called for becomes free, enabling her immediately to connect the subscriber who has made an ineffective call to the line asked for, as soon as it is disconnected from the line it was previously joined to. The idea is excellent, but it is pretty certain that its application would give rise to more troubles than it would cure.

Mr. William S. Paca, of Erie, Pa., patents and assigns one-half to Peter H. Adams, of the same place, a telephone exchange signal system having for its object the provision of supervisory signals in a magneto system which shall show constantly the condition of the two sub-stations connected, much in the same way as the supervisory signals of the common battery system fulfill the same function. Mr. Paca seems bound to make a name for himself as a telephone inventor, but so far it looks as if he would have to be merely content with credit for ingenuity, as in the case of the overflow switchboard

referred to last week. A glance at the diagram (Fig. 1) will show the complicated cord circuit and amount of extra apparatus required to secure on a magneto system a glow-lamp supervisory signal for each sub-station on Mr. Paca's system.

The signals are lamps L and L^1 operated by battery B^2, and controlled by relays H and O. When station No. 1 calls, by throwing drop B in the ordinary way, the operator on inserting plug E in jack C establishes a circuit from ground G at the exchange through battery B, relay H, cord $f\ f^1$, line $A\ A^1$, to ground G^1 at the sub-station which is thrown on to the central point of the ringer coils by the closing of contact K^1 effected by the release of the switch-hook when the receiver is taken down. Relay H closes contact h^1, and so completes the local circuit $f^2\ f^3\ f^3$ containing battery B^2 and lamp L, and L is lighted to full power. When station 2 is connected by means of plug E^1, and the called subscriber has taken down receiver, circuit is established from ground G through battery B and relay O to ground at sub-station 2 in the same manner as described for station 1. This energizes relay O, and the attraction of armature O^1 operates switch O^2, closing contacts $R\ S$ and h^3, and breaking contact h^2. This brings lamp L^1 into circuit, and the current from the battery divides

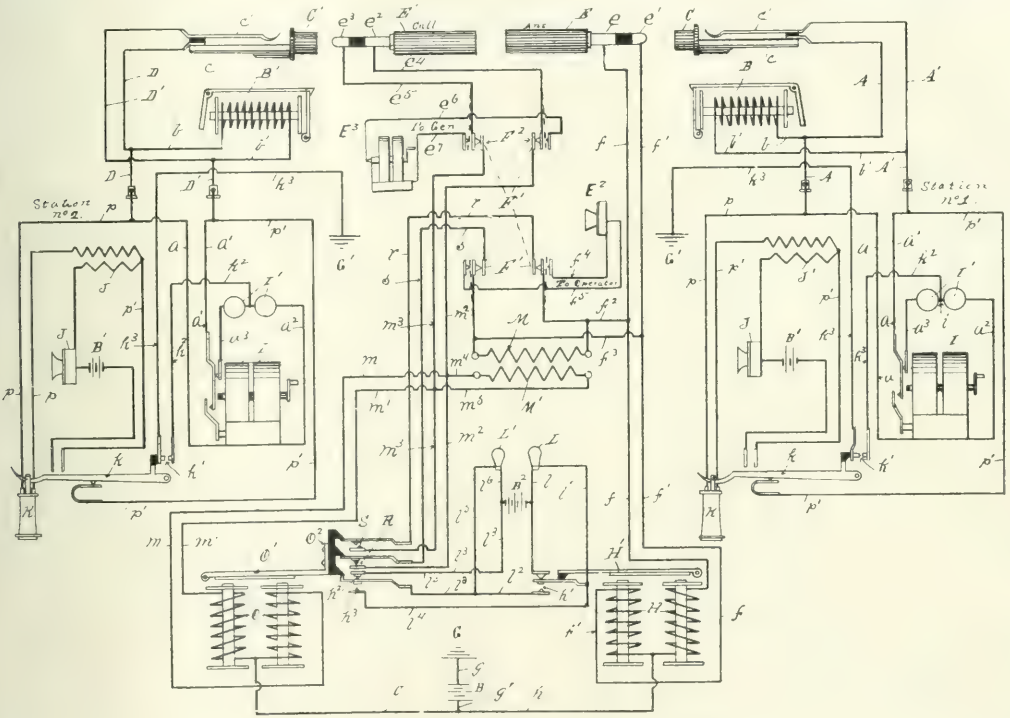


Fig. 1.—Paca's Telephone Exchange Signal System.

and passes through both lamps L and L_1 by wires $f^2\ f^3$, contact h^3 and wires $f^2\ f^3$ and f^3 lighting and maintaining the lamps at half glow, which indicates to the operator that the lines are connected and in use. The lamps remain at half glow until both subscribers hang up their receivers, when the relays are de-energized and the lamps are extinguished.

Mr. Newman H. Holland, of Brookline, Mass., patents and assigns one-half to Charles W. Holtzer, of the same place, an improvement in telephone exchanges the highly ingenious idea of which is to supply a signal which will indicate when a busy line that has been called for becomes free, indicating also the line which has made the call, so that immediately a disconnection has occurred the waiting connection can be completed. In the words of the inventory the invention is "to provide each operator at the central office with an automatic signal which will indicate when a busy line is clear in case a subscriber has called for connection with said line while it was connected elsewhere, the signal also being provided with means for indicating not only the line called for, but the line which has called for it. Assuming that a certain subscriber wishes to be connected with a certain other subscriber whose line is found to be busy at the time the operator can connect the line called for with a signaling device which will not actually operate until the said line is disengaged, the device being also provided with means for indicating after the signal is displayed the line of the calling subscriber who asked for the connection. The invention is applicable to any existing telephone system, and may be operated through the agency of the ordinary cord connections in conjunction with a suitable switch to connect the signal circuit to the line, or through the agency of a special cord circuit without the intervention of any switch. By utilizing cord circuits in this way the plugs serve as indicators to show the two lines to be connected, and, furthermore, both lines are in this way connected with the signal, so that if the calling line while the subscriber is waiting for the line originally called for has obtained connection elsewhere the signal will not be displayed even when the called line is free. While not essential, this is an important feature of the invention, since the signal will not be displayed until both lines are free, and the operator has nothing to remember, as the plugs indicate which lines they are."

The diagrams show the device applied to a magneto board (Fig. 2) and to a common battery board (Fig. 3), Fig. 4 illustrating a hollow plug for use in connecting the signal circuit to a plug instead of to a jack when that becomes necessary. In Fig. 2, station 241 is connected with station 1409, and station 411 has called for 241, has been told that it is "busy" and has been connected by the signaling device to 241 to await the disconnection of 241 from 1409. The signal consists of a lamp 23 controlled by a relay h, which can be thrown in and out of the cord-circuit by the switch c. The operator, on finding line 241 "busy," when trying to connect 411, connects the two lines by means of the plugs $a\ a^2$, depressing the switch c. The jack b^2, in which plug a^2 is inserted, is charged from battery D, by reason of the presence of plug a (connected to D by wire a^{12}, switch member c^8 and wire a^{14}) in one of the jacks of the same line, current, therefore, flows along wire a^{12} of plug a^2, switch-member c^8, which at this point is closed on the lower contacts, wire a^{13}, and through relay h to ground at G. Relay h is, therefore, energized and so remains as long as a plug is in any jack of the line 241.

The relay being energized allows the drop h^8 to fall on one of the contacts of the signal lamp circuit, but this circuit is incomplete until the exterior end of the armature h^3 falls on the other contact, which it cannot do until the relay h is de-energized. This occurs when the original connection of 241 to 1409 is taken down. The removal of

plug *a* cuts off the current, relay *h* becomes inert, and the armature drops and completes the local lamp circuit, thus lighting the signal. By the position of the plugs the operator knows which two lines the signal relates to. As the lines are already connected all that the operator need do is to ring both subscribers and tell them to go ahead.

The application of the device to common battery working requires

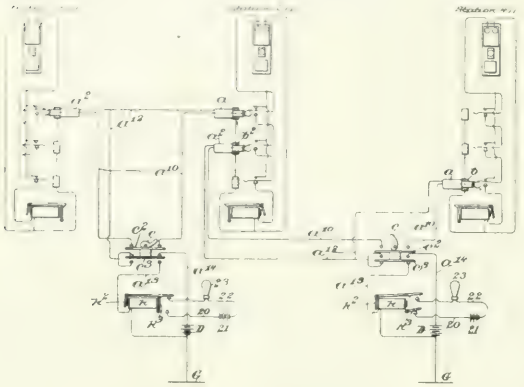


FIG. 2.—HOLLAND TELEPHONE SIGNAL.

a special cord circuit and plugs, as shown in Fig. 3. The signal circuit is practically the same, controlled by the relay *h*, which must be normally energized to keep the circuit of lamp 23 open, closing it only when de-energized. The two special plugs e^2 are shown inserted in jacks of lines 411 and 241, as in the other drawing. The jacks of a connected line being charged from battery *D*, plug e^2 conveys current to relay *h* as long as a connecting plug is in a jack of line 241. When the connection between 241 and 1409 is taken down the current

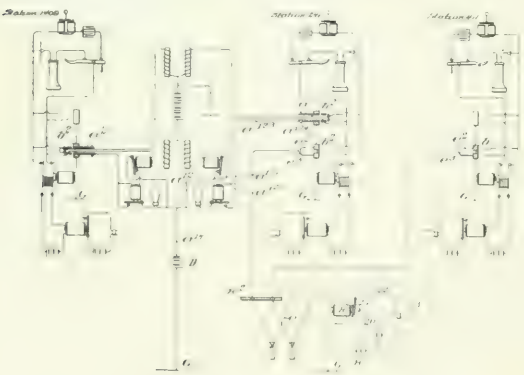


FIG. 3.—HOLLAND TELEPHONE SIGNAL.

is cut off and *h* is de-energized, lighting the signal. The operator then has to withdraw the special plugs and establish the connection between 411 and 241 in the regular way. The special plugs e^2 falling on the plate H^2 close battery *H* on relay *h* by means of the contacts e^3 at the base of the plugs and so maintain *h* energized and the local lamp circuit open.

Fig. 4 illustrates a device for connecting the signal circuit to a



FIG. 4.—CONNECTING PLUG.

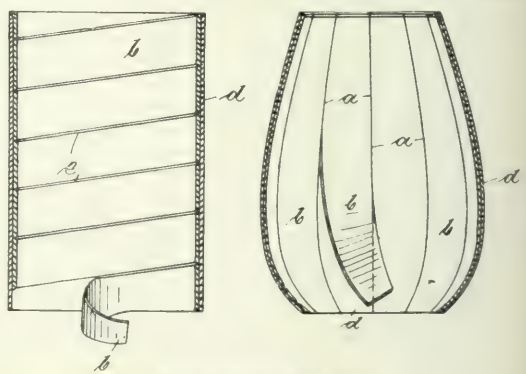
plug instead of to a jack when the jack of the line to be waited for available to the operator is already occupied by a plug which would occur when she herself had put up a connection in the multiple jack of the line in response to a previous call. This is a sort of hollow plug made to fit over the ordinary plug and making contact with it by means of the sleeve A^2.

There are many obvious difficulties in the way of the adoption of this ingenious device in practice in large exchange. To begin with, it is not applicable to trunked connections, which at once bars it out from all large systems, in which trunked calls form the greater proportion of the traffic. This practically limits its field to single exchange system employing multiple boards. In the next place, there is nothing to prevent two or more signal cords being plugged into the same line, and in practice this might be expected to happen often, resulting in a proportionate amount of confusion when several operators simultaneously got the signal to go ahead with a waiting connection—and went ahead. Again, the subscriber whose line was being waited for might often want a connection other than that arbitrarily made for him as soon as his line was free. In fact, so many disadvantages can be foreseen when actual traffic conditions are considered that the outlook for practical use of this invention is very unpromising.

Refining and Electro Deposition of Nickel.

Mr. Titus Ulke, of Sault Ste. Marie, Canada, in a recent patent, proposes a new solution of the old problem of separately recovering copper and nickel from alloys of those metals, and especially from the Bessemerized matter from Sudbury ore, rich in copper and not above 20 per cent in nickel. His method is briefly as follows: The alloy is cast into anodes and as such dissolved in a hot acid solution of the sulphates of its constituent metals, copper cathodes being used and copper precipitated in reguline form. Under these conditions the electrolyte tends to become rich in nickel and poor in copper, and the balance is restored by a double operation consisting in the periodical withdrawance of such proportion of the electrolyte as represents the excess of nickel, and the restoration of a quantity of acid copper solution corresponding to its deficiency in copper. In this manner an invariable constitution of bath is secured, and hence constant electrochemical conditions—a valuable feature, since in refining practice a minute and continuous adjustment of current density is impracticable.

To recover nickel from the withdrawn portions of the electrolyte



ELECTRO DEPOSITION OF NICKEL.

ammonium sulphate is added, and the acid solution refrigerated, whereby the double nickel-ammonium-sulphate is precipitated, this portion of the process following closely the procedure patented several years ago to Professor Ricketts. Metallic nickel may be obtained by redissolving this precipitate in water, rendering the solution alkaline by ammonia, and electrolyzing hot. In this deposition anodes of lead are preferably used, and are said to remain practically intact. It is to be hoped that this promising method may receive a commercial trial.

The recent work of Foerster and others upon the electro-deposition of nickel has proven the entire feasibility of obtaining thick deposits of the metal, capable of being rolled or hammered, and of the highest technical value for the direct formation of articles by electro-deposit. Such deposits are obtained, however, only from hot solutions, and consequently the usual matrices of wax or fusible compositions are inapplicable. Fusible metal cores are subject to the objection that they alloy with the metal of the deposit to an extent that renders it impossible to obtain clear and brilliant surfaces, and collapsible molds are expensive and difficult of construction. An ingenious matrix, recently patented to Carl Steinweg, of Ludensheid, Westphalia, solves the problem in the manner indicated in the ac-

companying figures. The matrix is formed of a metal or alloy of low tensile strength, of which lead may be taken as an example. The external face of the matrix is smooth and forms the base of the electro-deposit *d*; its inner surface is grooved as indicated at *a* and *e*, along such lines as will permit the sections *b* embraced between the grooves to be torn or stripped from the interior of the finished article. Matrices so formed are free from limitations of form or size.

Statistics of the American Gas Industry.

A report by Mr. Arthur L. Hunt has just been issued by the United States Census Office on the gas industry of the United States during the census year, 1900. They are not only of interest in themselves as showing the condition of a great industry, but are of special value to those engaged in the production of electric current for light, heat and power. According to Mr. Hunt, the indications are that the number of establishments engaged in the industry is not increasing to any considerable extent. This is made clearer when it is stated that while there were 66 new establishments constructed during the past decade, 92 establishments from which reports were received in 1890 failed to make returns in 1900. Of this latter number 47, or over one-half, were not in operation, having been dismantled, closed indefinitely or changed to electric plants. Of the 45 establishments remaining, nearly one-third now distribute natural gas; a few failed to make returns for census purposes; and 18 establishments that were

Mr. Hunt states that in eight States there has been a decrease in the number of establishments. This decrease is caused, as noted above, by the number of establishments reporting in 1890 that in 1900 were either abandoned or had lost their identity through consolidation. The greatest increase in number of establishments reported was in Illinois, which showed an increase of 17, followed by Pennsylvania with 16 additional plants. Of the 66 establishments which commenced operations during the decade, 12 were located in Illinois, 6 in New York, and 5 each in Michigan and Ohio. In Arkansas, California and Illinois new plants were constructed during the census year.

The accompanying table below sums up Mr. Hunt's results:

COMPARATIVE SUMMARY, 1850 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	Date of Census.					Per cent of increase.		
	1900.	1860.*	1870.	1800.	1850.	1890 to 1900.	1860 to 1870.	1850 to 1860.
Number of establishments	877	742	300	221	30	18.2	76.5	636.7
Capital	$507,000,500	$258,771,795	$71,773,694	$28,848,726	$6,674,000	119.1	148.8	332.3
Salaried officials, clerks, etc., number	5,904	‡1,864	§	§	§	216.7	.....	.....
Salaries	$5,273,500	$82,143,100	§	§	§	140.1	.....	.....
Wage earners, average number	22,459	12,996	8,723	5,730	952	72.8	52.2	501.0
Total wages	$12,436,296	$8,449,625	$6,549,734	$2,321,536	$390,684	46.3	182.0	494.2
Men, 16 years and over	22,446	12,952	8,705	5,730	950	73.3	51.0	503.2
Wages	$12,431,234	$8,492,797	§	$2,321,536	§	46.4	...	...
Women, 16 years and over	10	.....	.....	.....	2	.....	.....	¶100.0
Wages	$4,250	.....	.....	.....	§	.....	.....	.....
Children, under 16 years	3	44	18	.....	.....	¶93.2	.....	.....
Wages	$800	$6,828	§	.....	.....	¶88.2	.....	...
Miscellaneous expenses	$14,769,022	$7,799,385	†	÷	÷	89.4	...	.....
Cost of materials used	$20,605,356	$14,037,087	$10,869,373	$3,067,630	$503,074	46.8	196.4	629.0
Value of products	$75,716,693	$56,987,290	$32,048,851	$12,016,353	$1,921,746	32.9	166.7	525.3

*Includes 15 establishments operated by municipalities. †Year 1880 not reported. ‡Includes proprietors and firm members, with their salaries; number only reported in 1900. §Not reported separately. ¶Decrease.

reported separately in 1890 have since lost their identity through consolidation. The number of new establishments seems small when it is considered that of the 1653 cities and towns in the United States having a population of 2500 and over, there were 826 in which no gas was manufactured. Of the 1244 cities and towns with a population of 2500 and over in 1890, there were only 530 not enjoying gas privileges. Of the 877 establishments shown for the twelfth census, 269, or 30.7 per cent, were operated in connection with the generation of electricity, and it was reported in many cases that the production of gas was attended with an actual loss.

In calling attention to the statistics, Mr. S. N. D. North, the chief statistician of the department of manufactures in the United States Census Office, remarks that the modern tendency toward concentration of industrial enterprises is well exemplified in the gas industry, in which there is an increase, as compared with 1890, of but 18.2 per cent in the number of establishments reporting, while the increase in the capital is 119.1 per cent; the average capital per establishment for 1900 is $646,523, as compared with $348,749 for 1890, the average capital in 1900 being nearly double that in 1890. The increase in the number of cubic feet of gas consumed is 83.7 per cent. The average product per establishment has risen from 49,217,670 cu. ft. in 1890 to 76,503,482 cu. ft. in 1900, an average increase of 55.4 per cent per establishment. The reduction in price from $1.42 to $1.035 per 1000 cu, ft., the average price obtained throughout the United States, has caused the value of products to show a lower rate of increase, the $56,987,290 reported in 1890 increasing 32.9 per cent to $75,716,693 produced in 1900.

Electricity in Turkey.

It is well known, writes a correspondent from Turkey, that electricity is under the ban in the Ottoman dominions. Some American electrical appliances—reading lamps, toys with storage batteries attached, etc., were admitted in September, 1900, by the Constantinople authorities after considerable discussion. At Beirut merchants have succeeded in passing through the Custom House dynamos for the operation of Röntgen-ray machines, but generally speaking, the interdiction against electrical goods, and especially against dynamos, telephones and electrical plants, still exists.

In spite of this one hears continually of plans for electric light, electric railways, etc., even in Asiatic Turkey. The late Sir Ashmead Bartlett is said to have secured before his death concessions for electrical plants in Salonica and in Smyrna. Preferential rights for the construction of electric tramways in Beirut and Damascus were granted the Beirut, Damascus & Hauran Railway (French), which subsequently sold the concession to the Societe de Traction in Paris; and the Beirut Gas Company (also French) has preferential rights to introduce electric light in this city.

Lately rumors of still greater undertakings along electric lines have reached us from America. I quote the following press dispatches:

Jan. 8 (Special).—"If the Sultan of Turkey grants to them the concessions that are being sought after, a United States construction company, of Cleveland, O., will construct electric lines from Cairo, Egypt, to Mount Sinai, and along the coast of the Red Sea to Mecca, with a branch from Mount Sinai to Damascus. These lines are already projected, and the company's chief promoter in the Orient says that Palestine, by reason of the Zionistic movement, is full of possibilities for connecting Jerusalem with surrounding towns. The Cleveland company will finance the lines, with the understanding that it shall do the constructing work."

Jan. 9.—"Trolley cars are to displace the patient ass as a means of locomotion in the Orient. Cleveland and Chicago capitalists have been successful in negotiating with J. F. Spanier, of Rome, Italy, for concessions for electrical lines from Cairo, Egypt, to Mount Sinai, and thence along the coast of the Red Sea through Syria and Arabia to Mecca. A branch is to connect Damascus with the system of Mount Sinai. It is figured that business during a single one of

the annual Mahometan pilgrimages to Mecca will pay a handsome profit on the cost of construction. Letters received from Signor Spanier say that the Sultan of Turkey has granted an important part of the concessions for the system. The Cleveland Construction Company is working under an agreement to finance all the undertakings if given the construction contracts."

It is impossible to foretell when electricity will be given a free field in Turkey. But in view of the progress of Western ideas and methods in these regions it cannot be doubted that the day of emancipation is approaching.

Mr. Ibrahim Sabbag, of the powerful firm of H. Sabbag & Fils, in Beirut, is in correspondence with American capitalists with a view to acquire possession of the provisional concessions for electric street railways and electric light plants in Beirut and Damascus, and he is prepared to assist and co-operate with any bona fide American syndicate who may have under consideration electrical undertakings in Turkey in Asia.

Wireless Telegraphy in Paris.

Paris is, it is stated, ambitious to lead the development of wireless telegraphy. A proposal has been submitted to the municipal council to establish wireless telegraph posts on the boulevards and main streets. House owners, shopkeepers, hotels, restaurants and private citizens are invited to subscribe, just as they do at present for telephone service. Each customer is to have a small receiving post in his residence. The proposed wireless system is to be used for business, social and domestic purposes, but the company looks for its main support from the turf fraternity, and intends to install wireless posts on all the racecourses, so that sportsmen sitting at home in their armchairs will be able to follow the races second by second. The novel enterprise has been referred by the City Council to the technical committee. The advices received do not explain how the recipients of the messages are going to translate them.

Annual Banquet of the Automobile Club of America.

The Automobile Club of America gave its third annual banquet at the Waldorf-Astoria on Friday, March 7, when nearly 200 members and their friends sat down to an excellent dinner and heard some admirable speeches. Professor Elihu Thomson talked from the viewpoint of the expert engineer on the influence and mission of the horseless vehicle; Professor F. R. Hutton, of Columbia University, told of the future of the automobile, and Mr. Marconi coupled wireless telegraphy with the evening's topic in a brief speech, which was something of a surprise. For the first time in this country he described experiments successfully conducted by him for the utilization of wireless telegraphy in automobiling as an aid to military operations. He said of this work: "I shall not bother you with a description of the wireless system, because I do not know very much about it myself. I am at home in this company because I am the owner of two automobiles, a steam motor car and a motor cycle. The motor car is of a heavy, powerful type, selected for the purpose of experimenting with the possibilities of its employment with wireless telegraphy in military departments. The car was fitted with my instruments at Thorneycrofts, in England, and I found that I could talk with my base at a distance of 30 miles while touring the country. This was the limit I found possible, and I believe that the auto car equipped with wireless apparatus will be found of practical military service. The system is a handy thing for automobiles in general, especially when you break down and wish to call for help. I had such an experience in England, and was able to send a wireless message to my base, asking that dinner be kept hot. On another trip I thought two English policemen were after me with unpleasant intentions. I sent a message from my automobile and was able to notify friends to be ready to follow after and bail me out if the 'bobbies' should catch up with me."

President Shattuck was heartily applauded when in the course of a careful presentation of the needs of New York State for an improved public highway system he said: "We are ashamed that it has been necessary for the Legislature of this State to pass stringent laws to prevent the abuse of the highways by the owners of automobiles. This club believes that roads belong to all citizens in common, and that the owner of an automobile has no more right upon them than any one else, and, indeed, that the nurse pushing a baby carriage has far more right than he. We do not defend for a moment the driver of an automobile who goes at a furious pace, taking the middle of the road, and blowing his horn as an intimation to the rest of the world that it get into the ditch, or be killed if it stay in the road. There are a few such persons and they should be driven from the highways. We believe that we have persuaded the Legislature at Albany to enact a reasonable law which will prevent excessive speed and the inconsiderate use of the highways."

Borough President Jacob Cantor, of the Borough of Manhattan, promised smooth and unobstructed pavements "inside of two years, and, if we have the luck to stay, two years more."

Grand Rapids, Holland & Lake Michigan Rapid Railway.

At the Chicago Electrical Association meeting, March 7, Messrs. George A. Damon and William D. Ray described the construction and operation of the recently completed Grand Rapids, Holland & Lake Michigan Rapid Railway. Mr. Ray took up that part of the work which came under his supervision as electrical engineer of the Detroit Construction Company, which built the road, and Mr. Damon touched more particularly on the construction of the power house for which the Arnold Electric Power Station Company, of which he is managing engineer, had the contract. This road employs alternating-current distribution with sub-stations and rotary converters. The transmission voltage is 20,000 volts. Both trolley and high-tension feed wires are carried on center-pole construction, between the tracks. Two three-phase high-tension lines are placed on top of the poles on two cross arms and barbed wire is also run at the top of the poles on insulators placed at the apex of each pole for lighting protection. Provo glass insulators were selected. The power house has three-phase Westinghouse generators generating at 390 volts for use at the station direct in operating rotary converters. Step-up transformers raise to 20,000 volts for transmission. Static interrupters have been placed in each high-tension line next to the high-tension transformers. These interrupters are put between the high-tension switches and the transformers, and are for the purpose of avoiding dangerous high-voltage static effects when the circuit is open.

The paper went into the various engineering details connected with the construction of the road to considerable length and contained many features of interest.

Electrical Progress in British Honduras.

Mr. W. L. Avery, the United States Consul at Belize, British Honduras, writes to the State Department as follows: An appropriation of $10,000 has been voted, the consent of the Home Government ganted, the contract signed, and work has begun on the first telegraph line in this colony. This line will extend from Belize to the Rio Hondo, a distance of 100 miles, and offices will be established at Belize, Corozal, Orange Walk, and the Hondo River, and at the last-mentioned place business will be transferred to the overland line through Mexico.

Though Belize is only 850 miles from New Orleans, it has never had the benefit of telegraphic service, and a message from Europe or the United States, if forwarded on a given Thursday, could not be delivered here until 10 days later, and any message would take at least four days, being sent from New Orleans by mail steamer.

It is proposed that a telephone service be established at each of the offices; and in order that one wire may serve both purposes, the circuit will be shut off for two hours each day, giving ample time for local business. As three months are all that are required to build the line, it may be assumed that by May 1, 1902, Belize will be in closer touch with the rest of the world.

A bill is now before the colonial councils extending authority to the district board of Belize to contract for the establishment of an electric light plant in this town, and granting the contractor the privilege of lighting public and private houses. The bill will undoubtedly become a law, and the oil lamps of this town will soon be a thing of the past. The equipment for the telegraph line has been ordered principally from New York, and the material for the lighting plant will also be ordered from the United States.

CURRENT NEWS AND NOTES.

CORNWALL CANAL PLANT.—In the article in our issue of March 1 it should have been added that the plant was constructed by T. Pringle & Son, under the direction of their engineer, Mr. F. H. Leonard, Jr.

MOVING SIDEWALKS.—Commissioner Lindenthal, of the Brooklyn Bridge, has proposed the adoption of the moving sidewalk plan, to relieve the congestion of travel there, and would run the "sidewalks" across the Bridge and back in a circle, as at Paris in 1900. He would use three tracks, with speeds of 2½, 5 and 7 miles an hour.

NEW YORK ELECTRICAL SOCIETY.—The 222d meeting of the New York Electrical Society will be held at the College of the City of New York, corner Lexington Avenue and Twenty-third Street, at 8 o'clock, Friday evening, March 14. Professor Joseph W. Richards, of Lehigh University, will lecture on "The Electro-Chemical Industries at Niagara Falls."

"TELAUTOGRAPH" EXPERIMENTS.—The following dispatch, which may possibly refer to the "telegraphone," was sent from Paris on March 8: "The telautograph, an instrument which transmits handwriting by telephone, has just been tried in the central telephone office of Paris. Experiments were conducted over the Paris-Lyons wire, and, except for a slight tremor due to induction, were perfectly successful."

WIRELESS TELEGRAPHY FOR U. S. NAVY.—A special telegram from Washington of March 3 says: "On the recommendation of Rear Admiral Bradford, chief of the Equipment Bureau, the Navy Department has arranged for a test of the comparative merits of the wireless telegraphy systems of Marconi and Slaby and Arco, the German inventors. Sets of instruments have been ordered and the test will be made between the Washington Navy Yard and the Naval Academy at Annapolis. Stations are being erected at the Navy Yard and the Academy."

EXPOSITION DEBRIS.—The following from the *Pall Mall Gazette* is interesting, but we do not vouch for it: There are still vestiges of the Great Exhibition encumbering the Champ de Mars. Some one has wondered what has become of the Trottoir Roulant, which carried its passengers, leaning in a melancholy attitude upon its brass-knobbed sticks, round the Exhibition, and incidentally round a great deal of Paris. It was carried away to Australia, there to pursue its snake-like course for the pleasure of the Colonials, but its last end appears to have been the scrap heap. As to the electric railway, that is doing duty as a common train in Brittany. But at least it has its use in the world.

IOWA TELEPHONE ASSOCIATION.—A meeting of the Iowa Telephone Association, in Des Moines, Iowa, is scheduled for March 11 and 12. Following is the programme: "A Clearing House System for Settling Interline Toll Accounts," by Dr. Herr, of Ottumwa; "An Iowa Tariff Book," by E. H. Martin, Webster City; "Toll Line Traffic," by George N. Bandy, of Perry; "One Year's Experience with Checking Bureau," by Dr. Bennett, Waterloo; "Our Duty to Each Other," by P. C. Holdoegel, of Rockwell City; "What I Know About the Farm Line Movement," by F. C. Musson, of Atlantic. Papers will also be read on "Cable Work for Small Exchanges," and "Shall We Establish a Central Purchasing Bureau?" Mr. H. C. Raney, of Fairfield, is president of the Association, and Mr. Charles C. Deering secretary.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The applicants for membership in this society now number more than 300. The inaugural meeting will be held in Philadelphia Thursday evening, April 3, and is to be followed on Friday and Saturday by sessions to be held at the electro-chemical lecture room of the University of Pennsylvania at Philadelphia, for the reading of and discussion of papers. Twenty papers have been promised, and a large proportion of prospective members from the Eastern and Western States will attend. Friday evening will probably be devoted to social intercourse, and Saturday afternoon to visits to places of interest to electro-chemists. The detailed programme of the meeting will be duly issued. Mr. Carl Hering, 929 Chestnut Street, Philadelphia, is temporary secretary.

OMAHA UNDERGROUND WIRES.—The Omaha City Council has passed an ordinance requiring all electric wires used for light, heat, power and other commercial purposes, excepting telephone, telegraph and street car service, to be placed underground, in the business district of the city, before May 1, 1903. The conduits are to be constructed under the supervision of the city electrician, and work will begin immediately. The Nebraska Telephone Company have had a system of conduits in use for several years, but claim they have none to rent. The New Omaha Thomson-Houston Electric Light Company has had a plan under consideration for some time, but wished to be assured that any other lighting company attempting to install a plant in Omaha would not be permitted to string overhead wires when they had been themselves at a heavy expense to put wires underground.

TELEPHONING OVER TELEGRAPH CIRCUITS.—A telegram of March 3 from Chicago says: A train crew 400 miles from Chicago talked over the telegraph wires yesterday with Chief Operator Parsons, of the Illinois Central Railroad, at the Twelfth Street depot. As a result the railroad telephone invented by R. J. Tillman was declared to be a success. The train was stopped near Fulton, Ky., and theTillman telephone was connected with the regular telegraph wire running to Chicago. In spite of the fact that the message had to travel over iron wire, which ran parallel to more than a score of other wires, every word was distinctly heard by Mr. Parsons. The inventor asserts that it makes no difference whether or not telegraphic messages are being flashed over the wires simultaneously with the telephone message. This was tested by the successful transmission of a telegraphic communication from Fulton at the same time Parsons was conversing with the crew.

TELEPHONY IN CANADA.—The Dominion Government bill recently brought forward regulating telephones and telegraphs provides that the lines shall be so constructed as not to interfere with the public use of roads and highways or impede free access to any building. Tolls may be fixed for either the whole or any particular part of the company's line, but such tolls are to be uniform to all persons, and are to be approved by the Governor in Council. No company is to make any secret rebate to any customer. After two months' notice, the Government may assume possession of the property of any company, and, in the event of a difference as to compensation, reference is to be made to three arbitrators. A clause makes it compulsory upon a telephone company to supply telephone connection to any applicant upon the payment of lawful tolls. Power is vested in the Railway Committee of the Privy Council to determine any complaint respecting tolls charged by telephone or telegraph companies, unjust preferences by any company, and anything which the act requires or prohibits.

TREATMENT OF REFRACTORY GOLD ORES.—A patent issued March 4 to Henry Renner Cassel, of New York, proposes to treat such refractory gold ores as the sulphides and tellurides by electrolytic oxidation, thereby avoiding the preliminary roasting and its attendant losses. The ores are converted into a pulp with dilute sodium chloride solution, and agitated between carbon electrodes, the polarity of which may be reversed at will. Tellurium and sulphur are oxidized and the precious metal dissolved, the latter being at once reprecipitated in the form of a black non-adherent powder, which is scoured from the cathode by the abrasion of the core, and remains in the pulp, to be afterward recovered by the addition of cyanide or other suitable solvent. The apparatus, which forms the subject of a separate patent of the same date, consists of a carbon-lined vat with a carbon agitator, the lining and stirrer constituting respective electrodes. The novel feature of the process lies, not in the oxidation of refractory ores through the intermediary of the oxychlorides of sodium, but in the maintenance of current conditions to precipitate the gold in the particular readily soluble form above referred to.

UNDERGROUND WIRES.—Because of its experience in the recent storm the Pennsylvania Railroad Company has decided to lay all its wires between New York and Philadelphia underground, and will start the work at once.

PENSIONS TO EMPLOYES.—The New York Metropolitan Street Railway announces a plan for the establishment of a pension system for superannuated employes. The maximum age is 70 years, but those whose ages range from 65 to 69 may be retired under pension if found incapable.

INFORMATION WANTED.—We have received the following communication: "Gentlemen: I'm making parts of some new motive power machines and cannot put them together. Some one in the tenement over the shop wants to steal the idea with an X-ray machine. *How can I successfully prevent its action?*" We might suggest moving out.

"AT THE TELEPHONE."—A few months ago a gruesome play of the above title was produced in Paris. It has now been done into English, and a cable dispatch of March 1 says: "Charles Warner created a veritable sensation by his terribly realistic presentation of 'Heard at the Telephone.' This is one of the most blood-curdling of even the French plays, and Mr. Warner's portrayal of the husband who listens at the telephone miles away while his family are being murdered by burglars won for him an ovation such as London first-nighters rarely give."

LIGHTING ST. PAUL'S CATHEDRAL.—A cable dispatch from London, of March 8, says: The long-talked-of installation of electric light in St. Paul's Cathedral is nearly completed. Worshippers on Easter eve will see the new light there for the first time, though not in entirety, perhaps. All the wires are now ready, but for some reason there has been delay in getting the standards fixed. Not quite all of these will be fixed by Easter, but the choir will be seen in a blaze of light. It is estimated that the change from gas to electricity, the gift of Mr. J. Pierpont Morgan, will cost $50,000.

SHAWINIGAN FALLS TRANSMISSION.—The Shawinigan Water & Power Company has about completed its arrangements for the transmission of power from Shawinigan Falls, Que., to Montreal, a distance of about 80 miles. The Shawinigan Company has decided to use aluminum wires, in place of copper, for transmitting energy to Montreal. The Pittsburg Reduction Company is already manufacturing aluminum, on a large scale, at Shawinigan, and the company intends to at once install a plant for the working of aluminum into wire of various forms, including cables for the transmission of electric power.

AUTOMOBILE ENDURANCE RUN.—The Automobile Club of America will hold a 100-mile non-stop endurance contest on Decoration Day, Friday, May 30, 1902, starting from the clubhouse at Fifth Avenue and Fifty-eighth Street, and running 50 miles to a point near Bridgeport, Conn. (Southport), turning there and running back over the same road to the clubhouse without stopping. The road will be marked by yellow arrows. Reliability and endurance (not speed) are the underlying principles of the contest. The officials are: Winthrop E. Scarritt, chairman; George F. Chamberlin, John A. Hill, contest committee.

FIFTY-THOUSAND-VOLT TRANSMISSION TO BUTTE.—Word has just been received from M. H. Gerry, Jr., manager of the Missouri River Power Company, of Helena, Mont., that the 50,000-volt transmission line which this company recently built from its power house at Cañon Ferry on the Missouri River to Butte, Mont., has been successfully started, that the load is being taken on slowly and that all is working smoothly and no trouble is being experienced. Particulars of this 70-mile transmission can be found in ELECTRICAL WORLD AND ENGINEER of July 13. The transmission line of the Bay Counties Power Company, of San Francisco, has been designed to operate ultimately at 60,000 volts, but at latest reports had not been raised above the 40,000 volts at which it was recently started. If this is true, the Cañon Ferry Butte line is operating at the highest voltage yet put in every-day commercial use. The Bay Counties line has been run at 80,000 volts for short periods.

PROPOSED ELECTRIC RAILROAD IN SWEDEN.—Mr. Robert S. S. Bergh, United States Consul at Gothenburg, Sweden, writes the State Department as follows: The problem of employing electric power instead of steam for railroads receives more and more attention in Sweden. It is stated that the managers of the State railroads are making investigations in this direction, and a recent newspaper article announces that private concerns are also interested in the matter. A Gothenburg newspaper reports that the board of managers for the Falun-Vesterdalarnes Railroad Company has sent to the government a petition for the gradual adoption of electric locomotives, instead of steam engines, throughout the whole country, and the utilization of water power. The petition mentions that a machine firm in Switzerland has made a proposition to use the Huber system, by which an electric current can be generated when a train passes down inclines, which current can be utilized by other trains on the same road. The Swiss firm proposes to furnish the necessary rolling stock, a Swedish company will suply the electric power, and the railroad company is to furnish railroad lines for the experiment. But cash is still needed for the building of transformers, for raising the current to 16,000 volts and changing the same from three-phase curent to two-phase, for electric connection of the rails, etc., all of which it is estimated will cost 100,000 kronor ($26,800). The petitioners ask the government to furnish the money needed.

ELECTRO-PLATING BATHS.—M. Jules Meurant, of Liege, Belgium, in a recent patent describes a series of baths for the electro-deposition of zinc, tin, nickel, copper and silver, the characteristic feature in all cases being the addition to a neutral or alkaline solution of the metal, of an organic non-electrolyte, generally a carbohydrate, and in the majority of cases a polyatomic alcohol or derivative. The chief interest of the patent is in the bath described for the deposition of adherent coatings of zinc upon steel. This solution is formed by precipitating zinc from its chloride solution as carbonate, redissolving in ammonium chloride, and adding for each kilogram of zinc chloride taken, 300 grams of gum arabic or equivalent amounts of sugar or glucose. The patentee states that steel tubes coated with zinc from this bath were successfully submitted to the following tests preparatory to their acceptance by the Dutch Navy: (1) Crushing to completely flatten the tube; (2) folding the flattened tube upon itself; (3) crushing a ferrule cut from the tube in the direction of the axis of the cylinder; (4) elongation test of 27 per cent; and that the protecting layer of zinc showed no alteration either by scaling or breaking. Zinc baths containing carbohydrates are well known in the art, having been patented in France by Blas and Miest, in Germany by Kaselowsky and Basse, and in this country by Frauenfelder and Meyer; the claims of the present patent are limited, therefore, to the specific procedure in preparing the electrolyte.

ELECTRO-CHEMISTRY IN SPAIN.—Mr. Julius G. Lay, U. S. Consul General at Barcelona, Spain, writes in a report to the U. S. State Department: The important trade in "rough" chemicals for industrial purposes, for her supply of which Spain was entirely dependent upon foreign countries, induced some resident German engineers to plan the construction of works for the manufacture of two of the chief articles, i. e., chloride of lime and caustic soda. The electrolytic system of production was selected, and the company, under the name of Sociedad Electro-Quimica de Flix, commenced building operations in 1896 at the town of Flix, about 100 miles from Barcelona, on the railroad to Madrid, securing easy facilities of transport, cheap labor, a sufficient water supply, and access to plentiful limestone and salt deposits. The company started with a capital of 4,000,000 pesetas (about $600,000), and the estimated output of the works was 5000 tons of chloride of lime and 2000 to 2500 tons of caustic soda. At the end of 1899, the company began to place its manufactures on the market, causing some uneasiness to the foreign makers of these articles, as prices at that time had a decided upward tendency, and it was feared that considerable sacrifices would be necessary to meet the new competition. So far as can be ascertained, however, the Flix works have not fulfilled expectations. Foreign manufacturers have not suffered to any appreciable extent, and the imports of bleaching powder and caustic soda during the last two years show little, if any, falling off.

LORD KELVIN, accompanied by Lady Kelvin, has arranged to sail for this country April 12, arriving April 19. The American Institute of Electrical Engineers is consulting his wishes by arranging to hold the proposed reception in his honor on Monday, April 21. Columbia University seems likely to be the place. Lord Kelvin will be here only two or three weeks.

A BOOK BY MR. MARCONI.—"Wireless Telegraphy" is the title of the volume just completed after two years' work by Marconi. It will be published this spring by McClure, Phillips & Co. It recounts the experiments from the beginning to the final success, when the three dots received on the Newfoundland coast told the young inventor that he was in communication with Europe. The book is not technical, but it explains the new science of telegraphy so as to make it interesting and comprehensible to the general reader. It also is said to give an insight into the personality of this "twenty-seven-year-old wonder-worker." Mr. Marconi will, it is stated, personally supervise the making of the book, which includes many diagrams of scientific importance.

WIRELESS TELEGRAPHY IN MEXICO.—For some time a number of employes of the Mexican Federal telegraph lines have been busily engaged with a series of wireless telegraph experiments in the vicinity of Vera Cruz. This work is being done on the flat country adjacent to the coast, and proved so successful that the Government will prosecute it on a much more extensive scale. The present apparatus is placed on elevated platforms 14 meters above the ground. The employes will leave for Yucatan on the receipt of the necessary equipment that will permit them to continue their operations on a larger scale. The distances between the sending and receiving instruments will be gradually increased, and the effect of extending the distance will be carefully studied. It is possible that before the close of the present year the work will have so far advanced that the various ports along the coast will be equipped in such a manner as to allow of their uninterrupted intercourse with each other, as well as with the various lines of vessels that ply between Mexican ports.

NEW MEMBERS OF THE INSTITUTE.—At the meeting of the board of directors of the American Institute of Electrical Engineers on the afternoon of February 28, the following associate members were elected: Ayres, Albert Doane, salesman Westinghouse Electric & Manufacturing Company, 3803 Grand Boulevard, Chicago, Ill.; Burton, Charles Gillette, salesman Westinghouse Electric & Manufacturing Company, 6328 Greenwood Avenue, Chicago, Ill.; Chester, M. E., telephone engineer Western Electric Company, 463 West Street, New York; Chubbuck, Leonard Burrows, checker in draughting room, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Cooper, William, general superintendent, Bullock Electric Manufacturing Company, Cincinnati, Ohio; Cowen, Julian Betty, manager of export department, General Incandescent Arc Light Company, 572 First Avenue; Dryer, Erwin, salesman and engineer, Westinghouse Electric & Manufacturing Company, Chicago, Ill.; Eley, Josiah Norfleet, electrician and operating engineer, Georgia Electric Light Company, Atlanta, Ga.; Ferris Robert Murray, Jr., engineering department, the N. Y. & N. J. Telephone Company, 81 Willoughby Street, Brooklyn, N. Y.; Fuller, Edwin Ernest, representative engineer for Scotland for the British Thomson-Houston Company, Abbottsford, St. Andrews St. Ayr, Scotland; Lloyd, Edward William, assistant superintendent of construction, Chicago Edison Company, 139 Adams Street, Chicago; Miller, Geo. E., assistant to fourth vice-president E. & M. Company, 4911 Center Avenue, Pittsburg, Pa.; Morrill, Edward Francis, engineering department, the New York & New Jersey Telephone Company, 81 Willoughby Street, Brooklyn; Mulligan, Walter Lyon, assistant manager United Electric Light Company, Box 812 Springfield, Mass; Lowson, David, electrical inspector, Department of Electricity, 1721 Park Row Building, New York; Marbury, L. C., electrical engineer, General Electric Company, Schenectady, N. Y.; Ter Meer, Henry C., tester in meter department, Brooklyn Edison Company; Nichols, Louis Charles, electrical engineer, the Converse Transformer Company, Pittsburg, Pa.; Price, Norman I., Sibley College, Cornell University, Ithaca, N. Y.; Gaylord, Truman Penfield, engineer, Westinghouse Manufacturing Company, 610 Dearborn Avenue, Chicago, Ill.; Gibson, John Jameson, salesman, Westinghouse Electric & Manufacturing Company, 171 La Salle Street, Chicago, Ill.; Green, Chas. Maxwell, engineer on Brush arc dynamos, General Electric Company, Lynn, Mass.; Kintner, Charles Jacob, solicitor of patents and expert, 45 Broadway; Kintner, Samuel Montgomery, professor of Electrical Engineering Western University of Pennsylvania, Allegheny, Pa.; Remschel, Cesar Wilhelm August, G. P. O., San Francisco, Calif.; Ruffer, Chas. Shumway, electrician, the Telluride Power Co., Telluride, Col.; Sawyer, Willits Herbert, engineer railway engineering department General Electric Company, Schenectady, N. Y.; Sharp, Clayton Halsey, test officer lamp testing bureau, 14 Jay Street, New York City; Sloan, James Richard, electrical engineer, the Pullman Company, P. R. R. Depot, Jersey City, N. J.; Thomas, Alfred Clarence, engineer, the New York & New Jersey Telephone Company, 81 Willoughby Street, Brooklyn, N. Y.; Wagoner, Philip Dakin, commercial department, General Electric Company, Schenectady, N. Y.; Wilkinson, James, chief engineer Birmingham Railway, Light & Power Company, Birmingham, Ala.; Woodfield, Sydney, assistant engineer Electrical Power Distribution Company, York House, Norfolk Street, London, England. The following associates were transferred to full membership: H. S. Wilson, superintendent Puebla Electric Light Company, Puebla, Mex.; Christopher M. Goddard, secretary, National Underwriters' Association, Boston, Mass.; Byron T. Burt, superintendent, Chattanooga Electric Light & Power Company, Chattanooga, Tenn.; Lewis A. Howland, engineering department, Canadian General Electric Company, Montreal, P. Q.

Letters to the Editors.

Indicator for Measuring Angular Variation.

To the Editors of Electrical World and Engineer.

Sirs.—Having worked along a similar line, I read with much interest the account of the very ingenious arrangement for measuring the angular variation in the speed of flywheels, described by Mr. Mix in your issue of Feb. 8, 1902.

My experience with such devices indicates that possible sources of inaccuracy in the combination described are unevenness in the transmission of motion from the flywheel to the pintle of the friction wheel, and variations in the speed of the inertia wheel, the angular motion of which would possibly have different values, depending on whether the variation in the angular motion of the flywheel had a high or low rate of change. The air friction on the inertia disk would not be inconsiderable.

If the aluminum disk and the inertia wheel run 40 times as fast as the flywheel, there will be indications of the angular variation of speed of the flywheel at points in its motion of revolution 9 degs. apart, plus or minus a small amount depending on the angular speed variation. Hence, as the spots of light must follow each other rapidly, I believe to be correct the opinion expressed in the editorial note on the subject as to the difficulty of measuring the amplitude of vibration of the spot of light, for the spot would be of a very evanescent and elusive character.

I say this advisedly after many experiments with a device now nearing completion, the details of which will shortly be made public. This is intended to give the value of the speed of a flywheel in feet per second at any point in its motion of revolution. I have had great difficulty, just on acount of the elusive character of the value to be measured, in determining whether the readings obtained were accurate or not. Numerous experiments under varying conditions had to be made to locate the different causes of error, and one by one they were discovered and either removed or compensated for, until at this time the device is, I believe, an instrument of precision.

The device has a positive connection with the flywheel in contradistinction to a friction drive, and the scale is so arranged that the value of the speed can be as easily read, as atmospheric pressure is on an aneroid barometer. With this instrument the value of the speed at positions a small angular distance apart can be measured accurately in feet per second, and curves of angular speed variation can then be plotted, using either the rectilinear or polar system of co-ordinates.

The distinction between Mr. Mix's device and the one above referred to is that his will indicate the maximum angular variation of the speed, while the other will give the absolute value of the speed of the flywheel at any point of its motion. The device is also capable of gen-

eral application as a speed indicator, and the body whose motion is to be measured may move in either a rectilinear or curvilinear path.

BALTIMORE, MD. J. W. DARLEY, JR.

Measuring Three-Phase Circuits.

To the Editors of Electrical World and Engineer:

Sirs.—Your issue of Feb. 22 contains a letter giving what appears to the writer, Mr. M. G. Stratton, to be a peculiar state of affairs in metering the input in watts to a three-phase induction motor. Mr. Stratton has overlooked the fact that with a balanced three-phase load there is normally a phase displacement of 30 degs. between the current in one of the conductors (A) and the e. m. f. between this conductor and either of the other two (A to B, or A to C), even when the load is quite non-inductive.

Under these conditions (i. e., balanced non-inductive load) the two single-phase wattmeters connected as shown will read the same, and if compared with volt and ammeter readings will point to a power factor of 86.6 per cent, in spite of the fact that load is non-inductive, and hence power factor actually 100 per cent. Now, if the load is kept balanced, but made sufficiently inductive to cause a lag of 30 degs., the current and e. m. f. in one wattmeter will be in phase (30 degs. — 30 degs. = 0 deg. displacement), and for the other wattmeter will have an angular displacement of 60 degs. (30 degs. + 30 degs.).

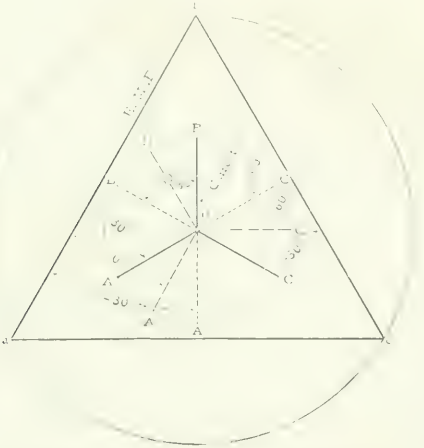


DIAGRAM SHOWING ANGULAR RELATIONS BETWEEN CURRENT AND E. M. F.

Again, comparing with voltmeter and ammeter, the first wattmeter will figure out 100 per cent as power factor, and the second wattmeter 50 per cent. Under this condition the power factor of the three-phase load is actually 86.6 per cent. If now the inductance is increased sufficiently to cause a lag of 60 degs., the power factor of the system will be actually 50 per cent, the current and e. m. f. in first wattmeter will be 30 degs. apart (30 degs. — 60 degs. = — 30 degs.), and for the second wattmeter 90 degs. apart (30 degs. + 60 degs. = 90 degs.). The second wattmeter will not run or indicate, and any further lag of current, i. e., power factor below 50 per cent, will cause this meter to run backwards if a recording instrument, or if an indicating instrument the needle will swing the other side from the zero.

The accompanying diagram shows the angular relations between current and e. m. f. The current coil of first wattmeter is in series with lead A, and its pressure coil between a and b. The second wattmeter has current coil in lead C and pressure coil connected

Referring to the diagram, $a\ b\ c$ is the triangle of e. m. f. OA, OB and OC show phase relation of current for a non-inductive load, or 100 per cent power factor. OA', OB' and OC' for a load with 30 degs. lag, 86.6 per cent power factor; OA'', OB'' and OC'' for a load with 60 degs. lag, 50 per cent power factor.

For the test quoted by Mr. Stratton the power factor should be determined in this manner:

True watts delivered to motor from sum of wattmeter readings,

8,000
3,600

11,600 watts

Apparent watts delivered to motor from ammeter and voltmeter readings:

600 volts × 15 amperes (per phase) × $\sqrt{3}$ = 15,570 watts (apparent)

$$\text{Power factor} = \frac{\text{True watts}}{\text{Apparent watts}} = \frac{11,600}{15,570} = 74.5 \text{ per cent.}$$

The figures appear to indicate that the motor, if a modern type, is about two-thirds loaded, and the power factor for a machine of this size should be somewhat better than the 75 per cent indicated.

BROOKLINE, MASS. JOHN TAYLOR.

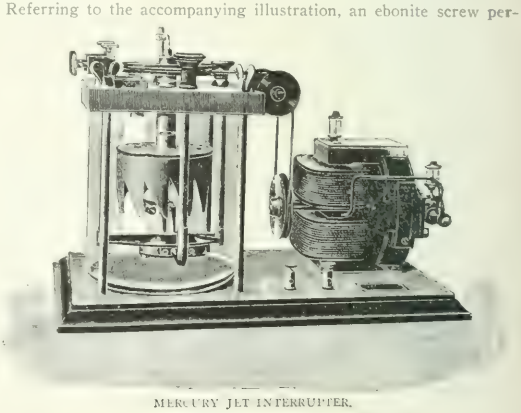
Mercury Jet Interrupter.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Oct. 12, 1901, I read with much interest an article by Dr. Cunningham describing a mercury jet interrupter. He mentions besides other advantages of this apparatus the possibility of varying the duration of the closing of the current from the exterior by employing V-shaped steel leaves and a means of adjusting the same.

I take the liberty of referring to the fact that my jet interrupter, described in No. 41, 1899, of the *Elektrotechnische Zeitschrift*, and in No. 19, Vol. XXXIV., 1899, page 713, of ELECTRICAL WORLD AND ENGINEER, possesses this same means of adjustment, but is much simpler in form.

Referring to the accompanying illustration, an ebonite screw permits the mercury jet to be elevated or lowered while the V-shaped steel leaves are rotating. Moreover, the variation of the number of contacts is accomplished in the same manner as in the construction of Dr. Cunningham, namely, by means of screws attaching the leaves to the disk.



MERCURY JET INTERRUPTER.

It is a matter of opinion whether the non-employment of a fluid non-conductor is an advantage. At present much favor, it may be remarked, is shown toward breaking circuits under oil. I do not consider that alcohol is appropriate, and in my interrupter I use petroleum. This fluid evaporates but little, it has a very high point of ignition and up to date has not given rise to any dangerous explosions in my interrupter. Several hundred of my mercury jet interrupters are in use in Europe for Röntgen ray purposes, and with Tesla and wireless telegraph apparatus. Some of the interrupters are also in use in your country.

In conclusion, I may refer to a remark of Dr. Cunningham, that he proposes to apply "properly adjusted air-gaps in series with the tube." Such sparking gaps make, however, a disagreeable noise and weaken also the useful spark at breaking contact. I, therefore, have used for some time choking tubes or "valve tubes" (Drosselrohren), which weaken the spark only at making contact, but let it pass almost without obstacle at breaking contact. These tubes are simply attached to the Röntgen ray tube, and their use is very advantageous, especially in the operation of "soft" Röntgen ray tubes.

BERLIN, GERMANY. MAX LEVY.

A 19,000-Volt Shock.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Jan. 11, 1902, I notice a communication from Mr. J. R. Cravath relating to an accident to an employe at the Santa Ana Cañon power transmission plant, California. The accident occurred about as related, but the statement that the man received no very large volume of current is in error. In point of fact, the man received a shock of sufficient volume of current at 19,500 volts to blow the fuses on the 750-kw, three-phase, 50-cycle alternator, which was fused to double its normal running capacity.

It is my opinion, formed from noticing short circuits of various resistances which have come in on that line at various times, that this man received at least 50 amperes through his body. The flesh was charred on his heel to the bone, and the flesh on his scalp for a space of 3 inches in diameter was burned to a crisp. The bone was also burned to a crisp, a piece of the bone 3 inches in diameter coming out of the skull of its own accord, leaving the brain bare.

The man sustaining this accident did not remain in this locality until cured, but, I believe, the wound healed without any grafting of skin. I saw the man a few weeks ago, and he is as well and in full possession of his faculties as any man could be. He is now superintendent of the San Joaquin Electric Company's plant at Fresno.

The writer believes that no shock of any potential whatsoever is necessarily fatal, unless the victim has some organic heart trouble, provided the contact endures for but a few seconds and resuscitation is begun within 15 minutes; but no one should become discouraged and cease to endeavor to revive the victim of such an accident for at least two hours. This man came to after an hour and fifteen minutes of patient, deliberate application of the methods of resuscitation as published some years ago by the *Electrical World*.

Los Angeles, Calif. O. H. Ensign.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Iron Alloys: A New Transformer Iron. Ewing, Baily and Brow. A long abstract of a very long (Brit.) Inst. Elec. Eng. paper on "Researches on the electric conductivity and magnetic properties of upwards of 100 different alloys of iron." The adjoining Fig. 1 gives

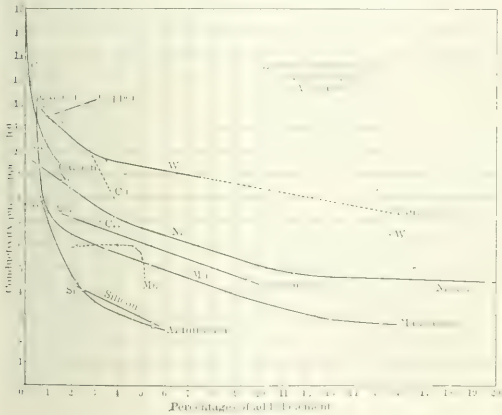


FIG. 1.—ELECTRIC CONDUCTIVITY OF ALLOYS OF IRON.

the change of electrical conductivity for the admixture of one element in increasing percentages to iron. Copper being taken as 100 conductivity, the curves must all begin at about 16, which is the conductivity of pure iron. It will be seen that the greatest reduction of conductivity is always produced by the first increments of the element added. As the percentage increases, the effect produced becomes less, and in the case of the more highly resisting alloys such as nickel and manganese, the difference between the conductivity of a 13 and 18 per cent alloy is hardly perceptible. The effect of carbon is so great that the conductivity of a specimen affords a rapid method of estimating the amount of carbon present. The specific resistance of the added metal affords no clue to that of the alloy. Electric and thermo-conductivity go together in all cases, and the increase of specific resistance of the alloy follows the same order as the increase of the specific heat of the added element, i. e., as the atomic weight decreases. The highest electrical resistance of any known metallic wire, commercially useful, has been found in some of the composite iron alloys. Thus an iron alloy containing 25 per cent of nickel and 5 per cent of manganese has a specific resistance of 97.5 microhms, and a comparatively low temperature coefficient. This alloy is easily drawn into wire, appears to undergo but little change in heating, and is not an expensive product. They then give the results of their tests of the magnetic properties. In general, the addition of anything to pure iron is likely to spoil its softness and permeability, but this is not universal. Silicon, and especially aluminum, improve it when not present in too great quantity. On the other hand, nickel first almost destroys it, so that the specimen becomes almost non-magnetic, but more than 25 per cent makes it magnetic again. In low manganese steels, i. e., when the manganese present does not exceed 3 or 4 per cent, high carbon injuriously affects the magnetic properties of the alloy; but in high manganese steels, i. e., when the quantity of manganese in the alloy is 10 per cent or over, increasing the carbon improves the magnetic properties of the alloy. The hardness of the manganese steels, as tested by the file, agrees precisely with their relative magnetic conditions. The very high remanence and coercive force, as well as the high value of the induction in a 7½ per cent tungsten steel, show that permanent magnets should be made of a steel containing from 5 to 7 per cent of tungsten. The effect of chromium is similar, but not so strong, yet when added as a third constituent to an alloy, the results are quite different with the two elements. The effect produced by the addition of a small quantity of a third element is very remarkable. Thus, high nickel steels are fairly magnetic, but when 5 per cent manganese is added, they become non-magnetic; although a 5 or even 8 per cent manganese steel is magnetic. When only 2½ of nickel are added to the latter, the alloy becomes non-magnetic, yet by itself a 2½ nickel iron is almost as magnetic as pure iron. These and other magnetic changes, such as the slight increase in magnetic susceptibility produced by the addition of copper, are no doubt largely due to the increased hardness or softness of the alloy thereby produced, mechanical and magnetic hardness going hand-in-hand. Of great importance is the promise

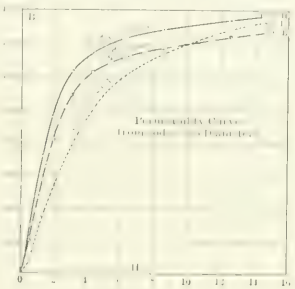


FIG. 2.—PERMEABILITY CURVES.

of a material for transformers which is better than the best soft iron. This is an iron containing 2½ per cent of silicon, which makes a soft and beautiful alloy, easily worked. It takes a good polish, but rusts more easily than pure iron. Even better is the alloy containing 2¼ per cent of aluminum. The results are given in the adjoining Fig. 2. With the aluminum alloy not only is the permeability greater, but the maximum induction in all fields up to about 60 units is also

greater than in any magnetic body yet known. From a theoretical point of view it is a very extraordinary fact that replacing the quantity of pure iron in a body by 2½ per cent of a non-magnetic body should so increase its magnetic qualities. The explanation suggested is that the addition of a small quantity of aluminum or silicon by combining with and removing any oxygen or oxide of iron in the molten metal leaves the granules of iron purer and of closer and finer texture than they otherwise would be. The conductivity of these alloys is poor; see, for instance, Fig. 1. In the discussion which followed, Lord Kelvin said that the increase of permeability produced by the addition of 2¼ per cent of aluminum was a magnificent result, and from that and the great reduction of retentivity it would be clear that this might be of great value in the use and manufacture of transformers. He asked for data regarding the amount of heat produced under alternating magnetization. Barrett gave the following data in which the first figure always refers to pure iron, the second to silicon iron, the third to aluminum iron; for $B = 9000$ the "watts per pound" 1.35, 0.98, 0.75; for $B = 4000$ the "watts per pound" 0.38, 0.27, 0.21; the Steinmetz coefficient 0.0011, 0.00078, 0.00059. Caldwell pointed out that the high resistivity of the aluminum alloy is a benefit as it will reduce the eddy currents and allow thicker sheets to be used in transformers. Barrett said that the question of ageing is still undecided.—Lond. *Elec. Times*, Feb. 20; more briefly, without illustration, in Lond. *Elec.*, Feb. 21.

Direct-Current Dynamo Design.—Clayton.—An article on direct-current dynamo design with regard to commutation. He criticises severely a rule, given recently by Kennedy, as was noticed in the Digest. He says that most designers have some rules to guide them in the right proportioning of field strength to armature strength, and he gives one. But he says that such rules have absolutely no bearing whatever upon the commutating qualities of the machine beyond preventing distortion of the field flux by armature reaction, and hence keeping the position of the brushes fixed during alteration of the load. He urges keeping the ratio value of the field ampere turns for gap and teeth to the armature ampere turns, fairly high. If it is desired to have no shifting of the brushes, it should not be less than 0.7 in large machines to 1 in small sizes. Many machines, especially traction generators, may be seen running in which the ratio is much less than the above, but such machines, although usually stated to require no shifting of the brushes, have a brush position for no load and one for full load. To produce the necessary ratio, a long air-gap with low density may be used or a short one with a high density. He believes, however, that a short gap with high density is preferable, as in such there is less liability of the flux being distorted by reason of armature reaction than in the long gap of low density. It must not be lost sight of, however, that with a short gap of high density, and highly magnetized teeth, one always runs the risk of inducing large eddy currents in the pole faces if the latter be of solid cast-steel, or even of cast iron. One must either laminate the pole-faces or else use partially closed slots, which eliminate these losses to a great extent, but both remedies mean extra expense in manufacture. With solid pole faces and open slots, short gaps can be used without incurring trouble from eddy current losses, by keeping a comparatively low density in the teeth and having many slots of small breadth instead of a small number of broad ones. The reason why highly magnetized teeth apparently help to improve commutation, is that they prevent distortion of the impressed flux. The cost of a machine for a given output and speed can be greatly reduced by using a high strength of armature as compared with field, and hence it is of the utmost importance to be able to use just the maximum without incurring any risk of bad commutation.—Lond. *Elec. Rev.*, Feb. 21.

Alternating-Current Machinery for High and Low Frequencies.—Behrend.—The conclusion of his illustrated article. For higher speeds, the difficulties attendant upon the construction of 60-cycle, slow-speed generators, disappear, but the mechanical construction of the revolving fields for high peripheral speed requires much attention. He then discusses 25-cycle generators, and shows that they are considerably less expensive to build. He compares direct-current motors (which naturally operate at a low frequency) with high frequency motors. The data given by him show that the compact direct-current motor weighs about the same as the disk-like induction motor. The cost of material in both machines is approximately the same, but the total cost of the induction motor is higher, owing to the greater expense of machinery, winding and handling of the larger parts. It is perfectly possible to build rotary converters for 60 cycles, but, in the great majority of cases, the station engineer will prefer the motor generator on account of the smaller number of brush-studs with their brush-holders. In regard to efficiency and cost, the rotary converter is superior to the motor-generator. The 25-cycle system has a powerful ally in the rotary converter. The power plant and the whole electrical equipment, excepting the transformers, are more economical from an engineering and from a commercial point of view. The 25-cycle plant is thus extremely well adapted to the distribution of power and of light wherever three-wire direct-current systems may advantageously be installed. Series arc lighting has to be done by light dynamos driven by synchronous or induction motors for 25 cycles, or by frequency changers. The development of the series alternating-current arc systems is, at present, the mainstay of the 60-cycle systems, although incandescent lighting is not at all a negligent factor in determining the choice of the frequency. He believes that there will finally be a complete differentiation of the central station for the distribution of power, and of such for the distribution of light. The frequency of 20 or 25 cycles will be used for the power systems while the central stations for the distribution of electricity for lighting purposes will be operated at 60 cycles.—*Elec. Rev.*, Feb. 22.

Influence of Sub-station Equipment on Cost of Electricity Supply.—Stewart.—A part of a paper read before the Newcastle Local Section of the (Brit.) Inst. Elec. Eng. He gives detailed estimates as to the cost and efficiency of different equipments of sub-stations. He finally concludes that "taking everything into consideration, it is apparent that only the very strongest engineering reasons can justify the adoption of motor-generators in preference to rotary converters. Such disadvantages as the latter may have are not at all serious, and do not, in the writer's opinion, justify their exclusion from a distribution system under ordinary conditions." In his estimates he finds that the total capital outlay on a sub-station with non-synchronous or synchronous motor-generators is about 20 per cent higher than with three-phase rotary converters and almost 30 per cent higher than with six-phase rotary converters. At the same time the efficiency is about 6 per cent better for rotary converters, including statics, than for motor-generators.—Lond. *Elec.*, Feb. 21.

REFERENCE.

Troubles with Electric Machines.—Schulz.—A convenient summary, in the form of a table, of the different troubles which may occur in practice with direct-current and alternating-current machines (for instance, stray sparking at the brushes of a direct-current dynamo; an induction motor cannot be overloaded, etc., etc.). For each trouble in the columns of the table, the possible causes are given, with hints showing how to find them out and how to repair them.—*Elek. Anz.*, Feb. 16.

POWER.

Electricity in Mining.—Gibson.—An illustrated article on the use of electric power for driving hoists, pumps, fans, drills, locomotives, etc. Brief descriptions are given of a larger number of installations. Incidentally it is said that induction motors are found most valuable in mines, as they are very simple in construction and require little or not attention. The conclusion is that while only a start comparatively speaking, has been made, the introduction of electric machinery is proceeding very rapidly. Indeed, the extent to which electricity is adopted corresponds very closely to the extent to which mine owners and managers become familiar with this new means at their disposal.—*Eng. and Min. Jour.*, March 1.

REFERENCES.

Hydraulic Equipment of the Colgate Power House.—Barbour.—A well illustrated description in detail of the Risdon tangential water-wheels and the Lombard governors, used at the Colgate power house.—*Jour. of Elec.*, Jan.

Electric Power in Cotton Mills.—Whaley.—An illustrated article on electric power in American cotton mills, especially in the South. The well-known advantages of direct connected electric motor drive are discussed.—*Cassier's Mag.*, March.

TRACTION.

REFERENCES.

Telpherage.—Clift.—A well illustrated article on the principal features of construction and some of the uses of aerial telpherage.—*Cassier's Mag.*, March.

Chicago.—Ellicott.—A critical report by the city electrician of Chicago on the conditions of the electric surface street railways in that city.—*West. Elec.*, March 1.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Supply of Electricity in Bulk.—EARLE.—A paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. He endeavors to show that the English power schemes cannot in any way be classed as speculative ventures. He gives an itemized estimate of the cost of installation, working cost, and revenues, for the Yorkshire Power Company, which is one of the proposed companies. It has four power stations scheduled, each of 25,000 hp, the three most important of which are situated on the coal fields and surrounded with factories and works of all descriptions, and with the exception of a small outlying portion of the area, 12 miles is practically the maximum distance to which it will be necessary to transmit energy. Of the total power 15 per cent is assumed to be used for traction, 60 per cent for motors, 25 per cent lighting. A load factor of 25 per cent is assumed. The calculations and estimates are given in great detail. The final result regarding the financial prospects is as follows: The total units per year sold equal 123,700,000, which at a charge of 2.2 cents per unit yields a revenue of $2,835,000; the annual expenditure is $1,588,750, leaving a profit of $1,246,250, which is equal to 4½ per cent on $3,333,330 debentures and 10.9 per cent on $10,000,000 shares capital. He, therefore, thinks that these British power schemes have a great future.—Lond. *Elec.*, Feb. 14.

WIRES, WIRING AND CONDUITS.

Fuse Wires.—MURDOCH.—A communication supplementary to the one noticed in the last Digest. He determined the time of fusing as a function of the current, No. 24 lead-tin wire of 3-inch length being used in all cases. With 6.32 amperes there was no fusion. The times in which the wire fused with 8.4, 12.25, 16.6 amperes were 28, 4.5, 2.1 seconds, respectively. The curve is of similar form to that obtained with constant current and variable length. It would be comparatively simple to design small fuses, so that they would, for a given current, "blow" after a definite time interval. At present almost any sort of length, size of terminals, wire, etc., is used for fuses. This may serve a useful purpose in the case of short circuit, but is frequently useless for cases where the current in a circuit rises to a dangerous extent through some defect.—Lond. *Elec.*, Feb. 21.

Insulation of Conductors of Electricity in India.—SCOTT.—MONCRIEFF.—A paper read before the Calcutta local section of the (Brit.) Inst. Elec. Eng. He first discusses the system of insulation for aerial conductors used by the Indian Telegraph Company, which is suitable for conductors weighing up to at least 1 lb. per yard run and for pressures up to at least 2300 volts. Vulcanized india rubber is a suitable covering for aerial lines. They have still to find out by experience the most suitable system of insulating underground conductors. House wiring, where there is any chance of dampness penetrating the cables, should not be done in wood casing. The climate of India is by no means a bad one for dynamos and motors. In fine wire coils surface leakage must be carefully guarded against. —*Jour. Inst. Elec. Eng.* (Brit.), Feb.

ELECTRO-PHYSICS AND MAGNETISM.

Thermo-Electric Force and Electric Resistance of Nickel, Iron and Copper.—HARRISON.—An illustrated account of an experimental investigation of the variation of the thermo e. m. f., and of the electric resistance of nickel, iron and copper, with the temperature between —200 degs. and + 1050 degs. The thermo-electric change in nickel-copper coincides approximately with the resistance change, but no thermo-electric peculiarity exists for iron-copper at the temperature of the Fe resistance change. As is shown by the Peltier coefficients, a marked change occurs at about 500 degs. in the case of Fe, Cu. This is approximately the temperature at which a flexure occurs in the copper resistance curve.—*Phil. Mag.*, Feb.

Conductivity of High Vacua.—STARK.—An article in which he first discusses the question whether the ether is an electrical conductor or not. According to modern views, a conductor is a body containing ions or electrons capable of free motion. The carriers of electricity are material particles, having a definite size and weight. If, therefore, the ether is regarded as an absolute vacuum, free from material particles, it must be an absolute non-conductor. If, on the other hand, our conception of the ether admits of the existence of ions within it, these ions will encounter no resistance in their motion, and the ether must, therefore, be a perfect conductor. The question thus becomes more a matter of definition than of fact. He applies the same reasoning to the highest vacua which we are at present able to attain and which cannot by any means be considered identical with pure ether. The probable strength of a current passing through a given vacuum is determined by the ionization, the gaseous pressure, and the distance between the electrodes. If the ionization in the gas is constant, the current increases as the pressure decreases, since the ions acquire a greater freedom of motion. But, as a rule, the ionization decreases as the pressure is diminished, for a gas absorbs less energy tending towards its ionization at a low pressure than it does at high pressure. To attain a strong current at a low pressure, a cathode with a large surface and a considerable distance from the wall of the tube must be used, since ionization goes on chiefly at the cathode. If, on the other hand, it is desired to have a small current, or to have cathode rays of high velocity, it is necessary to use a cathode of small surface, placed at a considerable distance from the anode and near the glass wall.—*Phys. Zeit.*, Jan. 15; abstracted in Lond. *Elec.*, Feb. 7.

Velocity of Ions Drawn from the Electric Arc.—CHILD.—A second article on this subject, at the end of which he gives the following summary: He compared the velocities of the positive and negative ions by four different methods. The first is a comparison of the average velocity of the positive with the average velocity of the negative ions. The second and third methods are comparisons of the most rapidly moving of the positive ions with the most rapidly moving of the negative ions. The fourth method is a comparison of the velocity of the slowest ions. In the comparison of the most rapidly moving ions and also in the comparison of the average velocities, the positive ions were found to have the greater velocity. In the comparison of the slowest ions little difference was found between the two kinds of ions. He thinks that these results are not in any way surprising. There is every reason to suppose that from anything as heterogeneous as the ordinary electric arc, many different kinds of ions are produced, so that among the positive ions there may be found the most rapidly moving and also the slowest. In this case the most rapidly moving ones appear to affect the average velocity so that it is greater than the average negative velocity.—*Phys. Rev.*, Feb.

Reflection of Cathode Rays.—STARK.—An article in which he gives a theoretical explanation of the reflection of cathode rays, based on the hypothesis that cathode rays consist of electrons, having a small mass in comparison with material molecules. For an electron, a metallic surface consists of a number of large particles irregularly distributed at intervals which are large compared with their size. When the electrons impinge upon such a surface, they either hit one of the front particles, or penetrate some distance behind the surface. There will be some force at play between the electrons and the molecules, and this force may be either gravitational or electrical. Whatever it is, it will tend to divert the electrons from their original path. The state of things will somewhat resemble that of a swarm of comets meeting a swarm of suns. Some of the comets will impinge upon the suns, and some will describe hyperbolic orbits about them. Some will penetrate far into the swarm of suns, and a few will penetrate the swarm altogether. But their path will have no direct relation with their original path. This is exactly what is known to happen in the case of cathode rays. He enumerates the known laws of the reflection of cathode rays, and finds some very remarkable and striking confirmations of his theory.—*Phys. Zeit.*, Jan. 15; abstracted in Lond. *Elec.*, Feb. 7.

Faults in Vacuum Tubes.—GOLDSTEIN.—A description of a simple method for detecting minute faults in vacuum tubes. He introduces a spark-gap of 12 mm. into the vacuum tube circuit, and then passes his fingers along the wall of the tube. Any fault in the glass is immediately indicated by a prickling sensation and a small spark is seen between the glass wall and the finger. The leak is cemented with gutta percha. If the prickling sensation is objected to, a separate vacuum tube may be used which carries a thin metallic plate attached to one of the electrodes. The sparks then pass to the other electrode which is held in the hand, and produce an optical effect of sufficient intensity.—*Phys. Zeit.*, June 15; abstracted in Lond. *Elec.*, Feb. 7.

Aurora.—STASSANO.—An article in which he brings out some relations between atmospheric pressure and the frequency of auroral display. Auroral maxima coincide with minima of barometric pressure in the upper atmosphere. A similar correspondence is seen in the annual and diurnal periods of the aurora. He believes that the aurora originates in the lower rather than the higher strata of the atmosphere.—*Comptes Rendus*, Jan. 13; abstracted in Lond. *Elec.*, Feb. 7.

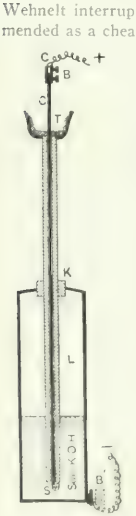
Electro-Chemistry and Batteries.

Artificial Graphite.—Fitzgerald.—An article on the Acheson process of making artificial graphite. In making graphite electrodes they are manufactured of petroleum coke and pitch like an ordinary carbon, such as is used in arc lights, but a certain amount of some carbide-forming material such as silica or iron oxide, is introduced. The electrodes are baked in the usual way, and are then ready for graphitization. To perform this operation they are placed in an electric furnace and heated to a temperature well above that of volatilization, of such bodies as iron, aluminum and silicon. In manufacturing graphite for other purposes, such as crucibles, paint, stove polish, etc., anthracite coal is usually employed. Artificial graphite electrodes are recommended for electrolytic and electro-metallurgical processes, and the advantages claimed for them are long life, low porosity, high conductivity and great economy.—*Eng. and Min. Jour.*, March 1.

Temperature Coefficient of the Daniell Cell.—Chandler.—An investigation of the temperature coefficient of the Daniell cell as a function of the concentration of the zinc sulphate, while the copper sulphate was always kept saturated. At extreme dilutions of the zinc sulphate, the temperature coefficient is negative, it becomes positive at a concentration of ½ per cent and negative again at a concentration lying between 7 and 8 per cent. The temperature coefficient is, therefore, zero at two different concentrations—at ½ per cent and at 7.5 per cent. The changes of temperature coefficient have their analogy in the amount of heat disengaged in the chemical reactions within the cell, and in the amount of e. m. f. itself. The former has a minimum at a concentration of 4 per cent, and the latter has a maximum at half of a per cent.—*Comptes Rendus,* Feb. 3; abstracted in Lond. *Elec.*, Feb. 21.

Units, Measurements and Instruments.

Carbon Electrolytic Interrupter.—A description of a new form of Wehnelt interrupter, shown in the adjoining diagram. It is recommended as a cheap, simple, self-adjusting instrument, well suited for continuous service. *C* is a carbon rod 3 mm. in diameter, and copper plated to within a few millimeters of the tip. This rod fits loosely in a "thistle-tube" *T*, which in turn fits the cork *K* of the lead jar *L* and dips into the electrolyte which is a solution of K O H. The end of the tube *T* has a little stirrup *S* drawn out on one side of it. Upon the point of this stirrup rests the carbon rod *C*. The copper plating, by increasing the conductivity of the rod, prevents excessive development of heat in it. As the rod wears away it slides down the tube and the copper wears off. The cork *K* has a small opening to allow the escape of gases. This interrupter is adapted for use with a 6-inch spark coil directly on a 100 to 110-volt direct-current or alternating-current circuit without the use of resistance in series. If some simple cooling device is used, such as immersing the jar in cold water, the jar may have a diameter of 2.7 cm. and may be 8 cm. high. To allow for automatic adjustment, the carbon rod fits the tube *T* rather loosely, and during operation the liquid is forced up into the bulb of the thistle tube until equilibrium is attained. The period of the interrupter may be varied by varying the depth of the solution. With a solution of one part concentrated K O H to four of water, this interrupter gives a current of 5 to 6 amperes on 100 volts with a 6-inch spark coil intended for use on an 8-inch circuit. By adjusting the stirrup *S*, or varying the size of the rod, an interrupter may be made to give almost any spark length up to the maximum which the secondary of the coil will stand. For use with X-ray tubes, direct current is preferable, but for many other purposes, as for wireless telegraphy, alternating current is preferable, because with it the interrupter works more evenly. This interrupter requires a minimum direct-current voltage of about 65 to 70 volts to give satisfactory results, and works best between 85 and 110 volts. With alternating current the minimum voltage is lower. One striking peculiarity is noticed when the interrupter is used on an alternating-current circuit, with an alternator and a direct-current ammeter in series. When the alternating current reads from 5 to 7 amperes the direct-current ammeter reads about 0.3 to 0.4 ampere. This is not accidental, but this excess current from the carbons to the lead seems to be due to the fact that the current is interrupted a less number of times in passing from carbon to lead than when passing from lead to carbon, for in the first case the break is probably caused mostly by the accumulation of oxygen on the anode, and in the second case mostly by the accumulation of hydrogen.—*Phys. Rev.*, Feb.



Interrupter.

Wheatstone Bridge.—Gott.—A description of what he calls a perfect Wheatstone bridge. In the bridges as hitherto made the wire in each coil of the arms and variable resistance is made of the same alloy, so that it shall vary uniformly, and may be corrected approximately by observing the temperature of the coils. If, however, the set of ratio coils on the line side is made of wire whose resistance does not vary through the ordinary range of temperature, there will be no occasion to observe the temperature of the coils. The bridge becomes self-correcting, whatever be the alloy or metal of which the coils are made, so long as they are all of the same material, and this for any ratio of the arms. He uses a small box containing 10, 100, 1000 and 10,000 ohms of manganine. All the samples of "Eureka" wire which he has tested, vary oppositely to manganine with varying temperature, so that the coils made of the two alloys may be arranged to neutralize any variation. There are several useful purposes which these extra coils may serve. For example, if they are adjusted to standard ohms, a bridge in Brit. Ass'n units can at once be converted into standard units. Several other advantages are mentioned which he believes make the bridge especially valuable at cable stations and on board cable ships.—Lond. *Elec.*, Feb. 21.

Telegraphy, Telephony and Signals.

German-American Cable.—A full illustrated English translation of the German article on the new Emden-Fayal-New York cable, recently noticed in the Digest. There are also some critical editorial notes on it. Attention is called to the fact that the shore and cable on the American side is provided with a double core for a distance of 10 nautical miles, one of these cores forming the line connection, and the other being joined at its sea extremity to the inner side of the sheathing of the cable, thus providing an earth for the receiving apparatus 10 miles out at sea and effectually preventing any local disturbances from stray currents of electric railways. It is questioned whether the Harwood duplex system which is used at the Emden end of the cable is as good as Muirhead's double block system on long cables. First, on account of the difficulty in maintaining high insulation of the sending battery, which is essential for the duplex balance when the battery is placed in the cross-circuit, and, second, on account of the extra retardation introduced by earthing the battery through the artificial line. This latter arrangement has the effect of blunting the impressed wave to a very remarkable degree, with the result that the signals at the receiving end of the cable lack the definition which they possess on the true double-block system.—Lond. *Elec.*, Feb. 14.

Theory of Wireless Telegraphy.—Claude.—An abstract of a paper, read before the Int. Soc. of Elec. in Paris. He assumes a predominating influence for capacity between the antennæ combined with the conductance of the earth. He performed some experiments showing that conductance for high-frequency currents already exists for the earth itself, and that it becomes immensely greater for sea water, a fact which explains the higher efficiency of transmission on the sea. If no actual connection exists between the antennæ and the earth, he states that there is always a capacity which tends to act as an earth connection—either of a plate at the transmission antennæ, or the capacity of the receiving relay. He thus explains the increase in the distance overcome as a result of lengthening the antennæ and the corresponding increase of capacity. The same remark applies to the effect of increasing the diameter of antennæ, an increase which, moreover, attenuates the damping of oscillations. This latter effect is mostly interesting in syntonic telegraphy, which involves resonance phenomena requiring the minimum of damping action. He criticises Ferrie's statement that the length of antennæ should equal one-quarter the wave-length, and contends that these are absolutely independent of one another. In reply, Ferrie briefly expressed his doubts regarding Claude's theory and maintained his opinion regarding the relation between length of antennæ and wave-length.—Lond. *Elec.*, Feb. 14.

REFERENCE.

Wireless Telegraphy.—Ferrie.—His long illustrated paper in full on "The actual state of wireless telegraphy by means of Hertzian waves," an abstract of which was recently noticed in the Digest.—*Bull. de la Soc. Int. des Elec.*, Jan.

Miscellaneous.

Lightning Photographs.—Walter.—An account of experiments in which he photographed lightning flashes with a camera mounted on an inclined axis and revolved with a known speed. One of the photographs shows a flash whose entire duration was 0.15 seconds. It consisted of three separate flashes, with intervals of 0.041 and 0.11 second between them, respectively. Only the first flash shows any branches, probably due to pilot discharges. These confirm the author's view that the flash originates in a brush discharge of positive electricity which penetrates more and more towards the earth. The question of the oscillatory or intermittent character of lightning still remains open.—*Phys. Zeit.*, Jan. 15; abstracted in Lond. *Elec.*, Feb. 7.

REFERENCES.

Electric Furnaces.—The first part of an article giving brief illustrated descriptions of a large number of electric furnaces. Resistance furnaces are dealt with and the discussion of arc furnaces is begun.—*Elek. Anz.*, Feb. 9, 13, 20.

Arnold.—O'Hara.—A biographical sketch with a good portrait of Bion J. Arnold.—*Cassier's Mag.*, March.

New Books.

National Electric Light Association. Twenty-fourth Convention, Niagara Falls, N. Y., May, 1901. New York: National Electric Light Association. 451 pages, illustrated.

The Report of the twenty-fourth convention of the National Electric Light Association forms a handsome volume of 451 pages. Two of the papers contained give it a permanent value, namely, the report of a Committee on Uniform Accounting, and Professor Matthews' report on the photometric value of arc lamps. The value of the latter, however, is much marred from the use of the Hefner unit. The report of the Committee on Uniform Accounting is of great value, as it contains a general outline of a system of accounting upon which there can be based a system for the smallest central station, as well as one for the largest.

Les Tramways Electriques. By Henri Marechal. Paris: Ch. Beranger. 328 pages, 188 illustrations. Price, 10 francs.

This is the second edition, revised and considerably enlarged, of a book first printed some years ago. Of the 12 chapters of the book, seven are almost entirely descriptive. The first chapter treats of generalities and includes a section on the principles of polyphase currents. The second chapter is on the roadbed, and following chapters are on the overhead trolley system, underground contact systems, surface contact systems and storage battery systems. A chapter treats of the rolling stock, and another of the power house and car barns. Chapter IX. considers briefly the production, transmission and transformation of electricity. Chapter X. is on operation, Chapter XI. on finance, and the final chapter relates to French laws and regulations applying to the franchises and operation of electric railways. The portion of the book that will be found of most interest to the American reader consists of the chapters giving descriptions of a large number of underground and surface contact systems. Otherwise the book is rather sketchy in character, and has little or no engineering value.

The Elements of Physical Chemistry. By Harry C. Jones. New York: The Macmillan Company. 565 pages, 67 illustrations. Price, $4.

Professor Jones is certainly a prolific writer. Hardly a year ago his "Electrolytic Dissociation Theory" appeared. Last November a second book of his, the "Elements of Electro-Chemistry," was published. Now we have a third and larger book of some 500 hundred pages, covering comprehensively the whole field of the shorter treatises. Such a Clyde Fitch rate of production can hardly be said to be beneficial to scientific accuracy. To borrow a electro-chemical metaphor, a heavy discharge rate decreases the efficiency of the output.

Marks of hasty work have certainly marred this book. To say nothing of errors in proof-reading, it would be no hard task to fill several columns with examples where Professor Jones has assumed on the part of his readers not only a knowledge of physics and chemistry, but also the ability to read between the lines, to find in the context what properly should be placed in the text. For instance, what is the use of stating in a didactic treatise the fact that the electrodes in the apparatus for measuring resistances of electrolytes should be platinized and not adding the reason for this procedure. In the chapter on electrolytic conduction, in the second class of conductors the Nernst filaments should be certainly included. Recent work on this subject has thrown a great deal of light on the very interesting subject of solid solutions.

As physics is the science of energy and chemistry the science of matter, we have a right to expect in a book on physical chemistry a great deal about energy and the energy-changes of matter, as well as the treatment of the changes of matter as affected by the different physical agents. A glance, however, at the index of this book shows under the heading of energy only one reference, viz., electrical energy. Compared with Nernst's "Theoretische Chemie," where the changes of electrical, thermal, photo-chemical energy into chemical energy, etc., have each their separate references, and where the subject is treated from the standpoint of thermodynamics, the American book, we very much regret to say, makes rather a poor showing.

Although the above criticism of the book on the ground of its being vitally deficient in neglecting the energy side of physical chemistry, as well as many minor details—especially the chapter on "Batteries in General Use," which should be especially full and up to date—yet the book does present some very commendable features as a brief for the dissociation theory of the present Ostwald's school of physical chemists. There is given from cover to cover a wealth of experimental evidence and proofs from this evidence of the substantial correctness of this theory, and as a skillful advocate Professor Jones does not gloss over some minor inconsistencies in his client's case, but exposes them, answers the objections when possible—even refutes many strong objections—explains away inconsistencies, and, in a word, minimizes its weakness as well as magnifies its strength.

Professor Jones brings out well the history of the rise of the new science in elaborating its present developed theory, shows the course of scientific evolution in eliminating the freak theories, but retaining their good qualities in their descendants of the day. The bones of the fossils of former ages help to fix in our minds the comparative morphology of the living animals. The numerous references and translations of the original memoirs emphasize this pleasing feature of the book. The language of the classic authors is often the best medium for disclosing the views held by them.

Then, too, it can be said that the book is up to date in many particulars, as, for instance, in the short account of J. J. Thomson's work on the "Electron Hypothesis." Taking it all in all, considering its merits as well as its demerits, Professor Jones' book is the best volume in English that treats on the subject of physical chemistry. Walker's "Introduction to Physical Chemistry" is too short and not comprehensive enough. Ostwald's "Lehrbuch" is too abridged in the English translation. Palmer has translated Nernst's great German work so inaccurately and imperfectly as to bar it out of any comparison. Accordingly, Professor Jones' book should be on the shelf of every chemist practical or theoretical who wishes to have at hand a book where the outlines of physical chemistry are printed in an available form in English.

BOOKS RECEIVED.

Electrical Engineering Testing. A Practical Work for Second and Third Year Students, Engineers and Others. By G. D. Aspinwall Parr. Philadelphia: J. B. Lippincott Company. 474 pages, 218 illustrations, 31 tables. Price, $3.50.

The Röntgen Rays in Medicine and Surgery. By Francis H. Williams, M. D. New York: The Macmillan Company. 658 pages, 390 illustrations. Price, $6.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, September, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

Power Transmission in Mexico.

The fact that Mexico possesses many admirable water powers within striking distance of her mines and cities has led to considerable electric power development, and in a growing number of the plants use is made of American apparatus. One of the most interesting of these enterprises is that for which an American company has been formed, chiefly by New Yorkers, to utilize the concession and franchise for furnishing electric current in Toluca, capital of the State of Mexico, and in towns adjacent.

The Rossiter-MacGovern Company, of 141 Broadway, New York City, who have successfully financed and built several electric power plants in this country, secured this concession, and have charge of the erection of the plant. The concession covers two separate water powers, aggregating over 8000 hp. Construction was begun on the smaller plant and the work inaugurated with considerable ceremony by Governor Vincente Villada and other leading officials of the State of Mexico in person on Jan. 2, this year. The high price of oil in the locality has made the people very anxious to secure electric light, and the project is regarded with much favor locally.

The plant will have a nominal capacity of 1200 hp, and contracts have already been made for the furnishing of power and light equal to two-thirds of this. The plant was designed by Mr. Alex. Potter, electrical engineer, of 150 Nassau Street, who is in direct charge of construction. The plans have been approved by Mr. W. A. Brackenridge, of the Niagara Power Company. Counsel for the company is



FIG. 1.—SAN SIMONITE FALLS.

Mr. Henry W. Goodrich, of New York City, and its Mexican counsel is Senor Pablo Martinez Del Rio, one of the best known corporation lawyers in Mexico.

Contracts have been let for all the machinery required, and it is expected to have the plant in operation in July next. The Pelton Waterwheel Company are to furnish three 450-hp turbine wheels, together with the steel flume, receiver, etc. The Stanley Electric Manufacturing Company have the contract for three 325-kw generators and transforming apparatus and switchboard in the station, and the General Electric Company will furnish all sub-station apparatus, rotary converters, transformers, switchboard, together with some 300



FIG. 2.—VIEW OF TOLUCA.

of their newest type 1200-cp arc lamps. The Western Electric Company are furnishing some 200 miles of copper wire, and all line material, insulators, etc., together with a complete telephone outfit.

The transmission lines will carry 22,000 volts, at which voltage the power will be transmitted to Toluca, which is about 22 miles from the main station. Power and light will also be furnished to the municipalities of Tenancingo and Tenango, catering altogether to a population of over 100,000. The water of the stream for which power is depended on has its origin in the rain and snow from Toluca Mountain, and is practically constant during the year. Measurements and gauging, which have been in progress since 1895, show a flow of 650 liters or 23 cu. ft. per second, and a fall of 720 ft. in 6000 ft.

The necessary capital required has been furnished by a syndicate, and upon completion of the plant it will be turned over to the Toluca Electric Light & Power Company, a corporation to be formed under the laws of the State of New York. The principal owners include Senator Chauncey M. Depew, W. W. Goodrich, H. C. M. Ingraham, E. V. W. Rossiter, D. H. Valentine, J. L. Greatsinger, T. S. Williams, C. L. Rossiter, H. C. Du Val and John R. Christie, many of whom are well-known in American electrical and traction work.

Small Plant Switchboards.

The General Electric Company now offers a complete line of standard small plant switchboards manufactured in a variety of capacities.

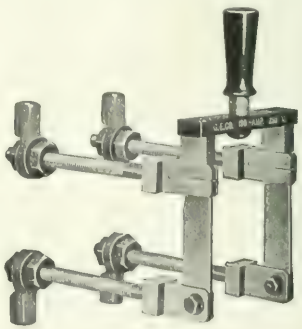


FIG. 1.—SWITCH.

The designs include a complete series of combination generator and feeder panels for low-potential direct-current small plant service. Each of these panels is a complete standard switchboard and is not intended for combination with other panels. The care used in le-

termining just what features should be embodied in panels of this type in order to make them serviceable in the largest number of cases, has resulted in a design embodying standard and finish and efficiency, and which can be produced at a reasonable figure in such quantities that orders may be promptly filled. These small plant switchboards are uniformly made to provide for one generator and two feeder circuits. The material used in the construction of these switchboards is black enameled slate, 1½-inch thick, selected with reference to freedom from impurities. After being baked perfectly dry, the slate is covered with enamel, each layer being baked on and rubbed down, the final hand polish resulting in a hard, brilliant surface. The height of the slate panel is 36 inches for all capacities, the width varying from 16 inches to 20 inches, depending upon the capacity. All exposed metal parts on the front of the board, except live copper, have black oxidized finish.

Two methods of support are manufactured, either of which is supplied according to the requirements. One is known as the angle iron support, the other the bracket support. In the first method, the panel

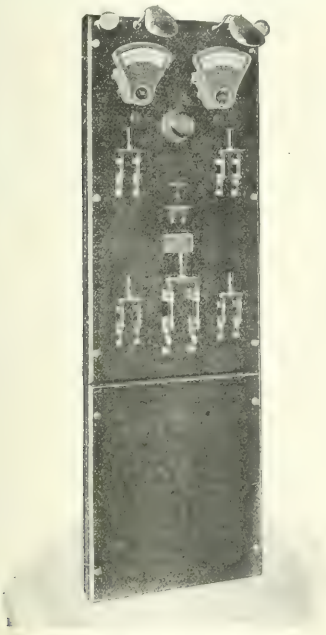


FIG. 2.—WITE BOARD PANEL.

is supported on angle irons 40 inches from the floor, the angle iron being provided with turn buckles and clevises for making wall attachment. In the second method, the panels are secured to the wall by bracket supports independent of the floor.

On these switchboards a General Electric lever switch is used, which conforms with the underwriters' requirements, and has solid forged copper clip blocks and studs. Blades are rigidly fastened to the cross-bars. The blades, clip blocks and stubs are all given a ground finish. The handles of the switches are of hardwood, finished black. All switches are provided with fuses.

On these panels, the ammeter is permanently connected in the generator circuit. The instrument is the company's round dial indicator, which is particularly adapted for long continued hard service. Its few parts are strongly constructed, and having no springs, it is particularly free from liability to change.

Magnetic Traction Device.

The Acme Magnetic Traction Company recently made tests of a magnetic device with a 35-ft. electric street car, in the car barn of the Jackson Street line, Seattle, Wash. The device tested consists essentially of a coil of insulated wire wound around the axle of each pair of driving wheels, the axle and wheels forming a horseshoe magnet, and the rails corresponding to the armature. When the current is turned on, the wheels grip the rails with great force. The increased hold on the track adds greatly to the pulling power of the car, magnetic adhesion taking the place of increased dead weight to increase the traction. The claims for this device are that it prevents slipping of the wheels of cars or locomotives, and in ascending grades it is only necessary to control the revolutions of the wheels by increasing the tractive force, and in descending to apply the ordinary brake pressure. About 3½ per cent of the current required to operate an electric car is needed to energize the magnets.

In the Seattle tests, the two motors were of 40 hp each. The car was connected by a cable to a dynamometer, which indicated the tractive power of the motors. Without the use of the magnet arrangement the dynamometer showed a draw-bar pull of less than half a ton, and the wheels slipped on the rails. With the magnetic device in operation, the pull jumped to more than two tons, the increase in traction thus being over 300 per cent.

An improved magnetic device for the same purpose will soon be tested by the Company on street cars and locomotives. In this type, instead of the drive wheels being used as magnetic poles, the coils are wound on the axle connecting two small wheels, about a foot in diameter, running on the rails as close as possible to the driving wheels of the car or locomotive.

By this method the magnetic circuit is closed through the rails, drive wheels and axles. In practice, a pair of these auxiliary wheels is placed at each end of the car, close to the outside pair of car wheels. Mr. A. A. Honey is the inventor, and the company's main office is in Tacoma, Wash.

A New Therapeutical Journal.

The title of a magazine just started in New York is the *Journal of Advanced Therapeutics*. This journal is the outcome of a combination of *The Journal of Electro-Therapeutics* and the New York *Lancet*. Its scope is actually much wider than that of either of the two journals mentioned. It will be devoted very largely to the various applications of electricity in therapy and diagnosis. Besides electro-therapeutics, various special branches will be covered, including radiography, thermo-therapeutics, hydro-therapeutics, climatology, therapeutic exercise, photo-therapy and dietetics. The journal is edited by Dr. William Benham Snow. Among the associate editors are G. Betton Massey, M. D., Philadelphia; Mary L. H. Arnold-Snow, M. D., New York; Francis H. Bishop, M. D., Washington, D. C.; Walter H. White, M. D., Boston; Robert Newman, M. D., New York; J. D. Gibson, M. D., Birmingham, Ala.; Clarence Edward Skinner, M. D., LL.D., New Haven; W. Scheppegrell, M. D., New Orleans. Dr. Snow will have the advantage of the collaboration of some of the most eminent practitioners in the profession. Among these are Drs. W. J. Morton, Max Einhorn, A. D. Rockwell, Margaret A. Cleaves, J. Edward Stubbert, Carl Beck, L. A. Weigel, Robert Reyburn, G. F. Hanson, Albert Abrams and Lucy Hall-Brown.

The first number, that for January, 1902, contains some able articles, and the general treatment of these would seem to give encouraging promise of an increasingly higher standard of technical accuracy and scientific dosage. There has unfortunately been associated with the study and practice of electro-therapeutics a great deal of empiricism, inaccuracy and uncertainty. This has inevitably been a source of reproach to the profession, and has created a great deal of distrust and prejudice. The advent of this new journal, however, as has been stated, would appear to justify the belief that a new era is dawning in the domain of this important branch of therapy. The purpose evidenced in its pages is to combine the kindred therapeutic measures in such a manner, as not only to break down the prejudice above-mentioned, but to show that the electro-therapeutist recognizes the value and necessity of other enlightened measures in conjunction with his own. The January number embraces special articles on the following subjects: "A Case of Rectal Stricture Treated by Electrolysis," by Dr. Walter H. White; "Treatment of Urethral Strictures by Electrolysis," by Dr. Robert Newman; "The Use of Electricity in Renal Disease," by Dr. A. D. Rockwell; "A Study in Contemporary Gynecology," by Dr. G. Betton Massey; "Therapeutics of Dry Hot Air," by Dr. Clarence Edward Skinner.

One of the most interesting articles in this edition is that on "Dermatology," in which the successful treatment of lupus and

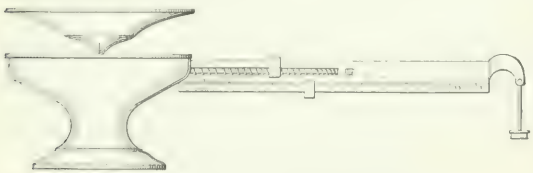
cancer by means of Röntgen rays comes in for special notice. Successful as has been the treatment of these diseases by the filtering of the rays of the arc light through quartz lenses, it is now generally recognized that Röntgen rays are likely to be the media of such treatment in future as being quicker, less expensive and more effective. Among the other branches covered are electrical applications in affections of the eye, ear, nose and throat, genito-urinary and constitutional diseases and the alimentary canal; also of therapeutics of dry hot air, skiagraphy, orthopedics, hydropathy, therapeutic exercises, dietetics, climatology, etc. This journal is the official organ of the Electro-Therapeutic Association, and is intended also to serve as a record of the meetings and transactions of the various scientific and kindred associations.

Weighing and Counting Machine.

In all large factories where punch press, screw machine, or small work of any kind is made or used to any extent, as in many electrical works, it is now necessary to employ a number of boys or girls to count this material that shop records may be kept up to modern standards. The cost of this continued but necessary handling is evidently overlooked by many concerns, and by others, simply regretted and classed as an unavoidable expense. To reduce to a minimum this important factor in shop costs is the object of a weighing and counting machine recently patented by Joseph S. Cortelyou, of New York City.

This device, the operation of which is based on well-known laws of the lever and fulcrum, provides a scale in which the point of application of the weight as well as that of the force, is made variable at will, thus increasing the range of the scale when weighing, and making it possible to obtain readings in any and all systems such as avoirdupois, troy, metric, etc., by the simple turn of a milled head. When used for counting material, it is only necessary to set the scale for that material by a turn of the same milled head, then proceed as in weighing and the scale will indicate the number of pieces instead of pounds or ounces.

We illustrate herewith a small scoop scale which weighs to 25 lbs. avoirdupois or its equivalent in any system, and counts to 5000. Referring to the cut, it will be seen that in general appearance the scale is similar to the ordinary weighing scale, but provided with a longi-



WEIGHING AND COUNTING MACHINE.

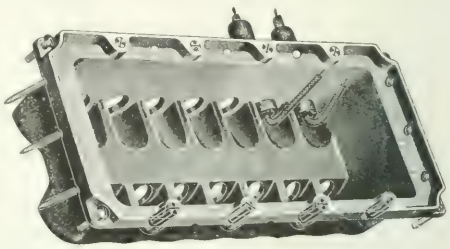
tudinal slot in the bar or beam in which a long screw having a right-hand thread on one end and a left-hand thread on the other, is placed and controlled by a milled nut on one end. The carriage supporting the pan is carried to or from the fulcrum as required for the different systems by the screw and is always counterbalanced by the weight on the other or outer end of this screw.

A series of graduations corresponding to the various systems and a scale of numbers from 1 to 5000 are laid out on the bar, from which the readings are taken. On the top of the frame through which the pan support projects, are arranged the index marks which show the proper position of the support for each of the different systems.

Combination Switch-Box.

We illustrate herewith a four-gang combination switch box, known as the Renim type, the name implying that this box may be used equally well for either "old" or "new" work. This is accomplished by the peculiar arrangement of the pockets, all of which face in the same general direction. The boxes are provided with four leveling screws, as shown in the cut, and are attached directly to the lath or other woodwork entirely independent of the plastering. The leveling screws are used for bringing the front edges of the box into the same plane with the plaster surface. When the attaching screws, which are drilled on an angle, are inserted, the box is fastened in such a manner as to be impossible to work loose from the constant jar caused by the operation of the switch.

This box is also provided with the same universal adjusting feature used by the same makers in their "universal" switch box, the



COMBINATION SWITCH BOX.

same box taking different makes of switches of the same type. It does not require a back plate, as each switch is attached directly to the box and may be adjusted independently. No special switch is required for gangs, the ordinary switches being used, thus greatly simplifying the "gang switch" problem. These boxes are manufactured by the Renim Specialty Company, 176 Federal Street, Boston, Mass.

Chicago Automobile Show.

The Chicago automobile show held in Chicago last week was an occasion for the formation of a national organization to be known as the "American Automobile Association." The membership in this national association will consist of clubs. Each club pays an entrance fee of $10, and the annual dues are to be $3 per capita for each member. The meetings are to be held each spring, alternating in the East and in the West. Five clubs will constitute a quorum. The following officers were elected: President, Winthrop E. Scarritt, Automobile Club of America; first vice-president, Frederick C. Donald, Chicago Automobile Club; second vice-president, W. W. Grant, Long Island Automobile Club; third vice-president, W. G. Morris, Automobile Club, of Philadelphia; treasurer, Jefferson Seligman, Automobile Club of America; secretary, S. M. Butler, Automobile Club of America. Directors: Officers and F. G. Webb and A. R. Pardington, Long Island Automobile Club; A. R. Shattuck, Automobile Club of America; W. J. Stewart, New Jersey Automobile Club; F. C. Lewin, Automobile Club, of Philadelphia; Dr. Chase, Automobile Club of Rhode Island, and the president of the Utica club.

The clubs represented at the Chicago meeting were the New Jersey, the Long Island, the Chicago, the New York, the Rhode Island, the Philadelphia, the Utica and the Grand Rapids.

The American Motor League also held a meeting at the same time and elected the following officers: President, Edwin F. Brown, Chicago; vice-presidents, C. E. Duryea, Reading, Pa.; Grant W. Murray, Detroit; S. Wallace Merryhew, New York; secretary, F. A. Fagan, New York; treasurer, F. B. Hill, Boston.

The show was well attended, both by manufacturers and visitors. Among the principal exhibitors of electric carriages were the Buffalo Electric Carriage Company, of Buffalo, N. Y., the Fanning Manufacturing Company, of Chicago; the Baker Motor Vehicle Company, of Cleveland, Ohio; the Waverly vehicles made by the International Motor Car Company; the National Vehicle Company, of Indianapolis; the Electric Vehicle Company, of Hartford, Conn., and the Porter Battery Company, of Chicago. Electric igniting apparatus for gasoline vehicles was shown by the Miller-Knoblock Electric Manufacturing Company, of South Bend, Ind.; the Everett Electric Company, of Indianapolis, Ind., and the Motsinger Device Manufacturing Company, of Pendleton, Ind. The National Carbon Company had a handsome exhibit of its batteries, especially suited for gas engine ignition. The only distinct exhibit of automobile storage batteries was made by the Porter Battery Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There has been a fairly good demand for money, with no diminution in the volume of loanable funds. The closing rates were 3½ per cent for 30 days, 4@4½ per cent for 60 to 90 days, and four, five and six months. In the stock market restricted activity continued owing to the heavy gold shipments and uncertainty as to the money market and the Northern Securities deal. Investment demands were large, bonds being firm, and high-priced dividend stocks showed a decided appreciation. Public interest in speculation, however, continues at a low ebb. The steel stocks were, on the whole, well supported and strong throughout the week. In the electric list General Electric was extremely strong on limited transactions, there being renewed reports that a stock dividend would soon be declared. The highest figure on record for this stock was reached on Thursday, when it was quoted at 302. The price fluctuated between this and 296, the stock closing at 299½, a net gain of 4½ points as compared with the closing price of the week previous. The total number of shares sold was 8900. In Boston, General Electric made an advance of 2¾ points. Western Union made a net gain of ½ point, closing at 91. Westinghouse Electric, common, showed considerable activity, 7900 shares having been sold at prices ranging from 178 to 185, the closing rate being 184½, which is a net gain of 6½ points. Westinghouse, 1st pfd., closed at 182. Quietness prevailed in Brooklyn Rapid Transit, and the quotations kept within narrow limits, the closing price being 64. Metropolitan Street Railway was also comparatively inactive and closed with a net loss of ¾ point, the last quotation of the week being 168. This stock fluctuated between 166¾ and 169¼, 20,500 shares having been sold. Manhattan Elevated was quiet, closing at 131, being a net loss of 1½ points. American Telephone & Telegraph made a net gain of 3⅜ points in Boston during the week. Following are the closing quotations of March 11:

NEW YORK.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
American Tel. & Cable...	—	80	General Electric.....	296	299½
American Dist. Tel.....	[illegible]	[illegible]	General Carriage.....	1¾	[illegible]
Brooklyn Rapid Transit	64¼	64⅜	Hudson River Tel.....	—	—
Ches. & Pot. Telephone	—	—	Metropolitan Street Ry.	167½	167
Commercial Cable.....	—	150	N. E. Elec. Veh. Tran....	½	⅝
Electric Boat.....	28½	28	N. Y. Elec. Veh. Tran...	13⅜	13
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n....	1⅞	1⅞	Tel. & Tel. Co. America..	—	—
Electric Vehicle.....	2⅛	2¼	Western Union Tel.....	90¼	90½
Electric Vehicle pfd.....	4½	4¼	West. E. & M. Co.....	178	181
			West. E. & M. Co. pfd...	180	185

BOSTON.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
Am. Tel. & Tel.....	150	102	Mexican Telephone.....	[illegible]	2¼
Cumberland Telephone...	—	—	New England Telephone.	140	140
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	90*	—
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	90	—
General Electric pfd....					

PHILADELPHIA.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
American Railways....	[illegible]	[illegible]	Phila. Traction.....	100	98
Electric Storage Battery	[illegible]	[illegible]	Philadelphia Electric....	5⅛	5¼
Elec. Storage Batt'y pfd..	—	60	Pa. Electric Vehicle.....	—	—
Elec. Co. of America.....	6⅞	—	Pa. Elec. Veh. pfd.....	3	—

CHICAGO.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
Central Union Telephone.	—	—	National Carbon pfd.....	84¼	84½
Chicago Edison.....	[illegible]	172*	Northwest Elec.....	30	38*
Chicago City Ry.....	215	215	Union Traction.....	14⅞	15
Chicago Telep. Co.....	—	175	Union Traction pfd.....	50½	48½
National Carbon.....	20⅜	19¾			

*Asked.

DIVIDENDS.—The Commercial Cable directors have declared the regular quarterly dividend of 1¾ per cent. A dividend of $1.50 per share on its preferred stock has been declared by the Savannah Electric Company out of the earnings of the company since Jan. 1, 1902, payable April 1. The Twin City Rapid Transit directors have declared the regular quarterly dividend of 1¾ per cent, payable April 1. Directors of the Chicago Telephone Company have declared a quarterly dividend of 2½ per cent. This is a reduction from 3 per cent, which was made in view of the increase in taxes. The capital stock of the company is to be increased $3,000,000. In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company, a dividend rental of $1.75 per share will be paid to holders of record of the common stock of the West End Company on April 1. The Otis Elevator directors have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 15. Manhattan Elevated directors have declared the regular quarterly dividend of 1 per cent, payable April 1. The executive committee of the Western Union Telegraph Company has recommended the declaration of the regular quarterly dividend of 1¼ per cent. Directors of General Electric have declared the regular quarterly dividend of 2 per cent on the common stock, payable April 15 to stock of record March 22.

STORAGE BATTERY OUTLOOK.—It is noted in advices from Philadelphia that before the Electric Storage Battery Company changed the time for holding its annual meeting from June to the month of March the management used to make about this date a preliminary statement of the financial results for the fiscal year ending Dec. 31. Now that the stockholders do not have to wait six months to learn of the operations of their company, no advance statement is given out. At the stockholders' meeting to be held March 19 the report for 1901 will show, it is said, gross earnings about equaling, but a trifle less, than those for the preceding year, when they reached $3,309,443. As the ratio of expenses runs about the same, it is expected that when the accounts are finally made up the net profits will also be about on a par with those for 1900. In that year they amounted to $1,317,865, or 7.8 per cent on the $16,875,000 share capital outstanding. These results, however, included $168,105 profits from the sales of securities. The company is paying regular dividends at the rate of 5 per cent per annum on both classes of stock, preferred and common. Since the first of the year, 1902, the company's business has been very favorable, and is stated to show up very flatteringly in comparison with corresponding periods of previous years.

SUBMARINE CABLE VALUES.—Discussing Mr. G. G. Ward's Commercial Cable report and his conservative but cheerful views as to the value of cable stocks, the *New York Herald* says: It is not the more or less successful transmission of letters across the Atlantic, or the somewhat unreliable service now existing between a floating lightship and passing vessels that will "convert submarine cables into scrap iron." It is for these reasons that the *Herald* congratulates Mr. Ward in the name of the public and in that of common sense. If a little of the latter be used the folly of the anxiety that of late has seemed to possess investors in submarine cable stock becomes apparent. The failure of the Marconi Honolulu Wireless Telegraphy Company shows the present practical inadequacy of wireless systems for commercial purposes. The public may take heart. There are still some years of very respectable dividends before those investors who have souls above 2½ per cent British consols or 3 per cent to 4 per cent railway stock, and who have placed their capital in submarine cable stock.

CLEVELAND TROLLEYS.—The *Plain Dealer,* of Cleveland, says that terms have been agreed upon for the consolidation of the Cleveland Electric Railway Company and the Cleveland City Railway Company, the two roads to be under the presidency of Senator Hanna. The consolidated company will include every street car line in the city, under the name of the Cleveland Electric Railway Company. Involved in the deal are arrangements for improvements, in transfers, and in all probability for the sale of six tickets for 25 cents. Stock to the value of $21,600,000 is involved, of which $13,000,000 represents the Cleveland Electric Company and $8,600,000 the stock of the Cleveland City Railway Company. All the Cleveland Electric Railway Company stock is to go into the general pool at $80 a share, the Cleveland City Railway Company to go in at $120 a share, or the Cleveland Electric Railway Company will go in at $100 a share, while the Cleveland City Railway Company will go in at $140 a share.

SAN FRANCISCO TROLLEYS.—According to Brown Brothers & Co., the plan for the merging of the electric roads of San Francisco includes the following properties: Market Street Railway, total mileage 183 miles, cars 766, capital stock $18,750,000, and funded debt $12,074,000; San Francisco & San Mateo Railway Company, mileage 30 miles, cars about 70, capital stock $1,000,000, no debt; Sutter Street, mileage 12.8 miles, cars 50, capital stock $2,000,000, funded debt $1,000,000; and Sutro Railroad, mileage 10 miles, cars 26, capital stock $400,000, no debt. The company to take over these properties is at the present time in process of formation, but particulars are not forthcoming.

ST. LOUIS TROLLEYS.—The arrangement by which E. W. Clark & Co., of Philadelphia, have secured the Eads Bridge Electric Railway and the St. Louis & Belleville Company's line from East St. Louis to Belleville, the electric roads of Belleville, and the Terminal Association's lines in East St. Louis involves an investment of $4,000,000, by which 125 miles of single track are acquired. The new owners will spend $1,000,000 in improvements, including additional power houses and equipment. A feature of the negotiation is that the syndicate has secured a 50-year lease on the Eads Bridge, and will widen the bridge to relieve congestion of traffic.

BELL TELEPHONE MOVES.—A special dispatch from Boston says: The recent visit of President Sabin, of the Central Union Telephone Company, to Boston and the appearance here of President Burt, of the Missouri-Kansas Company; President Yost, of the Nebraska Company, and President Caldwell, of the Cumberland Company, has given rise to a rumor that the subsidiary companies of the Western Telephone Company are to have placed at their head some of the above-named gentlemen. President Fish, of the American Telephone & Telegraph Company, believes that the property is too extensive and scattered to be managed by one president over all. It is probable President Sabin, of Chicago, will go to the head of the Cleveland and Michigan companies; President Yost, of Omaha, at the head of the Northwestern & Wisconsin companies, with either President Burt, of Kansas City, or President Caldwell, of Nashville, at the head of the Southwestern Company. This is a step toward the ultimate amalgamation of all the companies in the Middle West, with the new Western company. Before the close of the year, Chicago Central Union, Cumberland & Missouri and Kansas and the Nebraska Company may come into the Western Company under another plan of reorganization.

N. Y. & N. J. TUNNEL COMPANY.—According to a prospectus issued by the recently incorporated New York & New Jersey Railroad Company, whose object is to complete the half-finished North River tunnel, the officers of the company are as follows: William G. McAdoo, president; Walter G. Oakman, president of the Guaranty Trust Company, and Edmund C. Converse, former president of the National Tube Company, vice-presidents; Henry A. Murray, treasurer; Charles W. King, secretary, and Charles M. Jacobs, chief engineer. The directors, besides Mr. Oakman, Mr. Converse, and Mr. McAdoo, are: Elbert H. Gary, chairman of the executive committee of the United States Steel Corporation; John Skelton Williams, president of the Seaboard Air Line Railway; Anthony N. Brady, chairman of the Board of the Brooklyn Rapid Transit Company; E. F. C. Young, president of the North Jersey Street Railway Company; David Young, president of the Jersey City, Hoboken & Paterson Street Railway Company; John G. McCullough, of Vermont, director of the Erie Railroad Company; Frederic B. Jennings, of the law firm of Stetson, Jennings & Russell; G. Tracy Rogers, president of the Street Railway Association of the State of New York.

CANADIAN GENERAL ELECTRIC.—The statement presented at the annual meeting of the Canadian General Electric Company, held recently at Toronto, Ont., shows that the volume of business transacted during the past year, had been very much greater than any preceding one, and also that the current year commenced with more orders on hand than at the beginning of any previous year. The balance to credit of profit and loss amounted to $612,028, which is made up of $345,990 profit on operating (being an advance of 30 per cent over the year previous); $195,000 premium on new shares issued, and $71,038 brought forward. From this amount, dividends of 10 per cent on the common stock and 6 per cent on the preferred stock, amounting to $166,750, were paid. The sum of $167,596 was written off patents, plant, etc. It was also decided to apply to Dominion Parliament for authority to increase the capital stock of the company from $2,000,000 to $3,000,000.

NEW YORK & NEW JERSEY TELEPHONE.—The balance sheet of the New York & New Jersey Telephone Company (Bell) shows: Assets—Plant, $8,316,331; equipment, $1,292,325; real estate, $1,080,473; material and supplies, $462,961; accounts receivable, $789,826; treasury stock, $165,600; stocks and bonds, $422,490; cash, $857,028; total, $13,987,037. Liabilities—Capital stock, $9,540,000; general mortgage bonds, $1,324,000; real estate mortgages, $111,500; vouchers and accounts payable, $245,606; reserves, $162,936; dividend payable Jan. 15, 1902, $234,375; surplus Dec. 31, 1901, $2,368,019; total, $13,987,037.

TELEPHONY IN RUSSIA.—Advices from St. Petersburg say: Mr. H. T. Cedergren, of Stockholm, heads the syndicate of telephone men that purchased the plants of the International Bell Telephone Company, of Moscow and Warsaw. Previous to the sale of their properties in this city, the International Bell Company had over $1,000,000 cash in its treasury, and will make a handsome cash distribution to its stockholders in addition to large dividends that have been paid during the 20 or more years of its existence. The European headquarters of the company are at Antwerp.

PROVIDENCE ELECTRIC CONSOLIDATION.—The largest combination of commercial interests to occur in Rhode Island has been announced. It calls for the merger of the United Traction, capitalized at $8,400,000; Providence Gas Company, with $5,000,000 in stock, and the Narragansett Electric Lighting companies, capitalized at $2,750,000. United States Senator Nelson W. Aldrich, the president of the Union Traction Company, is working over the preliminary plan of forming the new company, the capitalization of which is not yet made public.

BELL TELEPHONE.—Rumors relating to a prospective stock issue by the American Telephone & Telegraph as a basis for the advance in price of stock are said to be premature. It is known that the company will be obliged to call, before the close of year, for new money to meet extensions and acquire its proportion of new stock issued by its sub-companies, but it is not believed that this new stock issue will come before July. The company is now said to be in unusually good financial condition.

UNITED ELECTRIC SECURITIES COMPANIES, of Boston, show for the year ending Feb. 28 a total income of $325,089, a net profit of $178,335, dividends of $70,000, and a total surplus to date of $385,998, or $110,066 more than last year.

Commercial Intelligence.

THE WEEK IN TRADE.—The mercantile agencies report that spring trade increases, notwithstanding the serious interruptions in some sections by floods and snowstorms, which restricted telegraphic and mail facilities and crippled railroads. All signs favor the indication that legitimate trade and industry is, except in a few instances, considerably more active than a year ago at this time. Although there is less apparent tension in iron and steel, the situation is a remarkable one. Floods and high water have interfered with production, limiting supplies of fuel, hampering productive operations and checking shipments. Finished products are active. Hardware is active at all markets. The interruption to coal production and shipments has caused some anxiety, but the advanced stage of the season prevents danger of small stocks being unduly shortened. Unprecedented activity is looked for in building lines this year, and all classes of this material are firmer in price. Copper was dull and uninteresting, and without any special feature; exports continued on a large scale. There was very little disposition to buy, while holders showed considerable willingness to sell. The closing quotations are 12¾@12⅞c. for Lake, 12@12⅛c. for electrolytic in ingots, cakes and wire bars, 11¾ and 11⅞c. in cathodes, and 12@12⅛c. for casting stock. The number of failures for the week ending March 7, as reported by *Bradstreet's*, aggregated 178 as against 204 the week previous and 208 the same week last year.

THE HAINES & NOYES COMPANY, Chicago, through its private telephone plant department, has closed the following contracts during the past month: Hotel Fremont, California, 130-drop switchboard and 130 telephones; Conservative Life Building, Los Angeles, Calif., 90-drop switchboard and 90 telephones; a large apartment building in Evanston, Ill., 35 telephones, and an apartment telephone system; the New High School, Chicago, 25-drop switchboard and 25 telephones; Messrs. Marsh & Uhlmann, Chicago, inter-communicating system of 17 hand microphones; the Globe-Wernicke Company, Chicago, a large inter-communicating system. Through the company's agents in Los Angeles, Calif., the Woodhill & Hulse Electric Company, 20 inter-communicating systems have been installed in Los Angeles and surrounding territory; and through the John M. Klein Electric Company, San Francisco, a 36-telephone system has been sold to the United States Government, for the Navy Yard, Puget Sound. The home office of the Haines & Noyes Company has closed contracts for 10 apartment telephone systems in Chicago. The company is also equipping the St. Anthony's Hospital with house telephones, also the J. S. Ford-Johnson chair factory, Michigan City, Ind.

ELECTRICALLY-DRIVEN MACHINE TOOLS FOR MEXICO.—The Compania Fundidora de Fierro y Acero de Monterey (the Monterey Iron & Steel Foundry Company, of Monterey, Mexico), of which concern Mr. Robert Meehan is president, is now placing some substantial contracts in this market for various equipment to be installed in the extension of its works, it having decided to enter into the manufacture of gasoline engines on an extensive scale. The additions to the existing plant will mean an expenditure of some $200,000. Everything in the shape of equipment is to be purchased in the United States. Manning, Maxwell & Moore, of 85-89 Liberty Street, New York City, have been allotted a contract for three large punching and shearing machines, to be built by the Hilles & Jones Company. The same Liberty Street concern has obtained an order for three rail drilling equipments by the Newton Machine Tool Company. These tools will all be electrically driven. The motors varying from 10-15 hp, are to be furnished by the General Electric Company.

BATTERY FOR EASTON, PA.—The Gould Storage Battery Company, of Astor Court Building, New York City, has just completed the installation at Easton, Pa., of a battery plant for the Easton Power Company, which is one of the properties of the Light, Heat & Power Corporation, of Boston. This plant consists of 255 cells of the Gould battery in lead-lined tanks, having a capacity of 408 kw-hours, and has a Gould patented C. E. M. F. regulating booster. This equipment is to be used in regulating the fluctuations of the street railway load, and replaces an equipment of half its size.

GOUDEY-M'LEAN CONNECTIONS ABROAD.—The Goudey-McLean Company, of 88 Maiden Lane, New York City, recently established for the purpose of acting as manager for foreign sales of a syndicate of manufacturers of electrical apparatus and fittings, a list of which concerns has already appeared in these columns, will be represented in England and Wales by a company called the Associated American Electrical Manufacturers, Limited, which has been registered under the British Limited Liability Act. The managing director of the concern will be Mr. A. F. Woodley, formerly identified in an executive capacity with the Edison-Swan Company, of London. The registered office of the company will be at 28 Bush Lane, London, E. C. The Scottish business will be taken care of by the Scottish Goudey-McLean Company, of Glasgow. Arrangements have also been made by Mr. Edward E. Goudey, the secretary of the firm, who is now in Europe, for the purpose of representing the company's interests in various parts of Continental Europe. The French business is to be taken care of by Legendre Feres, of 105 Rue de Turenne, Paris. The Dutch territory will be covered by Kopmann & Co., of Amsterdam, while arrangements have been consummated with Hubert Durselen, of Brussels, who will attend to the representation of the company's business throughout Belgium. Mr. Goudey, who will remain on the other side till May, also proposes to appoint agents in Germany, Copenhagen, Italy, Austria, Spain and Portugal.

CANADIAN BELL TELEPHONE COMPANY.—At the annual meeting of the Bell Telephone Company, held last week in Montreal, Que., the report of the directors showed that 4498 new subscribers were added during the past year, the total number of sets of instruments, now earning rental, being 42,858. The company now owns and operates 343 exchanges and 514 agencies. Over 2800 miles of wire were added to the long-distance system in 1901. Of these 1303 miles are in Ontario department, and 1540 in the Eastern department. The long-distance lines now owned and operated by the company comprises 24,193 miles of wire on 6634 miles of poles. During the year there were sold $550,000 worth of of 5 per cent bonds, the net premium on which, amounting to $53,361, has been carried to contingent account; the total bond issue now being $1,750,000. From the balance of revenue account, viz., $91,821, the sum of $50,000 has been written off plant and patent account; $10,000 has been carried to insurance reserve account, and $10,000 to accident reserve account; leaving a balance of revenue to be carried to 1902 of $21,821. The revenue account shows: Receipts, $1,851,535; expenses of operating, $1,324,424, and with other expenses, making a total of $1,433,799, which left the net revenue $417,735. From this, $400,000 dividends were paid to Jan. 15, 1902, and the balance was $17,735, which added to the balance of $74,085, totalled $91,821. This was disposed of as above mentioned.

ELECTRIC GRAIN ELEVATORS IN GALVESTON.—The Southern Pacific Terminal Company has closed contracts for a complete electric power plant, which will be used to operate its large grain elevator, now in course of construction in Galveston, Texas. The contracts for the 2000-hp boiler and engine plant were awarded to Charles C. Moore & Co., of San Francisco, who represent the Babcock & Wilcox Boiler Company on the Pacific Coast. The generating equipment includes three 300-kw units, each consisting of a General Electric 25-cycle alternating-generator direct connected to a Buckeye cross compound engine. Also, one 175-kw General Electric generator direct connected to a McIntosh & Seymour tandem compound engine. The plant will supply current for the electric motors that will operate the electric conveyers of the elevator. There will be six Babcock & Wilcox water-tube boilers and a self-supporting steel smokestack. A fuel oil system will be operated, using Beaumont oil. Among the steam apparatus may be mentioned Wheeler surface condensers, for the three large engines, and a smaller one for the small engine, vertical suction valveless air pumps, centrifugal circulating pump and the usual auxiliary machinery. John S. Metcalfe, of Chicago, is the architect of the buildings, and the plant should be in operation by Sept. 1.

VARIOUS ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Company, New York office, the Mail and Express Building, has lately secured an order for a 120-hp standard engine, to be direct connected to a 75-kw Sprague generator for installation in the stone cutting plant of B. N. & G. N. Williams, for general power purposes. The Woman's Hotel at Thirtieth Street and Fifth Avenue, is to be equipped with three 90-hp Harrisburg standard engines, direct connected to 60-kw General Electric generators, to be used for lighting the building. Two 45-hp standard engines to be direct connected with 30-kw generators supplied by the General Electric Company are to be furnished the new building now under construction at Albany and Greenwich streets. This is to be a lighting outfit. The Otis Elevator Company, for its Yonkers plant, has requisitioned for a 75-hp standard engine. The generator will be supplied by the Sprague Electric Company. One 150-hp and a 100-hp Harrisburg standard engine has been ordered for general light and power purposes by the Poidebaid Silk Manufacturing Company, of Hoboken. These engines will be direct connected to generators built by the Thresher Electric Company.

VINCENNES (IND.) ELECTRIC LIGHT PLANT.—In a recent issue a note in our "News of the Week" department stated that the local electric light plant "of Vincennes, Ind.," is being sued on a mortgage foreclosure lien for $23,000. The Vincennes Electric Light & Power Company, which has been doing business since 1885, writes us that there are two electric lighting companies in Vincennes, that it is not the one in difficulty, and ask that we make the necessary correction. We regret very much that the vague character of the notice has caused annoyance to the old and substantial Vincennes company, which Mr. H. W. Frund for many years has directed with such marked success.

BALL ENGINE CONTRACTS.—The Ball Engine Company, Erie, Pa., is building for the new station of the Pennsylvania Railroad at Camden, N. J., three 250-hp cross-compound engines, each arranged for direct connection to a Westinghouse alternator. These units will run in parallel, and the engines will be fitted with speed controlling devices. The First National Bank Building, Uniontown, Pa., will have a power plant consisting of four 175-hp tandem compound engines, built by the Ball Engine Company, each of which will be direct connected to a Crocker-Wheeler generator. It will be one of the most complete isolated plants in that section.

LIGHTING PLANT WANTED FOR COREAN MINES.—The Oriental Consolidated Mining Company, which has been incorporated under the laws of West Virginia, with a capital of $5,000,000, and in which Henry C. Perkins, William L. Bull, J. B. Haggin, Ogden Mills, L. S. J. Hunt, J. S. Fassett and William P. Palmer, are interested, is about to let contracts for the electrical equipment of its extensive mines located about 100 miles north of Chemulpo, Corea. The New York address of the company is 38 Broad Street.

ELECTRICAL EQUIPMENT FOR MEXICAN PLANT.—The Compania Minera de Penoles of Mapimi, Mexico, a Belgian concern owning extensive copper properties, is about to extend its plants. Manning, Maxwell & Moore, of 85-89 Liberty Street, New York City, have been allotted an order for an electric traveling crane of 50-ton capacity to be installed on the new power station of the company. The crane, which will be operated by a 105-hp motor, is to be built by the Shaw Electric Crane Company.

INVESTING IN COPPER.—A dispatch from Phœnix, Ariz., of March 4, says: The General Electric Company, of New York, is making some of the largest purchases of copper properties ever known in the Southwest. It is stated that the company intends to spend no less than $15,000,000 in securing copper producers in Arizona and Northern Mexico.

AUTOMATIC TELEPHONE SYSTEMS.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has recently supplied the Tolerton & Stetson Company, of Sioux City, Iowa, with an 18-point Clark automatic telephone system complete. It has also sold to the Smith Webbing Company, of Pawtucket, R. I., a 12-point equipment.

STEPHENSON CARS FOR PORTO RICO.—The John Stephenson Car Company, of Elizabeth, N. J., is about to make shipment to Porto Rico of two passenger cars and one freight, intended for the San Juan Light & Traction Company. The contract for the construction of the system was secured by J. G. White & Co., 29 Broadway.

INCREASE IN TELEPHONES.—The American Telephone Company (the Bell) reports an increase during February in the number of instruments under rental of 58,729, making total outstanding 2,637,355. This is an increase of 597,091 over a year ago, and more than double three years ago.

DANVILLE (VA.) POWER.—The Dan River Power & Manufacturing Company, R. A. Schoolfield, treasurer, is preparing to develop a water power near Danville at a total cost of $2,000,000, and will soon be in the market for bids on the equipment.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, has opened a New York office at 39 Cortlandt Street. The office will be in charge of Mr. J. P. Burckhardt, who was formerly in charge of the Cincinnati office of the Triumph Company.

WESTINGHOUSE CONTROLLERS FOR ENGLAND.—The Westinghouse Electric & Manufacturing Company is about to make shipment from its Cleveland (Ohio) plant to Manchester, England, of 150 motors, controllers, etc.

NIAGARA CURRENT.—The Oldbury Chemical Company, of Niagara Falls, contemplates building a new factory on the lands of the Niagara Falls Power Company, to utilize current from the power plant.

General News.

THE TELEPHONE.

[illegible] CAMP. A mutual telephone company is to be formed at this place. D. S. Parker and John Law, of Pomona, are interested.

MEDORA, ILL.—Citizens have organized a local telephone exchange.

MORO, ILL.—Farmers of Foster and Woodriver townships have decided to establish a telephone line.

SHIRLAND, ILL.—The farmers of this place are discussing the question of building a rural telephone system.

LEWISTON, ILL.—The farmers of Mount Chapel are talking of building a telephone line from Duncan Mills to Havana.

FARMER CITY, ILL.—Farmers in the vicinity of Gibson are agitating for a telephone system to connect with the city service.

CHICAGO, ILL.—The Metamora Telephone Company, of Metamora, Ill., has been incorporated by J. R. Wagner, L. B. Meister and S. M. Snyder, with a capital of $280.

ALTON, ILL.—Residents of Fosterburg and vicinity have decided to establish a telephone line to Alton. The Central Union Telephone Company will build the line.

NEW BELLSVILLE, IND.—A telephone line connecting this place with Gnawbone is to be built in the near future.

VEVAY, IND.—The telephone system, owned by Green Bros., of Rising Sun, Ind., is now being incorporated. It covers all of Ohio and Switzerland counties and a part of Jefferson County.

ROANOKE, IND.—The Roanoke Telephone Company, capital stock $2,500, intends to operate a telephone system in the town of Roanoke. The directors are Ervin E. Richards, Edmond M. Wasmuth, Blanche Wasmuth and Ida M. Richards.

LAFAYETTE, IND.—Thirty-three delegates representing the People's Co-operative Telephone Association, operating eighteen independent companies, have met in conference with M. J. Carney, general manager of the Bell telephone system, for the purpose of securing an entrance into Lafayette over the Bell line.

WEVER, IA.—The Rural Telephone Company has been incorporated at this place.

ELDORADO, IA.—A business men's mutual telephone company is being formed at this place.

ODEBOLT, IA.—The Sac County Mutual Telephone Company, capital $5,000, has been incorporated by John W. Younie and others.

AVOCA, IA.—The Harlan & Avoca Telephone Company will build a toll line from Avoca to Neola as soon as the weather will permit.

NEVINVILLE, IA.—A movement is on foot at Nevinville to organize a mutual telephone company. R. H. Gregory is one of the promoters.

GLENDON, IA.—A telephone line is in contemplation from Glendon, and a meeting will be held for the purpose of organizing a company.

WINFIELD, IA.—The local telephone company will build two lines southwest toward Mt. Pleasant. Another line will be built to Mt. Union.

ALBURNETTE, IA.—The Marion & Alburnette Mutual Telephone Company will build a line in the spring with a central in Alburnette.

PLEASANT VALLEY, IA.—The Pleasant Valley Telephone Company has been incorporated; capital stock, $10,000. J. S. Wilson is one of the incorporators.

JEWELL, IA.—The Jewell Telephone Company, $15,000, has been incorporated. F. G. Snyder is president, Byron Lewis, vice-president; A. Alexander, secretary, and Giler Knudson treasurer.

GRIMES, IA.—The Farm Mutual Telephone Company, capital stock $30,000, has been incorporated by B. S. Prunty and nine others. The purpose is to construct a mutual telephone exchange in Grimes and vicinity.

DES MOINES, IA.—The local exchange of the Indianola Mutual Telephone Company has been bought by the Hawkeye Telephone Company, of Perry, which will make improvements in it and in other parts of the system at a cost of about $30,000.

GLEN ELDER, KAN.—The Citizens' Telephone Company, capital stock $2,500, has been incorporated.

ABILENE, KAN.—The addition of new rural delivery routes in Central Kansas has made a demond for more farm telephones. There are now forty farms in the county that are connected with the county seat and other towns of the county.

GRAND RAPIDS, MICH.—The Union Telephone Company will put in an exchange at Clare.

LITTLE FALLS, MINN.—John Stroman, of Swanvilletown, will build a telephone line from Swanville to Little Falls this year.

MONTICELLO, MO.—The Lewis County Telephone County has increased its capital stock from $1,800 to $7,500.

JEFFERSON CITY, MO.—The Missouri & Kansas Telephone Company has increased its capital from $2,500,000 to $5,000,000.

ADRIAN, MO.—The Board of Aldermen has granted a fifteen-year franchise to the Austin Inland Telephone Company for a telephone system here.

AUSTIN, MO.—The Austin Inland Telephone Company, capital $2,000, has been incorporated by G. S. App, C. E. Schooley, C. Z. Wiley and others.

ST. LOUIS, MO.—The National Subway Company of Missouri at St. Louis [illegible] increase of capital stock from $[illegible] to $[illegible].

HOLDEN, MO.—The Farmers' Independent Telephone Company, which was recently incorporated, now has sixty party line subscribers and thirty-five miles of toll line. Its rates are $15 a year. The company is using Swedish-American telephone apparatus, and is an auxiliary to the Holden Telephone Company, which operates a National automatic board. The Farmers' Company is contemplating building twenty-five miles of full metallic toll lines, and twenty-five miles of party line grounded circuits.

JOPLIN, MO.—The telephone system of Joplin, Carthage, Webb City and Oronogo, Mo., have been merged into one company, known as the Mineral Cities Telephone Company, and has incorporated under the laws of Missouri, with a paid-up capital of $300,000. Headquarters are to be established in Joplin, and $50,000 is to be expended in improving the system. J. W. Layrie, of Carthage, is president of the new company. E. J. Layrie and J. L. Moore, of Carthage, and Geo. W. Layrie, of Joplin, are members of the company. Chicago and St. Louis capitalists are also interested.

WAHOO, NEB.—The Golden Rod Telephone Company, of Wahoo, capital stock $50,000, has been incorporated by W. H. Hurst, M. M. White and T. E. Parmele.

YORK, NEB.—There is to be a meeting of the county independent telephone companies in this city for the purpose of determining whether to establish a central station.

LINCOLN, NEB.—The Milburn & Anselmo Telephone Company filed articles of incorporation with a capital stock of $10,000. The company is to build a line between the towns of Milburn and Anselmo in Custer County. Calvin A. Snyder and W. E. Sengel are the incorporators.

VALLEY, NEB.—At a meeting of representative citizens it was decided to incorporate a stock company with a capital of $10,000 for the purpose of establishing an independent telephone system. The idea is to build in each direction from town and eventually connect with other independent companies throughout the State.

NEW YORK, N. Y.—Fire Commissioner Sturgis is giving trouble to the Manhattan Fire Alarm Company, which for several years past has been giving a valuable auxiliary service, and now has in New York 900 plants with 2400 fire alarm stations in hotels, theatres, factories, apartment houses, etc.

NEW YORK, N. Y.—Borough President Louis F. Haffen, of the Bronx, has begun a crusade against the telegraph and telephone poles on the principal thoroughfares of the Bronx. In these streets where subways have already been built Mr. Haffen will order the removal of all overhead wires. Urged on by numerous complaints, Mr. Haffen sent a letter to the Board of Estimate and Apportionment calling for its assistance in the matter.

BROCTON, N. Y.—The Portland Telephone Company has recently added fifty subscribers to its service, the total number now being 130. Its rates are $12 a year for residence telephones and $15 for office and business instruments. It uses apparatus of the Eureka Electric Company, Chicago, and is preparing to extend its lines about ten miles. It is also looking for an increase in the number of subscribers in the immediate future.

MINOT, N. D.—The Minot Light & Telephone Company has been incorporated by J. J. Barclay, F. C. Clark and L. M. Davis.

FARGO, N. D.—The announcement is made that the Northwestern Telephone Company will erect a new exchange building this spring.

MANDAN, N. D.—The Mandan Telephone Company has been incorporated by C. E. F. Draper, Hattie Draper, P. Tobin and T. R. Brewer.

NEPTUNE, OHIO.—A telephone exchange will be built at this place in the near future.

CONVERSE, OHIO.—The Jennings Telephone Company, with a capital of $10,000, has been incorporated.

DEFIANCE, OHIO.—The Central Union Telephone Company is equipping a new exchange building in Defiance.

MARYSVILLE, OHIO.—W. E. Liggett, of the local telephone exchange, is putting in a farmers' exchange at York, with 60 subscribers.

APPLE CREEK, OHIO.—The East Union Telephone Company has been incorporated by S. K. Garver, H. H. Murnam, J. P. Ryan, F. S. Kinstutz, G. W. Hackett and R. A. Pfouts.

CIRCLEVILLE, OHIO.—The Circleville Citizens' Telephone Company has increased its capital stock from $30,000 to $68,000. E. E. Smith is president and C. C. Chappelear, secretary.

BELLEFONTAINE, OHIO.—The Ada Telephone Exchange, including about 100 miles of toll line, has been purchased by C. E. Yoder, of Bellefontaine, and A. A. Geiger, of Bluffton, Ohio.

BELLEFONTAINE, OHIO.—The United Telephone Company, with a capital stock of $250,000 has been incorporated my G. M. Stimpson, Wm. Harris, Edward H. Fledderjohann, L. W. Fawcett, B. F. Coppers and C. E. Yoder.

OKLAHOMA CITY, OKLA.—Local capitalists are getting plans ready for the construction of a new long distance telephone line from here to Andarko.

CLEVELAND, OKLA.—The Cleveland Telephone Company, capital $10,000, has been incorporated by O. A. Gilbert, G. G. Means and G. W. Sutton, of Cleveland.

NORRISTOWN, PA.—The Montgomery Telephone Company, capital stock $5,000, has been incorporated. Directors: John H. Schultz, E. M. Michener, J. W. Brunner, A. H. Schults, D. M. Anders, B. W. Dambly and A. K. Dresher.

TYNDALL, S. D.—The Farmers' Telephone Company, capital stock $5,000, has been incorporated by Thos. A. Billy, E. A. Boska, Joseph V. Way and F. F. Chloder.

SIOUX FALLS, S. D.—Farmers living between the towns of Alexandria and Farmer are arranging for the construction of a telephone line between these points.

ALEXANDRIA, S. D.—The Edgerton Telephone Company, capital $8,000, has been incorporated by W. A. Caldwell, Frank L. Bond, M. Pitts, L. A. Piper and E. H. Card.

BEAUMONT, TEX.—The Beaumont [illegible] Company has increased its capital stock from $60,000 to $120,000.

GREENVILLE, TEX.—The Greenville Telephone Company has been incorporated by J. T. Young, C. H. Jones and L. A. Clarke; capital stock, $25,000.

HILLSBORO, TEX.—W. D. Okell and others have petitioned the City Council for a fifty-year franchise for the purpose of establishing an independent telephone exchange.

DENISON, TEX.—J. N. Hughes, president of the Chickasaw-Choctaw telephone line, states that the company's line will be extended at once from Durant eastward to connect with the towns on the Arkansas and Choctaw on the east, and then be built to Wister north. The line will then be built west from Durant to Wichita Falls, Tex.

SALT LAKE CITY, UTAH.—The annual report of the Rocky Mountain Bell Telephone Company shows that during the last year fifteen new exchanges and 3,622 subscribers were added to the service. New construction included 859 miles of new toll pole lines and 3038 miles of wire. These improvements, together with others not yet completed, cost $545,406. The financial statement of the year shows a net increase in revenue of $46,608.

LEESBURG, VA.—Arrangements are being perfected for a telephone line from Hillsboro into Loudon, to Harper's Ferry in West Virginia.

SWANTON, VT.—The People's Telephone Company, of St. Albans, is talking of building a line to Swanton in the spring.

EAGLE, WIS.—The Eagle Telephone Company, capital $3,000, has been incorporated by E. J. Lins, Frank Kloppenburg and Henry M. Loible.

EAU CLAIRE, WIS.—The Wisconsin & Minnesota Telephone & Telegraph Company, capital $75,000, has been incorporated by A. S. Munsell, T. F. Frawley and H. A. Field.

JUDA, WIS.—The Jefferson Telephone Company, capital $2,500, has been incorporated by George Barnum, J. S. Ohl, J. C. Emerich, Fred. M. Carter and M. Randall and S. D. Benage.

MONROE, WIS.—Farmers living near Juda have formed a telephone company to build a line through the farming country twelve miles south. The company will be incorporated for $5,000.

EAU CLAIRE, WIS.—A new telephone corporation has taken the franchise of the Osseo Telephone Company in the city of Eau Claire, which, however, continues to operate in a large outside territory.

APPLETON, WIS.—The operators in the Fox River Valley Telephone Company's office in this city went out on a strike a few days ago, the reason for their action being stated that the office superintendent was "too friendly" with one of the young lady operators.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, San Francisco, has been granted permission by the Board of Supervisors to erect a storage tank for fuel oil adjoining its electric power plant. The Mutual company will try petroleum, although one of the owners of the system is largely interested in coal mines.

SAN FRANCISCO, CALIF.—At a recent meeting of the Board of Presidents of the Salt Lake Valley Canal Companies, held in Salt Lake City, the project of establishing an electric pumping system for increasing the flow of water from the lake was considered without reaching a definite conclusion. It is estimated that the entire installation would cost about $15,000.

OAK PARK, ILL.—The electric light company's plant was seriously damaged by fire on March 3.

AYER, MASS.—Curtis & Sederquist, of Boston, have purchased the $10,000 5 per cent. twenty-year bond issue of the Ayer Electric Light Company, of Ayer, Mass., recently authorized by the railroad commissioners for extension of plant.

NILES, MICH.—The St. Joseph County Supervisors have granted a franchise to the Michigan Electrical & Hydraulic Company to build dams at Lelands, Henshaw, Becker and Colon on the St. Joseph River. It is the intention of the company to utilize the water power derived from these dams for manufacturing and street railway purposes.

HUNTSVILLE, MO.—The citizens of this city have appointed a committee to visit the neighboring towns to consult regarding an electric light plant.

ST. CHARLES, MO.—The last of St. Charles' city electric light bonds amounting to $4,500, were burned at the City Hall last week. St. Charles now owns its electric light plant, which is one of the best in the State in cities of the third class.

ST. LOUIS, MO.—The chief engineer of the water works extension advocates the building of a three-unit electric generating plant at the water works to supply power for lighting the insane asylum, female hospital, poorhouse, and several police stations and engine houses. His plan is for the city to buy a storage yard and erect shops in it.

JERSEY CITY, N. J.—On the night of March 4 an accident occurred in the electric light plant at the Pennsylvania Railroad Station in this city, which cut off all electric light in the big depot for a couple of hours after 10:30 o'clock. All the candles in the neighborhood were bought up, and passengers were ushered to the trains by candle and lantern light.

FOSTORIA, OHIO.—Barber Bros., of Delaware, Ohio, have been granted an electric light franchise and will give service as soon as possible.

ELYRIA, OHIO.—The Elyria Gas & Electric Light Company has been granted a franchise for steam heating, and will put in a plant to do such work throughout the city.

HUBBARD, OHIO.—The Council has passed a resolution setting forth the necessity of bonding the town for $8,000 for the purpose of building a lighting plant. An election will be held at once to vote on the measure.

FOSTORIA, OHIO.—The Fostoria Council has granted a franchise to the Barber Brothers of Delaware, Ohio, for a steam heating and electric lighting plant in this city. The company will build a plant at once and will enter into competition with existing lighting companies.

CLEVELAND, OHIO.—M. A. Bradley is preparing to erect another large power building. The Bradley Heat, Light & Power Company furnishes electrically transmitted power to a large group of buildings in the center of the city, nearly all of them owned by Mr. Bradley.

NEW RICHMOND, WIS.—A deal has been practically closed whereby a syndicate of Stillwater capitalists will become owners of the Apple River power plant, taking over all its property, water powers, rights franchises, etc., developed and undeveloped.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—Attorney General Tirey L. Ford, who represents the Baltimore syndicate which will purchase the Market Street Railway, has prepared the final papers of transfer and the properties will change hands on March 28. The total amount involved is $13,500,000, the largest street railway deal ever made on this coast. The transfer includes not only the Market street cable road and its branches, but the Sutter street cable road and the San Mateo electric line to the cemeteries.

SAN FRANCISCO, CALIF.—The outcome of the contest for street railway franchises in Los Angeles was the decision of the City Council to re-advertise for bids for the possession of the franchises. The Huntington-Hellman syndicate, which operates the Los Angeles Railway, was the original applicant for the franchises. It was awarded the franchises at a recent council meeting after the persons acting for Senator W. A. Clark had made the highest cash offer. The Huntington interests were allowed to raise their bid to $152,000, while the Clarks had bid $139,000. Mayor Snyder next vetoed the ordinance granting the franchises to the Huntington company, because he was opposed to permitting the hauling of freight within the city, as was provided in some of the franchises.

DENVER, COLO.—The Colorado Springs & Suburban Company has closed a contract with the North American Construction Company for the laying of new track on all its lines. Work will begin at the Manitou end of the line.

DANVILLE, ILL.—Henry Clague, Frank Caine, and Sherman W. Watterson, of Cleveland, have applied for a franchise from the county, for an electric railway to connect this city with Champaign and Urbana, traversing one of the richest agricultural sections of Illinois. They agreed to commence construction work immediately and have cars running within two years.

NEW CASTLE, IND.—The directors of the Newcastle & Pendleton electric railway have asked a subsidy of $27,500 from Henry Township and $16,500 from Harrison Township of Henry County. The first named township is not likely to vote the subsidy, as it is understood that the Union Traction Company is willing to build a line through the township without aid. In Harrison Township conditions are different and the subsidy will go through.

SHELBYVILLE, IND.—The Indianapolis & Shelbyville Traction Company, which is constructing a line between this city and Indianapolis, has filed a mortgage for $500,000 to cover a bond issue for construction purposes. The officers of the company say they will spend over $600,000 in the completion of the road. The company has also accepted a franchise from the city for one of the principal streets and a loop. The company expects ultimately to build on to Cincinnati.

WABASH, IND.—General Manager Law, of the Wabash River Traction Company, operating the interurban line between this city and Peru, announces the sale of the entire issue of $300,000 of 5 per cent bonds authorized by the company, at a fraction over 95, yielding $275,000. The proceeds are to be used in the construction of the Peru line or to build a new one to Marion. The company is also seeking the right of way through the counties of Miami and Cass to Logansport, and will soon have an extensive system.

TERRE HAUTE, IND.—No progress has been made toward a settlement of the strike and boycott of the Terre Haute Street Railway Company. Manager Clark has repeated his declaration that he will confer only with old employes and in no case will the matter of unionism be considered. The miners who have been holding a convention at Terre Haute voted $1,000 in aid of the strikers and refused to ride on the company's cars. This action has stimulated the strikers and renewed the boycott. Merchants are complaining of a loss of business, the boycott having lasted over six weeks.

INDIANAPOLIS, IND.—New York attorneys have filed four suits in the Federal Court for the Sprague Electric Railway & Motor Company of New York, and the Thomson-Houston Electric Company of Connecticut against the Indianapolis & Greenwood Rapid Transit Company and the Indianapolis and Greenfield Electric Railway Company. The Sprague company charges that the interurban lines are using certain improvements on motors and are infringing on the Sprague company's patents. The Thomson-Houston company makes the same charge in regard to the "contacts" and switches, and that the concerns that supplied them had no right to sell them. Both plaintiffs ask for permanent injunctions and an accounting of the profits derived from their use.

DETROIT, MICH.—The Grand Rapids, Holland & Lake Michigan Railway Company has increased its capital stock from $500,000 to $1,000,000. The extra stock has been taken by the present stockholders and the money will be used for improvements on the road.

CLEVELAND, OHIO.—Stockholders of the Cleveland, Elyria & Western Railway Company have ratified the recent purchase of the Elyria, Grafton & Southern Railway.

XENIA, OHIO.—The Greene County Commissioners have granted a franchise through the county to the Xenia, Cedarville, Jamestown & Wilmington Traction Company.

CANTON, OHIO.—The Stark Electric Railway Company, which is building a line from Canton to Alliance, has commenced proceedings to condemn a private right of way into the city.

COLUMBUS, OHIO.—The new power house for the Columbus, London & Springfield Railway, located between Vienna and Sumerford, was badly damaged by a wind storm recently. It was almost completed and ready for the roof.

WARREN, OHIO.—The promoters of the Conneaut & Southern Electric Railway Company have asked for a franchise through Trumbull County for the line which is to extend from Conneaut to Youngstown. Much of the road will be on private right of way.

FINDLAY, OHIO.—The various electric railway interests centering in this city are contemplating the feasibility of constructing a belt line around the city. Two lines are in operation, two more are partially completed and two others are being strongly projected.

PIQUA, OHIO.—The Western Ohio Railway Company is endeavoring to make a traffic arrangement whereby its cars may enter the center of Piqua over the tracks of the Miami Valley Traction Company, making it unnecessary to build a second line into the town.

CLEVELAND, OHIO.—In connection with the sale of the controlling interest in the Cleveland Electric Railway Company, the resignations of Henry A. Everett, Fred. E. Borton and Charles W. Wason as president, secretary and purchasing agent, respectively, have been handed in.

LOUDONSVILLE, OHIO.—Preliminary surveys are being made on the Wooster & Mansfield Railway. The road will pass through Loudonsville and Perrysburg, and it is stated that the power-house will be established at Loudonsville. The section of the road from Loudonsville to Wooster will be built first.

SANDUSKY, OHIO.—The promoters of the Sandusky, Bellevue, Monroeville & Norwalk Railway and the Sandusky, Clyde, Tiffin & Southern Railway are considering a plan for entrance to the city by means of a long overhead bridge over the Lake Shore tracks and other low points. The Lake Shore objects to another grade crossing.

COLUMBUS, OHIO.—The Mansfield, Greenwich & Norwalk Electric Railway Company, capitalized at $10,000, has been incorporated by S. S. Ford, Cleveland; W. W. Stark and J. C. Laster, of Richland County, and C. P. Wickham, R. H. Reynolds, J. Cleland and M. J. Roseboro, of Huron County. Officers have been elected as follows: S. S. Ford, president; C. P. Wickham, vice-president; Dr. R. H. Reynolds, second vice-president; W. W. Stark, treasurer; M. J. Roseboro, secretary, and J. Cleland, general manager. The company has secured private right of way for a line from Mansfield to Norwalk.

CINCINNATI, OHIO.—The Suburban Traction Company has given a trust deed for $600,000 to the Cincinnati Trust Company to secure 200 bonds for $1,000 each and 800 for $500 each, all payable Jan. 1, 1927, with interest at 5 per cent. The mortgage covers all property of the line now being built from Cincinnati to Bethel, Clermont County. G. K. Scrugham is president and Lee H. Brooks, secretary of the company.

DAYTON, OHIO.—The Dayton & Troy Traction Company and the Dayton & Western Traction Company have entered into an arrangement with the Southern Ohio Express Company whereby the latter will collect and deliver freight and express matter for these roads. The plan will be of great advantage to shippers and will obviate the difficulties caused by the city's ruling that cars must not be unloaded inside of a large district in the center of the city.

CLEVELAND, OHIO.—In providing additional equipment to take care of extensions under construction, the Cleveland, Elyria & Western Railway of Cleveland, has decided to install steam turbines for driving the new generators. Contracts have recently been closed for two 1000-kw Parson turbines running at 1500 r. p. m. to be direct connected to two 1000-kw, two-pole Westinghouse turbine generators. Also for two 30-kw exciters, to be direct connected to the shafts of the generators.

COLUMBUS, OHIO.—The Mansfield, Mt. Gilead & Delaware Electric Railway Company has been incorporated, with $10,000 capital stock, by C. E. Ertzinger, C. W. Fritz and W. J. Burkett, of Mansfield; W. P. Wiseley and F. L. Fenstemacher of Findlay, and C. D. Smiley, of Mt. Gilead. The line will be fifty miles in length and will form a connecting link between lines leading out of Columbus and Cleveland. The promoters claim the money to finance the road will be forthcoming as soon as twenty miles of right of way is secured.

CINCINNATI, OHIO.—Messrs. Sheets and Beard, of Brookville, Ind., and Martin Barnes, of Groesbeck, Ohio, are promoting an electric railway to extend from Brookville, Ind., through Scipio, Okeana, Shandon, Ross, New Baltimore, Barnesburg and Groesbeck to Fairmount on the outskirts of this city. Several roads have been projected over this route with no practical results, and now these parties, who are large property owners, will push the project. Land owners will be asked to subscribe $100,000 worth of stock in the company.

TOLEDO, OHIO.—The Toledo & Indiana Railway Company held its annual meeting recently. New officers were elected as follows: C. P. Griffin, president; George G. Metzger, vice-president; C. H. Masters, secretary; A. K. Detwiler, treasurer. Directors: C. P. Griffin, George G. Metzger, A. K. Detwiler, Frank Yesbera, C. H. Masters, Dudley Watson, Dr. James Donnelly, F. S. Ham, L. E. Flory, L. W. Brown and J. R. B. Ransom. Construction work will be resumed as soon as the weather will permit. Ten miles between Delta and Holland has been graded. It is the intention to have cars running between Toledo and Wauseon by Oct. 15.

PORTLAND, ORE.—The Oregon Short Line Railroad will begin the construction of an electric railway from Shoshone to Shoshone Falls, which later will be extended into Nevada.

PHILADELPHIA, PA.—The coalition of the Union Traction Company and the New Street Railway Company, organized under an act of the last State Legislature, was finally agreed upon at a meeting of the Board of Directors of the former corporation March 3. The question will be voted upon at a special meeting of the stockholders of the Union Traction Company on May 5, and there is no doubt of the ratification of the project.

WHEELING, W. VA.—A meeting of the directors of the Wheeling Traction Company was held a few days ago and it was decided to push the work on the

Contracts have been closed for the equipment of the new power station.

BARABOO, WIS.—For several years a movement has been on foot for the building of an electric railway between the Dells of the Wisconsin and Devil's Lake. Last fall a company was formed by a party of Chicago capitalists, including G. I. Hicks, E. W. Farnham and others, under the name of the Sauk County Traction & Power Company. This city has granted it a franchise. The power for the generating stations will probably be secured from the new dam across the Wisconsin River at Kilbourn. Beside a passenger traffic the company expects to do a freight business, connecting with the Milwaukee road at Kilbourn.

LEGAL.

TELEPHONE SWITCHBOARD CASE.—The decision of the lower court, in the case of the Western Electric Company against the Kinloch Telephone Company, was affirmed Feb. 18 by the Federal Court of Appeals at St. Louis. The Western Electric Company sued the telephone company for infringement of patents granted to John A. Seely in November, 1885, for an improvement in grouping spring jacks and annunciators for multiple switchboards. The telephone company alleges that the devices complained of were not those covered by the letters patent, but were the production of mechanical skill, and not the result of inventive faculty. The United States Circuit Court rendered a judgment in favor of the Western Electric Company to the effect that the Kinloch Telephone Company had infringed on the patent, and it enjoined the latter from using the invention. The Kinloch Telephone Company appealed the case, giving bond. The case was reviewed by the Federal Court of Appeals, which has upheld the judgment of the lower court. The Kinloch Company will ask for a rehearing, and in case this is denied, a new device would be introduced, it is said, by the manufacturers of the switchboards, without interference in the slightest degree with the service. The telephone company claims that the subject of the litigation was a minor device and not in anywise one calculated to interfere with service by its removal.

PERSONAL.

MR. CHARLES E. DUSTIN, president of the Charles E. Dustin Company, of No. 11 Broadway, New York, has returned from a six weeks' trip to Cuba.

MR. FREDERIC NICHOLLS, the well known general manager, etc., of the Canadian General Electric Company, has been in New York this week at the Waldorf, on a trip from Toronto.

MR. THOMAS F. RYAN has gone to California for a trip of some weeks' duration. His special car was caught in a serious railway disaster last week in Texas, but the party escaped from sustaining any noteworthy injury.

MR. W. T. WALLACE, the secretary of the United Telpherage Company, starts this week for England and the Continent, where this excellent system of aerial freight transportation is beginning to attract considerable attention.

MR. ROBERT W. BLACKWELL, after a visit of some weeks to this country, is sailing on March 15 for England, where the business of Robert W. Blackwell & Company has assumed very large proportions, with branches on the Continent.

GENERAL T. T. ECKERT has resigned as president of the Western Union Telegraph Company, but will remain in office as chairman of the board of directors. He is succeeded by Col. Clowry, now vice-president and general superintendent.

MR. JOHN S. BOYD, long time secretary and treasurer of the Southern Electric Company of Baltimore, Md., notifies us that he has now established himself as an electrical engineer and manufacturers' sales agent at No. 12 North Charles Street, that city.

MR. R. L. MACDUFFIE, of Wendell & MacDuffie, whose offices are in the Havemeyer Building, 26 Cortlandt Street, New York, has sailed for Cuba, with a view to closing some important contracts in connection with electric traction equipments in that part of the world.

MR. W. B. RANKINE, of the Niagara Falls Power Company, had the honor last week of receiving Prince Henry of Prussia at the big power-house at the Falls, and explaining its features of interest. Prince Henry was greatly pleased with what he heard and saw there.

MR. HENRY FLOY, the consulting electrical engineer, returned last week on the "Deutschland" from Cherbourg, having spent two months in Italy and France, with the object of ridding himself entirely from the effects of the serious attack of typhoid fever, from which he had lately convalesced. He has resumed active practice.

PROF. PASQUALINI, the chief electrician of the Royal Arsenal of St. Bartolomeo, Spezia, Italy, has resigned his connection with the Italian Government in order to become associated with the Galileo Works, of which Mr. G. Martinez is the manager, at Florence. This will give Prof. Pasqualini an excellent opportunity in the electro-technical industries.

MR. MAURICE COSTER, the present manager of the sales department of the French Westinghouse Electric Company, and well known also as the former manager of the Chicago offices of the same interests, was married on Feb. 19 to Miss Augusta Blanche Bennett, on the Isle of Jersey. A host of American friends join in congratulations and best wishes.

MR. WILLIAM D. RAY has opened an office for the practice of electrical and mechanical engineering in Detroit, at 1015 Chamber of Commerce Building. Mr. Ray was electrical engineer of the Detroit Construction Company in the building of the Detroit, Lake Orion & Flint Railway and the Grand Rapids, Holland & Lake Michigan Rapid Railways, and was for a number of years manager of the Everett, Wash., Railway & Electric Company.

MR. G. MARCONI has left New York for Canada to supervise the arrangements for a permanent signal station on Cape Breton. The inventor will confer with officials of the Canadian government to obtain final assurances of their co-operation and that the recent action of the English Postmaster General will

not affect the rights to the [illegible] Mr. Marconi will remain in the Dominion [illegible] returning to New York, on his way to England. As soon as the apparatus is installed at Cape Breton he will come back from abroad to conduct experiments.

Trade Notes.

MR. E. P. THOMPSON, the patent lawyer, 120 Fifth Avenue, New York City, has issued a batch of new literature relating to patent expert work, and giving also some testimonials from his clients, references, etc.

MESSRS. JOHNSON & MORTON, Utica, N. Y., are sending out a large private postal card containing some brief facts and illustrations of one of their standard junction boxes. The firm also announces that it has equally good things in switches.

THE TELEPHONE DEPARTMENT of the Electric Appliance Company, Chicago, has just issued circulars describing its Eaco visual signal metallic circuit switchboards and its Eaco country or party line switchboards for metallic or grounded circuits.

THERMOSTATIC FIRE ALARM.—Mr. H. C. Vierkant, Tarrytown, N. Y., is manufacturing a thermostatic fire alarm for dwellings, factories, etc., which appears to have some distinct advantages. It is adjustable to any degree of temperature, and apparently will work well and satisfactorily in practice.

DYNAMO FIELD RHEOSTATS.—The Wirt Electric Company, Philadelphia, Pa., in Circular No. 195 describes and illustrates the construction of Wirt dynamo and field rheostats. The various constituent parts are shown in illustrations, and tables give the dimensions of the different sizes of rheostats.

FORT WAYNE CALENDAR.—An artistic calendar for March has been issued by the Fort Wayne Electric Works, Fort Wayne, Ind. All of the lettering is represented in high relief with strong shadows, and makes a very effective and attractive calendar to hang up over the desk. The card contains illustrations of Fort Wayne induction wattmeters.

PANEL BOARDS.—Messrs. Zimdars & Hunt, 127 Fifth Avenue, New York, have issued two pamphlets on the subjects of panel boards and slate linings for panel board cabinets. Different styles of panel boards are illustrated in pamphlet No. 2, together with price lists, etc., and pamphlet No. 3 gives prices, code words and other information about slate linings.

ELECTRICAL SUPPLY CATALOGUE.—Messrs. W. R. Ostrander & Company, 22 Dey Street, New York, have just issued the thirteenth edition of their catalogue of speaking tube hardware, electric light material, telephone and telegraph instruments, electric bells and batteries, and general electrical supplies. The catalogue has 296 pages and is profusely illustrated.

BOOK TYPEWRITERS.—The Elliott & Hatch Book Typewriter Company announces that it has just placed on the market a very much improved book typewriter. It has also recently brought out four new sizes of machines. The merits of these book typewriters are described in special booklets which can be had on application at the company's office, 256 Broadway, New York.

THE STORY OF HUMAN PROGRESS.—Under this heading the Goheen Manufacturing Company, Canton, Ohio, has issued a pamphlet concerning its "carbonizing coating," which is a paint that protects iron and steel from rust and corrosion. This material has stood the test of time. Various illustrations show steel buildings, bridges, etc., on which this coating has been used.

MORE THAN A CATALOGUE.—It is a book of information on alternating current wattmeters. It treats in a most complete and comprehensive manner of the Gutmann integrating alternating current wattmeters. There is no reason why wattmeters should be a mystery—get the book—and that is easily done by dropping a card to the Electric Appliance Company, Chicago.

TELEPHONE CATALOGUE.—The Kellogg Switchboard & Supply Company, Chicago, in Bulletin No. 7 shows a few of the many styles of instruments which it is prepared to furnish. The various styles of complete instruments are clearly illustrated, the halftones used in the work being very artistically executed. The bulletin contains considerable information of interest to telephone [illegible]

"FEMCO" LAMPS.—A handsome new catalogue descriptive of the "Femco" incandescent lamp is being mailed by the Franklin Electric Manufacturing Company, Hartford, Conn. The several types in which the "Femco" lamps are made are shown in full sized illustrations. The catalogue contains much useful information for incandescent lamp users. A copy will be mailed to any one interested on application.

VARNISH CLOTH.—The Sills-Eddy Mica Company, Broad Exchange, New York, is sending out a folder to the trade containing a sample of its Imperial varnish cloth made up by its new method. This cloth is manufactured in rolls up to 500 yards of desired so long. The varnish is put on much more evenly and the goods, it is stated, stands a much higher insulation test than under the old method. The voltage breakdown test of this varnish cloth is stated to be 3500 to 6000 volts.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is sending out new bulletins of its apparatus, the subjects of which are: Compound starting rheostats with automatic release; non-reversible drum controllers for printing presses, machine tools, etc.; drum controllers with two reverse speeds, specially adapted for printing presses, and rope-operated reversible drum controllers for cranes, hoists, etc. These various pieces of apparatus are illustrated and price lists of the different sizes given.

CLARK TELEPHONE SWITCHBOARDS.—The Clark Automatic Telephone Switchboard Company, 15 Custom House Street, Providence, R. I., has just issued a 16-page pamphlet containing copies of many testimonial letters received by it from all over the country, and one from France. All the writers [illegible] letters speak in praise of the [illegible] of the apparatus of the company. A list at the back of the pamphlet shows that the Clark automatic system is used in England, South France, Amsterdam, Holland, Honolulu, etc.

THE LIBERTY ELECTRICAL SUPPLY COMPANY is the name of a new concern recently started at 136 Liberty Street, New York, to handle a full line of electrical supplies and act as manufacturers' agent for provincial houses. The new company is being managed by Mr. B. Rosenberg, for ten years with the Manhattan Electrical Supply Company, of New York, and Mr. J. H. Newman, well and favorably known in business circles. The company is starting out with a complete line of supplies, and states that it is prepared to fill all orders promptly.

MR. F. C. HARDON, secretary of the Carstarphen Electric Company, of Denver, Col., has recently been in the East on a business trip. The Carstaphen Electric Company is building the large induction coils and other apparatus to be used by the Pacific Wireless Telegraph Company at their stations at Los Angeles and Santa Catalina Island. Such instruments have not hitherto been manufactured in that region, and it is gratifying to note that Colorado now has an establishment that can produce the most delicate electrical and other scientific apparatus.

POLES, TIES, ETC.—The Maltby Lumber Company, Bay City, Mich., is sending out to its trade a folder giving a lot of interesting information regarding its poles and cross ties for steam and trolley roads. The company's principal yards for sorting poles are located at Boyne Falls and Pinconning, and it employs competent and trained inspectors at each yard to see personally to the count and grade of stock of every car shipped. Every one concerned in poles and cross ties will find much information of interest in this folder, a copy of which can be had on application to the company at Bay City.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, Dayton, Ohio, announces that it has recently made a change in the management of its Philadelphia office. Mr. P. B. Fenlon is no longer connected with the company as manager of that office, having been succeeded by Mr. O. G. Smith, who has been in charge of the company's air compressor department. Mr. A. L. McClurg, who has been connected with the Harrison Safety Boiler Works for the past six years, has also entered the employ of the Stilwell-Bierce Company, and will make his headquarters in Pittsburg in connection with Mr. E. F. Austin, the company's sales agent.

A NEW TYPE OF PUSH SWITCH has just been put on the market by the Hart & Hegeman Manufacturing Company, Hartford, Conn. This new switch differs considerably in pattern from any heretofore produced, and it is claimed for it that it is the most easily operated switch made. One of the features of the new pattern is a much longer break than is obtained in other switches of the kind. With this push switch, the manufacturers are supplying a face plate 1¾ inches wide by 4½ inches long—considerably larger than that furnished with any other push switch. This feature will prove particularly useful to contractors in installing the switch in old work.

DOWN-DRAFT FORGES.—The Buffalo Forge Company, Buffalo, N. Y., is calling attention to an interesting testimonial from the "Big Four Route" Railroad Company in reference to the Buffalo Company's down-draft forges, purchased and placed in service in 1895 in the railway company's blacksmith shop at Wabash. They have ever since been giving satisfactory performance. Mr. Garstang, superintendent of motive power, considers that the down-draft system is excellent, principally on account of the removing of the smoke from the shop and in not requiring overhead pipe or other obstructions to interfere with or prevent the handling of heavy work with cranes.

SMALL MOTORS AND GENERATORS.—The Northern Electrical Manufacturing Company of Madison, Wis., has issued a bulletin describing the Watson type of small motors and generators, which it has recently placed on the market. These little machines are a radical departure in design and construction from other small motors or generators being constructed with multi-polar fields. The armatures are also built on the same plan as followed in the construction of larger machines. They have slotted laminated cores laid with form wound coils and arranged for perfect ventilation. The illustrations show the machines to be neat, compact and symmetrical. At present the machines are built in sizes from ⅛ to 2 horse-power.

WISCONSIN GRAPHITE PRODUCTS.—Wisconsin graphite paint comes in six different shades, has a bright lustre, a very even surface, and long life. It practically incorporates itself into the iron and steel wherever applied. The Wisconsin Graphite Company, Pittsburg, has a most excellent graphite preparation, known as the Wisconsin graphite stack paint, which will wear for years and is being largely used by manufacturers and mill owners generally throughout the country. This company manufactures the well known Wisconsin flake graphite lubricant, which not only obviates all friction, but is positively without grit and is absolutely smooth. It is especially adapted for powerful engines, dynamos and machinery, and the best results have justified the company's advocacy of it. Free samples will be sent to any one upon request.

POLYGLOT CATALOGUE.—A novelty in the catalogue line has just been brought out by the Cutter Electrical & Manufacturing Company, Philadelphia, Pa. It is called the "I. T. E. Circuit-Breaker Polyglot Catalogue," and is stated by the Cutter company to be the most complete circuit-breaker catalogue ever published. It is printed in English, French, German and Spanish, and its translation into the foreign languages occupied more than a year's time. It contains very complete information on its subject in all four languages. The dimensions of the apparatus are given in inches and centimetres, and the weights in pounds and kilogrammes. This catalogue is very interesting and will no doubt serve a very useful purpose. The translation of its contents into these foreign languages will place in the possession of electricians in the different countries in which these languages are spoken information that would be difficult to obtain through the ordinary channels. The catalogue is of large size, and necessarily so since the text has been expanded into four languages. The front cover contains a view of an I. T. E. circuit-breaker printed in bronze colors to correspond with those of the metallic parts of the instrument.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 4, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

693,918. PROCESS OF FORMING BODIES BY ELECTRODEPOSITION; C. Steinweg, Ludenscheid, Germany. App. filed July 1, 1901. (See Current News and Notes.)

694,349. PROCESS OF RECOVERING GOLD FROM REFRACTORY ORES; H. R. Cassel, New York, N. Y. App. filed June 12, 1901. (See Current News and Notes.)

694,350. APPARATUS FOR RECOVERING PRECIOUS METALS FROM REFRACTORY ORES; H. R. Cassel, New York, N. Y. App. filed June 12, 1901. (See Current News and Notes.)

694,410. ELECTRIC ARC LAMP; M. S. Okun, New York, N. Y. App. filed Sept. 16, 1896. An arc enclosing globe having an opening for the carbon pencil and mounted to move laterally to accommodate irregularities in the pencil.

694,425. ELECTRIC RAILWAY SYSTEM; J. Ryan, Watertown, N. Y. App. filed Oct. 8, 1900. The switchbox contains a solenoid whose core carries a cup of mercury which is lifted when the solenoid is energized to carry the mercury into contact with two terminals. When the circuit is broken the cup lowers by gravity.

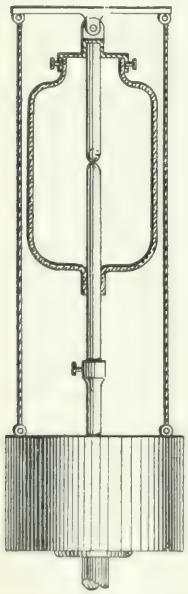
694,511. MOUNTING OF ELECTRIC BELLS; C. Woittequand, Charleville, France. App. filed March 5, 1901. Details of construction of the frame.

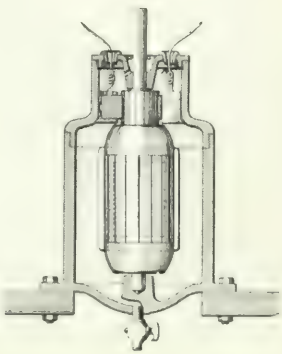
694,542. TELEGRAPHY; J. P. Gorton, Weston-Super-Mare, Eng. App. filed Oct. 31, 1901. For repeating from one circuit to another when the first circuit is subject to retardation, apparatus is so arranged that successive current impulses arriving at the repeating station will be transmitted in the form of well defined impulses.

694,546. SELF-WINDING ELECTRIC CLOCK; M. Hoeft and E. Schultz, Berlin, Germany. App. filed Sept. 25, 1900. The circuit closer is constructed to be self-cleaning at the contact points.

694,582. PLUG OR BRUSH FOR CONNECTING WIRES OR BARS TO PIECES OF METAL; E. A. Richardson, Charenton, France. App. filed July 20, 1901. A rail bond in which the end of the bond is held in a conical slotted plug in the rail.

694,639. ELECTRIC MOTOR; T. B. Hatch, Menomonie, Wis. App. filed Aug. 7, 1901. The field magnet of the motor is a sealed case containing oil, which excludes moisture, air and dust.





694,542.—Telegraphy.

694,[illegible]. Electric Motor; [illegible].

694,[illegible]. ELECTROLYTIC PROCESS; [illegible].

694,662. TELEPHONE EXCHANGE SIGNAL SYSTEM; W. S. Paca, Erie, [illegible].

[illegible]; C. W. [illegible].

lating pipes leading to a blower, which is started up when the current or

694,677. CABLE HANGING HOOK; C. P. Seyler and P. H. Auxer, Cleveland, Ohio. App. filed Nov. 4, 1901. A looped wire hook and a flat band adapted to pass through the loop and have its ends held by the plies thereof.

694,699. ART OF REFINING COMPOSITE METALS; T. Ulke, Sault Ste. [illegible].

of a yoke-shaped iron bar which is flexible to permit the ends of the yoke to approach and recede from each other as the circuit is interrupted.

694,791. STEERING GEAR; R. E. Sack, Detroit, Mich. App. filed Feb. 17, 1900. The swinging movement of the steering axle throws resistance into the circuit of one or the other of two magnetic clutches which permits one driving wheel to move at a different speed from the other.

694,792. ELECTRIC CALL; J. Salmon, New York, N. Y. App. filed Jan. 31, 1901. Details.

694,806. OUTLET MEMBER FOR ELECTRICAL CONDUITS; R. M. Thomas, New York, N. Y. App. filed Jan. 26, 1901. A sleeve of solid metal having an interior thread for attachment to the end of the pipe and a lip extending over the edges of the pipe and provided with a protective coating of enamel.

694,810. ADJUSTABLE ELECTRIC LIGHT SUPPORT; E. F. Walters, Lehighton, Pa. App. filed Sept. 5, 1901. A telescoping arrangement in connection with a spring drum to take up the slack of the conductor.

694,832. ELECTRIC METER; C. T. Claypoole, Sioux City, Ia. App. filed Jan. 18, 1902. The shunt circuit on which the meter operates is wholly within the casing, so that it cannot be tampered with.

694,855. ELECTRIC PROTECTIVE DEVICE; W. P. Hardy, Ottumwa, Ia. App. filed May 4, 1900. Two metallic conductors having the same coefficient of expansion are rigidly connected together and fastened at one end. When a current which flows through one of these conductors, rises above the normal, the heating effect warps the two conductors and closes an alarm circuit.

694,877. STOP MECHANISM FOR ENGINES; T. D. Millea, Springfield, Mass. App. filed May 9, 1896. A mechanical stop device set in operation by an electro-magnet.

694,902. GAS IGNITER; T. B. Wilcox, Newark, N. J. App. filed Aug. 2, 1901. A current is sent through a resistance consisting of platinum foil which when thrust into flowing gas, ignites the same. The chemical action of the gas on the platinum aids the battery in bringing the conductor to incandescence.

694,912. PLURAL FUSE CUT-OUT; C. J. Dorsey, Baltimore, Md. App. [illegible]. A plurality of fuses [illegible] a contact [illegible] by inserting plugs.

694,[illegible]. SPEED RECORDING APPARATUS; R. W. [illegible], Brunswick, Me. App. filed April 17, 1901. An electric circuit which operates a puncturing device on a clock is closed at each rotation of a shaft and at the end of a certain period the number of punctures shows whether the normal speed was exceeded or lowered.

694,914. ELECTRIC APPARATUS FOR EXPLODING MINES; S. Eversheld, London, Eng. App. filed June 4, 1901. An armature which closes the firing circuit is acted upon by the field magnets of the generator so that when the current rises to the firing point, the armature is at the same time moved to close the firing circuit.

694,918. TELEPHONE EXCHANGE; N. H. Holland, Brookline, Mass. App. [illegible].

[illegible]. ELECTRODE FOR PURIFYING LIQUIDS BY ELECTROLYSIS; W. R. Chipman, New York, N. Y. App. filed April 29, 1901. (See Current [illegible].

Electrical World and Engineer

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ONE CENT A CALL.

It is stated that capitalists in Elizabeth, New Jersey, are proposing to establish a telephone system there upon the basis of one cent per call, telephones being also installed free, with wires laid underground, which, of course, means also metallic circuits. This sounds like a telephone millenium, and we do not know that it has been realized on such terms in any American city yet. We should dislike to dampen the ardor and enthusiasm of the promoters, but must confess we can see no money for anybody in the plan. Elizabeth, not a large place, has two telephone systems now, and a third would find it "hard sledding," although at such bottom prices it might in the long run drive its competitors into bankruptcy, only to follow them there itself shortly after. Cheap telephony is a desideratum, and telephoning is already pretty cheap, but it is not to be inferred, as some people are doing, that because such plans are projected at Elizabeth they are either valid or if valid there good for general adoption. It is interesting to note the recognition in all recent telephone development of the measured rate basis of operation as compared with the old flat rate still prevalent in many quarters.

WIRELESS TELEGRAPHY.

One of the most important events of this week has been the conclusion of an agreement between Mr. Marconi and the Canadian Government for the establishment of a wireless telegraph system between the Dominion and Great Britain. Reference has already been made in some detail to this contract in our pages, the main point being a rate of 10 cents per word, whereas the existing cable rate is 25 cents; and the press rate is to be 5 cents. Some other features of the contract we shall have occasion to note and comment on later; but our object just now is to emphasize the tremendous fact that such a contract has been entered into at all. It implies on both sides a serious intention, and a serious confidence in the thorough feasibility of the enterprise. The immediate future is therefore full of interest, both as to what may directly attend the execution of the Marconi plans, and as to what the effect will be on cable rates and cable improvement. The only thing to be hoped for is that while existing rights may be fully protected, there will be no stupid governmental interference in England to check progress in this momentous development.

AUXILIARY FIRE ALARMS

Readers of the New York daily journals will have become familiar recently with the fact that there is a sharp controversy in progress as to the use of auxiliary fire alarm systems, the new heads of the Fire Department being opposed apparently to such service. It is not our desire or intention to intervene in the discussion, except to express our fervent hope that no reduction of this useful service will be permitted. After the recent series of terrible fires in New York, a sense of insecurity prevails as to the real safety of alleged fireproof hotels and other buildings, and it would be nothing short of a crime to lessen at this juncture, or, indeed, at any other time the protections and precautions that are thus thrown around life and property. These auxiliary systems are based upon a connection from the building to the nearest street box, and it is evident that in case of danger, the response of the nearest fire brigade must be materially expedited. To quote Mr. W. F. Allen, president of the system at which the movement appears primarily directed: "The enormous expense of installing and maintaining independent trunk-line systems covering the entire city would be so great that the service could not be

supplied at prices which the customers would be able or willing to pay. Absolutely the only way in which interior fire alarm service, so greatly needed, can be made available in every settled section of the city is through connections with street boxes, such as we are providing. It seems to us manifestly absurd that a fire-alarm system of recognized value should be interfered with because at this time it is the only system which is capable of meeting certain requirements. It also seems to us that it would be equally unreasonable to say that people in sections remote from trunk-line service should be obliged to go without fire-alarm service, or pay extravagant prices for trunk-line service, when the usefulness of the street boxes can be indefinitely multiplied through our well-known and approved form of service available everywhere at moderate cost, and without ever interfering with or injuring the public fire-alarm service. What we do is to allow citizens and taxpayers to operate a street box from the interior of their premises, and at their own cost. In other words, we enable a citizen to do from a distance precisely what he has a right to do at the street box itself, but with a saving of extremely valuable time."

This puts the case in a nutshell, and we can hardly believe that public opinion will tolerate any interference with so valuable an auxiliary. This is one of the modern methods of safety or of added convenience that the public owes to electricity, and its use should be widened and extended rather than curtailed. Moreover, aside from the additional protection it furnishes the citizen, it renders the fire service so much more efficient and flexible, enabling it with less expense and effort to reach a fire and quench it at the very start.

THE METRIC SYSTEM.

The Committee of Coinage, Weights and Measures of the House of Representatives has reported favorably the bill establishing the metric system as the legal standard of weights and measures in the United States, and requiring all Government Departments to use only that system, except in completing the survey of the public lands. This report was only rendered after a series of public hearings, at which opponents as well as friends of the system gave testimony, and that there were but two members of the committee of seventeen who cast dissenting votes, augurs well for the final success of the measure. In the same issue of the *New York Herald* which contained an announcement of the action of the committee, appeared a cable despatch stating that at the annual conference last week of the Associated Chambers of Commerce of Great Britain and Ireland, a resolution was adopted almost unanimously in favor of the metric system. In a recent issue we referred in general terms to the strong support that has been enlisted in favor of the metric system in the British Parliament. We have now before us a list of 259 names of members of the House of Parliament who have notified their approval of the adoption of the metric system for Great Britain. In addition, 30 members have signified their approval but withhold authority to publish their names. Some indication of the present strong trend of opinion in Great Britain is given by the fact that since Jan. 30, 31 members of Parliament have signified their approval of the system. The movement in favor of the metric system has undoubtedly gained enormously in strength in Great Britain during the past several years, and the time for definite action there in its favor appears to be almost ripe. As the adoption of the system by either country will inevitably force its adoption in the other, we sincerely hope that Congress at the present session will pass the bill now before it and thereby reserve to this country the credit of initiative in the great reform.

A committee of the American Society of Mechanical Engineers in a circular urges that members of that society address their Representatives in Congress protesting against the passage of the metric system bill, on the grounds that if the bill is passed it will make our present systems of weights and measures illegal. We must express surprise that such a statement should be put forth with the authority of the Society of Mechanical Engineers. As we pointed out in a recent issue, the bill in question seeks to make the use of the metric system compulsory only in the United States Government Departments and offices, and that, "In this land of liberty no man can be restrained from either measuring or stating the height of his horse in 'hands,' or areas of his barn in 'poles' as long as it shall please him so to do." This view has since been confirmed by Attorney-General Knox, who was asked for an opinion as to whether the bill would invalidate contracts made after it took effect, in which the weight or measure provided for should be expressed in terms other than those of the metric system. The opinion states that the bill does not compel people to use only the metric system, or prohibit them from the use of any other, and that it would not make invalid contracts expressed in other terms. Moreover, there has never been a time when a contract expressed as to weight or measure in terms of the metric system or any other system would not have been just as valid as if expressed in the terms in common use. Attorney-General Knox concludes by saying that he does not think it would be within the competency of Congress to forbid to the people the use of any system of weights or measures.

ELECTRIC SHOCK.

A meeting of the British Institution of Electrical Engineers last month appears to have been devoted to the consideration of papers on electric shocks, and three good papers on the subject were read. They were written by engineers for engineers, and set forth many of the important engineering facts and experiences that have been accumulated during a fairly long history of electrical applications. Unfortunately, however, the physiological and medical sides of the question do not seem to have been brought forward, and no treatment of the subject of electric shocks can be complete in any sense without taking the medical and physiological aspects into consideration. One of the writers described a number of valuable observations in connection with shocks, and absence of shocks, from trolley wires and trolley rails. According to Mr. Trotter, sensation, in connection with feeble shocks, is largely a matter of current-density; while the effects of more powerful shocks are mainly dependent on the total current-strength. He considers one or two milliamperes to be hardly perceptible, from 3 to 8 milliamperes readily supportable; while he sets the limits of endurance at 35 milliamperes. In this generalization we entirely concur, with sole reference, of course, to the ordinary superficially applied currents, such as may occur in accidental shocks.

It was generally admitted that pressures below 600 volts are very unlikely to produce fatal shocks; while the danger increases rapidly above 1000 volts. Of course, no rigid rule can be laid down; because, assuming that all persons are equally susceptible, which is unlikely, the degree of danger would depend both upon the path of the current through the body, and upon the strength of the current. The current-strength, in turn, depends both on the voltage, and upon the resistance in the path. A great mass of evidence has been collected concerning the electric resistance offered by the human body under different conditions, and the conclusion appears to be that it is capable of enormous variation according to the positions, surface-areas, and wetness of the electrodes. In electrocutions the resistance of the body is intentionally reduced to about two hundred ohms, by the application of large electrodes, thoroughly wetted with saline solution. Between dry finger-tips, on opposite hands, however, the resistance may be many thousands of ohms. The same applied voltage will tend to produce corresponding inverse current strengths in the two cases. Remarkable suggestions were made that the susceptibility to shock may be diminished by drunkenness, sleep, and weakness of intellect;

while it may, perhaps, be increased by kidney-disease. Such suggestions should be carefully examined in the light of future evidence.

The whole subject of electric shock calls for further physiological investigation. According to recent researches of Dr. Cunningham, death by the ordinary electric shock, when not caused by burning, is due to fibrillar contractions in the heart, or a state of abnormal muscular action in that organ, in which the normal functions are suspended, and the circulation stops. The researches which led to his conclusions were conducted upon dogs. It seems very important to have this conclusion verified, and researches instituted looking for a method of procedure which shall aid the fluttered heart in resuming its functions. According to some, while artificial respiration should be applied in all cases, yet it offers but little hope when the heart is seriously thrown into fibrillar contractions, and what is wanted is some means of applying corrective stimulus to the heart, to make it resume its normal muscular action. Assuming that this is the correct view of the matter, any means that might be experimentally discovered, of stimulating the heart of a person in suspended animation through electric shock, would be very valuable to the world of electric workers. We want to be told just what the physiological dangers are, and just what course to pursue when medical attendance is not at hand. Some curious views were presented bordering on the physiological question, such as the view that the conditions which produce a burn in electric shock, tend to reduce the danger of fatal consequences. Such opinions, it would seem, can only be supported by a great deal of testimony.

A Notable Power Transmission.

In these days of high voltage and long distance lines it takes something quite out of the ordinary to attract any considerable amount of attention or to merit especial attention. Only engineering features of especial interest enable a new plant to rise above the level of the commonplace. The great Mexican plant which we are describing in current issues, however, deserves more than passing consideration. Its first notable feature is the very unusual character of the hydraulic development. Briefly, the situation was as follows: Having as an objective point the City of Mexico, plenty of water was available, but not enough at any one point to supply the total amount necessary. Ordinarily the practice is to gather sufficient water, by long canals if necessary, to operate a single large power-house, but in this instance the practicable falls, five in number, were scattered over a considerable area and were located on two streams. The country was difficult for canals or flumes, and on the whole the cheapest way out of the difficulty seemed to be the installation of a small separate station at each fall, the total summation of the energy being electric instead of hydraulic. The situation somewhat recalls that on the Gorzente near Genoa, but while in that case there were but three stations operated independently, in this instance there are five power stations operated together. Obviously, the attendance required in such a group of stations is much larger than it would be if the ordinary practice were followed, but the sub-division was required by the hydraulic situation. Even so the hydraulic operations were none too easy. A rather singular feature is the use of masonry aqueducts in short runs over ravines. In common American practice wooden flumes would be used in similar situations, but conditions are somewhat different on the Mexican plateau and the use of masonry was doubtless justified.

With five generating stations small units were in order, and the size taken as standard was 225 kilowatts, which facilitated transportation, always a tough problem in a wild country. The periodicity chosen was 50 cycles, an excellent compromise frequency, but rather unusual in this country. If we remember aright, outside of the great network around Los Angeles, 50 cycles are used in only three or four American plants. The voltage, 22,000, is in line with the best recent practice and may now be considered as rather conservative than otherwise. The whole system is worked in multiple with the utmost freedom whenever convenient, the entire nineteen generators being sometimes thrown together. In this connection it seems odd that common practice so persistently adheres to synchronizing with the phase-lamps dark. The reverse connection, synchronizing with the lamps bright, is both more sensitive if the lamps are arranged for a low maximum brilliancy, and safer, as a lamp may burn out during synchronizing. Such an accident seems rather unlikely, but it has actually happened. By way of emphasizing the ease with which modern polyphase machines are operated in multiple the interesting condition is sometimes reached when a steam-driven generator at the principal sub-station near the City of Mexico is worked in multiple with the whole complex system. One unusual feature noted in the switchboard plans is the use of fuses between the generators and the bus bars. Of course, such a precaution is hardly needed to protect the generators, but there certainly is an advantage in having protection between the machines and the switchboard, so that in case of the short circuits that are not anticipated but do occur, a costly switchboard may not be utterly wrecked before the wheels can be shut down. The free use of wattmeters in the station equipment of these plants is specially to be commended. Far too many American plants are without them or are very inadequately supplied.

The main transmission lines themselves are unusual in that metal poles are used and the wire is "weather proof." The former point of variance may be necessary on account of the climate and the depredations of insects, but of what imaginable use on a 22,000-volt line weather-proof wire can be is beyond our comprehension. And the pole situation is difficult to understand, from the fact that the double pole line from the City of Mexico about half way to the generating stations is of redwood poles. An unique feature of the main substation is the use of a storage battery with a reversible rotary converter, which involves some very pretty problems in regulation of the voltage when running reversed. The distribution of energy for lighting and power in the City of Mexico involves some unusual features. The primary voltage of 2600 is the highest working potential for a large distribution with which we are acquainted, save in one of two instances in which a four-wire three-phase primary system has been used with 2200 volts or so between the phase wires and the neutral. Moreover, in the Mexican case part of this primary distribution is underground. The secondary distribution is likewise rather unusual—a two-phase system worked at 240 volts for motors and with a fifth wire converting the lighting system into an ordinary alternating current three-wire system at 120 volts on a side. It sounds a bit intricate, but much would depend in practice on the kind and amount of motor service, so that it may work out more simply than seems possible at first sight. The distribution is mainly from good-sized transformer units, and altogether it seems a particularly fine example of a pure two-phase distribution. The whole system strikes one as remarkably facile in the adaptation of means to ends. This is perhaps the strongest point of American engineering—the "get there" gait which is taken under all sorts of adverse conditions. Very few transmission plants have faced a combination of circumstances more peculiar than this one, but it has no terrors for the engineers, and the result speaks for itself. It is a plant peculiarly worth attentive study, by reason of its importance as well as on account of its unusual features. No two transmission plants are alike; each presents a new set of problems for solution and requires a treatment peculiar to itself. The art of the skillful engineer lies largely in his power to meet new conditions as they arise and to bend the means at hand to their treatment.

American Institute of Electrical Engineers Endorses the Metric System.

At the February meeting of the Council of the American Institute of Electrical Engineers, the following resolution, reported by the Committee on Standardization, was unanimously accepted and adopted:

Whereas, the metric system of weights and measures offers very great advantages by its simplicity, consistency and convenience in every-day use, as well as in all engineering calculations and computations, and

Whereas, these advantages have already been demonstrated by the universal adoption and entirely successful use of the metric system in all civilized countries except Great Britain and the United States. and

Whereas, all the electrical units in universal use, such as the volt, ampere, ohm, watt, etc., are metric units, and

Whereas, the industrial use of these electrical units would be much facilitated by the general adoption of the metric system,

Resolved, that this committee unanimously recommends the introduction of the metric system into general use in the United States at as early a date as possible without undue hardship to the industrial interests involved.

Resolved, that this committee favors such legislation by Congress as shall secure the adoption of the metric system by each department of the National Government as speedily as may be consistent with the public welfare.

Electrical Engineers of the Day—XXXVIII.

Edward G. Acheson.

Edward Goodrich Acheson was born March 9, 1856, in Washington, Pa., and secured his early education in that town. The expectation of a college career was frustrated by the death of his father and ensuing financial difficulties connected with the family estate, and at the age of 17 the youth was left to shift for himself. For a period of seven years, or until he was about 24 years old, he was employed principally in civil engineering connected with railroad work.

During the early part of the year 1880 he became greatly interested in the developments then occurring in the electrical field, principally through a close following of the work of Thomas A. Edison at Menlo Park, as outlined in the technical and daily papers of the time, and in September of that year went to New York. Up to this time Mr. Acheson had never been East or to New York, nor did he have a friend or an acquaintance in the metropolis or in the electrical field. His attempts to secure work with the leading companies of the time were unsuccessful, and finally he ventured to Menlo Park, depressed with doubt as to his ability to secure employment in Edison's laboratory. To his great pleasure, however, Mr. Edison's superintendent engaged him as an assistant draughtsman, his success thus being due to experience gained in civil engineering.

It was on Sept. 12, 1880, that Mr. Acheson commenced work at Menlo Park. He took great interest in the experimental work in progress in the laboratory, and that Mr. Edison appreciated Mr. Acheson's capabilities is indicated by the fact that within two months he was in charge of original experimental work in the laboratory. Under the personal direction of Mr. Edison, Mr. Acheson had learned the several details of the manufacture of incandescent lamps and the methods of installation as then practiced, and this led to his being selected for work in Europe, so that on July 20, 1881, he sailed from New York as first assistant engineer of the Edison interests abroad, and for service in connection with the Edison exhibit at the Paris Electrical Exposition, where he also did some official work.

At the close of the Exposition Mr. Acheson was given charge of the installation of the lamp factory as part of the Edison works at Ivry-sur-Seine. Following this he went on a tour of other European countries installing exhibit lamps. In this capacity he installed the first incandescent lamps in Belgium, Holland and Italy, Edison companies being formed as a result. He returned in 1884 and in 1886 he became associated with the Standard Underground Cable Company as electrician, leaving this company in 1889 to engage once more in private experimental work on the direct conversion of heat into electric energy. After a few months of experimenting, in order to obtain better facilities, he organized a local electric light company for Monongahela City, Pa., which commenced operations Nov. 20, 1890. His experiments on heat conversion were, however, unsuccessful, leaving Mr. Acheson in a frame of mind disposed to welcome a means of retrieving his fortune and gratifying his ambition.

It was then that he recalled to mind the results of an experiment made in Edison's laboratory in the fall of 1880, when an extremely hard material had been produced. It was this that led him to undertake experiments to make an artificial abrasive, the result being that he discovered carborundum in March, 1891. In the latter part of the summer of 1891 he organized the Carborundum Company, and business was commenced at Monongahela City, where it was conducted until the fall of 1895, when the works were removed to Niagara Falls. The importance of this discovery of Mr. Acheson's to the industrial world is best illustrated by the fact that the first sale of carborundum was 200 carats at 30 cents per carat, or about $560 per pound, while last year the plant produced 3,838,000 lbs., which sold at an average price of 10 cents per pound. To-day corborundum is used in all the industrial countries of the world.

While Mr. Acheson was developing the details of the manufacture of carborundum he observed occasional formations of a fine grade of graphite. Appreciating the possibilities involved, he took out a series of patents protecting the method of manufacture, and in 1897 he began the active development of the artificial manufacture of graphite. He organized a stock company under the name of the Acheson Graphite Company in 1900, and later organized a second company under the name of the International Acheson Graphite Company, the latter



absorbing the former. The first commercial manufacture of artificial graphite was in 1897, with a total production of 162,382 lbs. Last year the plant at Niagara Falls produced 1,436,900 lbs., the market extending to all European countries and to Japan. Mr. Acheson's patents embrace methods and processes for making graphite articles, such as electrodes for electro-metallurgical and electro-chemical work, and the production of graphite in bulk as grains or powders.

Mr. Acheson has contributed a number of papers to technical journals, and has read papers before the American Institute of Electrical Engineers, and the Franklin Institute of Philadelphia. He is a member of both of the above-named bodies, as well as of the American Association for the Advancement of Science. He has received two John Scott medals from the Franklin Institute, one for carborundum, the other for graphite; a medal from the World's Columbian Exposition for carborundum; a gold medal from the Trans-Continental Exposition of Omaha for a joint exhibit of carborundum and graphite, and a gold medal for a joint exhibit at the Pan-American Exposition, Buffalo. He also received a grand prix from the 1900 Paris Exposition for his personal exhibit of carborundum and graphite. The gratifying feature of the recognition given Mr. Acheson by the eminent jury of the last-mentioned exposition is found in the fact that Henri Moissan and Messrs. Borchers and Street were members of the jury that awarded the prize. At the dinner given to Prince Henry of Prussia, Feb. 26, at Sherry's, New York, Mr. Acheson was numbered among the 100 Captains of Industry invited to meet his Royal Highness.

The Transmission System of the Compania Explotadora De San Ildefonso of the City of Mexico—II.

BY STEPHEN Q. HAYES.

TRANSMISSION LINES AND ATTACHMENTS.

ALL of the 20,000-volt, high-tension transmission lines are protected by means of Westinghouse Lightning arresters, shown in Figs. 20-22. This part of the installation was very carefully planned, owing to the number and violence of the electric discharges during the rainy season, lasting four or five months of the year.

For circuits of more than 15,000 volts the arrester is mounted upon a marble panel. The non-arcing metal cylinders are held in porcelain holders on the front of the marble and the choke coils are mounted upon the back, being secured to marble partitions supported from the upper part of the panel. This construction is handsome in appearance, affords high insulating qualities, and is fireproof. The connections of the choke coils and non-arcing cylinders that go to make up this arrester are similar to those shown in Fig. 22, which illustrates a 15,000-volt, three-phase circuit.

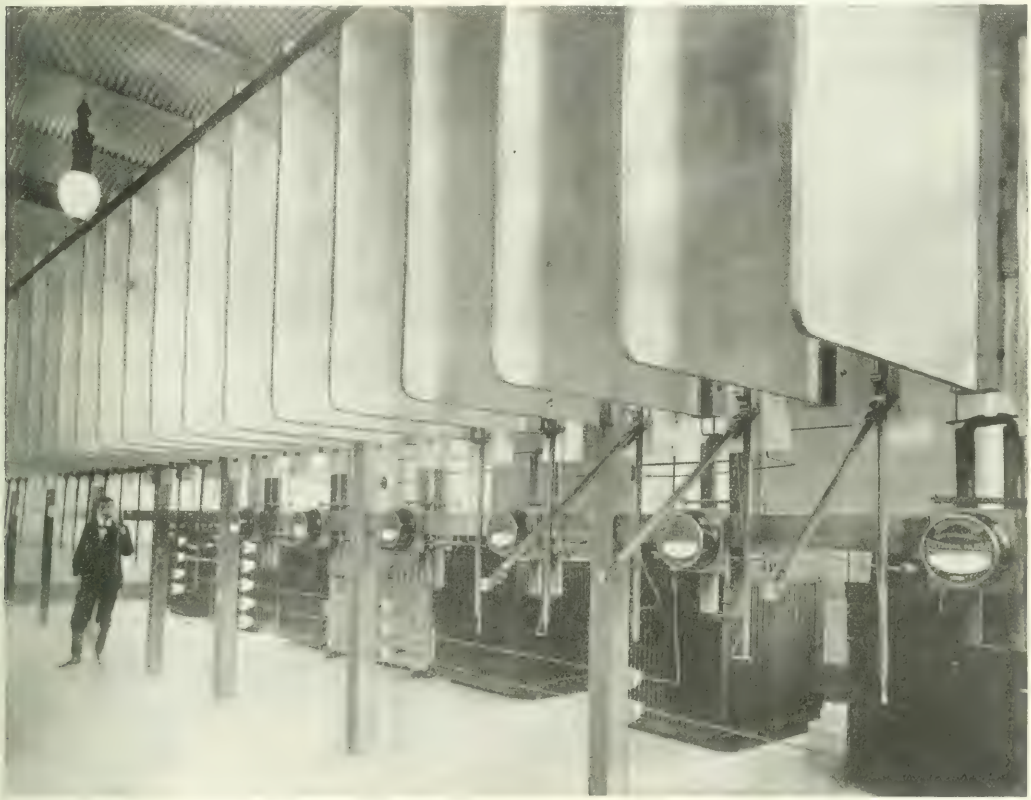


FIG. 19.—HIGH TENSION ROOM AT HERNANDEZ LEAL.

The two three-wire transmission lines running to Madin from the power houses along the Monte Alto River and the Tlalnepantla River are supported on metal poles 29 ft. high, made in three sections of, respectively, 5, 4 and 3 inches diameter. The weight of these poles is 385 lbs. They are stationed 130 ft. apart, and are planted 5 ft. directly in the earth without the necessity of masonry. Those that are placed in the damp valleys are encased in a cylindrical block of hydraulic cement, 2 ft. in diameter and 6½ ft. deep.

The wires are placed on two wooden cross arms on a summit of two equilateral triangles 2 ft. on the side symmetrically placed with reference to the axis of the poles. These cross-arms are fixed to the poles by means of U-shaped bridles, which present to the pole a large surface of contact. The supports of the insulators are eucalyptus wood pins boiled in paraffine. The insulators themselves are triple petticoat insulators, such as in Feg. 23, which have been tested to 40,000 volts before being placed in position; and the wires of the line are covered with a weather-proof composition. The two three-wire lines running from Madin to the City of Mexico, which transmit the entire output of the power stations, were to have been placed like these foregoing ones on the same pole. But several insulators, mischievously broken at the time of erection, showed the advisability of having the two lines entirely distinct and a new pole line was built. The poles are of Texas red wood, 32 ft. in height, of which sections at the bottom and top are squares, respectively, 9 and 5 inches on the side.

The diverging point of the two pole lines is indicated in Fig. 24. The three wires of the existing transmission lines were transferred in sections and placed on the wooden poles, at the vertices of equilateral triangles 2 ft. on a side. One of the wires is carried at the top of the poles by means of a glass triple petticoat insulator of the type employed with success on the 40,000-volt Provo transmission line. This insulator, shown in Fig. 25, is supported by a eucalyptus wood pin 9 inches high, boiled in paraffine. The other two wires are placed in the same way on a wooden cross-arm 31 inches long. The new transmission line from Madin to the City of Mexico is 10 miles long, while the old one was 8¾ miles. As the action of the reverse circuit breakers in the City of Mexico depends to a certain extent on the resistance of the two lines, it was necessary to use a larger wire on the new line than on the old one.

The high-tension junction switchboard at Madin, with its unique arrangement of wattmeters and synchronizing apparatus, is of particular interest. It will be noticed (Fig. 26) that either or both of the lines from the Monte Alto River, as well as either or both of the lines from the Tlalnepantla, can be connected with either or both of the lines running to the City of Mexico. The method of synchronizing these various lines before throwing them together is similar to

that described for the Chiluca generating station. The synchronizing apparatus of lamps and plugs is connected across similar terminals of the 100-volt side of the 20,000-100-volt shunt transformers fed from the lines running to Madin. These shunt transformers, with the series transformers shown, are also used for the main wattmeters which indicate the amount of power received at Madin over each of the four transmission lines. This high-tension board is shown in Fig. 12, last issue.

The indicating wattmeters in the lines running to the City of Mexico have their current coils connected to the same series transformers as the ammeter, and their voltage coils are connected to the middle of six-point voltmeter receptacles, so that a voltage in phase with the current (if the power factor were 100 per cent) or one at right angles to it, can be impressed on the wattmeter. In the former case it will indicate that component of the apparent energy, *Wa*, which is in phase with the voltage, or, in other words, the true energy, *Wt*. In the latter case it will indicate that wattless component of the apparent energy which is at right angles to the voltage. Calling this, for the sake of brevity, the wattless energy, *Ww*, it can readily be shown that the relative magnitude and phase relationship of *Wa*, *Wt* and *Ww* is that indicated by the triangle in Fig. 26. As the apparent energy *Wa* is in phase with the current, and the true energy *Wt* is in phase with the voltage, the phase angle between the two is the angle of phase displacement between current and voltage.

From the triangle it is seen at once that $\tan \phi = Ww/Wt$. In other words, by comparing the reading of the wattmeter with the voltmeter plug in the two different positions, the angle of phase displacement can be readily figured out, and the angle is one of lag or lead, according as the ratio of *Ww* to *Wt* is positive or negative.

As in all of these connections two single-phase wattmeters are used on a three-phase circuit, it may be well to give a short description of their operation. For description, as well as that of the operation of the reverse current-circuit breaker given later, the writer is indebted to Mr. Conrad, of the Westinghouse Electric & Manufacturing Company.

Fig. 27 shows the connection of the two single-phase wattmeters on the three-phase circuits of this plant, as well as the phase relation of the different currents and voltages in the circuit. By this arrangement it is possible to connect two single-phase indicating or integrating wattmeters in a three-phase circuit so that with a balanced load, each wattmeter will indicate one-half of the total energy supplied, irrespective of the power factor of the circuit; and in all conditions of an unbalanced load, the sum of the readings of the meters will represent the total energy of the three-phase circuit in which they are connected.

Referring to Fig. 27, *A*, *B* and *C* are the three mires of the circuit. *D* and *E* are two wattmeters of the usual construction, giving readings proportional to the product of the current, the voltage and the cosine of the angle of phase difference between them. The shunt windings of these meters are intended for use on a 100-volt circuit, and are connected to the low-tension side of the 20,000-100-50-volt shunt transformers. The series coils of these meters are wound for a full-load current of 5 amperes. *A'* and *B'* are series transformers with 2½-ampere secondaries, and *C'* is a series transformer with a 5-ampere secondary, 2½ and 5 amperes being the secondary current with full-load current in the primary.

Secondary coils of the transformers *A'* and *B'* are connected in parallel and supply current to the series coil of the meter *D*. The transformer *C'* is connected to the series coil of meter *E*. Thus the current in the series coil of meter *D* will be proportional to the vectorial sum of the currents in the wires *A* and *B*, while that in meter *E* will be proportional to the current in the wire *C*. The shunt circuit of meter *D* is connected to the secondary side of a 20,000-100-volt shunt transformer, whose primary connections go to the lines *A* and *B*, having the series transformers which are connected to this meter. The shunt circuit of meter *E* is connected on one side to the secondary of a 20,000-100-volt shunt transformer whose primary is connected across the line *B* and *C*, and the other end of the shunt circuit of meter *E* goes to the middle point—the 50-volt loop—of the transformer connected across *A* and *B*.

Referring to that part of Fig. 27 which shows the diagram of phase relation of the current and voltages in the three-phase circuit, the line *OA* represents the current in the wire *A*, the line *OB* the current in the wire *B* and the line *OC* the current in wire *C*. The meter *D* receives its series current from the two transformers *A'* and *B'*. This current is, therefore, equal to the resultant of the lines *AO* and *OB*, and is proportional to, and in phase with, *AB*. The voltage for the shunt of meter *D* being taken from the secondary of a transformer whose primary is across *AB*, is, therefore, in phase with the current *AB*.

The series current for the meter *E* being proportional to that in the wire *C*, is equal to and in phase with the line *OC*. The shunt connections of this meter are taken from that secondary terminal of the shunt transformer connected from *C* to *B*, corresponding to primary terminal *C*, and the other end being connected to the middle point of a shunt transformer whose primary is across *AB*. In this way the shunt current of meter *E* will be proportional to a line drawn from *C* to the middle point *F* of line *AB*, and (assuming in this case a non-inductive load) this voltage line *CF* will be in phase with the current *OC*.

The scales of the meters are marked to indicate the capacity corresponding to the ratios of the transformers through which the meters

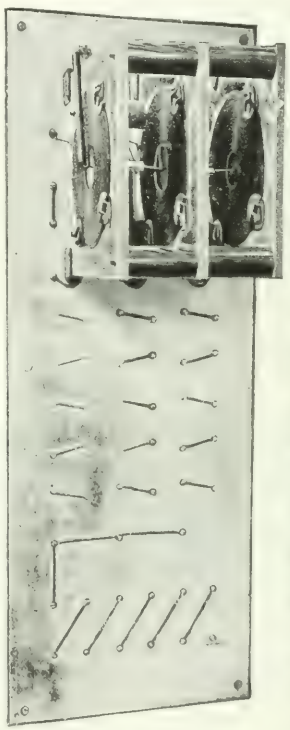


FIG. 20.—FRONT 30,000 VOLT LIGHTNING ARRESTER

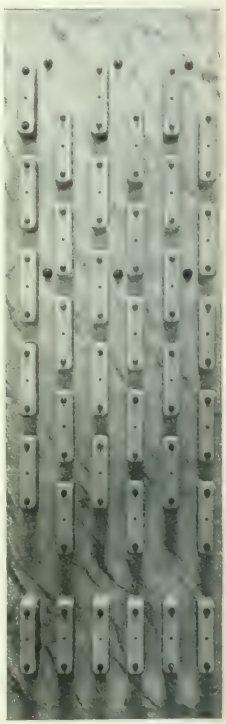


FIG. 21.—REAR 30,000 VOLT LIGHTNING ARRESTER

are connected to the circuit. Thus if we assume a 20,000-volt circuit and series transformers having a ratio of 100 5-amperes, the meter would indicate 2000 kw, this being the product of that current and voltage when a current of 5 amperes is passed through its series coil with a pressure of 100 volts on its shunt coil.

This applies particularly to meter *E*, as meter *D* is fed from two transformers, each with 2½-ampere secondaries; but the two being in multiple produce the same result practically as 5 amperes or actually $5 \times cos.30$ degs. equals $5 \times .866$ equals 4.33 amperes. As will be explained later, this is exactly the current wanted in this meter. If any load on the circuit is assumed it will be found that the meters will indicate this load directly. Thus at the full load of 100 amperes per wire at 20,000 volts between wires, the energy in the three-phase circuit will be current $\times$ voltage $\times \sqrt{3}$, or $100 \times 20{,}000 \times 1.732 = 3464$ kw.

Referring again to the diagram of phase relations in Fig. 27, 100 amperes in each line will give 2½ amperes in the secondaries of trans-

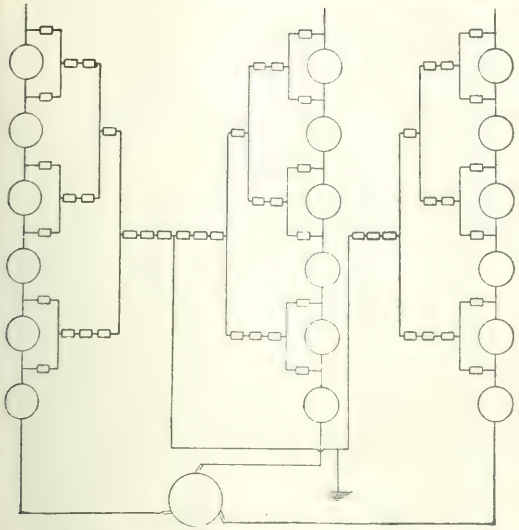


FIG. 22.—CONNECTIONS 15,000-VOLT LIGHTNING ARRESTER.

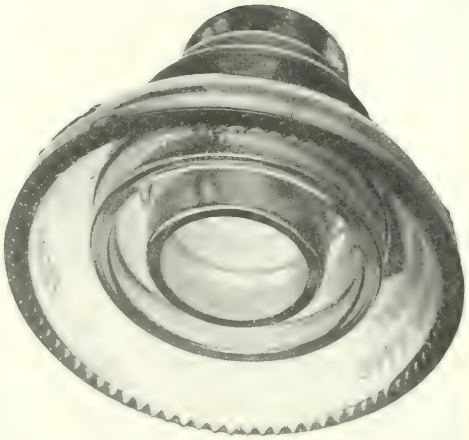


FIG. 25.—GLASS TRIPLE PETTICOAT INSULATOR.

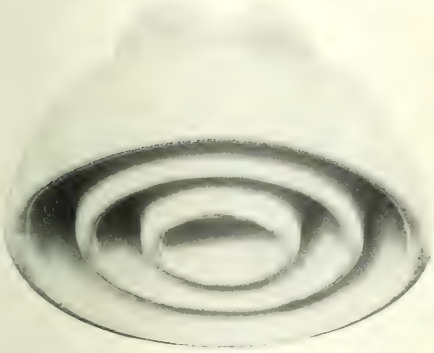


FIG. 23.—PORCELAIN TRIPLE PETTICOAT INSULATOR.

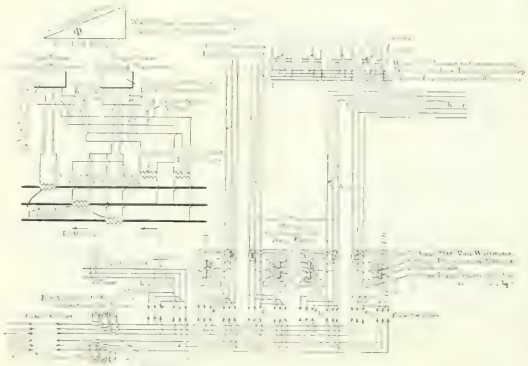


FIG. 26.—DIAGRAM OF CONNECTIONS MAIN JUNCTION.



FIG. 24.—LINES AT MAUS.

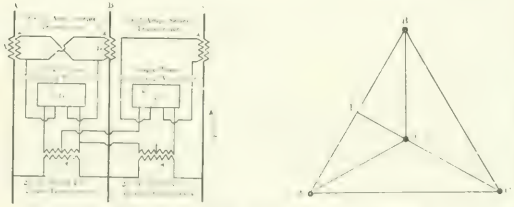


FIG. 27.—DIAGRAM OF WATTMETER CONNECTIONS.

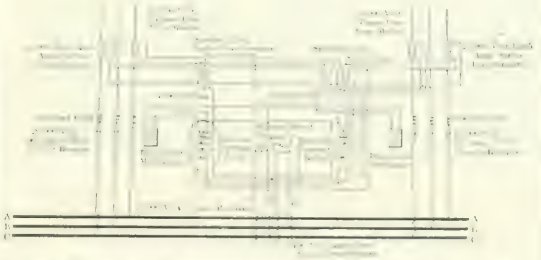


FIG. 28.—DIAGRAM OF CONNECTIONS REVERSE CURRENT BREAKERS.

MEXICAN TRANSMISSION SYSTEM.

formers A' and B' and 5 amperes in C'. The current in the series coil of meter D will be equal to 2½ amperes in the direction of AO and 2½ amperes in the direction of OB, which is equal to 4.33 amperes in the direction of AB. The shunt of this meter being connected to a transformer across AB will have a voltage of 100 on it, and multiplying the current by the ratio of the series transformers $\frac{100}{2\frac{1}{2}+2\frac{1}{2}} = 20$ by the voltage, and by the ratio of the shunt transformer $\frac{20,000}{100} = 200$, the wattmeter reading of $E = 4.33 \times 20 \times 100 \times 220 = 1732$ kw, or half of the energy.

The meter E, receiving its series current from the transformer C', will have 5 amperes in the direction OC in its series coil. As this shunt connection is equivalent to the line CF, as previously explained, this is equal to the voltage CB or CA multiplied by the cosine of the angle between CF and CB or CA. When CB equals 100 volts CA will equal $100 \times cos\ 30$ degs., or 86.6 volts. To get the wattmeter reading, we multiply the current by the series transformer ratio, 100/5 or 20 × voltage × ratio of shunt transformer (20,000/100 = 200), and we have the wattmeter reading of $E = 5 \times 20 \times 86.6 \times 200 = 1732$ kw, or half of the total energy. For any other power factor than unity the effect on each wattmeter would be to multiply its reading by the cosine of the angle of phase displacement, and it will be found that each meter still reads one-half of the total energy of the circuit.

Another point of interest in connection with the switchboard equipment of the Compania Explotadora transmission system is the pair of three-pole 20,000-volt, 150-ampere circuit breakers with time limit and reverse current attachments which are installed at the terminals of the two 20,000-volt, three-phase lines where they enter the La Veronica receiving station.

Fig. 29 is reproduced from a photograph of these circuit breakers. As shown on this photograph, each three-pole breaker consists of

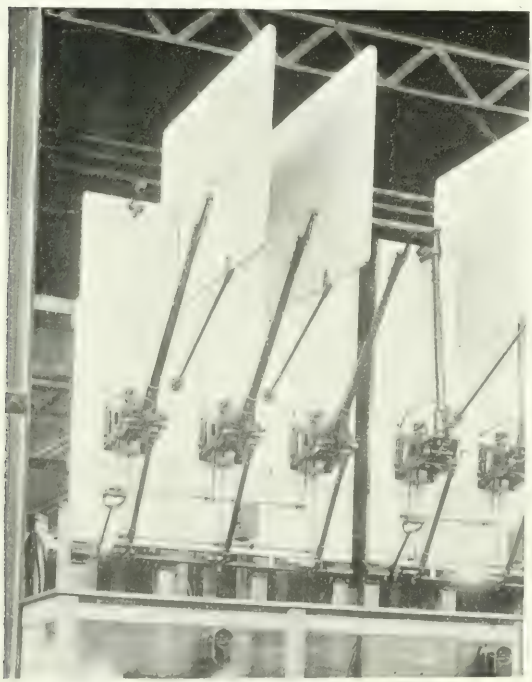


FIG. 29.—3-POLE, 20,000-VOLT CIRCUIT BREAKER.

three single-pole breakers, each mounted on a marble slab with one handle for closing all three breakers at the same time. No mechanical device is supplied for tripping these breakers together as they may be operated from a push button or the relays in multiple with each other, and either of which can trip the breaker. Below the main marble panels of the breaker, are smaller panels for mounting the time limit device with its system of shafts and levers. Below this is placed the polyphase relay and the push button, the series and shunt transformers being mounted on the framework on the back of the circuit breaker. Between each pole of the breaker is a large marble barrier to prevent the arc from passing from one pole to another. Fig. 29 shows the diagram of connections for these reverse current circuit breakers. The relay consists of a polyphase wattmeter connected in the circuits in the usual manner. In place of the usual counting train, a contact operates the tripping coil on the circuit breaker. When the flow of energy is in the normal direction, the contact in the relay is held open, but should the direction of flow be reversed, the movable part in the relay will turn and close the contact, completing through the tripping coil a local circuit that operates the breakers.

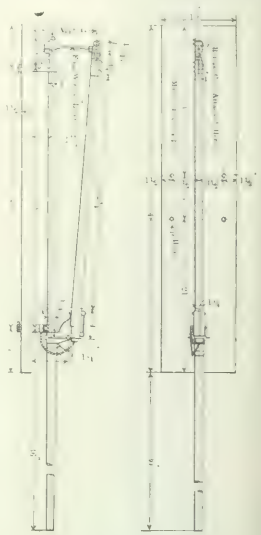


FIG. 30.—FUSED CIRCUIT-BREAKER.

The object of this device is to open a circuit whenever the direction of the flow of energy in this circuit has been reversed. This is accomplished by means of an ordinary circuit breaker, which in addition to the series tripping coil has a tripping coil wound with fine wire, and adapted to operate on a circuit of about 100 volts. This circuit is closed by a relay. On circuit breakers with time limit attachment, the magnet of the time limit is connected in place of the tripping coil.

The circuit breakers used in this installation are fed by two lines in parallel and required some additional apparatus. Should one of these lines be short circuited and cause the circuit breaker at the generator end to open, this line would still be fed from the sub-station end by the remaining line, which is in parallel with it. The result of this would be that the energy, instead of flowing over the line to the sub-station, would flow in an opposite direction, that is, from the sub-station to the line; but if the current taken by this short-circuited line was very great, it would cause an excessive drop in the other line, and so lower the voltage that the relay and circuit breaker tripping coil would not operate.

To keep the voltage up a special transformer is connected between the relay shunt and the line. This transformer gives, with normal line voltage, about 100 volts on its secondary. If the line voltage should drop to, say, about one-third the normal, the effective secondary voltage would not drop more than about 20 per cent. The primary of this transformer is wound for 100 volts, and connected to the secondary of a standard transformer with a 100-volt secondary.

A series transformer is used which has two primary coils and one secondary coil. Each of the primary coils is connected in series with similar phases of each line through secondaries of standard series transformers to obtain better insulation. This three-wire transformer is so arranged that when the currents in the two lines are in phase there is no current in the secondary; but when they are in opposition, it gives the full secondary current, the amount of which depends upon the ratio for which the transformer is wound. By means of this device no current is sent through the relay until one of the lines has been reversed. It is thus possible to make the transformers give a larger secondary current than the relays would stand continuously, thus operating them more positively. The shunts of the relays are connected across the circuit, through the medium of the special shunt transformer, which gives an approximately constant secondary voltage with variable primary voltage. This transformer performs, also, the function of keeping the current and voltage on the relay in phase.

On a long line the inductive drop forms a large part of the total drop, so that with a short circuit we should have a lagging current; and as the operation of the relay depends only on the true watts, the lagging current ordinarily tends to lessen the positive action of the relay. The special shunt transformer, however, gives a secondary

voltage leading in phase with respect to the primary voltage. The relay device is so adjusted that it gives its maximum effect with the shunt voltage leading. If an excessive current cause a drop in the line, the secondary voltage will shift and keep in the same phase relation to the series current in the relay. Thus the pull in the relay continues a maximum, even with a large lagging current in the line. The shunt transformer is designed to shift the phase of the voltage in the same proportion as an excessive line current causes an inductive drop in the line.

The function of the time limit on these circuit breakers is to delay for some predetermined length of time the opening of the circuit breaker, so that a momentary overload where the series coil comes into play, or a momentary reversal where the reverse current relay acts, will not open the circuit instantaneously. This time limit can be set to delay the opening of the breaker from one to ten seconds.

From the 20,000-volt, three-phase bus-bars in the La Veronica receiving station, the current passes through 20,000-volt fused circuit breakers to the lowering transformers. Fig. 30 shows an outline of one of these fused circuit breakers, consisting of two stationary contacts on a marble slab with a removable pole. In closing this breaker the upper contact on the pole is hooked over the upper stationary contact on the marble, and with that point as a fulcrum the pole is swung in until its lower jaw makes contact with the bottom block on the marble.

This removable pole comprises a stationary arm and a movable one hinged together. A strong spring tends to separate the arms. This tendency is resisted by the mechanical strength of a piece of aluminum fuse wire which passes through carbon blocks at the ends of the arms. An overload causes this fuse wire to melt and the movable arm flies out, opening the circuit. To renew the fuse the fixed arm is lifted from its contacts and the fuse replaced in safety. To trip this breaker when the fuse has not blown, it is only necessary to pull a cord operating a latch and releasing the fuse wire.

The method of mounting these fused circuit breakers is shown in Fig. 19, on page 503. In the high-tension room at Fernandez Leal, the most striking point of interest is the large wooden shields covered with asbestos, these being used to separate the different breakers.

Sub-Marine Cable Laying During a Canadian Winter.

By G. U. G. Holman.

On Dec. 6, 1901, was laid in the St. Lawrence River between the cities of Quebec and Levis, Canada, a cable, to be used for conveying electric power from Levis to Quebec. The successful laying of this cable ensured the successful carrying out of the terms of the contract for 750 kw to be supplied to the Quebec Railway, Light & Power Company, of Quebec City, by the Canadian Electric Light Company, of Levis, P. Q. It was considered to be a difficult, if not impossible, piece of work to lay an electric power cable between the shores of the St. Lawrence River at the above point, the cable measuring approximately 3 inches in diameter and weighing 7 lbs. to the foot, with the obstacles offered by thickly packed, floating ice, varying in thickness from 6 to 24 inches.

The cable consisted of four stranded conductors, each equivalent to one No. 2-0 B. & S. solid wire, and four No. 16 solid wires, used for pressure wires. About each of the stranded conductors was a rubber wall 5-32 of an inch in thickness served with one layer of tape and then covered with a serving of tarred jute. There was a tarred jute center and the conductors with the above serving were concentrically wound about this center and held in place by a double serving of tape. The four pressure wires, each having a ⅛-inch rubber compound wall, were laid in between and on the outer periphery of the larger conductors before this wrapping. The whole was then heavily served with tape and covered with a tarred jute cover and then armored with a spiral winding of No. 6 galvanized steel wire. The armor was covered with a serving of tarred jute in order to assist in protecting the cable in its journey from the works of the Safety Insulated Wire & Cable Company, of New York, to Levis. The cable is now delivering 750-kw alternating current at 2200 volts, and was tested at the factory as follows:

Each conductor before being made up into a cable was tested from ground at 20,000 volts alternating, for a period of three minutes, and after being made up into the cable was tested from ground and from each other conductor at 12,000 volts for a period of one minute. The pressure wires were tested from ground and from each large conductor at 12,000 volts for one minute. No fault appeared.

The accompanying illustrations show the ice conditions amid which the cable was successfully laid, after waiting a period of seven days with the cable on the ground, hoping each day for a lesser quantity of ice with a consequent greatly decreased danger of having the cable-laying apparatus interfered with, either by the ice puncturing the sides of the lighter which held the laying reel, or by the greater ease with which it would have been possible to have made a direct alignment from shore to shore. On the arrival of the cable, which was shipped on a flat car with stakes and boards on its side in order to prevent the cable, coiled in a figure 8, from becoming injured in transit, it was immediately, and in the midst of a snowstorm, coiled upon a huge reel, which in turn was mounted on a lighter (see Fig. 2). The reel flanges were 12 ft. in diameter, and its length 10 ft., the drum being approximately 5 ft. in diameter. We were enabled to coil nearly all the cable upon this reel, a few hundred feet being left on the lighter's deck coiled in a figure 8. We were then ready for the cable laying, and for that purpose had held a tugboat in commission since navigation had been closed and all other boats put up for the winter, from the 1st of December. The reel in question was the joint property of, and was kindly loaned by, the Great Northwestern Telegraph Company, Limited, and the Bell Telephone Company, Limited, of Canada.



FIG. 1.—PREPARING TO LAY CABLE.

On the seventh day of readiness to lay this cable we finally decided to do so, and started at flood tide from the Levis shore, against which the ice was most thickly packed, with the idea that if we got into trouble we would get it quickest at that point, and with the least cable paid out. At this shore the channel is also deepest, being 167 ft. at mean tide, the tide at Quebec being about 18 ft. The distance from wharf to wharf at the two shores is 3400 ft. The amount of cable provided was 4400 ft., of which we had remaining after the cable was laid and connected to the terminal boxes, 350 ft. This will be used in future possible repairs.

When finally ready for the cable laying we secured one of the ferryboats of the Quebec & Levis Ferry Company, Limited, which winter boats are good ice-breaking boats. This ferryboat preceded

the tug, to the stern of which was attached the cable lighter. The cable, however, was first attached to the Levis shore by tying a ¾-inch chain to the cable at two places and reeving the chain through the timbers of the wharf, an admirable place for the landing being secured by the Canadian Electric Light Company in a dock about 30 ft. wide flanked on either side by crib walls of excellent construction. This dock ran in for 40 ft., forming an excellent protection from floating and anchor ice. A spot for the Quebec landing was obtained at the corner made by a crib wharf and a projecting crib pier running out into the river some 40 ft. One of the vertical planks was removed from this corner, and the cable at landing, after being cut, was reeved through the timbers below low-water mark on the subsequent day, the cable being chain anchored as on the other shore. The time of the cable laying was 13 minutes.

A cable box on a terminal pole on both shores contains the single-pole static discharges to which each cable conductor is attached, the cable first running through a terminal bell end, filled with compound to protect the cable from static discharge. At the Quebec end the four conductors and four pressure wires are run out through porcelain tubes and have been connected to a trunk line running to the sub-station of the Quebec Railway, Light & Power Company, 7500 ft. away. A terminal box on the Levis shore is a duplicate of that on the Quebec side, the terminals being connected with the trunk line fed by the Levis sub-station of the Canadian Electric Light Company. This trunk line is 3300 ft. long. At the sub-station three sets of special step-down regulating transformers have been installed, which were built by the Wagner Electric Manufacturing Company,



of St. Louis, Mo. These transformers regulate on the low-tension side from 2700 volts to 2240 volts, thereby providing for the varying drop on the trunk lines by the cable in supplying the minimum and maximum power to the switchboard of the Quebec Company.

Power was first supplied to Quebec through this cable in any quantity, on the 12th of February, the initial amount being 225 kw, and the installation is a success. Credit is due to Mr. Wm. Rodier, of the Safety Insulated Wire & Cable Company, for the cable laying amid the difficulties of a Canadian winter.

SUB-STATION.

The water power development and the two sub-stations of the Canadian Electric Light Company, one at Levis and one at St. Romuald, both on the south shore of the St. Lawrence River, have previously been described in these columns, but the fulfillment of the contract for 1000 hp to be delivered in Quebec City by the Canadian Electric



FIG. 3.—LAYING THE CABLE.

Light Company called for additional and special apparatus. It was, therefore, decided to build a new sub-station building in Levis within a few hundred feet of the old one, in order that additional apparatus could be installed, and a little later the step-down transformers of the old station, be transferred to it. This new building, shown in plan and elevation in Fig. 4, is a one-story brick structure of an interior dimension of 36 ft. by 20 ft. and 18 ft. height of side wall, with a peaked roof. Fig. 5 shows the switchboard.

Additional transformers for the Quebec load consist of three sets of two step-down transformers each, making six transformers in all, the capacity of each being 200 kw, or 400 kw per set. Each transformer is built to transform 10,000 volts, three-phase at 66 2-3 cycles to a potential of 1980 volts, two-phase, but with the additional provision of a dial switch in each case, to which leads of the secondary coils were brought in order that the secondary potential may be regulated from 2200 to 2700 volts. It will be noticed that the movement of the finger contact of this dial switch is controlled by hand wheels on the transformer panels. There are two sets of bus-bars for controlling the two-phase circuit coming from each set of transformers. One bus has been termed the local bus, the other the Quebec bus. The regulating transformers may be connected to the local bus when their ratio is 10,000 volts to 1980 for use on the local lighting and power circuits. Two other transformers in the sub-station were in the old building, and are Westinghouse transformers having a ratio of 10,000 volts, three-phase to 1980 volts two-phase, with no regulating coils. By providing 1200 kw capacity in the regulating transformers there is ample provision made for supplying the 750 kw to Quebec with a complete spare unit. This spare unit will also act as a reserve unit for the local load, as above indicated. The regulating transformers and the new switchboard are the product of the Wagner Company, of St. Louis.

The three-phase lines from the water power station 8½ miles distant consist of two separate, medium hard-drawn, bare No. 4 copper wires. As shown in Fig. 5, each line is controlled just within the station wall by a G. E. 15,000-volt, 100-ampere, triple-pole, single-throw oil circuit-breaking switch, hand controlled from the switchboard panels. Through each switch a line is connected to one section of a bus consisting of three sections, the third section being provided for a future third line from the generating station. Each set of step-down transformers is connected, with the intervention, however, of a similar circuit-breaking switch, to certain sections of the 10,000-volt bus. In the event, therefore, of a breakdown, or trouble, from one of the operating transformer units, it can be cut out of service with a consequent greater safeguard to the apparatus, as each switch is capable of breaking the full ultimate load of the generating station, which will be 7500 kw.

The sub-station is provided with a traveling crane, which paid for

itself in the installation of the apparatus, and will make future repairs to possible breakdowns in the transformer coils, far quicker than otherwise. Provision is also made that the building can be extended with the growth of the business.

The six regulating transformers are of the air-blast type, the air being supplied by a Sturtevant blower driven by a single-phase Wagner motor, two of these motors being provided; in case of a breakdown to one the other could be called upon. There were also installed one 20-kw and one 3-kw transformers, 2000 volts to 220 volts, so arranged with a double-throw switch that either motor may be operated by either transformer. This provides against a possible breakdown in the motor transformer. The disparity in the size of the two motor transformers is due to the fact that the larger transformer is used in winter for supplying the energy to four Detroit 3-kw heaters of the bracket type placed against the wall of the building.

The foundations of the transformer and the ducts, both air and wall, are of concrete and laid on a solid rock foundation, which fortunately was on the sub-station site. The sub-station building is provided with double windows and an outer or storm door, which is necessary to keep out the cold of a Quebec winter.

From the sub-station building on the secondary side are the conducting feeders, the trunk line running to the Quebec cable being fed directly from a Quebec panel. It will be noticed that each feeder

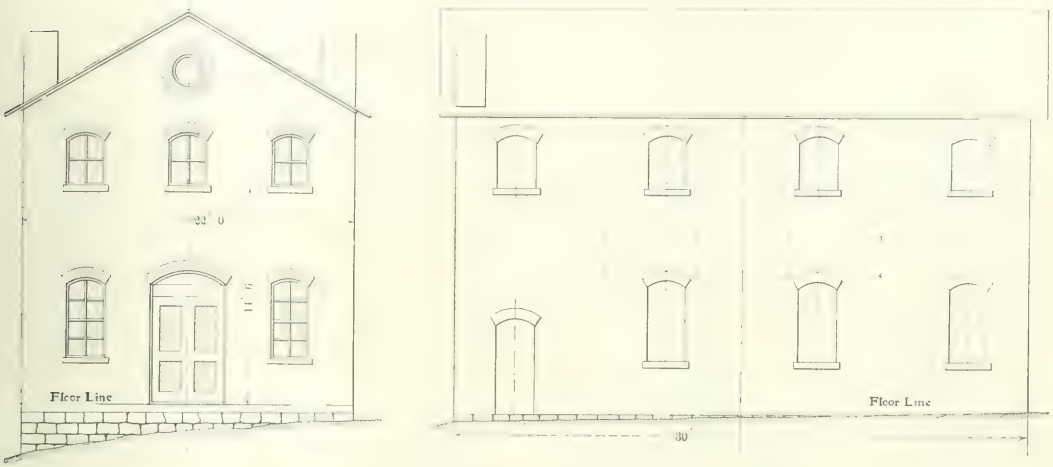


FIG. 4.—LEVIS SUBSTATION, CANADIAN ELECTRIC LIGHT COMPANY.

panel—except those belonging to the incandescent street light system—has mounted on it oil, circuit-breaking, automatic switches, which were manufactured by the General Incandescent Arc Light Company. Inspection of the switchboard design will show that the pressure wires from Quebec run back to voltmeters on the Quebec panel, making it easy for the sub-station attendant to provide the necessary volt-

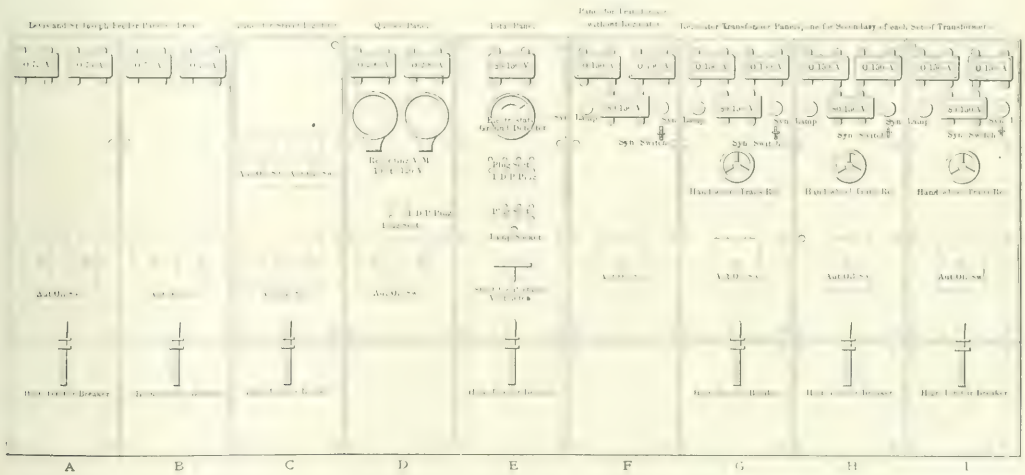


FIG. 5.—ELEVATION OF SWITCHBOARD, CANADIAN ELECTRIC LIGHT COMPANY, LEVIS.

age required at the Quebec distributing board. At this Quebec end there is to be provided a recording maximum power meter, for the mutual satisfaction of each company. Credit for the prompt installation of this machinery in order to fulfill its contract, is due to Mr. A. R. Henry, general superintendent, and Mr. Cyril R. Reade, construction superintendent of the Canadian Electric Light Company.

Problems of the St. Louis Exposition.

By Luther Stieringer.

TO those who do not study the subject, and look upon an exposition simply as another means of amusement, it doubtless seems that most expositions are alike, varying chiefly in size and in the addition or subtraction of one or two sensational features. To those who have been compelled to give the subject their best thought, every new exposition presents some new problem of its own, especially of late years. In the earlier period of exhibition work, one show was practically a duplicate of that which had preceded it, but nowadays the desire for that which is unique or sensational drives the organizers and architects of each successive "world's fair," or whatever else it may be called, to seek for some effect that has never been previously attempted. This in itself is a great danger that confronts all exposition managements, which also have to contend with the erroneous idea so widely entertained by the unthinking portion of the community, that mere size is merit in itself. As a matter of fact, expositions would gain greatly in economy and effectiveness if their managers would only subscribe to a self-denying ordinance to the effect that the latest exposition should not be larger than its predecessors, but smaller.

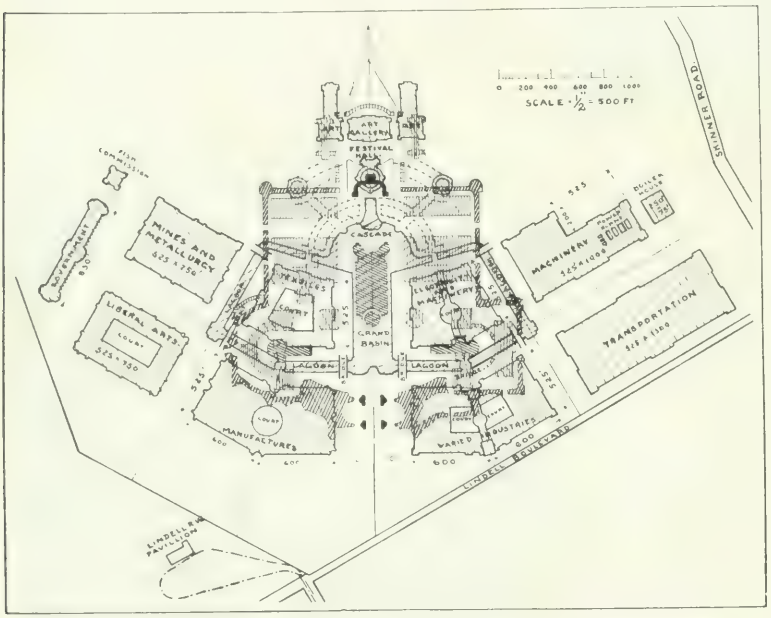


Diagram Showing Relative Areas of Pan-American and St. Louis Expositions.

That we have not reached this point in America is certainly shown by the data now available in regard to the St. Louis Exposition proposed for 1903, but more likely to be held in 1904. The question has of late been frequently asked of the writer, how does the Louisiana Purchase Exposition compare in extent with Chicago in 1893 and the more recent Pan-American expositions of Omaha and Buffalo? The best answer to this question is found in the composite plan submitted herewith, based upon the data now available, showing the relationship in area which the Buffalo Exposition of last year bears to the St. Louis Exposition soon to be held. The writer in preparing for his work as consulting electrical engineer at these great shows has always found it very helpful to institute such comparisons for his own instruction, and he thinks that the diagram now presented will be found interesting by a great many people. It will be clearly understood, however, that this map is confined strictly to main exhibit area, and that proportionate figures would apply to auxiliary and State buildings, midway shows and other extraneous features.

At the St. Louis Exposition there will be over 4,000,000 sq. ft. in the main buildings alone, while another large building, 2000 by 225 ft.—the largest of them all—is projected for agriculture paralleling and flanking Machinery Hall. This represents fully as much space as was in similar buildings at the Chicago World's Fair in 1893. None of the other expositions in this country, however, since Chicago, have exceeded 600,000 sq. ft. in main exhibit building space. This simple fact in itself will illustrate the magnitude of the plans adopted at St. Louis. The contrast in another direction is even more marked. This will be observed upon studying the principal areas within and surrounding the main buildings, such as the terrace lagoons and the canal court. The bearing of all this upon questions connected with lighting, structural illumination effects, power transmission and special spectacular displays is apparent to any one who has had anything to do with exposition work.

The St. Louis Exposition in the arrangement of the architecture of the main buildings, is one of the few that may properly be designated as productive of a court setting. This will be evident upon a glance at the main court or center axis, which presents an extreme vista of upwards of 3000 ft. in length. The Court of Honor at Chicago, magnificent and ever memorable spectacle as it was, had but 1800 ft. from the Administration Building to the Quadriga. In addition to this vast area, however, at St. Louis there are the lagoon courts, as shown upon the ground plan herewith. All of this lends itself to an admirable stage ensemble, especially for night illumination, although from his own experience the writer would be inclined to anticipate the criticism that the court needs to be closed in at the Lindell Boulevard end in some stately and appropriate manner, just as the vista at Buffalo was by the pylons, or as the Chicago Court of Honor was by the Triumphal Arches and statuary that shut in the enclosure from Lake Michigan. This, however, is likely to be done.

The large scale upon which the classical architecture of the St. Louis main buildings is projected will, it seems to the writer, admit of a more extensive scheme of illumination than the Pan-American, which was so much admired, and in regard to which the fervent eulogies of the press and the public have come more as a surprise than as a matter of course, although it was but an amplification of the results aimed at in Omaha. The fear that St. Louis would be handicapped electrically in not having as a source of power Niagara Falls, has been exaggerated. The advantage possessed in this respect by the Pan-American was in reality more assumed than real because, after all, the current had to be transmitted some 20 odd miles from the Great Cataract, a fact which is offset in St. Louis by the well-known cheapness and availability of fuel at that great center of Southwestern transportation. It will be helpful, in this respect, to glance once more at the map and note the location of the power plant at the outer end of Machinery Hall, with the boiler plant adjoining. The inclusion of this plant within the ground obviates and avoids all problems of heavy current transmission, such as complicated the situation at Niagara. There is no good reason why St. Louis should not eclipse in electrical magnitude its predecessors, that have won so much glory and praise in this respect, and it is only to be inferred from the contracts which have already been awarded, that a spectacle of the first order will be provided. It all depends on how the problems are met and the conditions are dealt with, and here the best talent that the country affords will have its opportunity. So far as the spectacular illumination partakes of the architectural or structural character, possibly the Pan-American represents the furthest reach, but there are many other ways in which the protean arts of electricity can be employed, and it is here that the test of versatility and originality will be found.

The Economic Design and Management of Telephone Exchanges—IX.

By Arthur V. Abbott, C. E.

THE EFFECT OF OBSTACLES.

IT often happens that the topography of the territory under consideration prevents the complete utilization of the shortest rectangular routes to all stations, and the effect of such interference in causing circuitous routes must be taken into consideration in selecting the telephonic center. An example of such a case is given in Fig. 14. By the rule given under the hypothesis that all subscribers could be brought to the office by the shortest rectangular routes, the axes would be $x\ x$ and $y\ y$, with the telephonic center at T.

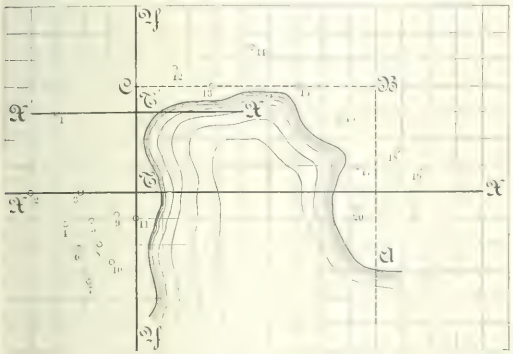


FIG. 14.—EFFECT OF OBSTACLES IN DETERMINING TELEPHONIC CENTRE.

But suppose that, owing to some unsurmountable obstacle, the stations from 12 to 21, inclusive, *must* be brought to T along the line $A\ B\ C$. Evidently, the effect of bringing stations 12 to 21, inclusive, to the telephonic center along $A\ B\ C$ is to deliver 10 lines at the point c on $y\ y$, and cause them to reach the office along $y\ y$. This is equivalent to moving them and concentrating them on the line $y\ y$ above $x\ x$. If, now, 10 stations are supposed to be at c, then the axis $x\ x$ must be shifted to $x'\ x''$ in order to fulfill the condition of equality in number of stations on each side of it. The true telephonic center is then at T' instead of T.

VI. THE EFFECT OF DIAGONAL STREETS.

In many cities, particularly the older ones, diagonal streets are of occasional occurrence that may be employed for wire routes, and

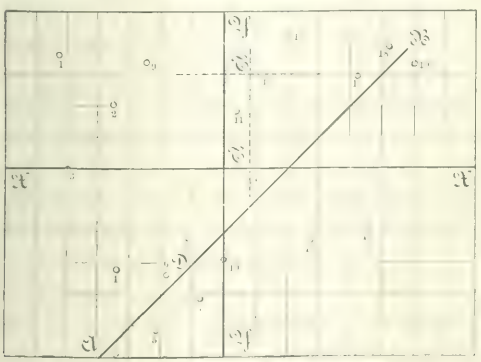


FIG. 15.—EFFECT OF DIAGONAL STREETS.

produce a saving in mileage over that required by running strictly rectangularly. While the advantageous use of such streets is infrequent, it is necessary to consider their effect on the location of the telephonic center in order that a complete solution may be found.

When a diagonal street can be employed that portion of each subscriber's line which follows the diagnoal street becomes approximately an air line, and is no longer referred to rectangular co-ordinates. Then each circuit will either be measured all rectangularly, all straight, or partly rectangularly and partly straight. This mixing of the methods of measurement so complicates the problem that no direct mathematical solution has been discovered, and it is only possible to ascertain the telephonic center by the method of trial and approximation, best accomplished by reference to a map on which the station locations are plotted. A concrete example will elucidate this method. In Figs. 15 and 16, let the line $A\ B$ represent any diagonal street intersecting the co-ordinate axes at any angle whatever extending any length. Let T be the telephonic center referred exclusively to the rectangular axes. Simple inspection shows that the stations which lie closely to $A\ B$ can reach T with the expenditure of less mileage by following the line $A\ B$ till it intersects either of the axes, and then proceeding along the axis, than by taking a purely rectangular course. But it is a question whether a new location for T at some other point would not still further economize mileage. Examining Fig. 15 it is seen that there are 19 stations, of which eight, Nos. 4, 5, 6, 7, 8, 17, 18 and 19 can shorten their wire mileage by taking the street $A\ B$, while for the remaining 11 the rectangular route would be the shortest, so there will be eight stations that can employ $A\ B$ to advantage and 11 that cannot. For these 8 stations that use $A\ B$, the location of the office on this line will give shorter wire routes than any point outside the line. If the office is not placed on $A\ B$, then these 8 stations must have their lines lengthened to reach it at some other point. But there are 11 stations that could not use $A\ B$, and for whom the best office location would be somewhere outside $A\ B$. Hence, if 8 stations have their wire mileage increased by moving off $A\ B$, and 11 their mileage have it decreased, it will not be economy to locate on $A\ B$. Turning to Fig. 16,

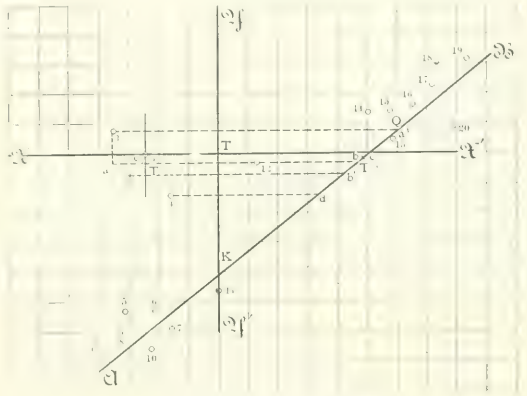


FIG. 16.—EFFECT OF DIAGONAL STREETS.

it is seen that there are 20 stations, of which 14 could use $A\ B$ as a portion of their wire route. Evidently, in Fig. 16, the conditions of Fig. 15 are reversed, that is, a greater number of stations could use the diagonal street $A\ B$ than would reach the point T rectangularly. Therefore, the effect of diagonal streets on the office location depends only on the question as to whether a greater number of stations can use the diagonals to advantage than can reach the office rectangularly.

To ascertain this condition locate the telephonic center for rectangular co-ordinates and draw the axes, then

1. If diagonal streets are found cutting only one of the quadrants, the use of such streets will not affect the office location. For (refer to Fig. 17) let $A\ B$ be the direction of any diagonal street in one quadrant making an angle α with the line $A\ C$, which may be either the axis of x, or y, or a line parallel to either, and assume the office to be at A, or anywhere to the left and above the point A. If any station, or cluster of stations, at any point N be brought to the office by rectangular co-ordinates, the location of the wire route will be from N to O, thence from O to A, and thence to the office, or by some equivalent rectangular route. If the diagonal street $A\ B$ be used as a portion of the route, the line will run from N to Z, from Z to A, and thence to the office. From A to the office the length of the route is not affected by the use of the street $A\ B$, hence it is only necessary to deal with such a part of the route as is to the right of and below A. The distance from N to A measured rectangularly is $A\ O + O\ N$.

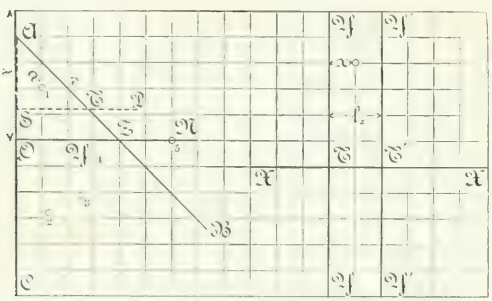
Let $X = A\ O$ and $Y = O\ N$. Then the distance $r = A\ Z$ (the

portion of the diagonal street occupied) is given by the expression $\frac{X}{\cos a}$ and the distance z n by $y - \frac{X}{\sin a}$ and the total distance from A to N using A S is $\frac{X}{\cos a} + y \quad \frac{X}{\cos a}$.

If the office is not at A, but at some other point distant rectangularly D miles from A, the total mileage for the group N from the office will be $D = \frac{X}{\cos a} + \quad \frac{X}{\sin a}$.

Turning back to Eq. 3, it is evident that any term in this equation may be replaced by the preceding expression for station mileage via diagonal streets, and if the same mathematical reasoning and processes be applied to the equation so obtained, the same condition is found to hold true for U and V, hence the location of the office is not changed by the employment of diagonal streets in this case.

To determine the distance from the office of such stations as can use diagonal streets, recourse may be made to the map on which the stations are plotted, and scale measurements made from the office to A, thence from A to Z, and thence from Z to N. If desired, the following geometrical construction may be employed to locate such stations as can make use of diagonal streets in such a hypothetical situation as will make their rectangular co-ordinates in their new position equal in length to the mixed rectangular-diagonal distance of their true position. From the point A lay off $A\ S + S\ T$ equal to $A\ Z$. From the point T draw $T\ P$ parallel to the axis of y and equal to $Z\ N$, then the sum of the distances $P\ T + T\ S + S\ A$ is equal to $A\ Z + Z\ N$. Therefore, so far as length of lines is concerned, it is allowable to assume the group N as located at P, and to measure the



FIGS. 17 AND 18.—EFFECT OF MOVING TELEPHONIC CENTER.

distance to the office rectangularly along $T\ S$ and $S\ A$, for this gives identically the same length as $N\ Z$ and $Z\ A$.

2. If diagonal streets be found passing through two quadrants, it is possible, though not probable, that the utilization of these streets will change the location of the telephonic center. The method of determining this is given under case third below.

3. If diagonal streets be found passing three quadrants or more, it is probable, though not certain, that the employment of these streets *will* change the location of the telephonic center. To determine whether the office is moved to a new position, turn back to Fig. 16. Using rectangular co-ordinates, the telephonic center is at T.

By inspection, it is seen that stations 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19 and 20 can avail themselves of the line $A\ B$, while stations 1, 2, 3, 4, 11 and 12 would use rectangular co-ordinates to reach T. Consider first the stations that can use the line $A\ B$. The location of the office for these will be somewhere on the line $A\ B$, at such a point as to numerically bisect the number of stations that follow this route. As there are 14 stations that can use $A\ B$, the office will be located between the seventh and eighth station or at the point Q. Inspection shows that if Q be moved to cross station 13, then for every unit it moves toward A, the lines to eight stations will be increased and to six stations decreased. By the same reasoning, if Q moves across station 14, the same condition will prevail, therefore, so far as these stations are concerned the office must be placed at Q between stations 13 and 14. Turn now to stations 1, 2, 3, 4, 11 and 12. It is possible to locate the proper telephonic center for these stations considered by themselves, which is found to be at T'. It is now necessary to combine the points T' and Q to obtain the true minimum mileage. As there are 14 stations that can use $A\ B$ advantageously, and only six that cannot, it is probable that the best office location will be somewhere on $A\ B$. Suppose each of the stations 1, 2, 3, 4 and 12 be brought to $A\ B$ by straight lines parallel to X, as shown by the dotted lines, to the points $a\ b'\ b\ c\ a'$, while station 11 is brought along $Y\ T\ Y$ to k. It has been shown that the proper office site for the stations 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19 and 20 is at Q, but by the introduction of stations 1, 2, 3, 4, 11 and 12, five additional lines will run toward Q from A, and one from B, so, now, there will be 12 lines to Q from A, and 8 from B. Hence Q must move toward A till it crosses two stations, thus numerically bisecting the total number. This will be at the point T'', between the lines from stations 3 and 12. Whenever, therefore, diagonal streets arise, the three preceding criteria may be applied to determine whether the use of such streets will cause the office to leave the telephonic center of rectangular co-ordinates. As the application of these criteria is a matter of some considerable labor, in a large group of stations, it is usually possible to decide, from a careful inspection of a properly prepared map, whether such departure will be of sensible magnitude, and of sufficeint importance to justify spending the time needed for exact location by the preceding method of trial and approximation.

VII. THE EFFECT OF MOVING THE TELEPHONIC CENTER.

It is often impossible, and sometimes inexpedient, to place the office exactly at the theoretical telephonic center, so it is necessary to consider the effect on the expense of the wire plant of a departure from the true location. The removal of the office in any direction is equivalent to shifting either, or both, of the co-ordinate axes. Let S be the total number of stations in the territory, and L the average rectangular distance to all stations, so that $S\ L$ is the total wire mileage to reach all stations from the telephonic center. Now, suppose the axis of y to move parallel to itself to the right hand away from the telephonic center T to a new position T' and let Lx denote the distance that the axis moves. Originally, there were $\frac{S}{2}$ stations on each side of this axis. Owing to the motion of the axis, each of $\frac{S}{2}$ stations on the left of the axis will have its line increased an amount equal to Lx units in a direction parallel to the axis of X, and there will be an increase in wire mileage of $\frac{S}{2}\ Lx$ units. As the axis of Y moves to its new position T', it will pass over, or cross, a certain number of stations. Or, in other words, there will be a certain number of stations included between its first and second locations. Let Sm stand for the number of these stations. Then, on one side of the axis of Y in its new location there will be $\frac{S}{2} + Sm$ stations, and on the other side $\frac{S}{2} - Sm$ stations. Owing to the motion of the axis this last number of stations will each lose Lx units of mileage, or there will be a decrease of $Lx\left(\frac{S}{2} - Sm\right)$ miles. Now, to ascertain the *effect* of the moving axis on the mileage of the stations that it crosses during its motion refer to Fig. 18. Let T be the true telephonic center, $Y\ T\ Y$ the axis of Y through that center, and $Y'\ T'\ Y'$ the axis of y in a new position through T' distant Lx units from T. Let S be any station distant x units from $Y\ T\ Y$ that is crossed by the axis of Y moving to its new position. Then S, when referred to $Y'\ T'\ Y'$ will have a new abscissa equal to $L_1 - x$, and the difference between the new and old abscissæ, for S will be $(Lx - X) - x = Lx - 2x$. If there are m groups of stations between $Y\ T\ Y$ and $Y'\ T'\ Y'$ having abscissæ varying from x to xm, these stations will have their mileage increased by an amount equal to

$$S_1(L_1 - 2x_1) + S_2(L_1 - 2x_2) + S_3(L_1 - 2x_3) + \quad Sm(L_1 - 2xm)$$

Then, with reference to the new axis of Y the total abscissæ of all stations will be increased by the following quantity:

$$\frac{S}{2}Lx \quad \left(\frac{S}{2} - Sm\right)(L_1 - S_1(L_1 - 2x_1) + S_2(L_1 - 2x_2) + \quad Sm(L_1 - 2xm). \quad \text{Reducing,}$$

$$SmL_1 - S_1(L_1 - 2x_1) + S_2(L_1 - 2x_2) + \quad Sm(L_1 - 2xm).$$

In this expression, S_1 to Sm are the stations crossed by the moving axis. The same reasoning may be applied to the axis of X; hence, to ascertain the effect of a change of location in either axis, it is only necessary to consider the amount that the moving axis will *change the perpendicular distances of the stations that it crosses.* If both axes move, the full solution is obtained by adding the partial

solution for each axis. For any given case, therefore, it is easy to imagine either or both of the axes shifted such varying amounts as will cover all central office sites worthy of consideration, then by substituting numerical values in the preceding expression a curve may be easily plotted, showing the relation between distances from the true telephonic center and increase in line mileage.

In Fig. 19 a concrete example is given. There are 27 stations.

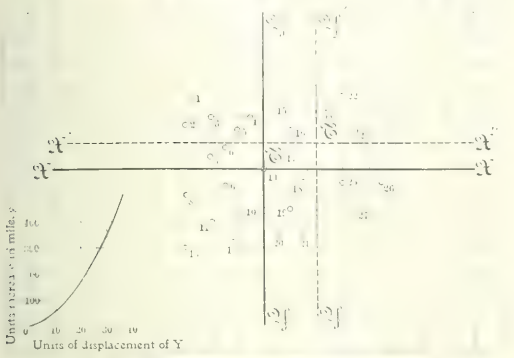


FIG. 19.—EFFECT OF MOVING TELEPHONIC CENTRE.

The axes are shown by the lines $X\ X$ and $Y\ Y$ cutting station 14, leaving 13 stations on each side of each axis, giving the true telephonic center at T. Now, assume Y to be shifted 20 units to the right, and X 10 units upward, as shown in dotted lines, to what extent is mileage increased. In Table No. 3 the perpendicular distances of all stations from both the true telephonic center and T and the displaced one T' are given.

TABLE NO. 3.

Effect of Shifting Telephonic Center in Fig. 19.

Station No.	Distance from $x\ x$	$y\ y$	$x'\ x''$	$y'\ y''$
1	26	28	16	48
2	17	30	7	50
3	20	20	10	40
4	20	5	10	25
5	15	10	5	30
6	9	15	1	35
7	5	20	5	40
8	10	30	20	50
9	6	15	16	35
10	17	9	27	29
11	20	20	30	40
12	28	12	38	32
13	30	30	40	50
14	0	0	10	20
15	25	5	15	15
16	15	10	5	10
17	5	7	5	13
18	5	15	15	5
19	15	10	25	10
20	25	5	35	15
21	25	15	35	5
22	30	30	20	10
23	20	25	10	5
24	15	35	5	15
25	5	30	15	10
26	5	45	15	25
27	15	35	25	15
Totals	428	511	460	677
Deduct			428	511
Differences			32	166
Add				32
Total increase				198

From this table the X ordinates are shown to be increased 32 units and the Y ordinates 166 units, a total of 198 units. Applying the formula just developed to determine the increase in mileage due to moving the X axis gives the following:

$Sm = 3$

$L_x = 10 \qquad Sm\ L_x = 3 \times 10 = 30$

$S_6\ (L_x - 2x_6) = 1\ (10 - 2 \times 9) = -8$

$S_7\ (L_x - 2x_7) = 1\ (10 - 2 \times 9) = 0$

$S_{14}\ (L_x - 2x_{14}) = 1\ (10 - 2 \times 0) = 10$

$S_{17}\ (L_x - 2x_{17}) = 1\ (10 - 2 \times 5) = 0$

$+2$

$Sm\ 1) \qquad 30$

Total net increase for x..... 32 units

The increase due to the shifting of the axis of y is calculated as follows:

$Sm = 7 \quad L_y = 20 \quad Sm\ L_y = 7 \times 20 = 140$

$S_{14}\ (L_y - 2y_{14}) = 1\ (20 - 2 \times 0) = 20$

$S_{15}\ (L_y - 2y_{15}) = 1\ (20 - 2 \times 5) = 10$

$S_{16}\ (L_y - 2y_{16}) = 1\ (20 - 2 \times 10) = 0$

$S_{17}\ (L_y - 2y_{17}) = 1\ (20 - 2 \times 7) = 6$

$S_{18}\ (L_y - 2y_{18}) = 1\ (20 - 2 \times 15) = -10$

$S_{19}\ (L_y - 2y_{19}) = 1\ (20 - 2 \times 10) = 0$

$S_{20}\ (L_y - 2y_{20}) = 1\ (20 - 2 \times 5) = 10$

$S_{21}\ (L_y - 2y_{21}) = 1\ (20 - 2 \times 15) = -10$

$46 - 20 = 26$

140

Total 166

Increase for shifting of axis of x..... 32

Total increase (check with Table 3).. 198

In the lower left-hand corner of Fig. 19 a curve is given, showing the relation of increase in mileage and displacement of the axis of y in the example of Fig. 19. The vertical scale is changed in wire-mileage, while the horizontal scale is units of displacement. A similar curve could be plotted for the motion of the x axis, while a combination of the two curves would give the resultant of a change in both axes. To completely cover the problem it is necessary to plot two curve for each axis in order to show the effect of motion in each direction. While from the formula and specimen curve of Fig. 19 it is easy to see that, in general, the curve of mileage increase will be parabolic or hyperbolic, differing station density will so change the constant that no general curve can be given, and it is necessary to plot a specific one for each case.

PRACTICAL LIMITATIONS.

While the preceding discussion indicates the method of selecting the central office site, in order to make the wire plant expense a minimum, there are certain practical limitations due to urban topography that must not be completely ignored. The underlying principles can be best illustrated by a concrete example, and as there is no exact mathematical treatment each case must be worked out by itself. In Fig. 20 let the plane of the paper represent any town laid off in approximately rectangular blocks, with 27 stations indicated by the small circles. By the method described the axes will be located at $X\ X'$ and $Y\ Y'$, with the telephonic center at T. On the left-hand the streets horizontally are designated by letters from A to E, inclusive, while vertically along the top they are numbered from 1 to 6, inclusive. Theoretically, the wire plant is supposed to extend from the switchboard to the sub-station instrument, practically it would run from the office manhole in the street, near the wall of the office building, to the wall of the subscriber's premises; the inside wiring of both sub-stations and office being excluded from the definition of wire plant. Theoretically, each line is assumed to follow the shortest rectangular route from the office to the sub-station, but practically this is not always possible. Thus, station No. 21 should theoretically proceed west to the line $Y\ Y$, and thence north to the center at T. Practically, station 21 must proceed east to Sixth Street, thence north to C Sreet, and hence west to the office. This course is necessitated, as it is ordinarily impractical to obtain access from the street to the premises of a station, excepting through the owners' frontage. Similarly stations 4 and 6 should run directly east to the axis $Y\ Y$, and thence south to the office location T. But this is impractical, as they are located in the

center of a block, and cable runs would not be constructed through private premises to reach the office; thus all lines must follow the shortest practical routes to the nearest street, and then be carried through conduits or on pole lines to the office. From inspection of Fig. 20 it is seen that the nearest street points to the telephonic center *T*, where an office manhole could be constructed, are the points *H* and *H'*, and that either of these locations is equally good, so far as length of cable from the manhole to the office is concerned, and it becomes only a question of which of these two points will give the shortest wire routes to the stations. Further inspection shows that for subscribers 4 and 6, there is very little choice between running east on B Street and south on Fourth Street to *H'* or west on B Street to Third Street, thence south to C Street and east on C Street to *H*; for subscribers 14 and 15 the route south on Fourth Street to *H'* is a little shorter than the mileage required to reach *H*, and the same is true for station 8. If *H* is used for the office manhole, the line to station 8 is shortened, while from stations 14 and 15 the lines are lengthened. Contrariwise, if *H'* is used, the lines of 14 and 15 are shortened and to 8 lengthened.

Considering the whole of the territory, it is seen that if all the sta-

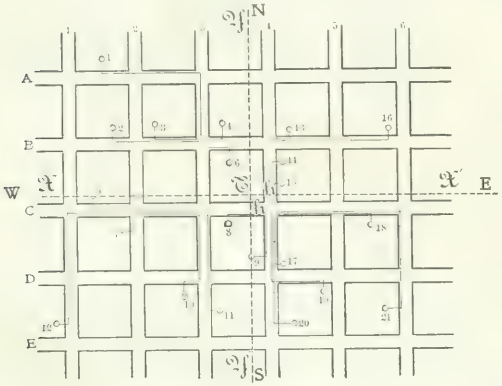


FIG. 20.—PRACTICAL LIMITATIONS IN DETERMINING TELEPHONIC CENTRE.

tions on the west of the axis of *Y*, except 8, are brought to the intersection of Third and C streets, there will be five lines running south on Third Street, three lines east on C Street and two north on Third Street, a total of 10 lines converging to this point. On the east side of the axis of *Y*, to the intersection of Fourth and C streets, there will be four lines proceeding south on Fourth Street, two west on C Street and four north on Fourth Street, a total of 10 lines. If station 8 be included there will be 11 lines from the west and 10 from the east. Similar reasoning may be applied to the stations on each side of the axis of *X*. Now, it is evident that the office manhole may be moved north or south on Third or Fourth streets, or east or west on B or C streets, without materially affecting the total mileage, so long as it is not carried beyond the rectangle formed by these streets. It is also a matter of indifference on which side of these streets the office is located. Hence the practical rule that the office may be located anywhere within a rectangle formed by lots abutting on the streets bounding the block in which the theoretical center is found.

Electrolytic Production of Caustic Alkali.

Patents issued March 11 to James D. Gilmour, of Glasgow, Scotland, and to Edwin D. Chaplin, of Winchester, and Henry G. Halloran, of Boston, Mass., fairly represent progress along the two lines upon which this art has developed—the mercury cathode, and diaphragm, types of cell.

Mr. Gilmour's cell, like that recently patented to Bell, aims to effect the circulation of mercury under the anodes and through the oxidizing compartment without the use of moving parts. Bell utilizes the pressure exerted by the generated gases for accomplishing this movement, whereas Gilmour effects the result by pressure exerted intermittently upon the surface of the mercury by a pulsating pump circulating the caustic solution. The electrolytic cell rests within and slightly above the bottom of the oxidizing chamber, and communicates with it through two conduits provided with oppositely opening check valves, the mercury in the two compartments being in communication through these conduits, and the whole disposition such that pressure exerted upon the surface of the mercury in the outer vessel will cause it to flow upward into the inner or electrolytic cell, returning by gravity to the outer vessel as the pressure is relieved. The caustic lye is forced intermittently through the oxidizing cell, and at each pulsation a quantity of mercury is forced upward through one of the conduits into the decomposing chamber, to flow past the anodes and out from the cell by the other conduit during the succeeding interval. At the same time the surface of the mercury in the outer chamber is thoroughly scrubbed by the caustic solution forced through the narrow channel between the bottoms of the cells.

The second or diaphragm cell is a modification of the well known type developed by Hoepfner, Bein and others, in which the electrodes are separated by two diaphragms retaining between them a neutral body of electrolyte into which the fresh solution is fed, and from which it passes to the respective compartments. In the cell as described, the anode and cathode are laterally separated by an impervious partial partition extending nearly to the bottom of the cell. The base if the cell below this partition is filled with the neutral body of electrolyte, above which, and separating it from both compartments, is a horizontal pervious diaphragm of asbestos cloth. The current efficiency of such a cell producing dilute caustic should be fairly high, but by reason of the devious path of the current within the vessel, the interposition of two diaphragms between the electrodes, and the smallness of the opposed active faces of the electrodes, the internal resistance must necessarily be high and the energy efficiency correspondingly low.

New Telephone Patents.

The issue of March 11, 1902, embraces three patents relating to telephony. One inventor contributes a register to indicate which station on a party line has called the central office, another a combined telephone and fire-alarm system, and a third a telephone receiver support.

Mr. Jefferson D. Hobbs, of Jersey City, patents a telephone substation registering system which has for its object to indicate to the operator by means of a registering dial and a bell signal which station of several on a party line has made a call, thus enabling the operator to charge the call to the proper party. Mr. Hobbs is unkind enough to allege that the party-line subscriber, when making a call which is to be charged against him by ticket, often gives to the operator a number other than his own. The invention then is "to provide a simple and effective means for automatically registering the number of an instrument when the same is used and thereby avoiding

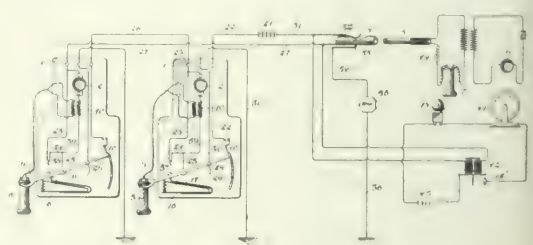


FIG. 1.—HOBBS' TELEPHONE REGISTERING SYSTEM.

possibility of fraud and deceit being practiced, as referred to." Mr. Hobbs makes the indication of the number occur at the end of the call by causing the switch-hook to pass over a sub-divided contact plate and so transmit a series of impulses to a relay controlling the register. A bell in the local circuit of the relay gives audible indication of the registration.

Referring to the diagrams, the switch lever 8 makes contact at its inner end with a curved plate 10 having two grooves in its surface, these grooves crossing at the top of the plate so that the point of the lever goes down one and up the other in its two movements. The down groove is clear and the up groove is interrupted by insulating bushings 14, 14; therefore, when the receiver is taken off and the lever moves its inner end down it makes uninterrupted contact with 10, and when the receiver is replaced moving the point of the lever

up it makes a succession of interrupted contacts, thereby sending impulses from battery 21 to relay 42, which controls register 41 and bell 15. In passing downward the lever 8 by means of pin 28 makes contact with the bent spring 29, and so grounds battery 21 through the drop, making the call. To cause the lever 8 to move with deliberation the bellows 16 is fitted below it.

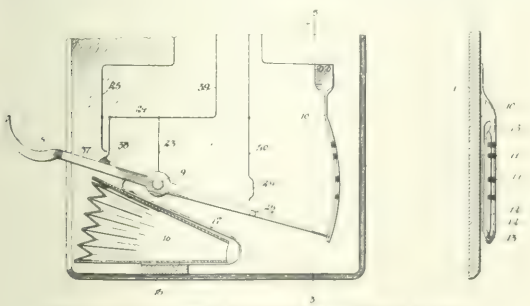
Mr. Hobbs' telephone circuit will hardly pass muster, and as the registering device and bell must be within close range of the operator, one registering machine and one bell for each party line it is not easy to imagine a telephone engineer equipping his switchboards with this device.

Mr. Leonidas G. Woolley, of Kenton, Ohio, patents a telephone and fire-alarm signal the object of which is "to have the telephone automatically turn in a firm-alarm to the central at the same time the occupants of the building are notified, and to so construct the parts that if a person is too nervous to operate the telephone he has only to break the pane of glass in a door of the telephone box, when the alarm is sounded and transmitted to central." Mr. Woolley is his own patent attorney, and his specification irresistibly reminds one of the too true saying regarding a man who is his own lawyer.

Briefly put, Mr. Woolley aims to supply a combination telephone and fire alarm with the object of conveying an alarm of fire to a telephone central office by means of an automatic operation of the alarm either by a thermostat or by breaking a pane of glass that releases a spring-actuated drum which revolves the generator, or by a normal operation of the alarm by hand and subsequent use of the telephone. The gist of the invention is a device by which the armature of the generator is automatically turned when a spring drum is released by a rocking frame normally held in place by the glass door. The frame is held in place by the door, and is consequently rocked either when the door is opened automatically by the action of the thermostat or when the pane of glass is broken.

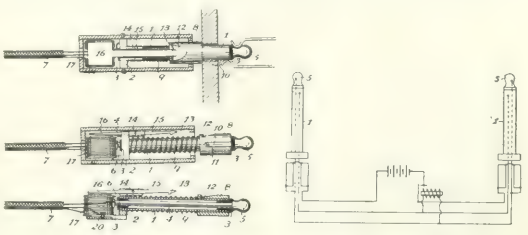
Mr. George M. Beerbower, of New York, patents a telephone receiver support of which the least said the better. The object of the invention is to provide an arm for supporting the receiver so as to admit of the user placing his ear against it and holding his head in any convenient position or moving it (the head) in any direction within reasonable limits while the receiver is kept constantly against his ear, leaving his hand free to take notes or handle memoranda. The money wasted in taking out patents on wholly useless devices of this kind must aggregate a large amount in the course of a year.

A patent issued to Mr. Charles F. Butte, of San Francisco, No. 692,005, of Jan. 28, 1902, which did not reach this office with the



FIGS. 2 AND 3.—HOBBS'S TELEPHONE RIG-SIGNING SYSTEM.

others issued on that date, covers an "automatic electric switch" that might better be entitled a self-ejecting plug, as that is the real object of the invention. The plug is fitted with a spring and loose sleeve sliding over the sleeve of the plug. When the plug is inserted in a jack the sliding sleeve bearing against the face of the switchboard compresses the spring and holds it compressed by the engagement of a latch in a notch on the sleeve. The latch is controlled by an electromagnet set in the base of the plug. When this magnet is energized the latch is raised and the spring, being then free to act against the sliding sleeve bearing against the face of the switchhboard, forces the plug out of the jack. The magnet operating the latch lever is included in a local circuit controlled by a relay, which is energized when the subscribers give the disconnection signal. Figs. 4 to 7 illustrate the construction and general idea of the device so clearly that no detailed description is necessary. Whether at busy times in a large switchboard self-ejecting plugs would not cause more confusion and loss of time to the operators than the present method of handling plugs is open to question, as it is comparatively rare for a plug to have a clear course from the jack where it happens to be to its normal seat. At a busy multiple switchboard it seems probable that self-ejecting plugs if left to themselves would soon produce a glorious tangle of cords. If the operator had to guide each self-ejected plug back to its place she would be doing practically as much work as usual. These practical objections, of course, could only be proved by actual trial, but they naturally occur to any one who has watched the operation of a busy multiple board and are entirely apart



FIGS. 4 TO 7.—BUTTE'S AUTOMATIC SWITCH.

from the obvious electrical and mechanical difficulties. In the common battery system, for instance, if the supervisory relays were used to control the ejecting magnets the connecting plug would not stay in until the called subscriber took down his telephone, and in the magneto system any ring on the line would throw out both plugs. How long the mechanism in the plug handle would stand the racket of being dropped from the jack to the keyboard is a point that also suggests itself.

Mr. Marconi in Canada.

Mr. Marconi, who spent last week in Ottawa, is now at Cape Breton. During his stay in the Canadian capital he was chiefly occupied with the negotiations preliminary to the conclusion of the agreement with the Dominion Government, of which we print an account in another column. Mr. Marconi has been, we understand, deeply gratified by the very cordial welcome which he again found awaiting him from the Canadian Ministers, and in government circles no less than from the leading representatives of unofficial society in Ottawa.

Immediately after the signing of the agreement, on Tuesday, March 18, Mr. Marconi, accompanied by his private secretary, left for Nova Scotia. The party, which included also Mr. and Mrs. Vyvyan and an assistant, reached Sydney a day or two later, since when Mr. Marconi has been busily engaged over the final selection of a site for the erection of his transatlantic station in Nova Scotia. This accomplished, and leaving Mr. Vyvyan as resident engineer in charge of the work of establishing the station, Mr. Marconi will return forthwith to New York, where he may probably pass a few days before sailing for England.

CURRENT NEWS AND NOTES.

THREE-CENT FARES.—The Cleveland three-cent street car fare ordinance has been passed finally by the City Council, there being but two dissenting votes. Mayor Johnson, who is interested in the company, stated that operations of building the new lines will begin within a month.

N. E. L. A.—Mr. George F. Porter, secretary of the National Electric Light Association, announces that the twenty-fifth convention of that body will be held at Cincinnati, Ohio, on May 20, 21 and 22 The headquarters of the Association will be at the Grand Hotel, and the rates will be: American plan, $3 per day; European plan, $1 per day and upward. Mr. Porter states that a very interesting and original programme has been arranged, which promises to make this convention particularly interesting and instructive. The Association in all its long and useful career has never visited Cincinnati, and the present opportunity will, it is hoped, be seized by a large number of members.

ELECTROPLATED FABRIC.—The production of copper and silver-plated laces, having the appearance of metal fabrics, flexible or stiff according to the quantity of metal deposited, was one of the earliest appliances of galvanoplastics, and it may be questioned whether the early work in this line has ever been excelled in point of quality. A method employed by Mr. J. A. Daly, of Washington, D. C., the subject of a patent issued March 11 consists in saturating the fabric with a solution of celluloid or other nitrated cellulose holding in suspension a metallic powder; this powder, enmeshed in the fabric, serves as a base for an adherent deposit. The method possesses little novelty, a substantially identical procedure having been patented in England in 1896 by Ash.

A NEWSPAPER DISCOVERY.—The ability of the daily newspaper reporter to make a brand new discovery out of some old and well-known practice is well illustrated by the amount of space recently given in a large Chicago daily to the alleged new discovery by a storage battery maker in that city of the process of cutting steel with the electric arc. Of course, the use of the electric arc as a substitute for the drill has long been known, and as far back as 1895 arcs of large current volume for piercing and cutting heavy metal vault plates and steel girders were practically applied in a workable method by Mr. Clyde J. Coleman at Chicago. Since that time much metal cutting with heavy arcs has been done in that and other neighboring Western cities, and it has proved a great help and time saver in some cases where alterations in steel frame buildings or in large chrome steel vaults have been made.

CHICAGO SUBWAYS.—There seems to be a suspicion that the superb subways of the Illinois Telephone Company, recently illustrated and described in our pages, are too large merely to carry telephone cables, and may ultimately be found devoted to traction purposes. Mayor Harrison is quoted as saying that so far as the size of the proposed trunk-line tunnel was concerned, it would easily accommodate traction lines. But this was not all. He was confronted with the fact that the proposed trunk line tunnel is higher than, and nearly as wide, as the La Salle Street tunnel. He said that it is also larger than part of the New York traction subway. He also noted that the plans of the telephone company provided for a system of these large conduits, which intersected in such a way as to afford an excellent opportunity for their being used as downtown loops for traction companies, should this be desired at a future time. The impression is gaining ground that the telephone company may turn over its franchise to the traction lines, although President Wheeler, of the former, vigorously denies the insinuation

WATER-WHEEL GOVERNOR.—With the usual form of water-wheel governor, operating simply to open and close a gate, the first effect of such opening or closing is always, owing to the inertia of the water, the opposite to that desired for governing purposes. That is to say, the opening of the gate acts momentarily to cause less velocity of water at the wheel owing to the greater orifice of flow, and the opposite occurs upon closing the gate, these effects lasting until the changed conditions can be imparted to the source of supply of water. To obviate this defect is the subject of a patent granted March 11 to Lamar Lyndon, one of the principal features of which consists in the insertion of a by-pass in the penstock or flume at a point near the water gate, and having a gate controlled by the same mechanism controlling the water gate, which gate or valve operates to allow a greater or less flow through the by-pass as the water gate is being opened or closed. Means are also provided for preventing excessive action of the governor in either direction due to inertia of its parts or other reasons, thereby preventing oscillation on either side of the regulating point. Another feature relates to the control of the governor by a dynamo driven by the water-wheel and so wound that the e. m. f. at the terminals is substantially independent of the load and varies with the speed, but at a rate greater than the speed variation in order to obtain greater sensitiveness in regulation. A clutch connects the by-pass operating device with the water gate operating shaft whereby the by-pass valve is controlled inversely to the water-gate—a controller responsive to the speed of the water-wheel making and unmaking the clutch connection.

WIRE INSULATION.—A patent granted March 11 to Elihu Thomson and J. G. Callan relates to a process for coating wires, and particularly those of small diameter, with a very thin skin of material which is flexible, tough, not easily inflammable and capable of resisting a comparatively high degree of heat. The basic material consists of cellulose tetracetate, which is mixed with a softener and applied in a plurality of coatings. The bare wire is led from a reel and first passed through a very thin solution of Canada balsam, rubber, or other adhesive, which serves the double purpose of dissolving any grease from the wire and covering it with a thin adherent coat, which closely binds to the wire the subsequent coats of cellulose compound. The wire is led from the adhesive coating bath through a drying-box, which may contain hot air. It is then led through another bath and a primary coating of the cellulose compound applied, consisting of a solution of cellulose tetracetate in chloroform or other suitable solvent, mixed with a quantity of Venice turpentine about equal in amount to the actual contents of cellulose acetate in the solution. This gives a coating which adheres closely to the balsam, rubber, or other adhesive film used and binds firmly to the wire the subsequent coatings of insulating cellulose compound. Second, third, fourth, or further insulating coats of the acetate in solution without the admixture of Venice turpentine are applied by subsequent baths, flexibility being imparted to the coating by any of the known softeners added to the solution. Good results have been achieved by adding to the solution a softener composed of five parts, by weight, of castor-oil and fifty of phenol for each hundred parts of solid cellulose acetate contained. The patent describes in detail the arrangement of baths, reel, drying box, scrapers, etc.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The inaugural meeting of the American Electro-Chemical Society will be held the evening of April 3 at the Manufacturers' Club, Philadelphia. This meeting will be devoted to the organization of the society, the adoption of a constitution and by-laws, election of officers, determining times and places of future meetings, discussing the question of publishing the transactions, etc. Meetings for the reading and discussion of papers will be held Friday morning and afternoon and Saturday morning in the lecture hall of the John Harrison Laboratory of Chemistry, University of Pennsylvania. On Friday evening there will be an informal reception of the members and friends at the Manufacturers' Club. Arrangements have been made for visits to the chemical works of Harrison Brothers & Co., where electrolytic sodium, nitric acid and other processes are in operation; the chemical laboratories of the University of Pennsylvania; the works of the Bethlehem Steel Company; the Lehigh Zinc Works at Bethlehem, Pa.; and storage battery sub-stations of the Philadelphia Electric Company and Union Traction Company. Following is the list of papers to be read: "A University Course in Electro-Chemistry," by Professor Joseph W. Richards, Ph.D., Lehigh University, Bethlehem, Pa.; "Electrodes," by Clarence L. Collins, Niagara Falls, N. Y.; "Note on the Gladstone-Tribe Couple," by Professor Wilder D. Bancroft, Ph.D., Cornell University, Ithaca, N. Y.; "The Nascent State," by C. J. Reed, Philadelphia, Pa.; "The Electrolytic Reduction of Lead," by Pedro G. Salom, Ph.D., Philadelphia, Pa.; "Electrodeless Conduction in Electrolytes," by Carl Hering, Philadelphia, Pa.; "On the Electrolysis of Sodium Nitrate and the Composition of the Developed Gases," by C. W. Volney, Ph. D., Keyport, N. J.; "Current Electro-Chemical Theories," by Professor Louis Kahlenberg, Ph.D., University of Wisconsin, Madison, Wis.; "A Zinc-Bromine Storage Battery," by Herbert H. Dow, Midland, Mich.; "Continuous Electrolysis of Solutions of Metals," by N. S. Keith, Ph.D., New York City; "A Method of Electrolytic Production of Zinc from Its Ores," by Samuel S. Sadtler, Philadelphia, Pa.; "The Electrolytic Rectifier," by Professor C. F. Burgess, University of Wisconsin, and Carl Hambuechen, Madison, Wis.; "On the Relative Speed of the Ions in Solutions of Silver Nitrate in Pyridine and Aceto-Nitrile," by Herman Schlundt, Ph. D., Madison, Wis.; "Fall of Potential in Electrolytes," by Carl Hering, Philadelphia, Pa.; "Caustic Alkalies and Chlorine by the Dry Electrolytic Process," by Charles E. Acker, Niagara Falls, N. Y.; "On a New Type of Electrolytic Meter," by Konrad Norden, Ph. D., New York City; "The Reversible Copper Oxide Plate," by Woolsey McA. Johnson, Hartford, Conn.; "A Thermodynamical Note on the Theory of the Edison Battery," by E. F. Roeber, Ph.D., Philadelphia, Pa.; "Electrolysis of an Aqueous Solution by Alternating Current," by Professor Joseph W. Richards, Ph.D., Lehigh University, Bethlehem, Pa.; "The Atom of Electro-Chemistry," by Arvid Reuterdahl, Providence, R. I.

A TRAIN TELEPHONE SERVICE.—The Chicago & Northwestern, Union Pacific and Southern Pacific will provide a quick service telephone system on the overland trains for the use of passengers arriving at Chicago, Omaha and San Francisco.

LOEB LECTURES ON LIFE.—Under the auspices of the faculty of pure science the ninth annual biological lectures will be delivered by Dr. Jacques Loeb. Dr. Loeb, who is professor of physiology and experimental biology at the University of Chicago, will deliver, in the large lecture-room in Schermerhorn Hall, Columbia University, New York City, at 4:30 P. M., a series whose general subject is "The Dynamics of Living Matter." His particular topics will be: March 18, "The General Chemical Character of Life Phenomena"; March 19, "The General Physical Constitution of Living Matter"; March 20, "Protoplasmic Motion, Muscular Contraction, and Cell Division"; March 21, "The Effects of the Galvanic Current Upon Life Phenomena"; March 24, "The Effects of Ions Upon Various Life Phenomena"; March 25, "The Effects of Light and Heliotropism"; March 26, "Artificial Parthenogenesis and the Problem of Fertilization"; March 27, "Regeneration and the Reversibility of the Process of Development." The lectures are open to the public.

Letters to the Editors.

Mercury Jet Interrupter.

To the Editors Electrical World and Engineer:

Sirs.—Referring to Dr. Max Levy's communication in your issue of March 15, in which he calls attention to the fact that certain desirable features that are present in the type of mercury jet interrupter described by me in this journal, Oct. 12, 1901, exist also in his form of that apparatus, kindly allow me to inform Dr. Levy through your columns that my failure to mention in that paper the various advantages for regulation, etc., that he claims for his interrupter was in no way intended to disparage his apparatus. As my paper was mainly devoted to the description of my own apparatus, for the sake of brevity I dwelt only in a general way, and at that very slightly, upon both the merits and the demerits of other varieties of mercury jet interrupters, and intentionally avoided discussing any of them in detail. Naturally before deciding upon the form of apparatus that I considered more suitable for my needs I carefully looked over all the other designs, and came to the conclusion that all of them, including Dr. Levy's, had certain very objectionable features, although some of them included in their design some very creditable features.

As regards the facility for accurately regulating the duration of contact in Dr. Levy's interrupter, one must admit its convenience, although it appears to me that this feature is more than counterbalanced by the mechanical complexity of the easily derangeable mechanism by which the up and down movements of the jet and turbine are accomplished. It is very evident that upon the least derangement of this mechanism from vibration, rough handling, etc., the central rotating shaft will either jam in its insulating sleeve or cause considerable wobbling of the upright jet and the turbine container, a condition totally incompatible with smooth running and regularity of action. Further, Dr. Levy's arrangement apparently necessitates the use of considerable mercury in order to keep the turbine submerged during its various excursions, and if the glass container is of any size, both the weight of the apparatus as well as the cost of initially charging it with mercury must be large.

Regarding the advantages of using petroleum in these interrupters, I differ decidedly with Dr. Levy. In the first place, its presence causes a prolongation of the arc formed on breaking a circuit containing inductance and capacity, as has been clearly shown by the experiments of Steinmetz. Secondly, even with high flash point oils the apparatus is liable to explode and catch fire. In fact, I have in my possession definite documentary evidence which states that one of Dr. Levy's interrupters exploded and set things on fire and that its further employment was discarded owing to this danger. Thirdly, in a very short time the mercury and the oil from constant churning form a nasty black mud that chokes the pump and jet and puts the apparatus out of action as well as makes the process of cleaning very laborious. As no petroleum is present in my interrupter, only a dry black dust forms, which does not interfere with the action of the apparatus until the expiration of a run of several weeks. This dust can be removed from the machine in a few minutes, and all the mercury contained in it readily recovered for future use.

Regarding the advantages of Dr. Levy's "choking tubes," I confess my inability to criticise as I have never used one. With my large 22-inch coil of special design the simple adjustable spark gaps inserted in series with the tube have always performed their function satisfactorily, and as for the slight hissing they produce, it is practically unnoticeable to most people. Their use certainly steadies the action of the coil and permits this variety of transformer to act as if the secondary was properly loaded, and not overloaded, as it usually appears to be when the terminals of the secondary are connected directly to the leading-in wires of a Röntgen ray tube of low resistance. In other words, probably owing to the effect of capacity, which all large coils possess, and to a more or less continuous flow of current through the tube, especially when the magnetic field of the primary collapses, by interpolating the gaps the e. m. f. at the secondary terminals appears to be able to rise to a pressure sufficiently high to force the current all at once through the tube circuit, whose total resistance vastly diminishes during the momentary arcing which is established at the gaps. With suitably shaped and properly placed discharging points and discs at the gaps, it is not a matter of great difficulty to prevent the make current from traversing the tube. The above arrangement, in my hands at least, certainly does not affect the working of the tube for worse; on the contrary, the tube behaves as if it were actuated by a static machine when the induction coil is actuated by my type of mercury jet interrupter, shunted by a condenser of suitable capacity.

New York. R. H. Cunningham, M. D.

Municipal Electric Plants.

To the Editors of Electrical World and Engineer:

Sirs.—The recent discussion in your columns of municipal electric plants, e. g., Detroit, and the suppression of such a project in Worcester, move me to speak my mind upon the subject. The whole matter has been discussed for years with much acrimony and little judicial fairness on either side. Meanwhile experience, much of it very costly, has been accumulating, and ought to be heeded. Personally, I have no prejudice for or against municipal electric plants. In principle a city ought to be able to own and operate its electric light plant just as readily and successfully as its water works. There is no argument against the former that will not apply with almost equal force to the latter case.

Yet, as a matter of pure experience, municipal electric plants have a bad record, and municipal water works a fairly good one. The reasons for this difference form an interesting subject of study. Assuming that a city starts *de novo* and establishes an electric lighting system of its own, it ought in theory to be able to operate it at substantially the same cost as in the case of a private corporation, and take to itself whatever of profit might result. In fact, save in a few small plants, this is not the result, and usually the reason is not far to seek. Instead of buying at a material advantage, and incurring lessened fixed charges, in virtue of better credit and lower rates for interest, the city usually gives up a rake-off on almost every dollars' worth of material purchased and so runs up the cost of the plant that the fixed charges go up instead of down.

It then puts the eight hour law into force and pays the maximum rate of wages to men chosen for their political usefulness—heelers of high and low degree. But assume for the sake of argument a virtuous city government that builds its plant with the same vigorous attention to specifications and bids that would be applied by a private corporation, and puts it under competent and careful superintendence with plenary powers—how then? Aside from the effect of the eight hour law in increasing the pay-roll, the results ought to be good. Sometimes, but rarely, they are: far more generally they are not.

Your analysis of the Detroit situation throws much light upon the subject. First, the plant cannot be kept out of politics for any great length of time, save by rare good fortune. But a better reason can be found in the conditions of financing the plant. You scored, and very justly, the trivial allowance of 3 per cent made for the depreciation in the Detroit plant. Depreciation cannot be treated on the ordinary basis of a sinking fund, for a plant does not mature like bonds or go to pieces at a given date like the famous "One-hoss shay." At best, one would have to deal with a sinking fund affected

by partial payments of uncertain amounts at indefinite intervals, for which feature allowance must be made.

Conceivably such an arrangement at 3 per cent might cover the depreciation due to age and use alone. I have seen putative experts testify under oath to such a rate for apparatus obsolete when they were sworn. But the deadly depreciation due to change in the art cannot be so cavilierly treated, and right here is where the Detroit proposition came to grief. Most of the older electric plants have been practically reconstructed two or three times in their history, and while the apparatus has been steadily improved, improvement has not come to a standstill.

A private plant faces the situation as it best can and pays for replacements out of its surplus, increases its capital stock, or goes through the hands of a receiver according to circumstances. But a public plant which has been administered with an eye to good yearly returns presently finds itself face to face with a big deficit. The searchlight is turned upon its system of accounting, and it has no privacy behind which to hide its blunders. The bald facts come out and the things which many a corporation has done quietly and unobserved, are mercilessly laid bare.

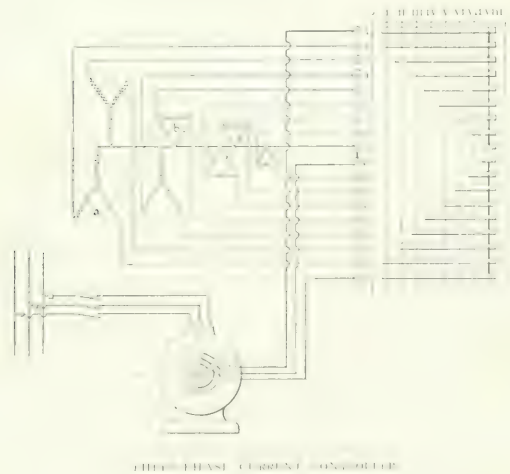
No plant, public or private, can dance to the tune of under-estimated depreciation without paying the fiddler sooner or later. The case is bad enough with private enterprises and has often led to disaster. Public plants, with every temptation to keep down their apparent expenses, are in constant danger from this cause, and when the day of reckoning comes there is nothing to soften the blow. When depreciation is figured with remorseless veracity, the public realizes some of the asperities of the electric lighting business, only too well known to those who have followed it.

Brookline, Mass. Louis Bell.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Simplified Three-Phase Current Controllers.—Klein.—An illustrated description of several modifications of the ordinary three-phase current controller. In the ordinary controller, designed for N symmetrical steps, 3 N contact knobs are used and $3N+3$ wires for the connections between these contact knobs and the motor and its starting resistances. The adjoining diagram shows a controller which is



much simpler, in so far as only $2N+2$ contact knobs are required and $2N+2$ wires for connections between these and the motor and its starting resistances. In the diagram N is 8. The eight different steps are obtained by moving the right-hand part of the diagram, marked at the top O, I., etc. VIII, to the left hand, so that gradually the 18 contact knobs, 1, 2 . . 18 are connected in various ways. It will be seen that a number of resistances are here rigidly connected in star fashion, for instance, *a*, or in delta fashion, for instance, *b*, and connected, through the contact knobs 9 and 10, to one slip ring at the three-phase rotor. By moving the controller gradually through the different steps, the various resistances are gradually connected in parallel; finally, the rotor is short circuited. He also gives arrangements for cranes, with rotation in both directions, and also describes the controller of a car for a three-phase tramway, which is said to have given satisfactory results in trial runs. The article is well illustrated.—*Elek. Zeit.*, Jan. 23.

Surging of Alternators in Parallel.—Foeppl.—A long, mathematical article in which he develops a theory of the phenomenon of surging of two alternators working in parallel, the period of the occurring oscillations being relatively long—several seconds. He finds that surging can occur only because the connection of the two machines is not entirely rigid, but the coupling is always somewhat elastic so that one machine can lead somewhat before the other, with the result that a resistance of an elastic kind then acts upon the former. He gives the full mathematical theory of the phenomenon under certain suppositions, concerning the causes. He has not tested his theory by experiments. If experimental tests will prove that no essential points are neglected in his theory, the formulas reached by him would give a simple remedy, against surging, by means of variations of details in the design in various ways.—*Elek. Zeit.*, Jan. 23.

References.

Shunt Regulating Rheostat.—Krause.—An illustrated description of a simple method for calculating the number of the steps and the size of the steps of a rheostat for regulating the voltage of a shunt machine. It is only necessary to determine some points of the voltage curve at no load in the neighborhood of the normal voltage, and the exciting current for maximum load and normal voltage. The method is illustrated by a numerical example.—*Elek. Zeit.*, Jan. 23.

Reversing Starting Switch.—Levy.—A communication in which he makes some remarks on a recent article by Krause on this subject and calls attention to a reversing starting switch of his own.—*Elek. Zeit.*, Jan. 23.

Progress in Electric Machinery in 1901.—Loewy.—A summary of very many inventions and improvements, made in 1901 by various inventors, taken from patent specifications and articles in journals.—*Zeit. f. Elek.*, Feb. 9.

Lights and Lighting.

References.

Railroad Station Lighting.—Jordan.—An illustrated description of the electric lighting installation of the Souther railroad station of Vienna. There are 41 arc lamps fed by alternating current, partly by the three-wire and partly by the two-wire system. The switchboard is described in detail.—*Zeit. f. Elek.*, Feb. 16.

Nernst Lamps and Arc Lamps.—An article with several tables in which it is shown that the Nernst lamp is not only much more economical than the ordinary incandescent lamp, but may also successfully compete in some cases with arc lamps.—*Elek. Anz.*, Jan. 19

Electric Headlights.—An illustrated detailed description of electric headlights on the Chicago, Milwaukee & St. Paul R'y.—*El'ty*, Feb. 26.

Traction.

Electric Traction on Railways.—Mordey and Jenkin.—An abstract of a paper read before the (Brit.) Inst. Civ. Eng. They first discuss direct-current methods. The principal alternative to the simple 500-volt, two-wire system is the three-wire system in various modifications. The City & South London R'y is the only important example in actual practice of a purely direct-current system using other than

the simple 500-volt arrangement. It is a three-wire distribution combined with feeders supplied at 2000 volts. They then deal with the combined direct and alternating-current system and the pure alternating-current system. They discuss the increase of resistance of the rails with alternating currents and the return of energy to the line when running down gradients and when stopping. They say that the following requirements should be met in any general system of electric railway working: "Extra high pressure for feeding sub-stations; avoidance of moving machinery in the sub-stations; on larger lines a high-pressure distribution to the trains, making necessary overhead conductors; easy extension of distributing system; ability to supply trains having different systems of motors and control; high acceleration when starting; the return of energy on gradients or when stopping; possibility of using different speeds; a variable ratio arrangement for starting, for speed regulation and for returning energy; possibility of using motors on a locomotive or distributed on the train; the train equipment and control to admit of extension and modification to work on other systems." The only method which fulfills all the conditions, is the single-phase alternating-current system. They describe a method in which a single-phase motor on the train drives a direct-current dynamo provided with means for separately exciting it and for varying its e. m. f. over any desired range. The current from this dynamo is to be taken to a separately excited direct-current motor. By this means there is provided a most flexible variable ratio transformation.—Lond. *Elec.*, Feb. 28.

An editorial criticizing several points in this paper. It is doubted whether the single-phase system described at the end of the paper will prove satisfactory. It is pointed out that every train would have to carry treble the amount of machinery which would otherwise be necessary.—Lond. *Elec. Rev.*, Feb. 28.

Providence, Warren & Bristol Railway.—A description of the branch line between Providence and Fall River, a distance of 20 miles, with a short branch at Warren running to Bristol. The power station is situated at Warren midway between the termini. It is equipped with two 850-kw, 625-volt generators, direct connected to two cross-compound condensing engines. Before the plant was running, a temporary power station was built adjoining the foundation which consisted of two 500-kw, 550-volt generators, belt driven from an old mill engine. This temporary plant is still used at times of heavy load. The circuits are kept distinct, a 550-volt current being used on the sections near the power house and 625-volt feeders going to the distant ends. Storage batteries are provided near each end, there being two duplicate batteries of 800 ampere-hours capacity each. The motor cars are equipped with four motors, each of 80 hp capacity, making 320 hp capacity per car. Cars are run in trains of two or three each, although single passenger coaches are sometimes operated. The motor cars are equipped with two trolley poles, cow-catchers under the platforms and air brakes. The trolley wire is supported from long ears, which are bent over it before it is soldered in place. The overhead work is both span wire from poles at the side and bracket construction. But one insulator is used between the trolley wire and the ground, viz., that above the trolley ear. Since the road was opened, the schedule time has been considerably reduced from the old steam trains which were formerly operated on this branch and the number of stops have been greatly increased.—*St. R'y Jour.*, March 1 and Int. Ed., March.

Paris.—Detroyat.—An abstract of a paper read before the Int. Soc. of Elec., on the Metropolitan R'y. of Paris. Direct current at 550 volts is used for driving the trains, and also for lighting the tunnels, trains, shops, etc. The power plant now contains one 1500-kw direct-current railway generator and two three-phase, 1500-kw, 5000-volt alternators. The station thus feeds the adjacent section of the line, and sends three-phase currents to a sub-station, which contains three 750-kw, six-phase converters. Both stations include a "storage battery of 1600 ampere-hours capacity, and for a maximum current of 3000 amperes." He showed how the Metropolitan system can be fed from other stations, which helped greatly in the early starting and regular running of the traction service. Four-car trains and 7-car trains are now in service. The latter have two motor cars controlled by one driver by a special system, using two double-motor equipments, which are coupled in series or multiple, by means of one connected cable. The reversal of the motors is accomplished by a special automatic reverser, operated by small wires.—Lond. *Elec.*, Feb. 28.

REFERENCES.

Twin City Rapid Transit Company.—An article giving one of the most complete financial statements of any road so far published. The company is very successful. Great care has been taken in track construction. About a little less than one-third of the total mileage has cast-welded joints, and considerable track has been laid on concrete beams supporting the rails with tie rods about three meters apart. Complete details of the cost of power and maintenance are given for the system. The auxiliary water power plant at St. Anthony's Falls, in Minneapolis, is used to reduce the cost of power, coal being high priced in Minneapolis and St. Paul.—*St. R'y Jour.*, March 1, and Int. Ed., March.

Municipalization of the Vienna Electric Street Railways.—Zuller.—An article on the meeting in which the offer of the city to take over the tramway system was accepted.—*St. R'y Jour.*, Int. Ed., March

Battery in Traction Stations.—An article giving the good results obtained in a particular case with a battery installed in a traction station for smoothing out the peaks and improving the load factor. The result was a very substantial saving after paying all new charges on the new plant. It is the relation of the peaks to the mean load which determines whether or not a battery would be a paying investment.—Lond. *Elec. Rev.*, Feb. 14.

The Lansing, St. John & St. Louis Railway.—An article on this high-speed railway now being built in Michigan. The especially interesting feature of the road is that the experiment will be made on it with a single-phase alternating motor taking current directly from a single trolley wire and running continuously.—*St. R'y Jour.*, Feb. 15, and Int. Ed., March.

Tokio.—An article on the electric railway equipment for Tokio. Twenty-two miles of electric track are to be built there, and the contracts have just been let for the construction of a large power station containing three 1200-kw generators. Power will be transmitted at 6600 volts. The working plans of the station are given.—*St. R'y Jour.*, March 1, and Int. Ed., March.

Automobiles.—A series of descriptions of various types of automobiles, more especially gasoline and steam carriages. Among the electric automobiles is the Ajax runabout. This issue is devoted almost exclusively to these descriptions.—*Sc. Amer.*, March 1.

Automobiles.—Mueller.—The first parts of a long mathematical article, in which he discusses the problem of utilizing the energy, generally wasted in braking, for recharging the battery, with the use of shunt motors or compound motors, the compound winding of which can be disconnected. No general results are obtained in these parts of the article.—*Centralblatt f. Accum.*, Jan. 1, Feb. 1, 15.

Installations. Systems and Appliances.

London.—An illustrated description of recent extensions, made in the plant of the City of London Elec. Lighting Co., which are called in a separate editorial note, "The crowning triumph of continuous current over alternating-current distribution." With an enormous capital expended in alternating-current machinery, this company resolved three years ago to introduce continuous current gradually. Utilized in the first instance to supply a power load as it was demanded, the continuous-current system was then employed instead of alternating current for each new machine required to supply new lighting consumers as well. The five large machines in the new power house have an aggregate capacity of 7000 kw. It is not proposed to place a battery at the generating station, but arrangements are made for the addition of large batteries within the area of supply. The district is now divided up into several small areas, each with a three-wire 2-by-202-volt distributing network of its own. Motor-generators are now on order to enable the alternating plant to assist the continuous-current extensions, and it is probable that the company may eventually use its high-pressure alternating generators simply as transmitters to the furthest areas to assist during times of heavy load, thus enabling the direct supply to be given from the direct-current generators during nine months of the year without any losses due to transformation.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Feb. 28; *Elec. Times*, Feb. 27.

Bristol.—A well illustrated article on the new municipal electric plant of Bristol. The system in the old station was single-phase alternating current at 93 periods for incandescent lighting and direct current at 600 volts for public arc lighting. A primary pressure of 2000 volts and a secondary of 105 volts was adopted for the former service. This initial frequency and pressure have been retained as the works grew. Single-phase is still used for incandescent lighting, and there are even a few motors on the single-phase mains, but in addition a fairly good power load at 250 and 500 volts direct current

is developing, and part of the single-phase supply is now given at the double pressure of 210 volts. The total connections of the old stations are equivalent to 3670 kw for private lighting, 156 kw for public lighting, and 732 hp of motors. As extensions were no longer possible, a new station was absolutely necessary, and the idea is to gradually take up all the lighting load for this new station as new plant is required and ultimately to supply power exclusively from the old station. The new station contains three 745-kw alternators, and two 165-kw, 500-volt direct-current machines.—Lond. *Elec.*, Feb. 14.

REFERENCES.

San Francisco.—An illustrated description of the Independent Electric Light & Power Company, San Francisco, Calif. Oil is used exclusively for the generation of heat in the boiler furnace.—*Power*, March.

Pressburg.—Ross.—An illustrated description of this Austrian lighting plant. The three-wire system, with 440 volts between the outers, is used. There are two 88-kw dynamos, and a storage battery giving 1200 ampere-hours, when discharged in 5 hours.—*Zeit. f. Elek.*, Feb. 2.

Electric Equipment of a Factory.—An illustrated description of the electric installation of an oleomargarine factory in Chicago. There are two 125-kw and one 45-kw, 125-volt direct-current dynamo, supplying a 110-volt system for both light and power.—*West. Elec.*, March 1.

Switchboards.—CLOTHIER.—The first part of an illustrated paper read before the Manchester section of the (Brit.) Inst. of Elec. Eng., on "The construction of high-tension central station switch-gears, with a comparison of British and foreign methods." After a brief summary of the chief functions, which a good switch-gear must fulfil, he gives illustrated notes on the general construction. He discusses the flat board, multiple frame, cubicle, basement and keyboard types.—Lond. *Elec. Times*, Feb. 20.

Switchboards.—HURTZBERG.—An article giving brief illustrated descriptions of a large number of commercial and special switchboards. —*The Eng.*, March 1.

Wires, Wiring and Conduits.

Waterproof Cable.—A description of the "diatrine" waterproof cable, made by a British firm. Next to the core is placed a layer of paper lapped on in the usual way. The paper, which is of the best quality manilla, is somewhat thicker than is ordinarily used, and is impregnated before being applied to the cable. After the lapping is complete, the covering is again impregnated and is then taped. Over the tape is placed a layer of a waterproof material, which is called dialite, and the composition of which is kept secret. The dialite is lapped with tape in the same manner as a rubber-covered cable, and is then vulcanized in steam. The cable is finished with braiding treated with preservative compound in the usual way. The results of tests made by Wordingham are given. The tested cable had a diameter of core over outside of strands of 0.322 inch, over outside of paper 0.461 inch, over outside of tape 0.482 inch, over dialite 0.671 inch, and over outside braiding 0.816 inch. The insulation resistance per mile in water of 42 degs. F. was found to be 158 megs, after 1 minute's electrification; 194 megs. after 2 minutes, 213 megs. after 3 minutes. The capacity was 0.79 microfarad per mile. The cable broke down at 18,000 volts alternating current. Dialite covering is claimed to be thoroughly waterproof. It is said that ordinary lead-covered paper cables are generally improved by the addition of a layer of dialite between the paper and the lead, while in many cases, where the conditions are suitable, dialite might with advantage be substituted for lead.—Lond. *Elec. Rev.*, Feb. 21.

Electro-Physics and Magnetism

Conduction of Electricity through Gases.—CROOKES.—An illustrated paper "read before the Prince of Wales at the Royal Society." He gives a review of his researches which were begun in 1884, and describes at length the very great difficulties encountered in getting pure hydrogen in the tubes, as generally mercury vapor diffuses from the pump into the tube. He describes the methods by which he overcame these difficulties. The phenomenon in general is a dark space near the negative pole, and stratifications in the other part of the tube, in the form of a series of "buttons." These buttons are pink in pure hydrogen, while traces of mercury cause a blue color. The changes of the phenomenon with varying degree of vacuum are described. At the end of the paper he gives some very interesting thoretical notes. At the exhaustion necessary to give stratifications, there is a wide, dark space round the negative pole. Here the negative electrons, issuing from the pole with enormous velocity, have sufficient energy to clear a space in front of them to a distance varying with the degree of exhaustion. The pink and blue luminosities show where the electrons and gaseous atoms meet. What he called radiant matter 25 years ago, now passes as electrons, a term coined by Stoney, "to represent the separate unit of electricity, which is as atomic as matter." A chemical ion consists of a material nucleus or atom of matter constituting by far the larger portion of the mass, and a few electrons or atoms of electricity. Many experiments made by him show that the liberated electrons do not behave as a gas—i. e., they have not properties dependent on intercollisions, mean free path, etc. They act more like a fog or mist, are mobile and carried about by a current of air to which they give temporary conducting powers, clinging to positively electrified bodies and thereby losing mobility, and settling on the walls of the containing vessel if left quiet. On the other hand, the crowd of hydrogen or mercury atoms, by virtue of molecular motion and intercollisions, act as gases. Whilst their mean free paths are conditioned by the degree of exhaustion, there may be among them a certain number of actual free paths differing widely on each side of the mean. Under the influence of the e. m. f. and at the right degree of exhaustion, these atoms arrange themselves in groups, while the rushing swarm of electrons driven from the negative pole meet them and render them visible. According to J. J. Thomson, the mass of an electron is about 700 times smaller than that of the hydrogen atom, and as these masses start from the negative pole in a vacuum tube, with a velocity of the order of half that of light, it is easy to see that their heating, phosphorescent and mechanical power must be stupendous. As a free positive electron is not known, he adheres to the original one-fluid theory of Franklin, and says that the negatively charged electron is the atom of unit of electricity. Then a so-called negatively charged chemical atom is one having a surplus of electrons, the number depending on the valency, while a positively charged atom is one having a deficiency of electrons. Differences of electrical charge may thus be likened to debits and credits in one's banking account, the electrons acting as current coil of the realm.—Lond. *Elec.*, Feb. 21, 28.

Electrical Conductivities Produced in Air by the Motion of Negative Ions.—KIRKBY.—An account of experiments which appear to corroborate Townsend's result that negative ions when moving with adequate velocity disintegrate other molecules upon colliding with them and thus generate new ions. This at least must be the case when the pressure is small. On the other hand, the positive ions do not appear to have the same effect.—*Phil. Mag.*, Feb.

Radio-Activity Imparted to Certain Salts by Cathode Rays.—McLENNAN.—An account of experiments in which several salts, showing no radio-activity as ordinarily prepared, were found to exhibit a very marked radio-activity on being greatly heated after being exposed to cathode rays. With several of the salts a temperature of 100 degs. C. sufficed to exhibit the effect, though with still higher temperatures the radio-activity was more pronounced. The radiation emitted by these salts was found to discharge positively charged bodies, but not those negatively electrified. In no case did it appear to impart a charge to an unelectrified body.—*Phil. Mag.*, Feb.

Path of an Electron.—RIECKE.—An article in which he shows that the path of a cathode ray particle can be calculated in certain simple cases. One case which can be experimentally realized is that in which the cathode consists of a long wire which can be considered of infinite length, placed in a magnetic field whose direction coincides with the axis of the wire. Cathode particles are projected outwards at right angles to the surface of the wire, but the magnetic field bends them aside so that they eventually describe a circular orbit round the wire. This happens when the electric repulsion of the cathode is just balanced by the centripetal action of the magnetic field. The actual path described by the electron is a spiral which asymptotically approaches the circle referred to. The radius of the circle is the smaller the stronger the magnetic field. He connects this with the contraction of the dark space in a magnetic field. The publication of the experimental results is promised.—*Phys. Zeit.*, Feb. 1; abstracted in Lond. *Elec.*, Feb. 14.

Spectral Rays.—BECQUEREL.—An account of a further study of the transformation of white phosphorus into red phosphorus through the agency of radium rays. He also made a comparison between uranium and radium rays, and found that of the three classes of rays emitted by radium the undeflected and easily absorbed rays al-

absent in uranium rays, while both substances have magnetically deflected rays which are easily absorbed, and magnetically deflected rays of great penetration.—*Comptes Rendus,* Jan. 27.; abstracted in Lond. *Elec.,* Feb. 14.

Electro-Chemistry and Batteries.

Electrolytic Chlorates and Hypochlorites.—An abstract of a paper by Foerster and Mueller, which has already been noticed in the Digest. The following editorial comment is made on the results. The fact that by using electrodes of platinum black, they obtained efficiencies approaching the theoretical figures, in conjunction with the fact discovered earlier by Mueller, that the addition of potassium chromate to the electrolyte in some unexplained manner greatly reduces the reduction losses at the cathode, appears to be of great industrial importance. Rapid progress of those industries is expected when the difficulties have been overcome, which are connected with the preparation of durable platinum-black electrodes.—Lond. *Elec.,* Feb. 28.

REFERENCES.

Conductivity of Mixtures of Solutions.—Wolf.—A theoretical discussion of the influences which determine the conductivity of a mixture of two electrolytes, besides the conductivities of the two components; also an account of some measurements.—*Zeit. f. Elektrochemie,* Feb. 20.

Electrolytic Oxydation.—Labhardt and Zschoche.—An account of an experimental investigation of a special case of electrolytic oxydation of methyle groups in aromatic compounds.—*Zeit. f. Elektrochemie,* Feb. 13.

Tantalum.—Moissan.—An account of experiments in which he obtained tantalum in considerable quantities in the electric furnace.—*Comptes Rendus,* Jan. 27; abstracted in Lond. *Elec.,* Feb. 14.

Ricks Lead Storage Battery.—An account of tests with several discharge curves, of this high capacity cell, which was recently noticed in the Digest.—*Centralblatt f. Accum.,* Feb. 1; translated in Lond. *Elec.* Feb. 14.

Pan-American Exposition.—Rabenalt.—An article on the storage batteries exhibited at the Exposition in Buffalo.—*Centralblatt f. Accum.,* Jan. 1, 15.

Units, Measurements and Instruments.

A Method for Accurately Measuring Large Phase Differences.—Breslauer.—An illustrated paper, read before the Vienna Electro-Technical Society. For measuring phase differences the wattmeter is unsuitable, if the power factor is below 0.1. There are, however, important cases in practice where large phase differences must be measured, for instance, in no load tests of induction motors, where the power factor is between 0.1 and 0.3, and in testing the quality of sheet iron, where it is necessary to determine power factors exactly down to 0.08. The method described by him is based upon the measurement of sum and difference of the instantaneous values of the e. m. f.'s. In Fig. 1 *A* is the apparatus, the watt consumption of which is to be determined; *R* is a non-inductive resistance in series

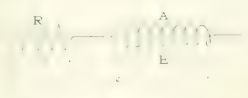


Fig. 1.—[illegible]

with it. He determines the geometrical sum *M* and the geometrical difference *N* of the two voltages lost in *A* and *R*. The power consumed in *A* is then equal to the difference of the squares of *M* and *N*, divided by 4 *R*. For determining *M* and *N* he uses a differential galvanometer, i. e., any electromagnetic instrument with two windings of exactly the same position in regard to the iron core. Any such instrument with a coil in which an iron core oscillates, can be used for this purpose when the coil is unwound and rewound with the same wire bifilarly. The connections of the instrument are shown in Fig. 2. By exchanging the connections of one of the coils, either *M* or *N* are measured. Still simpler and more suitable for practical purposes is the use of an ordinary voltmeter with iron core, which, however, has a series and a shunt [illegible] the latter can be connected in the same or in the opposite direction to the series winding. The theory of the instrument is given. Numerical examples are added.

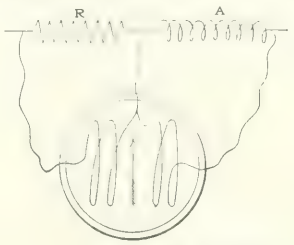


Fig. 2.—Connections of Instrument.

and it is said that power factors down to 0.07 can be easily measured with sufficient exactness.—*Zeit. f. Elek.,* Feb. 2.

Technical Terminology.—An anonymous pleading for more strictness in the ordinary language of electricians. Kw hour and kw should not be mixed up. A "recording wattmeter" is a watt-hour meter. Similar mistakes are often made with candle-power. Instead of voltage he recommends the term pressure. He recommends the more general use of conductance, as reciprocal of resistance, and conductivity as reciprocal of resistivity.—Lond. *Elec. Rev.,* Feb. 14.

Telegraphy, Telephony and Signals.

Musical and Talking Arcs.—Duddell. An abstract of a lecture delivered before the Royal Inst. He showed the talking and whistling arc which made audible the words and the tunes communicated to a telephone in a distant room. He demonstrated Ruhmer's method of wireless telephony. The light of an arc whistling in another room in response to a telephone was directed on to a selenium cell in the theater. A current through the selenium varied in accord with the alternations in intensity of the beam, and these variations reproduced the original sounds in telephone receivers. He further demonstrated syntonic wireless telegraphy. The shunt circuit of a musical arc represented the sending station. A similar circuit at some distance, played the part of a tuned receiving station; and a small incandescent lamp in this latter circuit indicated the receipt of etheric messages. While oscillations of the right frequency, gauged by the note emitted by the arc, existed in the sending circuit, the lamp glowed brilliantly; but if a frequency of a tone above or a tone below was used, the lamp shone but dully, while a note two tones above or below produced no visible effect at the receiving station. He remarked that the full advantages of syntony cannot be obtaind when the oscillating currents in the sending circuit die down repeatedly, as happens when sparks are used to create them, and he suggested it might become the lot of the musical arc, in the perfected tuned telegraphy we are waiting for, to produce the sustained oscillation so desirable.—Lond. *Elec.,* Feb. 28.

Paternity of Wireless Telegraphy.—An illustrated article giving historical notes. The invention of the coherer is due to Onesti, who investigated its properties in 1885. Blondel in 1898 and Tommasino in 1899 first suggested the use of a combination of one coherer and a telephone, and Guarini described the first arrangement with a telephone and another coherer. Numerous other inventions are also noticed.—Lond. *Elec. Eng.,* Feb. 24.

REFERENCES.

Block Signals.—Kohlfuerst.—The first part of an illustrated article on automatic electric block signal systems for main railroads.—*Zeit. f. Eleck.,* Feb. 16.

Wireless Telegraphy.—Sullivan.—An article giving some historical notes and discussing the well-known disadvantages of wireless telegraphy.—Lond. *Elec. Rev.,* Feb. 14.

Miscellaneous.

Electric Shocks.—Trotter, Aspinall, Webber.—Three papers read before the (Brit.) Inst. Elec. Eng. Trotter's paper deals with electric shocks at 500 volts. He says that 500 volts have been deliberately chosen because this pressure is not dangerous under ordinary conditions. Dry wood and dry boots without large nails offer so great resistance to electric current that it is perfectly safe to touch a trolley wire while standing on a dry tram car, or even while standing on the ground, or on the rails. Wet weather makes a considerable difference.

but boots must be very wet to allow enough current to pass to produce a severe shock. Dry clothing offers so great a resistance that no shock can be transmitted through it. With sound dry boots hardly anybody can feel a shock when standing on the live rail of an electric railway with one foot and a running rail with the other. With damp or wet boots a shock is felt, but neither the sensation nor the degree of wetness of the boots can be measured accurately. It is not possible to receive a shock by sitting or lying on a live rail so long as the clothes are dry and continuous and the live metal is not touched by the bare skin. Aspinall's paper deals with the physiological effects of electric shocks in general. Not only are different people differently affected, but the same person under different conditions does not feel the same. A diseased person may be either more or less susceptible, according to what disease one may be suffering from. The path which the current takes through the body is of great importance. The left side of the human body seems to be more vulnerable. The area of contact is of great importance. Burning seems to be to a certain degree a protection against fatal shocks, as the burning not only numbs the nerves, but also increases the resistance. If death occurs from an electric shock, direct current and alternating current are equally dangerous: but if death occurs from burns the direct current is more dangerous. He suggests that an electric shock acts somewhat like an anæsthetic, such as chloroform. He refers to the fact that "in two cases of an electric shock where death would have been expected, the men recovered, in the writer's opinion, from the head being lowered, thus flushing the brain with blood, which is exactly what the doctors do when they want to revive a patient who has collapsed when under chloroform." He says, however, that his evidence on this point is not yet conclusive. The paper by Webber is short, and deals with the legislative side of the question.—Lond. *Elec.*, Feb. 28.

[illegible]

Electric Welding of Rails.—Hicks.—A description of the Thomson electric welding process for making rail joints.—*The Polytech.*, Feb. 28.

New Books.

The Röntgen Rays in Medicine and Surgery. By Frances H. Williams, M. D. New York: The Macmillan Company. 958 pages, 8vo. Price, $6.

Dr Williams, a well-known expert in the science and art of radiography, has produced a volume destined to be of great service to the medical profession. In the opening chapter of this book, which is elaborately illustrated, he gives a brief review of what is known at present of the nature and properties of the Röntgen ray, and tells of the experiments that have been made to determine their penetrating power in regard to various substances. These experiments have shown that fats are more readily traversed by the rays than water, while the absorptive power of blood and muscles differs but little from that of water. On the other hand, bone, which contains the heavier elements—phosphorus and calcium—has a markedly greater absorbing power. From investigations made by himself with a number of chemical substances, the author is led to the conviction that by means of Röntgen rays we may recognize some changes in chemical composition induced in the body by pathological processes. Our ability to do this without beaker or reagent, or without disturbing the vital process, he regards as "a step in the application of chemistry and physics to practical medicine which hints at what the future may have in store for us."

The various forms of static machines and induction coils used to produce Röntgen rays are then enumerated and described. The machine employed by the author in his clinical work is of the Holtz form, and has four revolving plate-glass plates 183 cm. in diameter, and four fixed plate-glass plates 193 cm. in diameter. These eight plates weigh about 1000 lbs. It is run by a 1-hp electric motor, and receives its initial charge from an auxiliary machine of the Wimshurst type, with plates 40.5 cm. in diameter. To start the large machine, one pole of the exciter is connected with one terminal of the large machine and the other pole with an armature brush on the opposite side of the large machine. To permit the use of a considerable length of spark-gap and at the same time ensure, for purposes of examination with the fluorescent screen, a perfectly steady light, he uses a device of his own, a "multiple spark-gap" which consists of [illegible] mm. apart along the edge of a strip of vulcanite 1 cm. wide. This strip, with its balls, is free to move up and down through a vertical brass tube.

Where a machine of smaller size is wanted, the author recommends Elihu Thomson's dynamostatic machine, which has the additional advantage of being less influenced by moisture than the Holtz machine.

The tubes that have proved most satisfactory, both for static machines and coils, are made in accordance with the directions of Dr. Rollins—the double-focus tubes of the cooled target type or the rotary target type.

Much space is devoted to the application of the Röntgen rays to the diagnosis of diseases of the lungs and heart, and especially to tuberculosis, pneumonia, pleurisy and new growths. In other chapters thorough consideration is given to deformities, congenital and acquired, of the skeleton, fractures and dislocations, foreign bodies, diseases of the joints and dental apparatus. The therapeutic uses of Röntgen rays, and especially the action on micro-organisms in the tissues, are fully discussed, of particular interest being the pages dealing with the treatment of lupus and cancerous growths on the surface of the body.

The last chapter, on the examination of food and drugs, and on veterinary medicine, is very brief and fragmentary.

The Engineering Index. Volume III., 1896-1900. Edited by Henry Harrison Suplee, B. Sc., assisted by J. H. Cuntz. New York: The Engineering Magazine. 1030 pages. Price, $7.50.

Recognizing that "next to knowing a thing comes the faculty of knowing where to look for it," various attempts have been made from time to time to compile indices of literature bearing on various lines of knowledge. These attempts have been made by individuals, by societies and by publishing houses. Every wideawake man has a more or less elaborate scheme for keeping notes and references to important papers relating to his work, and, indeed, no publication will obviate the necessity for keeping such notes. But the range of literature is so wide that no person can pretend to keep thoroughly posted even along a single line of engineering unless he spends a disproportionate amount of time and money in simply reading what others are doing, and even then he may miss important articles in papers not at hand.

To meet the evident demand for a published index of current literature, various attempts have been made with more or less success. The Royal Society (of England) Catalogue of Scientific Papers, filling eight quarto volumes of a thousand pages each, lists scientific papers in many languages covering the period from 1800 to 1873, but it excludes technical and professional papers. Poole's Index covers current literature of general interest, but gives little attention to technical publications. The two volumes of Galloupe's Engineering Index covered about 25 American and British engineering journals during the period from 1883 to 1892. The indices in the *Transactions* of the American Institute of Electrical Engineers, in *Electrical Engineering* and in *Electrical Power* were excellent but short lived. Several of the European electrical journals have tried for shorter or longer periods printing lists of contents of their contemporaries. The quarterly *Fortschritte der Elektrotechnik* has covered electrical fields since 1887 with some satisfaction to those who read German, giving references to the important articles in the electrical press and abstracts of selected articles. Originally published several years behind hand, it has now caught up to the extent that the 1900 volume lacks only one number, while one number for 1901 is at hand. The digest in Electrical World and Engineer has furnished for the past nine years an increasingly valuable weekly digest of important articles on electrical subjects, but it does not aim to be a comprehensive index.

The honor and credit of achieving real success in keeping up an index along comprehensive lines belongs to the management of the *Engineering Magazine*. This magazine has continued and enlarged the index formerly conducted by Professor J. B. Johnson, published in the *Journal* of the Association of Engineering Societies, and collated in two volumes, Volume I. covering the years 1884 to 1891, and Volume II. covering the years from 1892 to 1895. The "Editor's Exchange Table," in the first issue of the *Engineering Magazine*, in April, 1891, gradually developed into so comprehensive and meritorious an index of engineering papers, that the index of the *Journal* was no longer a necessity, and the association abandoned its index with the understanding that the magazine was to continue it and also

to publish a compiled volume about every five years. To indicate the growth in the scope of the work, it is noted that while Volume II. contains about 6000 entries from 62 sources, Volume III. contains nearly 40,000 entries from nearly 200 sources. For a number of years the monthly index has been reprinted with one side of the paper blank, so that entries might easily be cut and pasted on slips for card catalogues. Those who have found these cards accumulating in geometric ratio with a corresponding amount of work in preparation and classification, will be relieved to learn that it is proposed hereafter to compile and publish an annual volume. It is to be hoped that the present volume will meet so cordial a reception as to warrant the publishers in fulfilling their promise of annual volumes.

To indicate something of the scope of the present volume of the index, it may be noted that of the 1030 pages, 6 are given to accumulators, 5 to acetylene, 20 to bridges, 17 to car, 24 to coal, 4 to dams, 3 to education, 122 to "electric," including 6 pages of electro-chemistry, 28 to gas, 10 to heating, 52 to railway, 8 to steam engine and 8 to telephony. Each page gives a number of cross references, which greatly increase the virtual number of references. Each entry gives the approximate length of the article, a brief note regarding its contents, name and date of the publication and frequently the name of the author. References to articles in foreign languages give a free translation of the subject, followed by the exact title in the original, making it more readily found. It is to be regretted that volume and page references are not also given, for dates are often inconspicuous and troublesome to find in the bound volumes.

The classification of engineering knowledge is a difficult problem. The monthly installments in the *Engineering Magazine* have the references classified conveniently under eight or ten different lines of engineering, which, however, overlap to some extent and sometimes require a searcher to look through two or more sections to find the desired entry. In the compiled volume the number of cross-references necessary with any such arrangement would become burdensome, and, therefore, all the entries are made under a single alphabetical arrangement so far as is practical.

The mechanical execution of this volume is excellent. At the top of each page are placed catchwords in bold-faced capitals, indicating the first and last main topics considered on the page. In the text, the main topics are indicated by catchwords in bold-faced capitals and sub-titles are indicated by bold-faced lower case type. Numerous cross-references increase facility in finding desired entries. For example, under *Electric Resistance* will be found cross-references to *Electric Conductivity, Electric Instrument, Electric Measurement, Electric Testing, Rheostat.*

In a monumental work of this character, it would be indeed surprising if there were not a number of typographical errors. Examination, however, shows it to be remarkably free from misleading errors. One occasionally finds a single incorrect letter in a proper name. The work, as a whole, is worthy of the highest commendation, and it will prove a valuable addition to any library.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 17-20, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF THE [illegible]. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Next meeting, Chicago, April 9 and 10, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

New Type of Lundell Fan.

One of the earliest and best known types of that distinctive American product, the fan motor, is the Lundell, made by the Sprague Electric Company, of New York City. Where an article has been

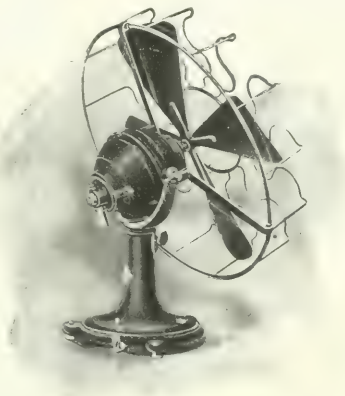
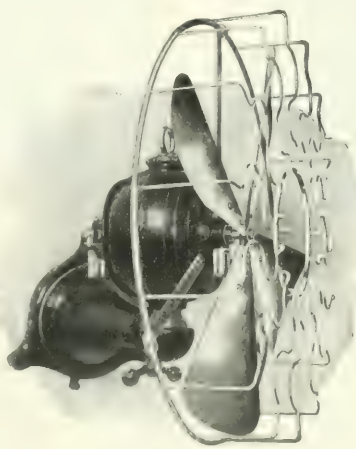


FIG. 1.—TRUNNION DESK FAN.

standardized and perfected through long years of study and experience, it is difficult to make further advances. The handsome fan catalogue for 1902, just issued by the company, shows, however, that



while the old styles remain popular and are, if anything, neater in build and comelier in shape than ever, it has been possible to add to the list of types; and that this season two new models have been introduced, the 12 and 16-inch swivel and trunnion desk fan and the

bracket pattern. They run at three speeds, 800, 1350 and 1900 r. p. m. in the 12-inch size, and 800, 1150 and 1450 r. p. m. in the 16-inch. They have self-aligning and self-oiling ring bearings, and a starting and regulating switch gives variations in speed. With regard to the old models, it may be noted that an increase in efficiency has been effected, the current consumption of the 12-inch, 115-volt motor, being reduced from 0.45 to 0.43 amp. The new types are herewith illustrated.

A New Regulating Incandescent Lamp.

In view of the enormous extension of incandescent lighting, it is only natural that considerable attention should be paid to such regulation of the lamp as will allow its candle-power to be increased or diminished at will, as is done in the case of the gas flame. Even to-day the complaint most often heard in regard to the incandescent light is that we cannot turn it up and down as we do gas. There would certainly seem to be a very large market for a device which should permit this desideratum to be attained, and we illustrate herewith



REGULATING LAMPS.

a new socket which aims successfully at the accomplishment of this purpose.

The Pinckard socket or "Tri-light" lamp is being manufactured by the Tri-light Electric Company, of Birmingham, Ala. This socket resembles in appearance the ordinary incandescent lamp socket and is operated in the familiar manner by turning the switch key. At each turn or step in the key movement a different amount of light is obtained. In the case of the double-filament lamp here shown, which is fitted with two filaments of 8 candle-power each, turning the key of the socket once throws these two filaments in series circuit and gives a light of about 2 candle-power; a second turn of the key leaves a single filament in circuit, giving 8 candle-power; a third turn throws in both filaments, giving 16 candle-power. At the fourth step both filaments are thrown out, so that no current at all is taken. It is obvious that by lowering the degrees of candle-power, an economy of current is effected. Any standard Edison base lamp can be used with the Tri-light socket, and Tri-light lamps can be used with any standard Edison socket, only one filament then giving illumination. The lamps are manufactured for candle-powers of 8, 10, 16, 32, 50 and 100.

The key socket is connected to the lighting circuit in the ordinary fashion, and this is true also of the similar wall socket. With keyless sockets holding lamps in places of inconvenient access, a special regulating switch is used, accomplishing the same purpose. Where ordinary sockets are already in use a special attachment plug is furnished which screws into the existing socket and is made with the three standard Edison, Thomson-Houston or Westinghouse devices. These new devices are all economical in purpose and should, it would seem, meet with a large demand wherever it is desired to have a light whose brilliancy can be increased or diminished at will—and there are few places where this is not the case. Mr. Chas. I. Hills, of New York City, is the general sales agent.

Ceiling Fan Development.

The fan season of 1902, now getting into full swing, finds the demand for ceiling fans larger and brisker than ever. We learn from



FIG. 1.—CEILING FAN.

the Hunter Fan & Motor Company, of Fulton, N. Y., that Tuerk alternating current ceiling fans have met with a greater sale this season than ever before, owing to their great economy in the use of current, taking only 100 watts to operate at full speed with a spread of blade of 60 inches and a width of 8 inches. Owing to this fact there

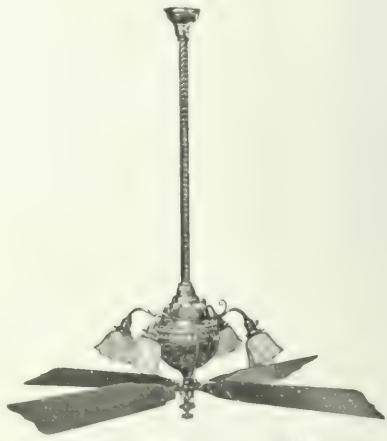


FIG. 2.—COMBINATION CEILING FAN.

has been but very little change in the construction of same for this year, but as there has been a call for a four-bladed alternating fan the company has brought out one. The special feature is that they will run at full speed with a consumption of from 100 to 110 watts with the same spread of blades and on widths as used on the two-bladed fan. They are also supplied with the same spiral grooved oiling system always used, as well as a stopping and starting switch and a blade adjuster which can be used to change the angle on two of the blades while in motion. The other two blades are always stationary at one angle. These fans are furnished to run on any cycles from 40 to 140, and any voltage from 50 to 230.

On the 40 and 50 cycle fans the Hunter Company uses a specially constructed motor which gives a speed of 180 revolutions per minute with a spread of blades of 60 inches and a width of 8 inches, and a consumption of 90 watts of current at full speed.

Electric Fans.

A new line of fan motors is being offered this year by the Fort Wayne Electric Works, Fort Wayne, Ind., the most unique of which is one known as the "Wood" revolving fan motor (Fig. 1), which is of the ordinary high speed type. It consists of a spherically incased motor suspended from a ball bearing so as to revolve around a vertical axis. The case of the motor is small and of light weight, being only 3⅝ inches in diameter and cast of aluminum. The shaft of the motor upon which the fan is mounted is placed at an angle of 45° to the vertical axis of the complete structure. The result is that since the top fan blades are farther from the center of rotation than the lower blades an unbalanced condition is produced, which causes the motor to revolve in a horizontal plane, distributing at intervals the air to all parts of the room.



FIG. 1.—REVOLVING FAN MOTOR WITH CORD SUSPENSION.

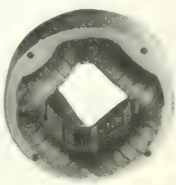
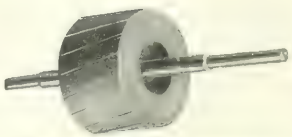


FIG. 2.—FIELD MAGNET ALTERNATING CURRENT FAN MOTOR.



ARMATURE OF ALTERNATING CURRENT FAN MOTOR.



—ARMATURE OF DIRECT CURRENT FAN MOTOR.

The 1902 fan motors are made for both alternating and direct current. The alternating current motor is of the induction type, provided with a four-pole field magnet (Fig. 2) and a squirrel cage armature (Fig. 3). It will be noticed that the slots in the core of the armature are slanted, the object of this being to prevent humming. The direct current motor is provided with a two-pole field magnet (Fig. 4), and a squirrel cage armature of the drum wound type (Fig. 5). The slots in this armature are diagonal to the face of the core, the construction being similar to that of the alternating current armature above described. Carbon brushes of rectangular cross section are used and are mounted in brass tubes into which they fit closely. The brushes are pressed against the commutator by springs that are contained in the tubes immediately back of the brushes, the spring tension being adjusted by means of screws in the back ends of the brush holders. The bearings are of the self-oiling type.

The line of desk type motors (Fig. 6) is similar to the revolving type, with the exception that the motors are mounted on a solid base.



FIG. 4.—FIELD MAGNET OF DIRECT CURRENT FAN MOTOR.

FIG. 6.—DIRECT CURRENT DESK FAN MOTOR.

the ball bearing suspension being omitted. They are built for both alternating and direct current, and the construction is similar to the revolving type, with the exception above mentioned.

These machines are all provided with 8-inch fans and run at a maximum speed of 2200 revolutions per minute. The power consumption is as follows: 50-volt motor, 17 watts at 60 cycles, or 36 watts at 140 cycles; 104-volt motor, 17 watts at 60 cycles, or 36 watts at 140 cycles; 115-volt, direct current motor, 17 watts.

Wiring the St. Louis Exposition.

The American Steel & Wire Company, of New York, has been awarded the contract for furnishing for the electrical power circuit of the World's Fair 3,300,000 feet of weatherproof and 43,000 pounds of rubber-covered wire. The contract price is $200,000. Director Taylor has also made public his plans for the great electric subway, which will carry the trunk lines of wire through the main exhibit district of the Exposition. This subway will be 4500 feet long, or nearly a mile in extent. It will be 7 feet high and 7 feet wide, buried some distance beneath the boulevards, promenades and buildings of the Exposition.

It will start from the mammoth switchboard at the big Westinghouse power plant in the western end of the machinery building. The supply cables carrying the current to be furnished by the Citizens' Electric Light & Power Company, four miles away, will also center at this switchboard.

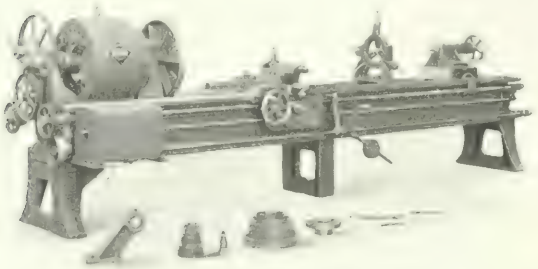
The cables carrying the current will be placed on shelves at the sides of the underground passage, instead of being drawn through ducts. These shelves will run along either side of the subway and will be 18 inches wide. Three feet of space is allowed between, in which the linemen may work. Pump-log conduits will leave the subway at intervals to convey the current to the buildings and to other places where light and power are needed.

Lateral conduits of unusual size will leave the machinery building and the eastern end of the subway and take a straight course for the

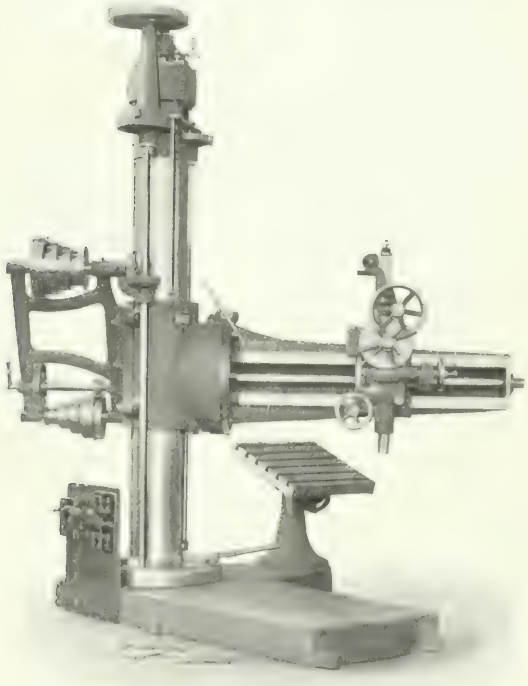
cascade gardens, where they will supply the vast illumination for Art Hill and the power to operate the motors and pumps which will take the water out of the grand basin and draw it to a height of 70 feet into the reservoir, which will supply the cascades. The contract for the wire, already let, does not include the cables which will be carried in the subway.

Electrically-Driven Machine Tools.

It is a comparatively simple problem to apply an electric motor to a machine tool requiring only one speed, such as punching machinery. The application of electric motors to this simplest case has,



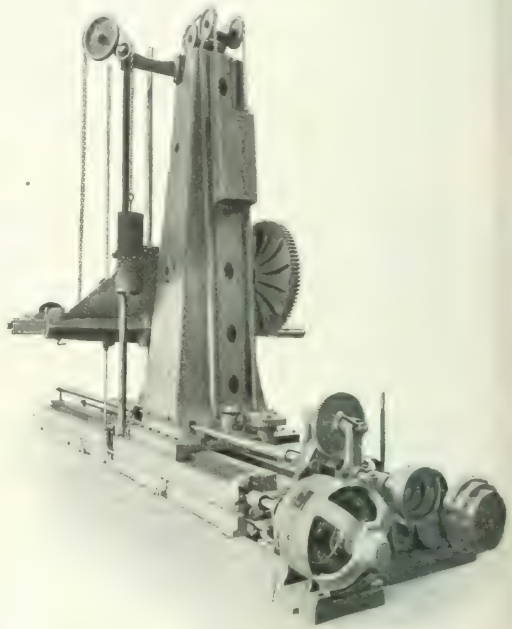
however, been the means of economizing space far beyond what is ordinarily supposed. For instance, in shipbuilding yards electrically-driven punching machines are installed in any convenient place they can be put, as the power is so readily brought to them. In machine shops they need not occupy space that may be better utilized for other



purposes, but can be set up in odd corners, the motor rendering it possible to run them anywhere.

It is when the motor has to be applied to machines requiring great variety of speeds that the problem presents a more complex aspect. Fig. 1 illustrates a 24-inch lathe built by the Niles Tool Works Company, driven by a Bullock motor. It has 10 changes of speed. The armature shaft is the lathe spindle, and the speed variation is obtained in the motor by means of the three-wire system of multiple voltage.

Fig. 2 is a Niles No. 1 radial drill, driven by a constant speed motor built by the Northern Electrical Manufacturing Company. The necessary variations in the speed are obtained by short belting used on the step pulleys, shown in the photograph. The motor is of the



vertical type, and drives a vertical shaft, the ordinary cones and back gear being preserved so that a constant speed motor can be used. Ordinarily the switch and rheostat are placed on top of the column and against the motor. In this case, however, as will be seen by reference to the illustration, the switch and rheostat are mounted on a board at the foot of the upright column.

Fig. 3 is a Niles horizontal boring, drilling and milling machine requiring 12 different spindle speeds. The motor, which is built by the Elwell-Parker Electric Company, has in this case a limited speed variation, and is geared to the cone sleeve, two sets of back gears being provided to give the machine the necessary range in speeds.

These three machines illustrate three different methods of obtaining the necessary variations in speed, the change of speed being obtained in the one case in the motor itself, in the second case by short belts acting upon cone pulleys, while in the third the speed is varied partly by the motor and partly by the gearing on the machine itself.

Rosin Solder.

A new product which has recently been placed on the market by the Kellogg Switchboard & Supply Company, of Chicago, is rosin solder. The company has for some time manufactured this material for its own use, it being used exclusively for all its telephone and switchboard work.

Among the advantages of rosin solder for telephone purposes is that there is no acid whatever used in its manufacture or any other material that would tend to corrode soldered connections. It is much cleaner, more convenient, takes up small space and is wound on spools, the same as wire, and therefore can be had in any quantities. The finished product has the appearance of spools of flattened wire, being about one-eighth of an inch in width.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in fair demand, and there was plenty of it, the closing rates being 4½ per cent for 30 days to six months. In the stock market there was a strong undertone and prices recovered with ease when subjected to bearish pressure. Speculation, however, was very narrow, specialties and stocks which had pool support furnishing most of the transactions. Amalgamated Copper was a heavy feature, its decline showing more or less uneasiness as regards the next dividend on the stock, although action in the matter has been deferred until the latter part of next month. The traction stocks were a prominent feature, Manhattan in particular distinguishing itself by an advance from 128 to 134¾, and Metropolitan and Brooklyn Rapid Transit also had rises. There was a good deal of manipulation in this group, supposed to be by a pool of prominent Chicago operators. Brooklyn Rapid Transit closed at 65, being a net gain of 1 point, on sales of 40,160 shares. Of Manhattan Elevated 133,400 shares were sold, the closing price being 134¼, a net gain of 4¼ points. Metropolitan Street Railway closed at 167½, being a net loss of ½ point. The highest price of the week was 168¾, the sales amounting to 13,700. United States Steel stocks were supported and showed strength, but did not assume prominence in the trading, notwithstanding the information which was given out on Thursday that it had been decided to issue $250,000,000 5 per cent bonds to retire $200,000,000 preferred stock and provide $50,000,000 for additional working capital. In the electrical list General Electric distinguished itself by reaching the highest point on record for that stock—307—which was also the closing price, representing a net gain of 7½ points. The transactions, however, amounted to only 4600 shares. Westinghouse was also very active and made the remarkable rise at one time of 15 points for the common, and 8¾ points for the preferred. The common stock fluctuated during the week between 181 and 199½, the closing price being 194. The first preferred, of which 300 shares were sold, varied between 190 and 199, the latter being the closing figure. It is difficult to trace the remarkable advance of this stock to any definite cause. There were rumors as to extra dividends, large earnings and probable consolidation with General Electric. Western Union Telegraph was quiet, closing with a net loss of ¼ point, the sales being 2600 shares. American Telephone & Telegraph closed at 84, being a net loss of 6 points as compared with the last quotation. Following are the closing quotations of March 18:

NEW YORK.

	Mar. 11.	Mar. 18.		Mar. 11.	Mar. 18.
American Tel. & Cable	80	80	General Electric	299½	316
American Dist. Tel	[illegible]	[illegible]	General Carriage	[illegible]	[illegible]
Brooklyn Rapid Transit	[illegible]	[illegible]	Interb. Rapid Tel	[illegible]	[illegible]
Chic. & Pot. Telephone	[illegible]	[illegible]	Manhattan Street Ry.	167	168¾
Commercial Cable	[illegible]	[illegible]	N. Y. Elec. Veh. Trans.	[illegible]	[illegible]
Electric Boat	[illegible]	[illegible]	N. Y. Elec. Veh. Trans. pfd.	[illegible]	[illegible]
Electric Boat pfd.	[illegible]	[illegible]	N. Y. & N. J. Tel.	[illegible]	[illegible]
Electric Lead Reduction	[illegible]	[illegible]	N. Y. Tel. Co. American	[illegible]	[illegible]
Electric Vehicle	[illegible]	[illegible]	Northern Union Tel.	[illegible]	[illegible]
Electric Vehicle pfd.	[illegible]	[illegible]	West. E. & M. Co.	181	194½
			West. E. & M. Co. pfd.	[illegible]	[illegible]

BOSTON.

	Mar. [illegible]	Mar. [illegible]		Mar. 11.	Mar. 18.
Am. Tel. & Tel.	[illegible]	[illegible]	Dominion Telegraph	[illegible]	[illegible]
Cumberland Telephone	—	—	New England Telephone	140	145
Edison Elec. Illum.	[illegible]	[illegible]	Pacific Tel.	[illegible]	[illegible]
Erie Telephone	[illegible]	[illegible]	Southern Tel. pfd.	[illegible]	98
General Electric pfd.	[illegible]	[illegible]			

PHILADELPHIA.

	Mar. 11.	Mar. 18.		Mar. 11.	Mar. 18.
Mercantile Railways	—	—	Phila. Traction	98	98
Electric Storage Battery	60	[illegible]	Phila. Traction Trust	[illegible]	[illegible]
Elec. Storage Batt'y pfd.	60	[illegible]	Union Traction Vehicle	—	—
Elec. Co. of America	—	[illegible]	Union Traction pfd.	[illegible]	[illegible]

CHICAGO.

	Mar. 11.	Mar. 18.		Mar. 11.	Mar. 18.
Central Union Telephone	—	—	National Carbon pfd.	84½	85
Chicago Edison	[illegible]	[illegible]	Peoples Gas	[illegible]	[illegible]
Chicago City Ry.	[illegible]	[illegible]	Union Traction	[illegible]	[illegible]
Chicago Telep. Co.	175	185	Union Traction pfd.	48½	54
National Carbon	[illegible]	[illegible]			

*Asked.

MARCONI'S WIRELESS TELEGRAPHY.—A Marconi company, with a capital of $10,000,000, will be incorporated under New Jersey laws to promote Mr. Marconi's wireless telegraphy system in the United States. Messrs. E. Rollins Morse & Bro. have charge of the financing of the new company. It is proposed to raise $750,000 through the sale of stock, of which amount $250,000 will be paid to the parent company, an English corporation, and $500,000 will go into the treasury of the New Jersey company for development purposes. Details as to the amount of stock to be sold, prices, etc., have not yet been determined upon. Papers relating to the incorporation of the company are now being drawn by Col. John J. McCook, of Alexander & Green. Mr. Marconi, who is now in Canada, estimates that $500,000 will be a sufficient amount to place the American company on a commercial basis. Nothing appears to have resulted from an earlier Marconi company planned and organized in New York some time ago by local financiers.

OPPOSITION TELEPHONY.—The following "inspired" dispatch from Boston says: The recent advance in the stock of the American Telephone & Telegraph Company is attributed to the fact that opposition in New York and the New England States has been squelched through an arrangement entered into in London last summer between President C. F. Cutler, of the New York Telephone Company, and representatives of Mr. Morse, whereby Morse bought in the interest of the Bell people a controlling interest in the stock of the Telephone, Telegraph & Cable Company of America. This was with the understanding that the Erie holdings of the Telephone Cable Company should be turned over to the Western Company, and that all work on the opposition plants in New York and New England should cease. Both of the above agreements have been carried into effect. The two exchanges in Boston and New York are simply maintained with a limited number of subscribers to hold possession of the franchises.

AMERICAN TELEPHONE & TELEGRAPH.—The following is the statement of resources and liabilities of the company Nov. 30, 1901, and of earnings and expenses from Jan. 1, 1901, to Nov. 30, 1901: Resources—Construction, $18,680,222; telephones and patents, $5,630,148; stocks and bonds, $82,614,980; real estate, $1,684,598; bills and accounts receivable, $11,460,746; cash and deposits, $3,705,265; American Bell Company, $22,110,400; total resources, $145,892,359. Liabilities.—Capital stock, $104,746,950; bonds, $15,004,500; profit and loss, $5,953,187; reserves, $2,637,935; bills and accounts payable, $1,579,577; contingent, $15,970,210; total, $145,892,359. Earnings.—Dividends, $4,890,318; rentals, $2,612,231; telephone traffic, $3,190,994; real estate, $92,059; interest, $381,005; miscellaneous, $497; total, $11,167,104. Expenses.—Operating expenses, $747,869; legal expenses, $90,693; interest and taxes, $1,134,294; telephone traffic, $1,844,197; net revenue, $7,350,051; total, $11,167,104.

BOSTON SUBURBAN.—On the Boston stock market there have recently been sharp advances in the 4 per cent preferred and common stocks of the Boston Suburban Electric companies, the former advancing 8 points to 94 and the latter to 33. These stocks have not been listed on the Boston Stock Exchange, and being somewhat closely held the market is somewhat narrow, which fact may have been a factor in the recent advance. The company has recently taken over the Waltham Gas & Electric Light Company, capitalized for $175,000 stock and $50,000 bonds, giving two shares of preferred and one-half a share of Suburban Company common stock for each share of Waltham Company stock. This plant will be used as a power station.

STORAGE BATTERY CONSOLIDATION.—The Consolidated Storage Battery Company has been incorporated with a capital of $10,000,000 by Frank H. Lord, G. T. Holmes and Oscar L. Gubelman, all of New York, under the laws of New Jersey. The capital stock is all common, par value $50 per share. The new corporation is a consolidation of the interests of the United States Battery Company, and the International Storage Battery Company, and is attracting attention in electrical circles. It is likely that details of the new company's ideas and plans will be given out next week.

WESTERN UNION'S QUARTER.—The report of the Western Union Telegraph Company for the quarter ending March 31 (partly estimated) shows a continuance of the large receipts. Net earnings increased $95,774 and the surplus $90,805. For the nine months ending March 31, there is an increase of $484,822 in net earnings and $474,880 in surplus. The total surplus on March 31 is set down as $10,348,856. The surplus for nine months amounts to $1,029,570, or over $160,000 more than for the full fiscal year ending June 30, 1901.

EMPIRE STATE TELEPHONE.—A bill has been introduced at Albany, N. Y., for the incorporation of the Empire State Telephone Company, with a capital stock of $1,000,000 and the right to increase it to $10,000,000. The bill provides giving the company a broad charter.

BRITISH WESTINGHOUSE.—Financial organs announce that the British Westinghouse Electric & Manufacturing Company has issued £500,000 4 per cent mortgage debenture stock to defray the cost of the new additions to the plant.

DIVIDENDS.—The Union Switch & Signal directors have declared the regular quarterly dividends of 2 per cent on the preferred stock and 1 per cent on the common. A dividend of 1½ per cent has been declared for the quarter on American Telephone & Telegraph. A quarterly dividend of 1 per cent has been declared by the Union Traction & Electric Company of Providence, R. I. United Traction & Electric of New Jersey directors have declared a dividend of 1 per cent, payable April 1. The directors of the Electric Storage Company have declared a quarterly dividend of 1¼ per cent on the preferred stock and a quarterly dividend of 1¼ per cent on the common stock, payable April 1. The directors of the Cumberland Telegraph & Telephone Company have declared a quarterly dividend of 1¾ per cent, payable to stockholders of record March 20. The American Stoker Company directors have declared the regular quarterly dividend of 2 per cent on the preferred stock, payable April 15. Directors of the Rochester Railway have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 1. United Gas Improvement Company directors have declared the regular quarterly dividend of 2 per cent, payable April 15. The Detroit United Railway Company has declared a quarterly dividend of 1 per cent, payable April 1.

GENERAL ELECTRIC GOSSIP.—A special dispatch from Boston remarks: The General Electric Company keeps up the record of large earnings. Earnings for the 1901 year aggregated $12,000,000, or about 40 per cent upon its capitalization, and 15 per cent upon the present selling price of the stock, $300 per share. We understand that the work for the year just beginning has been fully mapped out and that it is estimated that net earnings of fully $15,000,000 are in sight for the present fiscal year. Such net earnings would equal 37½ per cent on the company's prospective capital of $40,000,000 when it returns to stockholders this spring the shares taken from them in the reduction in the capital stock in 1898. It should not be forgotten that the General Electric Company saves about $2,000,000 this year in its copper requirements alone. It bought early in the year practically a full year's supply of copper from the Amalgamated Copper Company at 11 cents per pound, and on the basis of the consumption of 3,000,000 lbs. per month there is a saving of 6 cents per pound over the bulk of the copper it purchased from the Amalgamated Company in 1901. This saving is equal to the 8 per cent dividends the General Electric is now paying to its stockholders.

Commercial Intelligence.

THE WEEK IN TRADE.—The week closed with a very favorable aspect, particularly as to weather and industrial conditions, which are reported by the mercantile agencies to have greatly improved in various sections of the country. Sections heretofore reporting favorable conditions repeat them, while less favorably situated sections, the South and Southwest, return more cheerful advices. There was less excitement but more strength in iron and steel. A specially noteworthy indication of general prosperity is the fact that agricultural implement manufacturers bought heavily of bars, the Pittsburg sales being reported at 100,000 tons, almost all, however, at old prices. New buyers must pay the advance of $2 per ton demanded. Illustrations of the strong situation in all lines are seen in the reports that bar manufacturers are sold five months ahead; the rail mills are sold ahead for the entire season; steel and wire mills have booked orders for three months' capacity and the Valley furnaces have sold three-fourths of their entire year's product. The United States Steel Corporation's vast business is shown by the official announcement that there are now on the books of the corporation uncompleted orders for various sorts of finished products amounting to $60,000,000. This, at the selling prices, represents business aggregating $300,000,000, and assuming that the corporation received no fresh orders, those now on the books will keep its plants busy for nine months to come. The demand for building material increases as spring influences manifest themselves. Coal is still in active demand and strong in price. In railway operations, the gross earnings for the month of February showed a net gain of 3.9 per cent over a year ago, notwithstanding the adverse conditions as a result of storms, freshets, etc. The Pacific roads showed a gain of 19.2 per cent; the Northwestern lines one of 16 per cent; Southern lines 2.2 per cent, while those of the Central Western and Middle States show a gain of .9 per cent. Trunk line earnings have increased 1.3 per cent. The Southwestern lines showed a loss of 2.6 per cent. The copper market was very quiet throughout the week, although the undertone was much stronger than it has been for some time. The demand from consumers is good. Quotations are as follows: Lake, 12¼ to 12½c.; electrolytic, 12⅛ to 12¾c., and casting stock, 12 to 12¼c. According to *Bradstreet's*, the business failures for the week aggregated 224, as against 178 the week previous and 207 the same week last year.

CROCKER-WHEELER EQUIPMENT IN UNITED STATES [illegible] orders for eleven more motors to be added to its already large equipment in the new Philadelphia Mint. This brings the total number furnished to 120, besides four generators aggregating 625 kilowatts. Nearly the entire installation is of Crocker-Wheeler manufacture and the plant is most interesting in the completeness of the distribution of power by electricity. In fact, the metal is electrically treated from the time it enters the building until it leaves it. The electric current refines it, the tough ingot is topped, rolled, cut and weighed all in motor driven machines, an acid bath then leaves it ready for the coining machines, which are a unique application of a small motor driving a large fly-wheel of sufficient momentum to insure a heavy pressure at the instant of stamping. The whole plant demonstrates the extent to which electric operation may be successfully carried. An elaborate illustrated article on the subject has appeared in these pages.

THE KILBOURNE & CLARK COMPANY, of Seattle, Wash., has just completed the installation of 25 Western Electric enclosed type motors with Cutler-Hammer multiple switch starting rheostats and controllers, ranging in capacity from 5 hp to 40 hp in the shipbuilding plant of the Moran Brothers Company of that city, who were recently awarded a contract for the building of one of the new first-class battleships, the disadvantage of distance from base of supplies for construction material being overcome by the citizens of Seattle, who raised by subscription $500,000 within three days as a bonus. The motor contract was secured in the face of competition and under the most rigid specifications, but the installation has been completed and motors are now in operation, giving complete satisfaction.

WAGNER-BULLOCK CONTRACTS.—Among the contracts closed through the Wagner-Bullock Electric Company's Pacific Coast agency may be mentioned: An electric light plant for Blaine, Wash.; a 75-kw Bullock single-phase generator will be installed in the lumber mill of L. W. David; Wagner transformers, switchboard, etc., are included; a 32-kw direct-current Bullock generator, direct connected to a Union Iron Works engine to be used for light and power in the United States Naval Station, Bremerton, Wash.; electric light installation to operate 3000 lights, and a few motors in the large six-story Young Building in Honolulu, H. T. There are to be two Bullock 100-kw generators and one 40-kw generator. Each generator is direct connected to a Union Iron Works engine.

NEW POWER HOUSE FOR SAN FRANCISCO.—The Market Street Railway Company has given orders to prepare the site for the erection of its new 16,000-hp electric power station near Black Point, in San Francisco. Contracts are now being filled for a 3000-hp Babcock & Wilcox boiler plant, and a Union Iron Works engine. The General Electric Company will supply two 1250-kw engine-driven generators and three 750-kw rotary transformers, and additional machinery contracts may soon be closed for this power house. After the proposed consolidation of the Market Street with three other lines by the purchasing syndicate, much more power will be required. Several cable lines will be changed into electric lines by the new owners.

THE H. W. JOHNS-MANVILLE COMPANY has recently secured several contracts for the application of its covering, among which are the Park Realty Building, Sixty-third Street and Madison Avenue, New York, moulded sectional covering. Asbestocel sectionel covering is being used by the International Silver Company, of Meriden, Conn., and the club house, at the Jamaica race track is also being fitted. Fire felt and Asbestocel coverings are being used for insulation by the Landers Frary & Clark Company, New Britain, Conn.

AMERICAN ENGINE COMPANY, of Bound Brook, N. J., reports large sales of its American-Ball duplex compound engines, including four to Snellenburg & Company, Philadelphia, one to the American Steel & Wire Company, Cleveland, and one to the United Gas Improvement Company. Among engines of this type now being installed are three, each of 400 horse-power, for the Ansonia apartments in New York City, and another of 325 horse-power for the American Steel & Wire Company.

AUTOMATIC TELEPHONES.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has closed a contract with the Maine Insane Hospital for a 60-point Clark automatic telephone equipment.

BALL ENGINE ORDER.—The Durham Traction Company, Durham, N. C., has recently ordered a 300-hp tandem compound engine, direct connected to a General Electric generator. The Ball Engine Company, Erie, Pa., will build the engine.

ST. JOSEPH, MO., POWER PLANT.—The St. Joseph Railway [illegible] plant at a total cost of $100,000.

FEDERAL CHEMICAL COMPANY, of West Nashville, Tenn. [illegible]

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended March 5: Antwerp—5 pkgs material, $198; Argentine Republic—6 pkgs material, $302; 1874 pieces conduit pipe, $1,800. British East Indies—322 pkgs machinery, $8,328; 3 pkgs material, $79. British Possessions in Africa—163 pkgs material, $10,858; 238 pkgs machinery, $7,392. Bristol—2 pkgs machinery, $620. Brazil—404 pkgs. material, $12,197; 5 pkgs. machinery, $1,437. Bilboa—4 pkgs. material, $200. Bradford—1 pkg. material, $40; 51 pkgs. wire, $2,600. British West Indies—12 pkgs. material, $225. Chili—8 pkgs. material, $118. Cardiff—83 pkgs. wire, $1,150. Central America—25 pkgs. material, $693. Cuba—1 pkg. machinery, $200; 12 pkgs. wire, $331; 16 pkgs. material, $506; 39 pkgs. wire, $203. Dutch West Indies—2 pkgs. material, $17. Dublin—1 pkg. material, $449. Egypt—15 pkgs. machinery, $1,500. Genoa—7 pkgs. material, $202. Glasgow—10 pkgs. material, $700; 34 pkgs. machinery, $2,500. Gainsborough—1 pkg. motors, $175. Hull—1 pkg. machinery, $45. Hamburg—12 pkgs. machinery, $1,870; 45 pkgs. material, $2,874. Huddersfield—10 pkgs. wire, $3,300. Leghorn—1 pkg. material, $400. Liverpool—198 pkgs. machinery, $7,556; 46 pkgs. material, $1,639; 535 pkgs. copper material, $28,440; 35 pkgs. wire, $3,683. London—109 pkgs. machinery, $3,947; 66 pkgs. material, $4,132. Mexico—613 pkgs. material, $3,411; 69 pkgs. machinery, $10,530. Naples—12 pkgs. material, $91. Nordkoping—1 pkg. material, $15. Newcastle—1 pkg. material, $250. Nuremburg—1 pkg. material, $15. Philippines—25 pkg. machinery, $1,445. Stockholm—5 pkgs. material, $90. Southport—20 pkgs. machinery, $2,870. Uruguay—7 pkgs. material, $240. Venezuela—35 pkgs. material, $739.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Chicago, has recently completed arrangements for increasing its capital stock and consequently its facilities. This company, although enjoying a wonderful growth the past five years, has not been able to keep up with the demands of the trade for apparatus, and the increase in capital stock simply means that the facilities can be increased more rapidly to take care of the business offered. There will be no change in management. To those familiar with the company's rapid growth and the immense factory it recently purchased it will be a surprise to learn that this tremendous business amounting to over $300,000 a month, has been carried on with the original capital stock of $50,000. The amount of new stock issued will exceed $2,000,000, and will depend on the earnings. The opportunities for an increase of manufacturing facilities which this increase of capital offers gives the company a very strong position in the field. Eugene H. Satterlee and Thomas W. Finucane, Rochester, N. Y., capitalists, are to take a large amount of the new stock. These gentlemen are stockholders in the independent exchange at Rochester and in extending their operations in the construction of independent exchanges will now have control also of a source of supply.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has within the last few weeks closed the following contracts for storage batteries to be used for trolley regulation: The Altoona & Logan Valley Railway, Altoona, Pa.; Allegheny County Light Company, Pittsburg, Pa.; Pittsburg Railway, Pittsburg, Pa.; Sandusky, Monroeville, Bellevue & Norwalk Traction Company (two batteries), Sandusky, Ohio; Parkersburg & Interurban Railway, Parkersburg, W. Va.; United Electric Company, Newark, N. J.; Pueblo Traction & Lighting Company, Pueblo, Col.; Boston & Maine Railroad, Concord, N. H.; Camden Inter-State Railway (two batteries), Huntingdon, W. Va.; Seattle Electric Company, Seattle, Wash.; Seattle & Tacoma Interurban Railway (three batteries), Seattle, Wash.

THE BUFFALO FORGE COMPANY, of Buffalo, N. Y., with New York office at 41 Cortlandt Street, is not complaining for lack of business. It is supplying the American Smelting & Refining Company, at Maurer, N. J., with a heating and ventilating plant, and is also putting a small heating plant in Siegel & Cooper's store, Eighteenth Street and Sixth Avenue, and a drying plant in Abendroth & Root Manufacturing Company, at Newburg, N. Y., is to be used for drying galvanized iron pipe and sheet, as it is taken out of its acid bath. Heretofore the method for drying has been by using direct steam, whereas, through the substitution of this system, the time has been reduced one-fourth of that formerly used. Another advantage is the saving of space occupied by the drying plant.

VAST WATER-POWER PROJECT.—Final surveys have been completed in connection with a vast water-power project, which is to be carried out with a view to furnishing the city of Duluth, Minn., and vicinity, with cheap power for light, traction and manufacturing purposes. The enterprise is to be operated by the Highland Canal & Power Company, of which Mr. C. C. Cokefair is the president. The chief engineer of the company is Mr. F. A. Cokefair, his son. The water is to be brought from the Rice Lake district. A lake three miles long will be dug and the water will be carried to a hilltop 775 feet in height in the immediate vicinity of Duluth. In the first instance it is proposed to erect a plant having a capacity of 30,000 horse-power.

THE GREEN ENGINEERING COMPANY, Chicago, reports a great number of sales so far this year of its traveling link chain grates, among the orders taken being: American Tin Plate Company, 6000-hp; Union Steel Company, 6000-hp; American Steel Foundry Company, St. Louis; Crane Company, Chicago; Armour & Company, Kansas City; Armour & Company, East St. Louis; Armour & Company, Chicago; Cudahy Packing Company, South Omaha, repeating order; Danville, Ill., Street Railway & Light Company, repeating order; Ballard & Ballard Company, Louisville; Emery, Bird, Thayer Company, Kansas City; Cleveland Worsted Mills; Norwood Water Works.

JOLIET WATER POWER.—A special dispatch from Chicago of March 15 says: The first of the contracts for the completion of the water power plant of the Economy Light & Power Company of Joliet have been let. The total cost of the additional improvements will be about $200,000. Twelve water wheels of nearly 400 horsepower each will be installed. Five hundred horse-power will be used to operate the Bridgeport pumping works, and 2000 horse-power is leased to the Edison company here to be used in lighting the city. The demand for water power makes it probable dams may be constructed at two other points in Joliet for water from the drainage canal.

BROWN HOISTING MACHINERY FOR AUSTRALIA.—The Brown Hoisting Machinery Company, of Cleveland, Ohio, whose New York offices are in charge of Mr. Bert Stadelman, at 26 Cortlandt Street, is about to make shipment to the Queensland Government Railways of a 10-ton traveling crane equipment, which will be used for handling coal at the Brisbane docks. The equipment will be operated by a 125-hp Elwell-Parker motor. The contract was secured through the export commission house of Henry W. Peabody & Company, whose New York offices are in the Chesebrough Building, State Street.

ELECTRICITY BUILDING AT ST LOUIS FAIR.—The contract for the electricity building of the World's Fair was let to Wm. Goldie & Sons Company, of Chicago, who undertake the job for $399,940, a sum just $60 less than that of the estimate of the architects who planned the building. The dimensions of the building are 525x600 feet. The specifications provide that a section of the wall of the building shall be left open to admit the passage of railroad cars bearing machinery to be installed. A feature of the building will be a series of exterior galleries.

EQUIPMENT FOR EASTON, PA., PLANT.—The Consumers' Electric Light & Power Company, of Easton, Pa., has just let a contract to the Harrisburg Foundry & Machine Works, of Harrisburg, Pa., Mail & Express Building, New York, for a 450-hp engine, to be direct connected to two generators of 150 kilowatts, to be built by the Northern Electric Manufacturing Company. The contract also calls for a 150-hp Harrisburg engine, to be direct connected to two 50-kw generators each, also of Northern Electric build. The latter engine is intended to be utilized for the driving the day load.

LARGE INDUCTION MOTORS.—The Westinghouse Electric & Manufacturing Company recently closed a contract through its San Francisco agency for two 800-hp, induction motors. They will be installed in the new works which the Standard Portland Cement Company is building at Napa Junction, Calif. A motor of the same size and type was used in operating the movable sidewalk at the Paris Exposition. There are no motors at present on the Pacific Coast that approach these in large capacity.

LARGE COAL HANDLING PLANT FOR INDIA.—The Link-Belt Machinery Company, of Chicago, Ill., is reported to be figuring on an important contract for the building of a large coal handling plant, etc., at the Calcutta docks, British India. Two of the company's engineering experts are now in India in regard to the matter. It is reported that the execution of the contract will entail the construction of warehouses, etc., which will mean the employment of over 2000 tons of structural steel.

BULLOCK APPARATUS FOR BRITISH NAVAL BARRACKS.—The new British naval barracks at Portsmouth, it is reported, are to be equipped with electric lighting machinery, manufactured by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. The contract for the complete electric lighting and other electrical work was awarded to Bergtheil & Young, of Camomile Street, London, E. C., which concern represents the British interests of the Bullock Company.

THE C. W. HUNT COMPANY, of West New Brighton, Staten Island, New York, has recently received an order from the United Railways & Electric Company, Baltimore, Md., for a set of electric hoisting machinery. This is a repeat order.

NEW FACTORY BUILDING.—The Johnson Electric Service Company, Milwaukee, Wis., expects to build a new factory building in the near future. The present quarters are already too small.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Lewiston & Grass Range Telephone Company will construct a telephone line from Lewiston, Idaho, to Grass Range. The company was incorporated recently by James H. Charters, A. W. Warr and [illegible] with a capital stock of $[illegible].

SAN FRANCISCO, CALIF.—The West Gallatin Telephone Company, which [illegible] C. Nelson, J. M. Robinson, W. C. Nesbit, and E. B. Martin, will construct a telephone line from Bozeman, Mont., to West Gallatin. The company's capitalization is $10,000.

DENVER, COLO.—The new Telluride exchange of the Colorado Telephone Company has reached the 200-mark, and the list is growing every day.

DENVER, COLO.—Three additional telephone wires are now being strung from Denver northward. They will run parallel as far as Louisville Junction. One will then be run to Boulder, one to Lafayette and one to Longmont.

COLORADO SPRINGS, COLO.—Improvements which the Colorado Telephone Company has authorized in Colorado Springs will cost about $50,000. Manager Morris has ordered the necessary material and work will begin at once. The underground lines of the city are to be extended and aerial cables will be strung over a large portion of the city. A new switchboard will be added to the local exchange and two additional ones for the toll service. Improvements are to be made all over the State by the company and a number of towns not in communication with Colorado Springs now will be added to the service.

DENVER, COLO.—A large portion of the $1,000,000 recently appropriated by the Colorado Telephone Company for improvements is being spent in the Glenwood district. This exchange has now 96 telephones connected and the exchange will probably have to be enlarged to accommodate 200 more during the year. There are 70 miles of circuit outside of the town limits connected with the exchange, showing that the farmers are beginning to appreciate the conveniences of the instrument. The line to Sunshine has been completed, as well as that to Spring Gulch. One improvement that will open up a new district is the line which is to be built through the Grand Canyon, affording connection with the Eagle River valley. At Rifle an exchange with 24 subscribers is being put in. There will be four circuits leading out from Rifle. One up Rifle Creek, one leading to Beaver Creek, one to Antlers and one to Parachute. These are all under course of construction.

HAVANA, CUBA.—Governor General Wood, of Cuba, has issued an order making liable to a fine of not less than $100 nor more than $500 any person, company or corporation installing a telegraph or telephone line or other public or private enterprise without proper authorization of law. The order places such person or company liable to additional fine of $25 for each day the enterprise is continued in operation after due notice for its discontinuance has been served.

CARROLLTON, GA.—The local telephone exchange of this city operated separately from the exchange of the long distance office, managed by the Gainesboro Telephone Company, is considering with the Gainesboro Telephone Company a proposition to consolidate their exchanges in this city.

BLACKFOOT, IDAHO. The Rocky Mountain Bell Telephone Company will extend its line from Blackfoot to Mackay, Challis, Bayhorse, Clayton and Custer, thence over the Jordan Creek trail to the waters of the Middle Fork of Salmon River, where it is to connect with the line coming in from Boise, and then extend to Thunder Mountain and Roosevelt.

ROCKFORD, ILL.—The Ogle County Telephone Company is putting in an exchange at Forreston.

CARBONDALE, ILL.—Owing to the taking in by the telephone trust of the lines of Southern Illinois, a meeting was held recently at Benton at which a complete reorganization was effected, to go into effect April 1. The officers of the association are as follows: President, F. H. Stamper, of Benton; secretary, F. W. Willard, of Anna.

HENRY, ILL.—A franchise was granted by the Board of Supervisors of Bureau County to the Milo & Bradford Telephone Company, for the construction of a telephone line on the public highways between the two towns, or so much of the route as lies in Bureau County. The Henry Telephone Company was also granted a right of way on Bureau County highways for the extension of its service to such points in that county as is desired.

OAKLANDON, IND.—The Stansbury Mutual Telephone Company, capital $1,000, has been incorporated by H. C. Fred, O. D. Kleppfer and George W. Apple.

INDIANAPOLIS, IND.—The Centerville Co-operative Telephone Company has incorporated with a capital stock of $5,000, and Hardin H. Pielle, Thomas C. Dunbar, Andrew Kramer, Caleb B. Jackson, Jr., and George McConaba as directors.

FT. WAYNE, IND. The Electrical Investment Company, of this city, has let the contract for the underground work for the Independent telephone plant at South Bend to the J. F. Butterfield Company, of Chicago, at $19,500, this being the lowest of six bids. The contract for the equipments will be let soon.

PORTLAND, IND.—The City Council has granted a franchise to the Home Telephone Company, an incorporation recently organized and composed entirely of local business and professional men. The company proposes to install an exchange, also toll lines and promises to make the service cost about one-half what it does now.

NEW CASTLE, IND.—Henry County is one of the best telephone counties in Indiana. Here are located over 3000 of the 56,000 telephones in the State. In this city there are about 300 telephones in use, with several hundred connected [illegible] The Cadiz company connects with over 1600 telephones and the rest are divided up among the other towns and parts of the county.

INDIANAPOLIS, IND.—In a recent interview President Sherin, of the New Telephone Company, stated that business all over the State was on the jump, and that the company had difficulty in keeping up with the demand for service. "Everybody is using the telephone," he said. "The instrument is being used for every purpose now; little tots three and four years old lisp over the telephone; invitations are given, church matters attended to, orders are given for household necessities, and people visit over the telephone."

FRANKLIN, IND.—There is much activity in Johnson County in the telephone business. Independent companies have been organized in the last month at Whiteland, Greenwood and Morgantown, and they are building lines into the country that the farmers may have the service. The organization of a company at Trafalgar is talked of. Lines from Franklin now reach almost every hamlet in the county, and the fever is spreading among the farmers. Nearly all the lines are operated by home people. There are 1000 telephones in the county, and the number is increasing as rapidly as the companies can fill the orders.

DES MOINES, IA.—The Tri-City Telephone Company has increased its [illegible] tal to $135,000.

GRINNELL, IA.—The Interior Telephone Company, capital, $35,000, has been incorporated by J. P. Lyman and others.

PERRY, IA.—The Hawkeye Telephone Company, of Perry, has bought the local exchange of the Indianola Mutual Telephone Company, and will make improvements to it and other parts of the system.

ELDORA, IA.—The Eldora Mutual Telephone Company has just been organized here with a capital stock of $10,000. Its principal place of business will be at Eldora and it will conduct a telephone business in Hardin and adjoining counties. The officers of the company are L. J. Spurgin, president; A. S. Howell, vice-president; Herbert A. Huff, secretary; Ellis D. Robb, treasurer, and J. D. Newcomer, Ed. R. Davis and Thomas Larson, directors. The company has applied for a franchise which will be voted upon at the city election, Monday, March 31, 1902. The new company has over 100 telephones pledged and has made arrangements to connect with over 200 farmers' telephones in the county.

PADUCAH, KY.—Mayor D. A. Yeiser sold a telephone franchise for an independent system, and it was bought by J. L. Dunne, of Wilkesbarre.

LOUISVILLE, KY.—A special dispatch states that a war of rates has been begun between the Cumberland and Home telephone companies. The Home Company is a new independent company which has had a fine plant built by a construction company in Cleveland, and will begin operating next month. It claims to have secured 5,000 subscribers. The Cumberland is the Bell Company and is under vigorous management and has about 8,000 subscribers. It is preparing to cut prices. Telephone rates will be low in Louisville from now on.

LAKE PROVIDENCE, LA.—The Cumberland Telephone Company will build a telephone line from Lake Providence to Floyd, La., and another from Lake Providence to Tallulah, La.

MONROE, LA.—A fight is on between the Home and Cumberland telephone companies. The city has already revoked the franchise of the Great Southern Telephone Company, which was purchased by the Cumberland, on the ground of non-compliance with its provisions. Legal proceedings may ensue.

MONROE, LA.—The Monroe Telephone Company has held a meeting to consider a proposition to sell its plant to the Cumberland Telephone Company, and a board of liquidators was appointed. It is further said that A. A. Forsythe has endeavored to form a company to purchase the plant and keep the Cumberland company from securing the exchange.

DETROIT, MICH.—The Common Council has granted the Co-operative Telephone Company, organized in opposition to the Bell Company, a franchise to do business, establishing the maximum rate at $24 for residence and $48 for business telephones. The ordinance contains a provision that the company must sell its plant to the city when the city obtains the right to operate a municipal telephone exchange.

DULUTH, MINN.—The exchange of the Zenith Telephone Company was destroyed by fire on March 7. The damage was $20,000 and the company carried $17,000 insurance.

MINNEAPOLIS, MINN.—The Twin City Telephone Company, St. Paul and Minneapolis, has met the Bell rate to Superior and Duluth, and its rates will now be 40 cents for the first three minutes and 10 cents for each additional minute. Night rates, 25 cents for the first three minutes and 5 cents for each additional minute. The Bell Company reduced its rates on March 1.

CLEVELAND, MISS.—The Bolivar Telephone Company has organized with a capital stock of $10,000. Fred Clark is president.

JEFFERSON CITY, MO.—The Lewis County Telephone Company has filed a statement of increase of capital stock from $1,800 to $7,500.

BRAYMER, MO. The Regal Telephone Company, of Braymer, with a capital stock of $1,375, has been incorporated. The incorporators are H. N. Bunche, C. M. Burnett, Daniel Braymer and others.

NEVADA, MO.—Theo. Cary, president of the Macon Telephone Company, has purchased the Nevada exchange, and is organizing a strong company, which will include a number of the leading citizens as stockholders; $10,000 will be [illegible] that it will cover Vernon County.

ST. JOSEPH, MO.—The Missouri River Telephone Association, comprising owners of independent lines, met here recently, executed agreements and tariffs for the present year, and agreed on joint construction of considerable work. Thirty members were present. Officers were elected as follows: H. E. Ralston, [illegible] City, secretary and treasurer.

JACKSON, MONT.—Bids are being received by the trustees of the Dillon & [illegible]

OMAHA, NEB.—[illegible] articles of incorporation. The capital stock [illegible] must be paid in before the company begins business. It is proposed to construct and operate a complete suburban telephone system, covering the greater part of the rural precincts of the county. The incorporators are Mons Johnson, George Cowles, A. E. Dodson, L. B. Byars, S. H. Howard, J. G. Seefus and I. N. Esmay.

YORK, NEB.—Representatives of the York County independent telephone companies met for the purpose of either consolidating into one large company or to entertain the proposition from the Plattsmouth Telephone Company. A majority of the delegates favored consolidating all the independent companies of York County, and a motion was passed to this effect. The meeting then decided to organize a company known as the York Independent Telephone Company, with headquarters at York, and to be entirely independent of the Plattsmouth company, except that the Plattsmouth company will run in the York office its copper toll line, which now reaches 20 counties in Southeastern Nebraska.

ELIZABETH, N. J.—The Interstate Telephone Company has paid into the hands of John W. Whalen the price of 293 shares of the old Elizabeth Mutual Telephone Company, being the full amount of shares, less seven, at 30 cents premium on the dollar. It is announced that an extra dividend of 25 per cent will be declared to the stockholders, and the new company will assume control of the Elizabeth Mutual Company.

GENESEO, N. Y.—A local telephone company has been organized in Geneseo and expects to start business with 300 subscribers.

ALBANY, N. Y.—The Eastern New York Telephone & Telegraph Company, capital $50,000, has been incorporated. Directors: Watson M. Holmes, Ralph D. Smith, and Levi E. Worden, Hoosick Falls.

CONCORD, N. C.—The town has amended the Bell Telephone franchise, permitting the company to put in a long distance service but not a local exchange. The Bell has been trying to enter the town for some time.

MAYVILLE, N. D.—The Burgesses of Anetz, it is said, will soon extend their telephone line to Hatton and take in farmers between the two towns.

PEMBINA, N. D.—The long-distance telephone company is preparing to extend its lines from Crookston north to St. Vincent. Grand Forks will also be connected with Drayton and Devil's Lake.

ASHLAND, OHIO.—The Star Telephone Company will build new lines from Ashland to Redhaw and a small exchange will be installed in the latter place.

MARYSVILLE, OHIO.—The Marysville Telephone Company is preparing to establish a farmers' community system centering in the village of York.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has leased a portion of the Frechtling building for an exchange. Work will start at once on the system.

ALLIANCE, OHIO.—The Eastern Ohio Telephone Company is preparing to build a line to Minerva to connect with the Stark County Telephone Company's line to that place.

DAMASCUS, OHIO.—The Damascus Telephone Company has been incorporated with $10,000 capital stock to operate telephone lines in Columbiana, Mahoning, Stark and Portage counties.

SANDUSKY, OHIO.—Sidney Kilbourne, secretary of the Sandusky Telephone Company has been succeeded by John C. Hauser. J. A. Giedeman succeeds the latter as treasurer of the company.

NORTH GEORGETOWN, OHIO.—The North Georgetown Telephone Company has been incorporated, with $5,000 capital stock, by W. J. Kelly, J. M. Earnst, E. G. Saffell, E. E. Summers, Ed. Reichenboch, and others.

PERRY, OHIO.—President DeVoe, of the Madison Telephone Company, is preparing plans to thoroughly rebuild the system in Perry. The company has installed a new switchboard at Madison and improvements will be made in Geneva.

FINDLAY, OHIO.—It is stated that eastern people are desirous of securing the 60 per cent interest held in the Findlay Home Telephone Company by the Federal Telephone Company of Cleveland, whose affairs are now in charge of a bankers' committee.

DEFIANCE, OHIO.—The Central Union Telephone Company will overhaul its local system. The present party lines will be replaced with selective signal instruments, full copper circuits, and the Blake transmitters will be replaced with long distance instruments.

PROSPECT, OHIO.—The Prospect Telephone Company, of Prospect, has incorporated, with $30,000 capital stock. W. M. Heseltine is at the head of the project. The company will operate systems in Prospect and Radnor and build lines connecting Delaware, Richwood and Marion.

TOLEDO, OHIO.—The Empire Construction Company of Toledo has secured a franchise for an independent system in Los Angeles, Cal. The franchise is for 50 years and it is said that 1,500 subscribers have already been secured in the face of strenuous opposition from the Bell Company.

NAPOLEON, OHIO.—The village Council has practically refused to grant the application of the Central Union Telephone Company for a franchise because it is claimed the erection of additional poles and wires would endanger buildings in case of fire. The company has applied to the Probate Court and will endeavor to force a franchise.

GLOUSTER, OHIO.—John J. Gordon and Walter Ross, president and general manager, respectively, of the Union Telephone Company, operating in Nelsonville, Murray City and Glouster, have sold their interests in the company to David Edwards and Dr. B. W. Pickering. New officers were elected as follows: G. W. Rose, president; D. Edwards, secretary-treasurer; A. B. Allen, general manager.

BELLEFONTAINE, OHIO.—The United Telephone Company, of this city, recently incorporated with a capital stock of $25,000, which controls nearly all the independent lines in this portion of the State, has announced the adoption [illegible]

aries are $50 or less are to be conidered to the extent of that salary, so far as dividends are concerned, the same as stockholders.

OTTAWA, OHIO.—A committee of citizens have visited Chicago and inspected the plant and plans of the Columbia Telephone Company which proposes to locate here, and have reported favorably on the proposition. The preferred stock of the proposed new company has all been subscribed and it is announced that the factory is certain to be located in Ottawa. Proposals for a site have been asked for and a permanent organization will be effected within a few days.

CLEVELAND, OHIO.—Stockholders of the Federal Telephone Company met at Trenton, N. J., a few days ago and by a vote of 75 per cent of the stock indorsed the collateral trust plan, as recently outlined. Also a plan to sell the entire assets of the company in an entirety if a sufficiently good offer is made. Now that the stockholders have taken this action, vigorous efforts will be made at once to sell the $6,500,000 worth of bonds to be issued under the collateral trust plan. It is the intention of the bankers' committee to proceed if possible under this plan, rather than to sell the assets of the company. The members of the committee have great faith in the plan, and in the future of the Federal properties, and they do not wish to see the control of the company pass out of Cleveland.

CLEVELAND, OHIO. The bankers' committee in charge of the Everett-Moore affairs has closed a deal with President Lanman and leading Columbus stockholders of the Columbus Citizens Telephone Company, to sell enough of the stock of the company held by the Federal Telephone Company to give the Columbus people the controlling interest in this exchange. In return the Columbus people agree to extend the business by putting in an additional switchboard at a cost of $300,000, and to give the syndicate an option upon the shares they buy, so that the Federal company, if offered an opportunity to dispose of the telephone interests in their entirety, may be able to sell. The Columbus company has 5500 telephones in operation and orders for 1000 more. It is claimed that by the time another switchboard is installed, there will be orders for 3000 or 4000 more telephones. Under these conditions the Columbus stockholders were exceedingly anxious to secure control in order that the improvements might be made at once. Chairman Newcomb, of the bankers' committee, states that similar arrangements are being made with stockholders of the Jackson, Mich., Telephone Company, as immediate extensions for this plant are desirable. This deal will be closed up at once. It is the intention of the committee to sell the uncompleted plants of the People's Telephone Company, Detroit, and the Dayton Home Telephone Company, Dayton, as it would require $1,500,000 to complete the Detroit plant and $600,000 to place the Dayton plant in operation. Negotiations for the sale of these properties will probably be closed in the near future.

CARWILE, OKLA.—The Farmers' and Business Men's Telephone Company has been incorporated by J. H. Madaris, O. A. Brewer, Guy T. Johnson, J. B. Van Dyne and C. M. Brewer. Capital, $10,000.

PORTLAND, ORE.—The Pacific States Telephone & Telegraph Company has been granted a 25 years' franchise by the city authorities of Portland. It operates the same system that was formerly known as the Sunset Telephone & Telegraph Company.

PORTLAND, ORE.—It is said that a strong combination of telephone systems is being formed in the Pacific Northwest with lines radiating from Portland. As far as the Pacific Northwest is concerned the combination as at present formed includes telephone companies in Portland, Seattle, The Dalles, Forest Grove and McMinnville. Lines, it is announced, will be run into every town in Oregon and Washington, and probaby parts of Idaho and Montana. The company controlling most of the companies named is the Northwestern Telephone Company, of Youngstown and Warren, Ohio.

NEWTOWN, PA.—The Standard Telephone Company has been granted a franchise covering a number of streets in Langhorne and an extension of 90 days in its franchise for Sellersville, which provided that the system there should be completed by March 11.

MONTREAL, QUE.—The management of the Windsor Hotel in Montreal has decided to install four hundred telephones in the rooms of the hotel, which, in addition to being connected with the hotel office, will be connected with the city and long distance telephone lines.

COLUMBIA, S. C.—The South Carolina Telephone Company is preparing to rebuild the lines in the Pee Dee section and make improvements in all exchanges. A large part of the material has been ordered.

HUDSON, S. D.—A franchise has been granted to the Hudson Telephone Company, which is composed of local business men.

MANCHESTER, TENN.—The Cumberland Telephone Company has purchased the Dixie line between this place and Tracy City, including the entire system in Warren, Grundy and Coffee counties.

DALLAS, TEX.—The National Telegraph Company, of Dallas, with a capital stock of $10,000, has been incorporated by G. C. Felton, J. L. Newton and J. J. Stephens.

TEXARKANA, TEX.—The Frerman Telephone Company, operating about 500 miles of lines and touching 36 towns in Arkansas, was on March 3 absorbed by the A. I. Kiger Telephone Company.

HOUSTON, TEX.—The telephone exchange of the Houston & Texas Central Railroad has been equipped with a new switchboard of the latest pattern and new telephones have been installed in the principal offices, some twenty in all.

SALT LAKE CITY, UTAH.—The City Council has granted a franchise to the Utah Home Telephone Company. The new company will have $500,000 capital, and will be backed by Eastern capital.

MORGANTOWN, W. VA.—The Merchants' Protective Association, composed of prominent business men, has ordered its secretary to notify the Bell Telephone Company to remove all telephones in the offices of merchants. The action was taken because of the refusal of the company to make the concessions asked for by the association.

TOMAH, WIS.—Tomah Electric & Telephone Company, capital, $25,000, has been incorporated by Charles W. Croty, William B. Naylor, Jr., Edward E. Schwerer.

MILWAUKEE, WIS.—Another attempt is being made to secure the passage of the ordinance granting a franchise to the Great Western Telephone Company to do business in Milwaukee.

CHEYENNE, WYO.—The Rocky Mountain Bell Telephone Company is preparing to erect its line across Wyoming from south to north, as was the announced intention last fall. The gap to be bridged extends from Lander to Basin City.

ELECTRIC LIGHT AND POWER.

SELMA, ALA.—The Selma Light & Power Company, of this city, has been purchased from its owners in this city by a party of Virginia and Pennsylvania capitalists. The company will be reorganized and the officers for the coming year will be elected.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company, which is now operating the longest electric power transmission in the world—from the Colgate Station to Stockton, Calif., 220 miles—recently completed the installing of the last 2000-kw generator. It is a Stanley machine, direct connected to a Risdon Iron Works impulse wheel.

SAN FRANCISCO, CALIF.—It is reported that the Quartette Mining Company will install several current wheels in the Colorado River near Quartette, Ariz. The wheels to be experimented with were invented by J. A. Walker, who expects them to drive the company's electric power plant and transmit electricity 18 miles to operate its mines and mills.

SAN FRANCISCO, CALIF.—The Mount Whitney Power Company, which has a 3,000-horse-power electric transmission plant on the middle fork of the Kaweah River, 27 miles from Visalia, will extend its power lines to Dinuba, Tulare County. Electric pumping for irrigation purposes is carried on extensively in the districts traversed by the company's lines.

SAN FRANCISCO, CALIF.—Mr. Frank M. Stone, of this city, and Colonel W. H. Dow, representing a New York syndicate, it is stated, have formed a company to utilize the waters of the Snake River at Shoshone Falls. A plant of 20,000 hp capacity will be installed, and the electric energy will be utilized largely in irrigation work and the operation of electric street railways. There is a drop of 215 ft. at these falls.

SALINAS, CALIF.—The Salinas Water, Light & Power Company has taken over the electric and water works plants of the Salinas Light & Water Company, located in Salinas. The new company, which was incorporated by residents of Los Angeles, has filed a deed of trust to the Title Insurance & Trust Company, of that city, for $150,000. The officers of the Water, Light & Power Company are: O. Z. Hubbell, president; F. J. Whiffen, treasurer; R. C. P. Smith, secretary; J. M. Gardiner, vice-president and manager.

SAN FRANCISCO, CALIF.—The electric transmission lines taking power from the Standard Electric Company's generating station at Electra, Alpine County, Calif., will be extended from Campbells to Los Gatos and Gilroy. It is possible that another extension will be constructed to Salinas, Hollister, Monterey and Santa Cruz. Milpitas and Berryessa have been connected with the main transmission lines by a branch from a point near Warm Springs. The Electric Improvement Company, of San Jose, attends to the distribution of a large part of the Standard Electric Company's power in these localities. The Consolidated Light and Power Company also distributes a part of the electric power in the counties south of San Francisco.

ATLANTA, GA.—The Atlanta Water & Electric Company, capital $500,000, has applied for a charter for electric and water power. S. Morgan Smith is interested.

NEW ORLEANS, LA.—The Council has adopted a municipal lighting ordinance and abandoned the ten-year plan of acquiring a plant. The decision of the Supreme Court is said to be accountable for this action. Legal entanglements, it seems, are involved in the case.

EVART, MICH.—An election will be held in the near future to decide on the proposition of expending $4,500 in enlarging the local lighting plant. The plant has been profitable and the proposition is being favorably received.

MINNEAPOLIS, MINN.—The St. Paul Gas & Electric Light Company has recently ordered two 650-hp Westinghouse gas engines, which are to be installed in the company's St. Paul power-house.

NEW ULM, MINN.—The city will advertise for the sale of the bonds voted for the new electric light plant, and also for bids for the erection of the necessary buildings. The plant will cost in the neighborhood of $50,000.

BILOXI, MISS.—The Biloxi Electric Light Company has decided to enlarge [illegible] light [illegible]

VALLEY PARK, MO.—A syndicate of Pittsburg capitalists has purchased Valley Park, Mo., and will establish a model town, with electric lighting, etc., in charge of D. J. Murnane, Robert Naysmith and W. W. Darley, of Pittsburg.

HELENA, MONT.—After a number of delays Butte electrical power from the Missouri River dam near here is now being transmitted to Great Copper Camp, Where Never Sweat, St. Lawrence, Anaconda and other mines. The Amalgamated Company is lighting and hoisting at plants furnished with motive [illegible] steam. For the purpose of transmitting electricity to Butte a double-pole line was constructed which carries six wires. These wires contain more than 1,000,000 lbs. of copper. Eight thousand horse-power is thus transmitted for a distance of 65 miles. The pole line crosses the main range of the Rocky Mountains. Extensive experiments were made which proved beyond doubt the feasibility of [illegible]

JERSEY CITY, N. J.—The Western Lighting Company has been incorporated here. Capital, $500,000. Incorporators: W. M. Greene, Nelson R. Vanderhoof, Charles N. King.

JERSEY CITY, N. J.—The Cincinnati, Newport & Covington Light & Traction Company has been incorporated here. Capital, $10,000,000. Incorporators: E. T. McLaughlin, Jersey City; Henry W. Clark, James C. Converse, New York City.

SMITHFIELD, N. C.—The Town Council is considering the question of submitting a bond issue to the people for electric lights.

WASHINGTON, N. C.—The Washington Light & Water Company has been incorporated at Washington, with a capital of $20,000, with the privilege of increasing to $200,000. Geo. T. Leach, of Washington, N. C., and Pennsylvania capitalists are interested.

GOLD HILL, N. C.—The Whitney Reduction Company is rapidly pushing the work of harnessing the narrows of the Yadkin River. The company will have a private telephone line and will build a railway about seven miles long from the Narrows to New London, N. C.

HALIFAX, N. S.—The directors of the Halifax Electric Tramway Company propose to issue 1,000 shares of new common stock to pay for improvements in the company's lighting plant in order to bring that portion of its business to an up-to-date condition, as the company will give the city of Halifax a new system of street lighting, for which the company has a five years' contract.

NEW YORK, N. Y.—It is stated that a syndicate of American capitalists has been formed for the purpose of manufacturing electricity in the Philippines on a large scale. If conditions warrant it millions of dollars will be invested in electric light and power plants, traction lines, etc., in the new Eastern possession of the United States. Preliminary steps have been taken in this direction by the organization of the Manila Electric Company with a capital stock of $125,000. The capital will be largely increased, however, if the projectors see their way clear to carry out their plans.

CANTON, OHIO.—After a long controversy, the council has granted a franchise to the Central Heat & Power Company. The ordinance provides that the maximum rates shall be not more than 13 cents per kilowatt hour. The grant is for 25 years.

DAYTON, OHIO.—E. J. Barney and others have completed plans for the erection of a large market house, office building and arcade. Contracts for structural work have been placed with the Brown-Ketcham Company, of Indianapolis. The power plant includes electric lighting and machinery for six electric elevators.

COLUMBUS, OHIO.—The circuit court has sustained the lower court in dissolving the temporary injunction restraining the city of Columbus from constructing and maintaining its own lighting plant. J. P. Lind brought the action to enjoin the city, claiming that notice had not been properly published, and the voters had not been given the proper authority to vote on the proposition.

COLUMBUS, OHIO.—A meeting of the stockholders of the Columbus Electric Company has been called for March 25 to ratify or reject a contract entered into between the directors of the company named and the Columbus Edison Electric Light Company, favoring the consolidation of the properties. If the measure goes through the company will be known as the Columbus Edison Company. The capital stock will be $1,000,000, of which $550,000 will be preferred stock.

ABBEVILLE, S. C.—W. M. Thompson, of Anderson, S. C., has purchased the stock of the Electric Light & Power Company of Abbeville, and it is said that he will rebuild the power plant and machinery recently destroyed by fire.

CENTERVILLE, TENN.—The new electric light plant was put in operation recently and for the first time in the history of the town electric lights were used.

NASHVILLE, TENN.—A charter has been granted to the Holston Water & Electric Power Company in Sullivan County. James Gamon, E. K. Crymbie, W. T. Neely and others are interested.

NASHVILLE, TENN.—A 600-hp engine has been received for the municipal lighting plant and when the new plant is put into operation Nashville, it is said will be one of the best lighted cities in the United States.

NASHVILLE, TENN.—Application has been made to the Council for franchise for the Great Falls Power Company. The company was given a franchise a year ago, but not having completed its plant a new franchise had to be sought. The company is to have power for distribution by January, 1901.

LOGAN, UTAH.—At the meeting of the City Council of Logan the establishment of a municipal lighting plan was discussed. It was decided to send a committee to American Forks to investigate the workings of the plant there. A piece of land has been purchased for the site; about 25 miles below the town, and if the plant is constructed power and light will be sold to the surrounding towns. Later—The City Council of Logan has received a report on the proposed municipal electric lighting plant. The estimated cost of the new system was $42,000.

EVANSVILLE, WIS.—A municipal light and water plant is to be operated here and $51,000 in bonds are to be issued for its purchase.

MILWAUKEE, WIS.—The Milwaukee Harvester Company has awarded a contract for a Westinghouse alternating 600-kw 440-volt two-phase generator to be direct connected to a Corliss engine.

NEW RICHMOND, WIS.—A $100,000 water power deal has been closed whereby Stillwater capitalists will take over all the stock in the company now held by Eastern parties. The Stillwater parties will also invest much money in the enterprise. This probably means the development of another water power on the Apple River, in addition to the power now developed and being used at Somerset. Almost every manufacturing plant here and the street lighting and the pumping at the city water works are operated by electric power [illegible] this city.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Board of Aldermen has granted some additional franchise rights to the Birmingham Railway, Light & Power Company. J. R. Adams and associates were also granted a franchise permitting them to enter the city with an electric railway.

DECATUR, ALA.—J. T. Crass, who owns several electric railways in Tennessee and Kentucky, has visited Decatur to investigate prospects for a new line. Mr. Crass desired either to obtain the franchise of the Decatur Street Railway Company, granted by the Decatur Land Company as an exclusive franchise before the incorporation of New Decatur, or to obtain a new franchise.

DENVER, COLO.—The Whitney-Ryan-Widener-Elkins syndicate has practically completed the deal to secure the Denver City Tramway. The price paid is said to be $8,500,000 which covers the Denver City Tramway Company, the Metropolitan Street Railway Company, the West End Railroad Company, the Denver City Traction Company and the Colfax Electric Company. The company is stocked for $5,000,000 and has $5,875,000 in bonds outstanding.

LOUISVILLE, KY.—Promoters have sought right of way for an electric railway to run from Louisville to Mt. Washington. The road proposed is 22 miles long and $400,000 would be required for its construction. Among local capitalists interested are Peyton M. Clark, Jas. C. Wright and possibly Ohio capital.

GLASGOW, KY.—The Glasgow, Burkeville & Cumberland Valley Traction Company has effected permanent organization by electing officers as follows: Dr. J. S. Leech, president; C. W. Alexander, treasurer, and W. P. Dickerson, secretary. The projected lines will be about 40 miles in length. About two-thirds of the right of way has been secured.

MONROE, MICH.—The Detroit River & Lake Erie Terminal Company has been incorporated by George Spalding, George M. Landen, Chas. E. N. Cales, D. B. Cunningham and others who are connected with the Strang Construction Company which is building the Detroit & Toledo Shore Line. While the parties decline to explain their intentions it is believed they propose to build a line from the present terminus of the Shore Line at Trenton into the city of Detroit with a view to disposing of it to the purchaser of the Shore Line.

MINNEAPOLIS, MINN.—The Electric Storage Company of Philadelphia is busy with the installation of a 1500-horse-power storage battery for the Twin City Rapid Transit Company at the power-house in this city. A similar battery is being installed in St. Paul.

MINNEAPOLIS, MINN.—A very unusual fall in the Mississippi River so reduced the capacity of the Twin City Rapid Transit Company's power plant at St. Anthony Falls, Minneapolis, that it has been found necessary to reduce the number of cars in service in both St. Paul and Minneapolis. For this reason, and also because of the constantly increasing number of passengers, the railway company finds it necessary to enlarge its power plants.

BILOXI, MISS.—It is reported that parties who were considering the matter of an electric railway and electric light plant will renew their application before the Town Council. A road is contemplated to extend to Gulfport. Another franchise of similar nature is yet before the Council.

ST. LOUIS, MO.—A charter has been granted to the St. Louis Belt & Terminal Railway Company, with a capital of $3,000,000, to build a belt line round the city and connect with and furnish terminal facilities for the Missouri Pacific and the St. Louis & San Francisco. The length of the line will be 21 miles.

WILMINGTON, N. C.—It has been decided not to substitute electric power on the Wilmington Seacoast Railway, at least not for twelve months. This decision was made in view of the length of time required for getting the necessary equipment and by other delays.

CHARLOTTE, N. C.—It is learned that the Four C's Electric Company of Charlotte has planned an extension of its electric railway to Biddleville within two years; also a local extension in the city.

BALLSTON, N. Y.—The Schenectady Railroad Company has decided to build a branch from Schenectady to this village, a distance of 15 miles.

PENN YAN, N. Y.—The Penn Yan & Lake Keuka Electric Railway Company has been incorporated with a capital of $120,000.

JEFFERSON, OHIO.—The village of Jefferson has granted a franchise to the Pennsylvania & Ohio Railway for its line from Ashtabula to Jefferson.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway between this place and Wellsville was tied up because of recent high water in the Ohio River.

TROY, OHIO.—After long delays the Council has granted a franchise enabling the Dayton & Troy Traction Company to build to the center of the town. The company agreed to pay one-quarter of the cost of bridges over canal and river.

HAMILTON, OHIO.—It is announced here that the proposed Hamilton, Eaton & Richmond Electric Railway will be constructed this spring. The contract for building the line has been awarded to the Falk Construction Company, Milwaukee.

TOLEDO, OHIO.—It is stated that the Toledo Railway & Terminal Company, which is building a thirty mile steam belt line around the city, proposes to operate electrically driven cars for passenger service, in addition to the steam freight business.

CLEVELAND, OHIO. The Cleveland Electric Railway Company is planning to extend its Wade Park Avenue line to the Windemere car barns as soon as the financial situation is cleared up. The extension would open up fine suburban residence property.

CINCINNATI, OHIO.—Indications are that arrangements will soon be completed between the interurban roads building into Cincinnati and the Cincinnati Traction Company whereby the former will enter the center of the city over the tracks of the latter.

COLUMBUS GROVE, OHIO.—The Columbus Grove Council will receive proposals for the operation of an electric railway over a recently established route through town. A company which will build from Findlay to Ft. Wayne, Ind., wants the franchise.

FINDLAY, OHIO.—It is stated that the promoters of the Findlay & Southern Railway Company have finally completed arrangements for the sale of the bonds. Options have been secured on a right of way from Findlay to Columbus by way of Mt. Blanchard and Forest.

EAST LIVERPOOL, OHIO.—Local people are interested in a project for an electric railway from East Liverpool to Chester, Hooks town and Conway, W. Va. It is the intention to operate steam trains at night, as there are rich undeveloped coal fields on the proposed route.

MADISONVILLE, OHIO.—The Madisonville Council has granted a franchise to the Cincinnati & Columbus Midland Traction Company. The company has secured right of way between Columbus and Blanchester. The road will form the most direct route from Cincinnati to Columbus.

CINCINNATI, OHIO.—The Cincinnati, Newport & Alexandria Traction Company has been organized by A. S. Berry, John Todd, James C. Wright, A. R. Brothers, John Fromholtz, J. L. Thurner and Frank Thatcher. It is the intention to build a line to Alexandria, Ky. Surveys are being made.

DAYTON, OHIO.—The Gem City Street Railway Company is being organized by local people to build a street railway line from the Monument in North Main Street to the Davis Sewing Machine Company's factory and over a circuitous route embracing South Park, whose street car facilities are wholly inadequate.

BELLAIRE, OHIO.—Theodore Neff, of Bellaire, is said to be negotiating to build a line from Bellaire to Marietta, 90 miles; from Bellaire to St. Clairesville, 12 miles; from Carlington to Barnesville, 28 miles, and from Bellaire to Barnesville, 28 miles. Rights of way over considerable portion of the route have been secured.

CHILLICOTHE, OHIO. The Chillicothe Electric Street Railway, Light & Power Company has closed an option on a six acre site for a power-house. The present station is inadequate and inconvenient and the intention is to erect a station near the center of distribution and convenient to a railroad. A car house will also be erected.

SPRINGFIELD, OHIO.—The Dayton & Kenton Traction Company is planning to build a branch line from New Carlisle to Springfield, thus making a through line from Dayton to Springfield. It is claimed that the route between the two cities will be shorter than that of the Dayton, Springfield & Urbana Railway and that there will be competition between the two lines.

TOLEDO, OHIO.—An issue of $50,000 in receiver's certificates on the Lake Shore Electric Railway has been sold in Toledo and Detroit. The certificates pay 6 per cent interest and are due Jan. 1, 1903. They are prior liens over even first mortgage bonds and there was no difficulty in placing them. The money obtained is being used for pressing improvements to the property.

COLUMBUS, OHIO.—The Columbus, Delaware & Sunbury Railway Company has been incorporated, with $10,000 capital stock. The road is to extend from Delaware to Sunbury by way of Berkshire, a distance of nine miles, and it is to be used as a feeder for the Columbus, Delaware & Northern Traction Company, the same capital and the same people being back of the project.

DAYTON, OHIO.—The Chase Construction Company of Detroit has established construction headquarters in the Eaker Building, this city. The company is building the Dayton, Covington & Piqua Railway, the Muncie, Hartford & Ft. Wayne Railway and the Dayton & Troy Railway, the latter being practically completed. Several miles of track have just been laid on the Covington line.

PORT CLINTON, OHIO.—Work is to be resumed in near future on the Tiffin-Port Clinton Railway. The project has been financed by the Kerlin Brothers, of Toledo, and the line will touch Tiffin, Fremont, Port Clinton and Lakeside. A power house will be established at Port Clinton. This is a distinct project from the Central Ohio Railway Company, which is building between Tiffin and Fremont.

CINCINNATI, OHIO. At the annual meeting of the Northern Ohio Traction H. A. Everett was elected president to succeed E. W. Moore. Will Christie, of Akron, vice-president; J. R. Nutt, Cleveland, treasurer; C. F. Moore, Akron, secretary; Charles Currie, Akron, general manager. As the property is paying well it is thought it will not be sold by the committee settling the Everett-Moore affairs.

FOSTORIA, OHIO.—It seems quite probable that the Ohio Northern Railway from Fostoria to Jerry City will be built this summer. Plans are being prepared for the details of the road. The line between the two towns will be thirteen miles long and there will be a three-mile loop connecting all the passenger stations in Fostoria. The road will pass through a thickly settled farming section and will form a through connection from Fostoria to Toledo. William D. Marks is president of the company.

TOLEDO, OHIO.—It is announced that the litigation pending for some time between the Toledo Railways & Light Company and the former owners of the Toledo & Maumee Valley Railway has been practically settled. The basis of the settlement has not been announced, but it is understood that the former Maumee Valley people have agreed to pay a stipulated sum in settlement of all claims. It is said that the purchase of the Maumee belt line was an excellent investment and that it has enhanced the value of the Toledo Railways & Light Company's property to a considerable extent.

AKRON, OHIO. There is considerable speculation as to what the Tucker-Anthony syndicate will do with the right of way for the Canton, Massillon & Akron Railway which was included in the properties recently purchased from the Everett-Moore syndicate. The right of way was purchased in order to make it impossible for a competing line for the Canton-Akron Railway now nearly completed. The right of way is Y-shaped, including nearly 30 miles of private property, about 13 miles of it graded. The property was purchased outright and the farmers who sold it would not pay anything like the price they received to

CLEVELAND, OHIO.—The transfer of the control of the Cleveland Electric R[illegible] March 8. Mr. Andrews handed to Chairman Newcomb, of the bankers' committee, a check for $3,545,000, and received orders for 43,000 shares of the Cleveland Electric and 1000 shares of Cleveland City. Immediately after the transfer a meeting of the Cleveland Electric Railway Company was held. Mr. Andrews was elected president; Henry J. Davis, secretary of the National Carbon Company, secretary, vice Fred S. Borton. Vice-President Harmon and Treasurer George S. Russell continue. It is probable that the companies will be consolidated.

NEW CASTLE, PA.—The New Castle & Sharon Electric Railway Company has let the contract to William McIntyre & Sons, of Sharon, for the erection of a $10,000 power house and sub-station at New Bedford, this county.

CHARLESTON, S. C. A movement has been on foot for some time to build an electric railway to Summerville. Now the Magnolia Electric Railway, Light & Power Company, of Summerville, has applied for a charter for this purpose. The capital stock is placed at $5,000 with the privilege of increasing to $1,000,000. The applicants are all of Troy, Ohio, and are Chas. N. Burns, J. L. Brump, Robt. J. Smith and Gilmer T. Thomas.

CHATTANOOGA, TENN.—The operation of a second rapid transit railway has been inaugurated to the foot of Lookout Mountain. The Chattanooga Electric Railway Company promises to build up the mountain but has yet taken no steps in that direction.

NASHVILLE, TENN.—The Nashville & Columbia Electric Railway has been chartered by Frank P. Bond, Joseph Fulcher, Chas. W. Ruth and others. The capital stock is $50,000. The company proposes to build an electric road from Nashville to Mt. Pleasant.

NASHVILLE, TENN.—Local capitalists have under consideration a scheme for constructing an electric railway from Nashville to Lewisburg through Williamson County into Marshall County. It is reported that Edgar M. Jones, President of the Union Bank & Trust Company, is interested.

SAN ANGELO, TEX.—The San Angelo Rapid Transit Company has been organized at San Angelo, with a capital of $10,000. Incorporators: J. J. Nussbaumer, A. S. Grant, A. J. Morgan, C. H. Powell. The object is to provide transportation by automobiles for passengers and U. S. mail with adjacent towns.

HAMPTON, VA.—Engineer R. T. Pierce has just completed a survey of the route of the electric railway to be constructed from Jamestown, Va., through Williamsburg and Yorktown to Hampton. The line will be thirty-seven miles in length.

RICHMOND, VA.—The House has passed a bill to incorporate the Richmond Electric Railway Company. The bill provides for the promotion of an electric light, power or heat business in Richmond and adjoining territory. The incorporators are Dr. C. Archer, C. P. E. Burgwyn, R. B. Chaffin, W. B. Frayser, R. H. Nelson, J. W. Reams, Franklin Stearns and J. W. Turner.

TACOMA, WASH. An electric railway is to run from the Great Northern road at Rock Island, Wash., to Waterville and Buckingham. Power is to be derived from Chelan Falls.

WHEELING, W. VA. The Wheeling Traction Company will make extensive improvements to its power-house on Forty-second Street. Two 2000-hp engines, two 600-kw generators and two 500-hp boilers have been ordered and will be installed as soon as possible. A number of new cars will be ordered. The present transfer system will be improved and extended.

DEPERE, WIS. At a recent meeting of citizens a franchise for an electric street railway was considered. The franchise was presented by the Fox River Electric Railway Company.

SHEBOYGAN, WIS.—J. M. Seaman is preparing to resume work on his interurban line between this city and Elkhart Lake, Plymouth and Waldo. The line to Elkhart Lake will be in operation by July 4.

LA CROSSE, WIS.—The La Crosse & Eastern Railway Company has been incorporated to acquire and operate a street, suburban and interurban railway to Viroqua. Several routes are already surveyed and construction upon it will begin in the spring. The incorporators of the company are Mayor Joseph Boschert, D. H. Palmer, J. B. Taylor, J. P. Reeve and E. C. Highbee.

THE AUTOMOBILE.

BIDS WANTED FOR AUTOMOBILES. Recently the Cleveland Board of Public Works advertised for bids for the operation of an automobile bus line through the boulevards and park system of the city. Thus far not a single

NEW INDUSTRIAL COMPANIES.

THE UNION ELECTRIC MANUFACTURING COMPANY has been incorporated at Milwaukee, Wis., with a capital of $50,000.

THE POTENTIAL ELECTRIC COMPANY has been formed in New York City by A. C. Reeves, James Smith and Andrew Hunter. The capital is $1,000.

THE BUCKEYE ENGINE COMPANY has been incorporated in Jersey City, N. J., by Horace S. Gould, John I. Billings and K. K. McLaren. Capital stock,

THE ELECTRIC MOTOR COMPANY OF AMERICA, of East St. Louis, Ill., capital $100,000, has been incorporated by Wallace Delafield, Jr., A. D. Scott, and Maurice E. Breed.

THE MASSENA ELECTRIC STEEL COMPANY, of Syracuse, N. Y.; capital, $500,000, has been incorporated. Directors: M. R. Conley, D. P. Factor and T. T. Seeley, New York City.

THE PEERLESS ELECTRIC COMPANY, of New York, has been incorporated with a capital of $2,500. The directors are Jesse M. Yount, W. M.

THE CONSOLIDATED WIRELESS TELEGRAPH & TELEPHONE COMPANY was recently incorporated in Phoenix, Ariz., by M. Van Booskirk, M. McEntee and others. The capital stock was placed at $25,000,000.

THE J. LANG ELECTRIC COMPANY has been incorporated in Chicago with a capital stock of $15,000 to manufacture electrical machinery and apparatus. The incorporators are Walter D. Hawk, Robert D. Dunn and Warren Ripple.

LEGAL.

AMERICAN ALKALI TROUBLES. Charging fraud, [illegible] stockholders [illegible] Alkali Company, [illegible] a bill in the United States Circuit Court at Trenton, N. J., asking that the company be dissolved and its affairs wound up. The company was organized in New Jersey in April, 1899, with a capital stock of $[illegible] [illegible] shares of common stock and 120,000 shares of preferred stock at a par value of $50 each. The charge is made by Winfield S. Campbell, Washington Righter, David S. Thompson and W. Paul Subers, of Philadelphia. Campbell owned 5,100 shares, Righter 100 shares, Subers 20 shares, and Thompson 8,700 shares of preferred stock. The latter also held 700 shares of common stock. Soon after the incorporation of the company it organized the Canadian Electro-Chemical Company, Limited, through which it established at Sault Ste. Marie, Canada, a plant, expending therefor $246,142.59, which plant was put in operation in January, 1901, and continued until Sept. 25, 1901. The bill prays that the company may be enjoined from prosecuting assessment suits and from further prosecuting the business, except to preserve its assets and wind up the business. The patent rights under which the American Alkali Company first operated were originally secured for the United States and Canada by Hermite & Dabose and John C. A. Rhodin. The company's office is at 815 Drexel Building, Philadelphia, and its management is in the hands of the following officers: W. W. Gibbs, president; F. H. Clergue, vice-president and general manager; George Philler, second vice-president; Clayton E. Platt, secretary and treasurer. The board of directors is composed of W. W. Gibbs, F. H. Clergue, George Philler, Samuel R. Shipley, Dr. Herbert M. Howe, W. M. Kerr and Ernest E. Davies.

OBITUARY.

WILLIAM LOHMILLER, [illegible] and president [illegible] the N[illegible], both [illegible] at La Crosse, Wis., aged 48. He was secretary of the La Crosse Telephone Company and director of the Wisconsin Independent Telephone Association for many years.

LIEUT. PAUL D. STOCKLY.—It is announced from Washington that the name of Second Lieutenant Paul D. Stockly, Twenty-first Infantry, has been ordered stricken from the army rolls. The officer is now officially dead. On January 12, 1901, Stockly disappeared while stationed in the Philippines, and since that time no trace of him has been found. It is thought that he was murdered by the Filipinos. Lieutenant Stockly was the son of George W. Stockly, president of the Sims-Dudley Arms Company, and well known for years as the forceful president of the old Brush Electric Company, of Cleveland. Mr. Stockly has exhausted every means to discover his son's fate. Young Stockly went to the front in the Philippines with a dynamite gun battery and was very reckless while on the firing line, so that there is little doubt that he fell into an ambuscade or died in some hand to hand encounter. He was a most amiable and intelligent officer, and would have won distinction in any path in life. We can but record our own profound sorrow at his death, and join in the general

PERSONAL.



[illegible] R. C. Clowry

COL. R. C. CLOWRY, of Chicago, as noted by us last week, succeeds General [illegible] as president of the Western [illegible] Telegraph Company, a date [illegible] he will [illegible] He [illegible] and general [illegible] of the directors. Col. Clowry, the new president, has filled positions with the Illinois and [illegible] and the Western Union telegraph companies as messenger, operator, manager, superintendent, general superintendent [illegible] At the [illegible] placed in charge of the United States military telegraphs in the Departments [illegible] and Arkansas. At the close of the war he received a brevet commission as lieutenant-colonel from President Johnson for meritorious service and devoted application to duty. His name had already been mentioned more than once for the presidency of the corporation he has served so efficiently out West.

MR. G. G. WARD, president of the Commercial Cable Company, is making a long trip on the Pacific coast.

MR. ARTHUR WARREN, of the British Westinghouse Electric Company, is due in New York this week from England.

MR. CARYL D. HASKINS [illegible] before the Franklin Institute, Philadelphia, March 20, entitled "Electrical Measuring Instruments."

MR. A. FREDERICK COLLINS gave a demonstration on wireless telegraphy at the Baron de Hirsch Trade School, New York, on the evening of March 12.

MR. E. H. R. GREEN, president of the Texas Midland Railroad, is working on wireless telegraphy and taking out patents. He will apply the system to his own road.

MR. R. E. T. PRINGLE, of Montreal, Can., has informed us that the business heretofore carried on by himself will hereafter be conducted by a Canadian corporation to be known as the R. E. T. Pringle Company, Limited.

MR. ARTHUR WILLIAMS has joined the ranks of the electrical editors, and is now issuing for the New York Edison Company a neat little monthly bulletin devoted to information concerning the company's work, customers, etc.

MR. W. ETENGER, of the telegraph department of the Pennsylvania Railroad Company at Jersey City, is working on the problem of getting all the wires underground between Jersey City and Philadelphia, between which points the road has 24 through wires.

MR. EDWARD H. COX, recently on the New York staff of the Electric Vehicle Company, has joined the technical and selling forces of the Automobile Company of America. For many years past, Mr. Cox has specialized on hydrocarbon engines, and on their application in automobile work brings to bear a vast amount of experience.

MR. THEODORE P. COOK, district superintendent of the Western Union Telegraph Company at St. Louis, Mo., has been tendered and has accepted the position of general superintendent of the Western Division, with headquarters at Chicago, to take effect on April 1, in the place of Col. R. C. Clowry, recently elected president and general manager.

MR. BERNARD DRAKE, of Drake & Gorham, the well-known English electrical engineers and contractors, is now in America looking around and getting posted on the industrial situation. It is some 20 years since Mr. Drake was last over here, and since that time he has done a lot of good pioneer work in the introduction of electrical inventions. He returns to London this week.

MR. R. PERCY SELLON, of the Brush Electric Engineering Company, Limited, of England, is now on a trip to this country, which he has reached via the West Indies, where he and his wife have made a winter tour of recreation. Mr. Sellon is an active member of the English Institution of Electrical Engineers and English official bodies interested in standardization of apparatus, and while here is studying up the work done by the American Institute of Electrical Engineers in that direction.

MR. U. N. BETHELL, the general manager of the New York Telephone Company, the Chesapeake & Potomac Telephone Company, etc., has just been admitted to practice in the United States Supreme Court. He was presented for admission by ex-Attorney-General Griggs, who is said to be likely to fill the vacancy on the Supreme Court bench. Mr. Bethell began his study of law while a government clerk in Washington, and has already practised in the Supreme Court of the District of Columbia.

MR. F. A. CROSELMIRE, well known in the electrical trade, has associated himself with Mr. W. F. Ackor, in the gold, silver and platinum business, under the firm name of Croselmire & Ackor. Having been associated many years in the same line of business with his father, Mr. C. F. Croselmire, and who has retired, he brings to the new firm the experience of years. The new firm has just completed one of the most modern and up to date plants, with all the latest and most modern machinery for working platinum in any shape or form.

MR. CHARLES C. MARTIN, consulting engineer of the New York department of bridges, was tendered a complimentary dinner on the evening of Saturday, March 15, by the citizens of Brooklyn in recognition of Mr. Martin's long devotion to the public good in his intelligent and upright administration of the affairs of the Brooklyn Bridge from its design to the present day. During his long period of office as chief engineer of the bridge he has had many electrical problems to solve relating to lighting and traction. A pleasant feature of the evening was the presentation of a bronze statue of David to the guest of honor.

Trade Notes.

CORRESPONDENCE SCHOOL WORK.—Mr. Frank O. Hubbard, of Chicago, recently completed the stationary engineering course in the American School of Correspondence and received his diploma. Mr. Hubbard is an electrician with Marshall Field & Co.

THE ELECTRIC APPLIANCE COMPANY, Chicago, distributing agent for the Gutmann alternating current integrating wattmeters, is at last, through increased facilities at the factory, able once more to fill orders promptly. The rush of business which caught it unawares was something that no foresight could anticipate.

BULLOCK APPARATUS.—The Bullock Electric Manufacturing Company, Cincinnati, Ohio, has recently issued a folder giving illustrations of various types of its generating apparatus, and power motors. Among the machines shown is a three-phase generator installed at Shiek's Island, Canada, which plant was described quite fully in these columns March 1.

PERKINS SWITCHES.—The principal office and the entire manufacturing department of the Perkins Electric Switch Manufacturing Co., Hartford, Conn., located at that city, have been removed to Bridgeport, Conn., and hereafter all correspondence should be addressed to 1421 State Street, in the latter city. The addresses of the New York and Chicago offices remain the same as now.

THE METROPOLITAN SWITCHBOARD COMPANY, New York, announces that, owing to the increase in the amount of work, it has been compelled to secure more space, and has therefore removed its factory and office to 227 West 29th Street. Mr. T. J. Murphy, the proprietor of this business, opened the new quarters on March 17, and presented every caller on that day with a green souvenir.

THE BURT MANUFACTURING CO., of Akron, O., has issued two very neat little booklets describing its Cross oil filter and the Burt exhaust head, copies of which will be mailed to any one upon application. It may be mentioned here that this filter was awarded the highest medal at the Pan-American Exposition and that its sale has extended to 28 different countries while nine governments have adopted it for use in their navies, arsenals, etc.

THE CINCINNATI MILLING MACHINE CO., Cincinnati, O., has just issued a new 1902 catalogue showing its new line of milling machines. This is a very handsome piece of book work, the illustrations being in half-tone throughout. A number of interesting improvements are illustrated and described in detail, including the company's new all-gear feed mechanism, whereby all feed changes are instantly obtained by movement of the lever, the drive being always positive, permitting much heavier and faster cuts than the old belt-fed mechanism.

CHARLES H. BESLY & CO., No. 10-12 N. Canal Street, Chicago, Ill., report their general business very good. They are receiving many orders for their celebrated Gardner grinder with spiral grooved discs; recent shipments being made to California, Washington, Oregon, Wisconsin, Ohio and Pennsylvania. They are also receiving many orders from the Pacific Coast for their Helmet oil, Badger and Bonanza cups. The late edition of Charles H. Besly & Co.'s general catalogue with discount sheet will be mailed free to any address upon application.

CEDAR PRODUCTS.—The C. H. Worcester Company, Marinette, Wis., has compiled a complete telegraph code suitable for the requirements of buyers and sellers of white cedar products, and published the same in a pamphlet of 16 pages. The Northwestern Cedarmen's Association standard specifications of white cedar products are also included, together with other valuable information on the subject. The C. H. Worcester Company is producer and wholesaler of Michigan white cedar telegraph poles, railway ties, etc., and has 12 branch yards in Michigan and Wisconsin.

MULTIPOLAR DYNAMOS.—In its Bulletin No. 160 the Jenney Electric Manufacturing Company, Indianapolis, Ind., describes and illustrates with a large number of excellent cuts, its line of multipolar dynamos. The many illustrations in detail and accompanying description bear out the claim made that these machines embody the most modern ideas of dynamo construction. There are four general types, viz., slow-speed belt-driven generators ranging in capacity from 1 to 250 kilowatts; intermediate-speed belt-driven generators ranging from 4.6 to 225 kilowatts; moderate-speed belt-driven generators ranging in capacity from 75 to 150 kilowatts, and direct-connected generators ranging from 7½ to 125 kilowatts.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is anticipating an extremely heavy demand for supplies and construction material in spring work. It has laid in one of the heaviest stocks on record. It is prepared to furnish promptly from St. Louis stock, a complete line of wires and cables, cross arms, cross arm braces, insulators, construction tools of every description, overhead material for electric railways and, in fact, everything pertaining to outside electrical construction. It is also carrying a very large stock of rubber covered wires and cables, conduit and fittings, outlet and switch boxes and kindred material. The company states the outlook for a large increase in electrical construction of every description for the coming year is the best ever known. It issues a very complete line of catalogues, etc., which will be mailed on application.

SMALL MOTORS.—With this title the General Electric press has issued a 64-page pamphlet profusely illustrated and printed on an excellent quality of half-tone paper, the size of page being 8½ by 10 inches. A very interesting section is devoted to General Electric motors for operating machine tools, which contains illustrations of more than a score of tools fitted with electric drive. Other sections are on belted motors, special motors, special applications of motors, motors for automobiles, and small alternating-current motors, single and polyphase. The designs of the section title pages are extremely effective, and the cover design is a work of art, though unfortunately marred in effect by the color of the cover paper. The pamphlet forms a treatise on small motors of considerable technical value. Much of the text would have been welcomed by technical journals for use in their columns.

FANS DOWN SOUTH.—Newman-Spranley Company, Ltd., New Orleans, reports a great boom in all departments, particularly in electrical apparatus. Having sold over 30 Diehl motors and dynamos during the past month, it states that while cities in the North were snow bound, it was enjoying balmy weather and sold a good many fans. It has taken the agency for the full line of goods manufactured by the Diehl Manufacturing Company, Elizabethport, N. J. A shipment of its stock order has been received consisting of six carloads. This quantity is without dispute the largest ever made to any concern in the world and reflects great credit on the business ability of the Newman-Spranley Company, who anticipated an increasing demand for good fans and made preparations to meet it. This six-carload shipment included an assortment of both types of ceiling, 2 and 4-blade, electroliers, column, electrolier column, in ten designs and all finishes; also desk, bracket, trunnion and universal joint desk in three sizes, 9, 12, and 16-inch. This makes not only the largest shipment, but the greatest assortment of fans to select from, which fact will be appreciated by its patrons.

STOKERS FOR HALF A MILLION HORSE-POWER.—The list of recent installations of Roney mechanical stokers, which has just been compiled by Westinghouse, Church, Kerr & Co., goes far toward substantiating their claim that such apparatus forms a part of the equipment of most of the modern steam plants in which a high standard of engineering has been adopted. The list starts with the four large organizations upon which New York City depends for its lighting and transportation service; namely, New York Edison Company, Metropolitan Railway Company, Third Avenue Railway Company (now controlled by the Metropolitan) and the Manhattan Railway Company. These plants aggregate 128,500 horse-power boiler capacity fitted with Roney mechanical stokers. Lighting, street railway and industrial concerns throughout the country, swell the aggregate to a round half-million horse-power. The list is thoroughly representative of industries using power and includes central station and isolated electric lighting plants, street railway power houses, steam railroad shops and terminal stations, refineries, chemical works, cotton, woolen and silk mills, mining, smelting and refining plants, paper and flour mills and large manufacturing companies of every description.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 11, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

694,425. ELECTRIC RAILWAY SYSTEM; John Ryan, Watertown, N. Y. App. filed Oct. 8, 1900. A sectional electric railway system employing two sectional conductors, one of which is between, and the other, outside, the track. The car carries a storage battery to regain the power current if broken. Connected with each pair of sectional conductors is a pair of solenoidal switches which close the car supply circuit when a car is over a section.

694,946. METHOD OF COVERING TEXTILE AND POROUS MATERIALS WITH METAL; J. A. Daly, Washington, D. C. App. filed Aug. 30, 1900. (See Current News and Notes.)

694,977. ELECTRIC SWITCH; R. C. Moore, Kansas City, Mo. App. filed March 1, 1901. A selective device for party line and similar service involving a modification of the step by step ratchet switch device.

694,989. INSULATED COMPOUND; H. N. Potter, Gottingen, Germany. App. filed Aug. 9, 1899. Consists of soapstone or talc-powder and water combined with a binder such as tragacanth.

694,991. ELECTRIC IGNITER; C. C. Reid, Cleveland, Ohio. App. filed Nov. 30, 1901. Details of a sparking device.

694,999. DYNAMO-ELECTRIC MACHINE; C. P. E. Schneider, Le Creusot, France. App. filed Oct. 11, 1901. Caps of magnetic material are secured to armature teeth and extend to close wholly or partially the slot opening, thereby facilitating armature winding and securing practically the advantages of a tunnel winding.

695,033. PRODUCTION OF CHLORIN AND ALKALINE HYDRATES ELECTROLYTICALLY; E. D. Chaplin, Winchester, Mass., and H. G. Halloran, Boston, Mass. App. filed April 26, 1900. (See Current News and Notes.)

695,049. BURGLAR ALARM FLY SCREEN; D. S. Hill, Cincinnati. Ohio. App. filed May 1, 1901. The screen is under tension and when the tension is altered by tampering, certain contacts are allowed to come together and close an alarm circuit.

695,105. TELEPHONE SUB-STATION REGISTERING SYSTEM; J. D. Hobbs, Jersey City, N. J. App. filed Jan. 26, 1901. (See page 514.)

695,118. CONTROLLER FOR ELECTRIC MOTORS; R. H. Read, Schenectady, N. Y. App. filed July 26, 1901. Tubes conveying air under pressure are directed towards the several contacts of the controller and blasts of air are directed across the contacts at the moment when the circuit is broken, to disrupt the arc.

695,122. SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; C. B. Stewart, Jr., Schenectady, N. Y. App. filed May 13, 1899. A visual signal automatically shows when the exposed working conductor is charged.

695,127. INSULATED CONDUCTOR; E. Thomson, Swampscott, Mass., and J. G. Callan, Lynn, Mass. App. filed Nov. 7, 1901. (See Current News and Notes.)

695,134. CIRCUIT BREAKER; C. C. Badeu, Schenectady, N. Y. App. filed July 25, 1901. The tripping armature is provided with an auxiliary magnetic field of sufficient density to overcome the friction of the moving parts, which renders the armature free to respond to a smaller excess of current than when such friction must be overcome by the load current.

695,143. ELECTRIC METER; T. Bruger, Frankfort-on-the-Main, Germany. App. filed Nov. 29, 1901. An electric meter, comprising a plurality of conducting systems connected in parallel, each system including an active coil and a resistance connected by a collector-segment arranged between the resistance and active coils, the resistances being connected at a common point, with means for supplying current at said common point of connection.

695,144. ELECTRIC BRAKE; F. E. Case, Schenectady, N. Y. App. filed April 4, 1898. After the controller handle cuts off the current, it engages with contacts which start a brake applying motor. This motor acts through a worm gear so that after the brakes have been set, the current may be turned off without releasing the brakes.

695,150. ELECTRIC SWITCH; C. D. Haskins, Schenectady, N. Y. App. filed July 27, 1901. Provision for permitting a flow of oil under pressure across the separating contacts to extinguish the arc.

695,163. FIELD MAGNET FOR DYNAMO ELECTRIC MACHINES OR ELECTRIC MOTORS; R. Lundell, New York, N. Y. App. filed Dec. 18, 1901. A supporting-frame for a laminated field-magnet, consisting of two end brackets with connecting-pieces between them, the frame being absolutely rigid by itself when bolted together.

695,188. KNIFE SWITCH; J. A. Wright and W. O'Neill, Wilkinsburg, Pa. App. filed July 12, 1901. A double switch blade bulged in opposite directions at its handle end and having a projection which enters a notch in the handle, affording a rigid connection between the blade and handle.

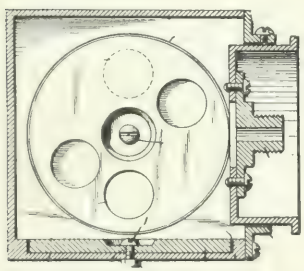
695,203. AUTOMATIC TELEGRAPH; A. C. Gilmore, Chicago, Ill. App. filed April 22, 1901. The apparatus includes separate electrical devices relatively quick and slow acting to respond differently to variably timed current impulses of signal code combinations, and selector mechanisms arranged to be variably actuated by said devices into position to make the signal corresponding to the combination of impulses received.

695,220. ELECTROMECHANICAL WATER WHEEL GOVERNOR; L. Lyndon, New York, N. Y. App. filed Sept. 13, 1900. (See Current News and Notes.)

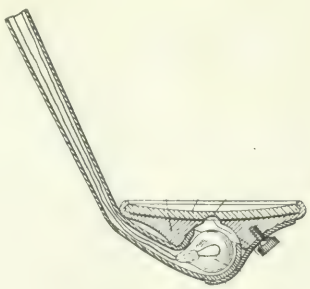
695,243. ELECTRIC JUNCTION OR OUTLET BOX; J. H. Stahley, New York, N. Y. App. filed Jan. 17, 1902. A disc having openings in it is pivoted against the wall of the box so that it may be turned either to cover the openings in the box or expose them.

695,245. ALARM ATTACHMENT FOR INCUBATORS; R. H. Stevenson, Jr., Western Springs, Ill. App. filed May 4, 1901. Details.

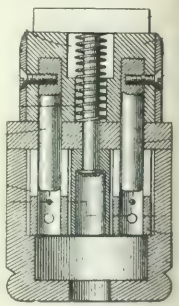
695,253. ELECTROMAGNETIC ENGINE; P. B. Watson, Philadelphia, Pa App. filed May 28, 1901. Electromagnets and a fly wheel set up on the plan of a reciprocating engine.



695,243.—Electric Junction or Outlet Box.



695,338.—Combined Light and Mirror.



695,366.—Combination Plug Switch.

695,260. TELEPHONE AND FIRE ALARM SIGNAL; L. G. Woolley, Kenton, Ohio. App. filed Dec. 28, 1899. (See page 515.)

695,268. TELEPHONE RECEIVER SUPPORT; G. M. Beerbower, New York, N. Y. App. filed May 27, 1901. (See page 515.)

695,302. APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS; J. D. Gilmour, Glasgow, Scotland. App. filed April 29, 1901. (See Current News and Notes.)

695,308. LAMP HANGER; H. J. Harrison, Juneau, Alaska Ter. App. filed Sept. 5, 1901. Details.

695,338. COMBINED LIGHT AND MIRROR; G. J. Paynter and F. C. Watson, Philadelphia, Pa. App. filed Aug. 7, 1901. An incandescent lamp is seated in a cavity in the back of a dental mirror and shines through a small transparent portion of the center of the mirror.

695,358. MAGNETO ELECTRIC GENERATOR; J. M. Wilson, Battle Creek, Mich. App. filed April 27, 1901. A rotating field-magnet is driven through a friction clutch interposed between the driving pulley and the magnet structure. Centrifugal force acting on the clutch regulates the speed of the field-magnet.

695,366. COMBINATION PLUG SWITCH; J. I. Ayer, Malden, Mass. App. filed Sept. 20, 1901. A compound plug switch having means for preventing the shifting of the switch or changing the contact connections for different combinations while the main supply current is in active circuit therewith.

695,383. MAGNETIC TRACTION; S. A. Gibbs, Tacoma, Wash. App. filed June 19, 1901. Magnets carried by an engine have their poles presented closely to the rails to increase the tractive force of the engine.

695,398. CIRCUIT MAKER FOR ELECTRIC FIRE ALARMS; F. W. Jordan, Norwood, Mass. App. filed July 19, 1901. A lever is connected with a wiring moulding in such a way that it is normally in contact with one of the wires and held out of contact with the other by a fusible block. A fire melts the block and permits the lever to make contact with both wires of the moulding and thus establish a short circuit.

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OVERHEAD WIRES IN CITIES.

The question of overhead wires in Greater New York has been brought up again by a letter written by Commissioner Dougherty, of the Department of Water Supply, Gas and Electricity, to the traction, telephone, telegraph and other companies requesting them to confer with him, with a view of having their ærial wires placed underground. The matter is doubtless a very important one, but this move brings out strikingly the manner in which the progressive policy of the Metropolitan Street Railway Company has anticipated the march of events in regard to it. The Vreeland regime in street railway traction in New York City will ever be memorable for the introduction of electricity and for the manner in which it saw the trolley conduit system improved and perfected, so that it at once became a standard for the civilized world. This needed courage and ability of the highest kind, and the result has been that without having any additional burden of poles and wires imposed on the street surface, New Yorkers have for years enjoyed the best urban transportation that is known to the science and the art. Other cities are confessedly emulous of New York in this respect, and it is unquestionable that in the future we shall see large sums of money devoted to the adoption of trolley conduits for crowded thoroughfares and dense traffic. Meanwhile, these agitations for removing wires in the city area have little importance to the Metropolitan managers, who have not a foot of superfluous or unnecessary ærial wire anywhere.

Turning to Brooklyn, which is equally affected by Mr. Dougherty's intentions, a different state of affairs exists. There President Greatsinger has inherited a vast network of overhead wires, and it is absolutely certain that for many years to come that network will stay up, for even as it is the company has overtaxed its resources to provide that plant, and would virtually have to duplicate its line investment if it changed over to the conduit. That is, of course, out of the question, while the further fact remains that for most avenues of travel in Brooklyn the overhead trolley is adequate and is admirably suited. As to the work of putting its feed wires underground, however, this we are glad to say is in active progress, without the need of any stimulus from Mr. Dougherty, while further large sums are to be spent in that direction. The practice of carrying feeders overhead was quite general in the early days of the trolley, and still survives, but the opinion and experience of engineers tends wholly to placing the feeders safely underground on important thoroughfares, and large sums are being spent on the improvement. Here, as in other branches, the public impatience encounters the difficulties due to wiping out older investment and methods, but, after all is said and done, we Americans remain the greatest "scrappers" in the universe, when it comes to the swift adoption of meritorious reforms, novelties and inventions.

BELL TELEPHONE.

President Fish is to be congratulated upon his first annual report as head of the American Telephone & Telegraph interests. The Bell system shows for the year a remarkable expansion of business and is certainly in better shape to advance and prosper than it has been for a long time. One reason for the improved outlook is the settlement of the vexatious difficulties that arose out of the Erie muddle, for here the Bell people appear to have come again into their own. Another reason, strange as it may seem, is the extraordinary activity in the independent field, which has acted as a sharp stimulus to the "old line" companies. The independents have proved the enormous

capacity of growth of the telephone industry, for their figures, if added to the Bell, still leave a vast area for development and occupancy. Moreover, the Bell system has ceased to be a "monopoly," fenced in by "iniquitous" patents. It stands to-day on the broad basis of merit and in its ability to sustain competition lies its chief hope for the future. That capital and financial influence will be forthcoming for its further development is indicated by the powerful additions to its directorate. We must confess to our great pleasure at seeing once more on the list of officers the name of Mr. Theodore N. Vail. It recalls the early days when the telephone art was yet in the making, and when he exercised his talents so brilliantly and successfully to build up this great modern electrical industry, one of the most useful and beneficial that the public has ever received at the hands of the American inventor.

The Lessons of the Sleet-Storm.

The damage inflicted upon overhead wires of every description by the sleet-storm of the 21st of February exceeded previous records. For several days Philadelphia was telegraphically isolated from the rest of the country as completely as though invested by a besieging army. Baltimore was in nearly as great a predicament, and even New York was crippled in its telegraphic communication with the outside world. Such a condition had not been confronted for half a century. In order to produce such disastrous conditions it is necessary that the air lying close to the surface of the earth should be below 0° C, while the superincumbent strata should be relatively higher in temperature. With precipitation in the form of rain, congelation then occurs upon the incident surfaces, and each wire may become the axis of a cylinder of ice. Telegraph and telephone wires went down for miles. On the Pennsylvania Railroad the poles beside the track were in places carried away, broken, or uptorn by the dozen together, and where the poles stood, the cross-arms were often torn away. Where both poles and cross-arms held their own, the wires were broken in many instances. Electric light wires, being generally larger, suffered less, and trolley wires least of all, save where broken trees and poles fell across the road. The forests were injured for hundreds of square miles. The Atlantic coast was involved in this storm from Maryland to Connecticut.

The question arises whether, in view of the enormous cost of restringing the destroyed lines of wire, it would pay to carry the wires in the open country underground. In large cities the wires are buried already. This is a very large question, involving great outlay and engineering difficulties. It is a question of engineering economics. It would seem, however, that under existing conditions it would not pay to bury the wires at large. While the buried wires would be sheltered from sleet they would be at the mercy of pick and plow. Wherever a wire runs, through earth, water, or air, its continuity is threatened by special dangers, and immunity is a mere matter of degree. Moreover, there would be enormous expense in making and laying the wires and relatively large expense in repairing them, although repairs might be less frequent. The buried wires would be very much slower in transmission than the overhead wires, and the cost of transmission would be increased. We must refer our readers to the admirable letter on the subject in this issue from the pen of Mr. Francis W. Jones.

The solution of the difficulty must be found along existing methods of construction. As time goes on it will probably be found economical to use larger and stronger telegraph wires and stronger poles, or to increase the capital cost of trunk lines in order to reduce the cost of maintenance and repair. It is quite likely, however, that it would pay to carry a light underground cable of twisted-pairs of insulated wires between important cities, such as New York, Philadelphia, Baltimore and Washington, which are not far apart, and where the expense of cabling a few wires would be justified by the necessity of maintaining telegraphic communication under every condition of weather. These wires would form a handful of conductors as an alternative route to the ordinary overhead trunk lines, and while they would be slow-speed wires for the quantity of copper they contained, they could, with sensitive instruments, be made to carry all the essential telegraphic traffic during an emergency. Outside of such selected underground trunk lines, we must be prepared to carry wires overhead over the length and breadth of the land, in stormy weather or fine. Moreover, if wireless telegraphy or telephony impend, on land, to any serious extent, it can certainly be largely used in such emergencies of storm and stress, if only as a "stand by" auxiliary, like fire escapes and lifeboats; and then the expensive undergrounding of cross-country telegraph and telephone wires would prove to have been rather unnecessary.

Stability of Synchronous Motors.

Mr. Baum's paper on this pertinent topic, presented in this issue, will repay careful reading. Instability in motors or rotary converters is a most unpleasant condition, very frequently encountered, and anything which throws light upon it is heartily welcome. The phenomenon most often appears in rotaries, perhaps owing to their increasing number and the fact that they are often installed on lines with bad regulation. At first when hunting appeared, the tendency was to look for periodic disturbances in the prime mover, but a little experience usually shows the difference between hunting due to that cause and that produced by purely electromagnetic causes. The latter is by far the more likely to rise to formidable magnitude and to throw the machines out of step. A very interesting case not directly taken up by Mr. Baum is the effect of changes in load of the system upon a motor or rotary running at constant output. Obviously a change of the constants of the system affects all the apparatus upon it, and if a motor or rotary is working steadily in a condition verging upon instability it may easily be upset by changes on the rest of the system.

Another most curious phase of instability is the extraordinary persistence of hunting when once fairly established. A motor driving a substantially uniform load may be set into oscillation by a load change in the system and hunt persistently at almost constant frequency and amplitude for hours. We have seen records of such performances that were simply astonishing in their obstinacy. A change in the field strength will often bring back stable conditions, but another change in load may bring back the hunting again and give the attendant another session of sorrow in finding means to avert the trouble. Still another factor in the matter of hunting is the absolute stability of the motor field. A regular pulsation of the exciting current accompanies hunting of a motor or rotary, and it sometimes seems as if this feature of the case was the controlling one in the matter of persistence. If the motor field is strongly affected by the armature reaction, quite irrespective of its relation to the generator field, a condition is set up which tends to make the hunting persistent. Likewise the inertia of the armature and its attracted load appears to exercise a very strong influence upon hunting. A powerful flywheel effect sometimes, indeed generally, tends to keep up the hunting after it is once started, although it may muffle the effects of moderate changes in load. Some particular value of the moment of inertia would doubtless exist for which hunting would be a maximum.

It is fortunate that those conditions on the system which tend to minimize hunting are also those which are in themselves important from the standpoint of operation. Small drop in the line, good regulation at the sub-station, steady load and machines with good inherent regulation running at uniform speed, are all things desirable in themselves as giving good service upon the system as a whole. They

also are the very things to give stable operative conditions. It is a fact in general that bad design of generators and motors leads to no end of trouble in giving good commercial service, and a carelessly planned conducting system tends to the same evil end. In transmission plants especially, most of the difficulties which have been dreaded are directly proportioned to the shiftlessness of the general design. It is only making the punishment fit the crime to have hunting depend as directly as it does upon improper engineering and careless operation. And certainly upon this basis some plants ought to be hunting twenty-four hours of the day, or more if possible. As a matter of experience, hunting can generally be suppressed by a little foresight and care, and its existence on any considerable scale is a severe criticism upon both the apparatus and its management.

The Ocean Cable and the Trolley.

An interesting case has recently been tried, on appeal, between the Submarine Cable Company landing at Cape Town, South Africa, and the Cape Town trolley road. It seems that the 1600-knot cable from Loanda to Cape Town was landed at the latter port a few years ago, and made ground connection on its own sheath. It operated in undisturbed seclusion until the wicked trolley road made its appearance, employing rails-and-ground return. Thereafter the cable operators knew no peace, and the trolley currents trespassed upon the hallowed precincts of the cable house. Every time that a trolley-car took up a new passenger, the starting current of the car registered a *te deum* on the recorder tape of the cable company, and so far from awakening a response from the operator, rendered the cable signals illegible.

It seems that the cable company carried a special ground-return cable out to sea, parallel to the Loanda cable, for a distance of ten miles, and that while this procedure reduced the disturbance, it did not remove it entirely, for the duplex adjustment still could not be maintained. The theory of action, so far as it has been developed, points to the passage of some portion of the trolley return-current through the sea water of the bay at Cape Town, and the exercise of an inductive disturbance on the cable shore-end, en route. It is said that it may be necessary to lay a special twin-wire or concentric double cable shore-end, the inner insulated conductor leading to Loanda, the outer insulated conductor to a distant ground, and both within a continuous metal sheath, before the inductive disturbance on the cable can be eliminated. The plea was set up in the argument that a leakage return current from a trolley-system was "on the same footing as a vicious animal" in the eye of common law. This suggests the resemblance between an electric current and a quadruped that does not appear to have been presented previously. We are familiar with contests for "the earth" between electrical engineers serving the telegraph, the telephone and the trolley, but here is a unique case for disputing the joint use of the sea, as a return circuit, the decision in which may be far-reaching.

The Magnetic Properties of Iron Alloys.

A paper by Prof. Barrett and Dr. Brown was read last month, on this subject, before the Institution of Electrical Engineers in London, and abstracted in the Digest of March 15. The paper was called "Researches on the Electrical Conductivity and Magnetic Properties of Upwards of One Hundred Different Alloys." There is a plethoric vehemence in this title, that recalls the "Thousand and One Nights" of the celebrated Sultana, and it is said that the paper fell upon the ears of but a small audience, although Lord Kelvin and Dr. Glazebrook helped to make up in selectness for deficiency in numbers. The fact is, however, that although such a paper is repellant on account of its enormous wealth of detail, it deals with a matter of great importance. Iron is the wonderful substance to which modern civilization is so much indebted. The railroad, the steamer, the modern edifice, the vast army of machines and machinery, all depend for their very existence upon the mechanical properties of this substance, and of its alloys. In electrical engineering, it is the magnetic properties of iron, quite as wonderful as its mechanical properties, that have created the dynamo. Without cast steel, we should have no extensive development of the electric railway motor. It is difficult to believe that the capabilities of nature are already exhausted in this direction, and such researches as those of Prof. Barrett are consequently very important.

If chemists and physicists could produce an iron that could be poured and cast, which would be not only a good magnetic conductor but also a fair electric insulator, the product would be of great industrial value, because it would no longer be necessary to laminate armature cores, pole pieces, induction motors and transformer carcases. Such machinery, instead of being toilsomely assembled, would be generously poured, like "the gentle rain from heaven upon the place beneath." Hysteresis might still continue to exist, but eddy currents would be no more. The "upwards of one hundred" alloys of Prof. Barrett do not seem to point to such an ideal substance; but it is from such researches that advance is made, and knowledge accumulated. Broadly speaking, the results seem to corroborate the previously existing belief that in iron and its alloys, mechanical and magnetic hardness go hand in hand. In general, an iron that resists the rasp of the file may not be wooed to respond to the softer touch of the magnetic field. It would be interesting to analyze from the tabular results whether the hardness of mechanical surface, and the hardness of magnetic heart, are in all cases strictly, or only crudely, proportional. Next, it appears that while the alloying of tungsten with iron affects the conductivity least, some substances affect the conductivity in marked degree. A particular alloy is described containing nickel and manganese, which is easily drawn into wire and which attains the high resistivity of nearly 100 microhm-centimetres. Here is, certainly, a high electric resistivity, but the magnetic resistivity seems, unfortunately, to be very high also. It is said that the resistivity of carbon alloys rises with the quantity of carbon up to a certain limit, and affords a fair means of estimating the amount of carbon present.

Some very interesting anomalies are presented in the magnetic behavior of certain alloys. Thus 2½ per cent of nickel in iron hardly affects the magnetic quality, and 5 per cent of manganese in steel leaves a strongly magnetic material. But 2½ per cent of nickel, plus 5 per cent of manganese in steel, makes non-magnetic steel. Two iron alloys are described as being magnetically superior to soft Swedish iron. One contains 2½ per cent of aluminum, and the other 2½ per cent of silicon. The former alloy is said to possess a permeability of 6000, or to develop a flux-density of 12,000 maxwells at a magnetizing force of 2. This property ought to be useful in particular classes of magnetic apparatus. Curiously enough, it has been known for years that aluminum added to cast iron in the furnace increased the permeability of the casting; but it frequently happened that analysis failed to reveal any appreciable quantity of aluminum in the resulting alloy. It was, therefore, sometimes believed that the aluminum was valuable more in the breach than in the observance, and was useful in combining with the impurities of the cast iron, by eliminating such impurities in the form of a slag, leaving the cast iron purer and more permeable. Silicon is sometimes purposely introduced into transformer sheet steel; not to increase permeability apparently, but to stop increase in hysteretic loss by age. It transpired in the discussion of the paper that the Dublin trolley system, and the laboratory iron coal-scuttle, vied with each other in disturbing the normal value of the earth's horizontal magnetic component, in the testing room where the measurements were made. The research must have involved a very large aggregate amount of labor.

Developments in Wireless Telegraphy.

A special dispatch from Halifax, N. S., of March 23 states that Mr. Marconi has finally decided on Table Head, fifteen miles from Sydney, as the location for his Cape Breton station.

Mr. Marconi informed the officials of the town council that flashes from trolley wires would interfere with his system, and he asked if the town could not take some action in the matter. A meeting of the council was immediately called and a resolution passed that for a period of five years the town would prevent any electric trolley system from being operated within one-third of a mile of the station. Marconi stated that work on the construction of the station would begin at once and would be completed within three months.

Mr. Marconi had an escape from being seriously injured on Saturday night. While his special was making slow time passing through Dominion Colliery, a large stone came through the window of his car nearly striking him. The escape from being badly hurt was very narrow.

The contract for the construction of the buildings has been awarded to Rhodes, Curry & Company. The land required for the station has been given to the Marconi Company free by the Dominion Coal Company.

Considerable interest has been aroused by the publication during the present week in the *New York Herald* of an alleged and apparently bona fide interview with Prof. Slaby, in which that well known investigator and experimenter flouts Mr. Marconi, praises the Arco-Slaby system, says that Emperor William has ordered that system for the German Navy because Prince Henry could not get messages through the Marconi stations from the steamers carrying him, and that he, Slaby, "wished to appeal in behalf of humanity against any undue commercialism in the employment of wireless, or rather the spark, telegraphic system." This appears to be directed at the Marconi contract made with Lloyds and the contract with the Canadian Government. Prof. Slaby is also quoted as speaking of Mr. Tesla as the "father of wireless telegraphy," and as citing in proof the work issued by T. C. Martin in 1894 on "The Inventions and Researches of Nikola Tesla." He is also quoted as saying that he has transferred to the General Electric Company of America over 40 patents on his system, which if true was certainly unknown hitherto. He also expressed doubts about oceanic transmission.

In regard to the last point, Mr. Tesla is quoted in a subsequent interview in the *Herald* as follows:

"While I do not believe that wireless messages over the sea will be as cheap as some enterprising people have asserted of late, still I cannot quite share Professor Slaby's opinion in regard to wireless transmission of energy across the Atlantic. I began nearly two years ago the design and installment of power plants for commercial use, with the fullest confidence of success, basing my assurance on exact tests and measurements, which admit of no doubt.

"This work was commenced only after I had completely mastered the problem of insuring the absolute privacy of messages, and inasmuch as I have received in this undertaking the most generous help, I would be unfortunate indeed if my expectations were not to be fully realized. I hope, however, that the transmission of messages without wires is only the first and comparatively insignificant phase of a great revolution which will be wrought by the transmission of vast quantities of energy for industrial purposes to the most distant points on the globe without wires."

Electrical Engineers of the Day—XXXIX.

W. W. Hanscom.

William W. Hanscom was born in San Francisco in December, 1868, and received his early education in the public and private schools of that city. Leaving the high school in 1883 he began a mechanical engineering course in the National Iron Works of San Francisco, where he spent three years in the foundry, pattern and machine shops, after which a further course of two years in the machine shop of the famous Union Iron Works completed his practical apprenticeship.

His ability was promptly recognized in his appointment as assistant to the mechanical engineering superintendent of the Union Iron Works, and this position was held until the summer of 1890, when he entered the draughting office as assistant to the engineering chief. In the meantime during his practical apprenticeship, his studies were pursued in an evening school of mechanical drawing and under his father, Mr. W. W. Hanscom, at that time one of the leading mechanical engineers of California.

In 1886 he became interested in electricity. It was in that year he built some telegraph instruments and erected a social telegraph line which soon grew to be over twelve miles in length with a list of forty members. A few months sufficed to make him an expert telegraph operator, and, seeking other experience in electrical work, he was placed in charge of the electric light plant of the Union Iron Works. His experience in this direction is a recital of the growth of the electrical department of the Union Iron Works, for from 1887, when its first dynamo was installed, its growth has been probably unequalled by that of any other manufacturing industry on the Pacific Coast.

Among the work which came under his supervision as chief electrical engineer of the Union Iron Works were the design and construction of the 10,000-hp switchboard for the Bryant street powerhouse of the Market Street Railway Company of San Francisco, which Mr. Hanscom also installed, together with the entire equipment of generators and auxiliary electrical apparatus. He has installed a number of isolated electric lighting plants as well as nearly sixty elec-



trical equipments on ships of the United States Navy and the merchant marine, beginning with the cruiser Charleston, which was under construction in 1887 and including such ships as the San Francisco, Monterey, Olympia, Oregon, Marietta, Farragut, Wisconsin, Hancock, etc.

In 1896 the Union Iron Works began the manufacture of the electrical apparatus required in every line of its work, with the result that at the present date all that is required in the line of generators, motors, switchboards, steering gears, ammunition hoists, turret turning gears and ventilating apparatus, together with all bell, annunciator, signal and tell-tale apparatus, is designed and built on the grounds. At times the electrical department operates 300 or more employees and its contracts on hand at one time, have reached an imposing figure. And all the while the steam plant at the works has been being gradually superseded by electrical power so that now all the cranes and tools are being operated by electric motors, which have been designed by Mr. Hanscom and built on the spot.

Mr. Hanscom has equipped an extensive private laboratory at his home for electrical and chemical research. During the past four years much of his spare time has been spent in perfecting methods of, and apparatus for, the manufacture of storage batteries, and that his efforts in this direction have not been in vain is shown by the fact that a set of batteries which he built and sent to London in 1899 took the Gold Medal at the Agricultural Hall Exhibition for commercial efficiency, after over six months' practical use in a Riker cart. It is worthy of note further that this same set of batteries is in use at the present time.

Mr. Hanscom is a member of the American Institute of Electrical Engineers and several other engineering societies, has served as expert in a number of engineering tests of various descriptions and was for a year a member of the Board of Electrical Examiners for the Civil Service Commission of the City and County of San Francisco.

Electric Haulage in Coal Mines.

BY W. B. CLARKE.

THERE is a striking analogy between an electric mine haulage plant and a railway system; in fact, some of the principal mine haulage plants compare very favorably in size with the street railways in moderately large cities. This statement is well illustrated by the following data regarding the mines of the Berwind-White Coal Mining Company, at Windber, Pa., all located within a radius of three miles:

Aggregate generating capacity, located in seven power houses, 2550 kw; number of miles of underground trolley lines, 75; number of mine locomotives, 43; aggregate horse power of mine locomotives, 4300; average number of mine cars per trip, 35.

The first electric mine locomotive* in this country was constructed in 1887 for the Lykens Valley Colliery of the Pennsylvania Railroad Company, in the anthracite district. Two smaller locomotives of an experimental nature were used a few months previously in a German colliery, but the Lykens Valley installation was the first electric mine haulage successfully operated on a practical scale. The locomotive illustrated in Fig. 2, another "Pioneer," was built by the Thomson-Houston Electric Company in 1889, and is still in everyday use hauling coal. The owners of this machine, upon being asked if it could be resurrected from the scrap-heap for exhibition at the Pan-American with other historical apparatus, replied with some show of indignation, that the machine could be loaned, provided a new locomotive would be furnished to do the work during its absence.

The electric mine locomotives of the principal manufacturers follow street railway practice very closely in their construction. Regular railway motors are used, mounted on the axles in the usual manner and spring-suspended from the side frames of the locomotive. (Fig. 7). The controllers and resistances are similar to those used in the street railway work except that the controllers are simply rheostatic without the "series-parallel" feature, in the ordinary sense of the word. In locomotive service it is found that a greater

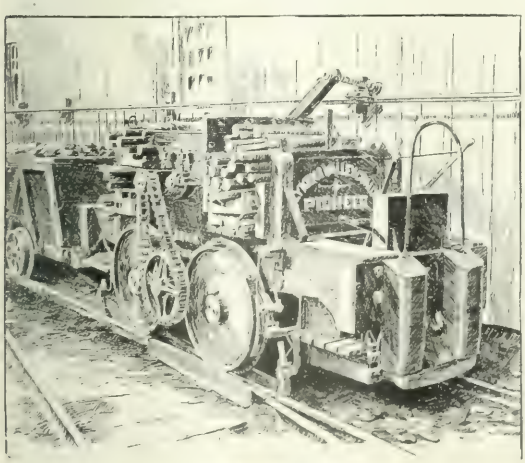


FIG. 1.—LYKENS VALLEY LOCOMOTIVE.

load can be started and hauled with the motors in multiple, since the drivers are entirely independent and the slipping of one pair of wheels has no effect on the other. If the motors are in series, the counter e. m. f. of the motor driving the slipping wheels, limits the current in the other motor and decreases the potential across its terminals, thereby reducing both its torque and its tendency to accelerate. In order that the motors may be operated in series on light service, a commutating switch is incorporated in the reverse cylinder of a modern type of mine locomotive controller. The reverse lever has four "on" positions, two for each direction, one with the motors in series and the other with the motors in multiple.

The overhead construction in the mines embodies no essentially special features, consisting simply of ordinary trolley wire with bonded rail return. There is some difference of opinion regarding the most desirable potential, some using 500 volts, while others prefer the lower voltage of 250.

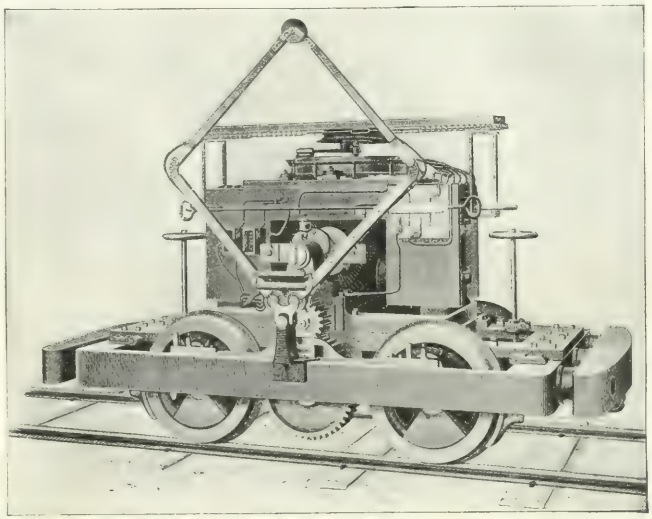


FIG. 2.—LOCOMOTIVE BUILT IN 1889, STILL IN USE.

There is unfortunately one particular in which the mine haulage

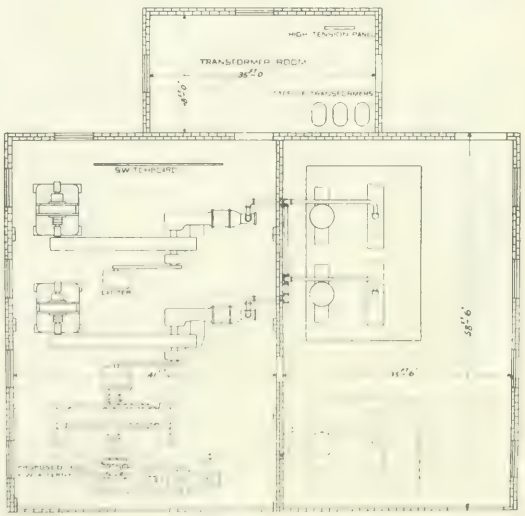


FIG. 3.—GENERAL PLAN OF POWER HOUSE.

system differs widely from the street railway. The equipments of even small street railways are usually subject to a regular system of inspection and maintenance, while in mine haulage, where the conditions are even more severe, renewals and repairs are ordinarily effected only as a consequence of a "break down."

It may be interesting to carry the analogy a little farther and describe briefly the installation of the Webster Coal & Coke Company

*See *Electrical World*, Sept. 24, 1887; Oct. 22, 1887; Nov. 19, 1887.

at Ebensfeld, Pa., the main heading [illegible] gradually the advantages of electrical transmission [illegible] with alternating current at a high voltage. The haulage at this mine was accomplished by the rope system and mules until the main heading attained a length of nearly two miles. At this point the necessity of substituting a more flexible and efficient system became very apparent. Since the main heading will continually extend [illegible] underground, there was practically no alternative and the electric haulage system was adopted.



FIG. 5.—LOCOMOTIVE AT MOUTH OF PIT.

In accordance with the usual practice, ordinary direct current generators would have been installed at the pit-mouth. On account of the length of the main heading, present and prospective, and the large output of the mine, this system would entail a prohibitive investment for feeder copper, especially in view of the low potential.

where by means of transformers and a 250-kw rotary converte direct current at 275 volts is delivered to the haulage circuits.

The power-house (Fig. 3) contains two 150 kw General Electr belt driven, double-current generators, separately excited and deli ering direct current at 275 volts from one side, and from the othe three phase alternating currents at 179 volts. The direct current



FIG. 6.—SWITCHBOARD IN POWER HOUSE.

275 volts is fed into the outer end of the haulage circuit in the usual manner, one terminal of the generator being connected to the trolley wire and the other to the rail return. The potential of the alternating currents is raised from 179 to 5000 by step-up transformers. The transmission line consists of a three-conductor, No. 0 B. & S., rubber insulated and lead covered cable, laid in the return air-way, parallel to the main heading.

The step-up transformers in the power-house and the step-down

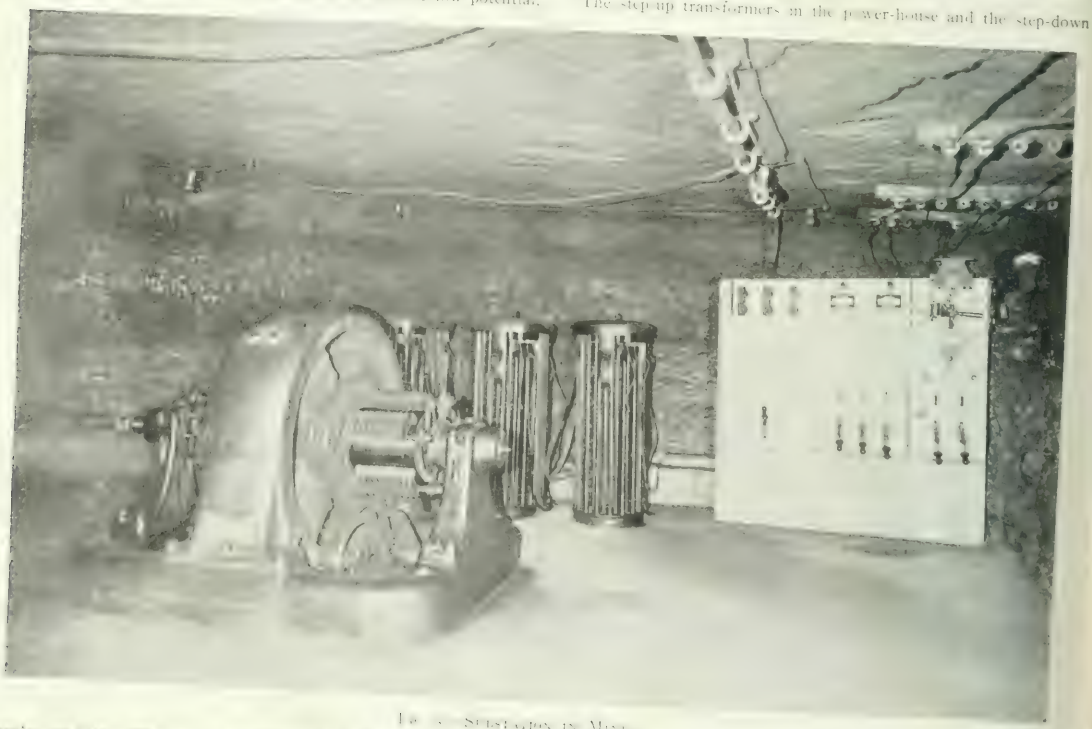


FIG. 7.—SUBSTATION IN MINE.

transformers in the sub-station (Fig. 5) are oil cooled and are exact duplicates. Taps are brought out from the primary windings in order to compensate for the line loss, and consequently the direct current voltages of the rotary converter and the generators at the power-house are the same. The transformers are connected in

"delta," so that the disconnection of one of them cannot effect the system except by overloading the remaining two.

In mine haulage, the reduction of the line drop, or in other words, the maintenance of the voltage at the motors, is of even greater importance than in a street railway system. There is a certain uniformity of conditions, in that the worst loads are concentrated to some extent at the point most remote from the power-house, i. e., near the working face of the coal, especially if locomotives are used for "gathering" the coal cars from the chambers. In ordinary rail-

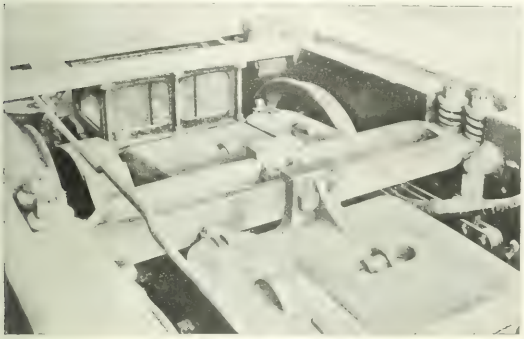


FIG. 7.—TRUCK OF ELECTRIC LOCOMOTIVE.

way work, however, the load varies widely in a geographical sense and an occasional excessive line loss, due to a temporary concentration of the load, is by no means serious. The mine haulage conditions, however, are uniformly the worst.

The double current generators in the power-house are simply rotary converters, exact duplicates of the converter in the sub-station, with their shafts extended for belt driving. It is proposed, as the occasion requires, to remove these two generators from the power-house and establish additional rotary converter sub-stations in the mine. Large engine-driven revolving-field alternators will be installed in the power-house and will deliver 5600-volt, three-phase currents direct to the transmission line. Direct current for the outer end of the haulage circuit will probably be supplied by a rotary converter located in the transformer room of the power house. By

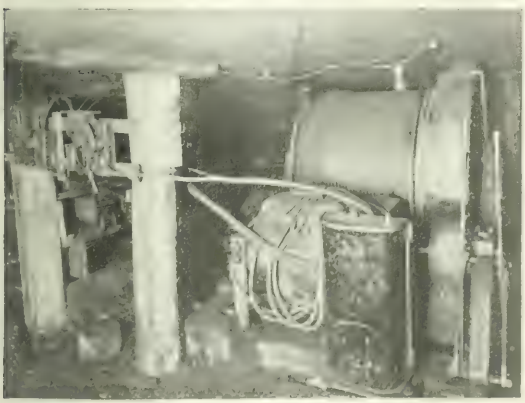


FIG. 8.—[illegible] IN MINE.

using the double-current generators a very considerable saving in the original investment was effected. These machines have operated in the most satisfactory manner, and their regulation with a rapidly varying alternating and direct current load has been surprisingly good.

In many mines the conditions are such that double current generators would constitute an ideal permanent installation. The induction motor with "squirrel-cage" armature, is pre-eminently suitable for use in the mines, principally on account of the absence of the commutator and of armature insulations. The Davis Coal & Coke Company, for instance, with extensive operations at Thomas, Coketon and Henry, W. Va., use direct current for mine haulage only. For all other purposes alternating current induction motors are used and generators of both types are installed in each of the power-houses. By means of the double current generator, both classes of service may be operated from one machine, while at the same time the advantages of high voltage transmission are within easy reach. The writer ventures to predict the frequent use of the double-current generator in mining work.

The present load at the Webster power plant consists of four 13-ton electric mine locomotives, and four electric hoists, each equipped with an 80-hp railway motor with controller and rheostats. The mine locomotives regularly haul trips of 50 mine cars on the main headings, which are driven practically level and laid with 50-lb. steel rails. These conditions are especially favorable for what may be called express haulage, i. e., long trains of cars moved rapidly on good substantial track. Branch headings are driven on a 10 per cent grade to the left from the main heading, and at their ends are installed the electric hoists operating as engine planes. On level entries turned to the right and left from the branch headings, the mine cars are handled from the rooms to the inclines by mules, or "hay-burners," as they are familiarly known. Trips of twenty-five cars are handled by the electric hoists on the branch headings or inclines. As the output of the mine increases and as the main heading progresses additional locomotives and hoists will be installed.

The Marconi Wireless Telegraph System in Canada.

BY WILFRID BLAYDES.

ON Monday, the 17th instant, Mr. G. Marconi, on behalf of Marconi's Wireless Telegraph Company, Limited, and of the Marconi International Marine Communication Company, Limited, the two English companies that control the Marconi patents, and Sir Wilfrid Laurier, G. C. M. G., Prime Minister of Canada, on behalf of the Dominion Government, affixed their signatures to an agreement, of which it is the object of this article to give some account. In all, the agreement consists of but fourteen clauses, and it may therefore be worth while to consider them *seriatim*, merely disentangling their provisions from legal verbiage.

Clause 1 provides that the Marconi companies shall erect and equip two stations on the coasts, respectively, of Great Britain and Nova Scotia, for the purpose of carrying on wireless communication on a commercial basis between Canada and Europe. By Clause 2 the Dominion Government agrees to pay the sum of $80,000 for or toward the erection and equipment of the station on the Canadian side. Clause 3 is purely administrative in its nature. By Clause 4 the companies secure for their messages over all government land lines the right of transmission at rates not less favorable than those which may be charged from time to time to other telegraph companies for the transmission of ordinary commercial messages.

Clause 5 puts the government land lines on terms not less favorable than any other lines in the event of the companies making any arrangement with such other non-government lines respecting the division of rates on through messages.

The clause numbered 6 is that to which, perhaps, most public interest will attach, especially, I should imagine, among holders of cable stock, although, be it said in passing, no one with any proper knowledge of the subject, certainly no one in touch with Mr. Marconi's own views upon it, is so foolish as to believe that, at any rate for a considerable time to come, there will not be enough work for cables—though not impossibly at reduced rates—and "wireless" both.

This clause, the sixth, in brief, establishes a shore-to-shore rate for wireless messages between Canada and Great Britain, which is to be "fully sixty per cent less than the rates now charged for cablegrams" between the coasts of those countries. "That is to say," the clause proceeds, for the sake of precision, "that whereas the present rate per word for such messages is now twenty-five cents, the companies undertake to charge not more than ten cents per word for such messages." The rate for government and press messages is next fixed at five cents per word, and the clause goes on to provide, finally, that in no case shall a higher rate be charged for wireless messages between Canada and Great Britain than from time to time may be charged for similar messages between Great Britain and any other part of "the Atlantic coast of the continent of North America." The significance of the frequent appearance of the word "coast" in this

clause lies, of course, in the fact that the companies cannot control land rates and, no more than the cable companies, can they undertake to deliver a message from England to a destination at some place, say, in the Northwest Provinces, at the same rate at which they can afford to deliver such a message in an Eastern district. "Shore-to-shore" rates, therefore, seemed to offer the best method of avoiding any possible confusion.

Clause 7 is very brief. It merely embodies the natural wish of the Dominion Government, to which the companies readily assented, that, so far as possible, Canadian machinery, labor and material should be used in the construction of the station in Nova Scotia.

The next five clauses (8, 9, 10, 11 and 12) contain provisions relating to the establishment of Marconi stations which the government may desire to erect "for communication with any of its lighthouses or life-saving stations on the coast, or between the mainland and any island within the jurisdiction of Canada, or with any ships passing to and fro, or in any way to assist in its operations for the protection of life and property on the seacoast or inland waters of Canada, or for the improvement or assistance of navigation." The general effect of these provisions is that, in the first instance, the companies are to be given the option of erecting, equipping and maintaining all or any such stations at their own expense. In the event of their so doing, they will of course receive the whole of the tolls, over the rate of which at the shore stations, i. e., upon shore to ship messages (only) the government, of course, retains the control which, with respect to all Canadian telegraph rates, is vested in the Governor in Council.

In the event, on the other hand, of the companies not desiring to avail themselves of their option in any particular case or cases with regard to the establishment of such stations, then the government shall be at liberty to take the same in hand upon its own account, the companies agreeing in such case to furnish the machinery and apparatus required at "fair and reasonable prices," to waive their claim for patent rights and royalties, and in the case of ship tolls, to take for themselves only those collected on the ships by their own agents for the transmission of messages from ship to shore, leaving as the property of the government the tolls to be collected at the shore stations for messages transmitted from shore to ship.

The effect of Clause 13 is to include within the sphere of operation of the agreement all lighthouses and stations maintained by the government on the coast of Newfoundland, "in so far as the companies have power" to give practical force to such inclusion—the proviso, of course, being advisable in view of the recent attitude of the Anglo-American Telegraph Company.

The fourteenth and last clause is framed chiefly, I think it may be safely assumed, in view of the possibility of an American company or other corporation acquiring the American rights of the Marconi patents, in which will be included, naturally, the right to use the Marconi system for direct communication between Great Britain and the United States. The clause fully secures to any such corporation or company its due monopoly with respect to such communication, laying down clearly that the companies shall not be bound to accept messages in Great Britain for wireless transmission via Canada, to destination in the United States or in other parts of the continent of America outside the jurisdiction of Canada.

This review, in the course of which I have endeavored to avoid the omission of any important point, may, I hope, suffice to show that the agreement is one which, whilst it may well afford matter for legitimate satisfaction to Mr. Marconi and his companies, is yet eminently fair and reasonable from the standpoint of all parties. It is not too much to say that its conclusion represents an important epoch in the practical development of wireless telegraphy, not only on this side of the Atlantic, but in the world generally. It is true that this is not the first official government recognition received by Mr. Marconi, since his system has for several years been employed in the British Navy, thirty-seven ships of which carry installations of the Marconi apparatus. The latter, however, is still of an old pattern, dating from before the days of "tuning," although it is rumored that the British Government in its wisdom has from time to time contemplated the idea of improving it upon lines and by methods of its own devising. Even so recently as a few weeks ago Lord Londonderry, the English Postmaster-General, is reported to have stated in the course of a speech before the House of Lords that at the present time the Admiralty is conducting experiments in the neighborhood of Portsmouth, from which the government looks—it must be said, with a cheerfulness unwarranted by experience—for "very important results." In the meantime, however, and pending some justification of this rather airy official hope, Mr. Marconi, who would appear to regard the British Government in its capacity of rival inventor, with some equanimity, has pursued the development of his system to such a point as to justify him in the undertaking, under the agreement which we have been considering, of regular commercial transatlantic work. And upon the substantial character of this later development, as already demonstrated by Mr. Marconi in the course of his experiments last December at St. John's, Newfoundland, and, more recently, on board the American Steamship *Philadelphia*, it will ever remain the distinction of Canada that its government has been the first to bestow official recognition, as it is first also among governments to have made proof of that practical faith in the value of transoceanic wireless telegraphy, which is demonstrated by its subsidy of $80,000 to the Marconi companies for the purposes of their work in Canadian territory.

This is not to say, of course, that under the agreement herein referred to and analyzed, the Dominion Government has not secured to itself, in return for its financial grant, advantages, particularly in respect of cheap rates, which I think must be deemed, as I have no doubt whatever that they will be deemed by the people of Canada, to constitute an ample *quid pro quo*. Such fact, however, in no way detracts from the interest of the consideration to which I have just alluded, and that consideration, I venture to say, is one which, in history, will redound to the credit of Canadian administrators for a wise far-sightedness beyond what has been displayed by government officialdom in some other parts of the world, where it would seem to be almost an object to compel to be carried out in foreign countries and under foreign control, the development of a system which to-day—had but more wisdom prevailed in British counsels a few years ago—might have been possibly the most valuable monopoly of the British Empire. I do not, of course, expect the American readers of this journal to share my own personal regret that this is not the case. They will readily assent, however, I am sure, to the justice of the sentiment which the spectacle of such supineness in high places at home can hardly fail to rouse in an Englishman acquainted with the facts. As matters stand, the Marconi companies, though English in their constitution and domicile, are probably the most cosmopolitan in existence in the range of their enterprise, and, as England's loss is thus the gain of the world, there is, perhaps, national feeling aside, no great matter for impartial regret. But an increasing number of English people will, I think, nevertheless, feel some sorrow that the credit of being the first to recognize the vast and far-reaching importance of a discovery which, for instance, makes it possible for orders to be instantaneously transmitted from Portsmouth direct to the Fleet at, say, Madeira, the Cape Verde Islands, or in any part of the Mediterranean—not to go beyond the distance over which Mr. Marconi has already successfully received messages—sorrow, I say, that credit will not now belong to their own government. Since, however, that was not to be, I think they will consent that the next best thing is that such credit should go, as it now must, to the government of a British Dominion "beyond the seas."

Tests of a High Tension Switch.

Some interesting tests of a high tension switch were recently made at the Colgate power house of the Bay Counties Power Company, California. A single pole switch was connected directly across the 40,000-volt bus bars that were receiving current from generators having a rated capacity of 7500 kilowatts through transformers of equal capacity. This switch was closed and opened ten times in the space of two minutes and it opened the dead short circuit each time safely and easily and without damage to the switch, transformers, or lines. One of the two Bay lines that were in parallel was then cut out at Colgate but left in parallel with the other at a station 120 miles from Colgate, and the switch connected across this line, thus giving 240 miles of line between the switch and bus bars. The switch was closed and opened fifteen times in the space of three minutes, and it opened the short circuit each time safely and easily and absolutely without damage to transformers or lines. The switch opened the short circuit the twenty-fifth time fully as well as the first time, and was in no way damaged by the extremely severe test of opening a dead short circuit at 40,000 volts with generator and transformer capacity of 10,000 horse-power behind it, twenty-five times. This switch was designed and built by J. Nelson Kelman, superintendent of the Colgate division of the Bay Counties Power Company, and the tests were made in the presence of Mr. L. M. Hancock, General Superintendent of the company, and others.

The Transmission System of the Compania Explotadora De San Ildefonso of the City of Mexico—III. (Concluded).

BY STEPHEN Q. HAYES.

THE DISTRIBUTING SWITCHBOARD AT LA VERONICA.

THE distributing board at La Veronica receiving station is shown in Figs. 33 and 34. This station, located in the suburbs of the City of Mexico, is shown in Fig. 32. It has a total length of 38 ft., and is made up of panels of white Italian marble

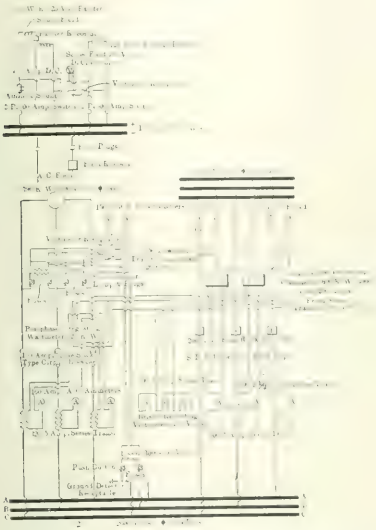


FIG. 31.—GENERATOR AND TRANSFORMER CONNECTIONS.



FIG. 32.—LA VERONICA RECEIVING STATION, EXTERIOR.

for the exciter, feeders, direct-current side of the rotary, with panels for the generator and transformer, alternating-current side of the rotary, and the storage battery. As Fig. 33 shows clearly the general arrangement of the board and the type of meters, switches, etc., used, it is unnecessary to give a detailed description. Some features, however, are worthy of note.

Panel *B*, which controls the 375-kw, 2600-volt, three-phase generator, has, in addition to the apparatus usually supplied, a polyphase integrating wattmeter which registers the total amount of power supplied by the steam-driven generator. By subtracting this amount from the total power recorded by the wattmeters on the outgoing lines, the power received from the transmission line is readily determined. On panel *C* are three Bristol recording voltmeters which record the voltage fluctuations for a period of 24 hours.

On all of the alternating-current feeder panels the switches are knife-blade switches, having a hole in the end of the switch and operated by means of a long wooden pole with a hook at the end of it. These hook-type switches are boxed in by marble barriers so that it is impossible for the attendant to come in accidental contact with the live portion of this switch. In connection with these switches it would be well to note that they are not intended to open the 2600-volt circuit when the load is on, as this is readily done by the circuit breakers.

Fig. 31 shows the diagram of connections of the first three panels —the exciter, the generator and one bank of lowering transformers. On the exciter panel the connections are so made that the exciter or the storage battery, or both in multiple, can feed the field bus-bars. The two four-point receptacles are so connected that the voltage of the battery or of the exciter can be read before connecting it to the field bus-bars back of the generator panel. The middle pole of the exciter switch is at the present left unconnected, but will ultimately run to an equalizer bus-bar when a second exciter is installed.

On the alternating-current generator panel the circuit breaker is used as a main switch for connecting the machine to the bus-bars after the synchronizer lamps have indicated that the machine is in synchronism and the two voltmeters have shown that its voltage is the same as that of the bus-bars.

By means of two shunt transformers and an eight-point voltmeter receptacle, the voltage across any phase of this machine can be read. As will be noticed, the same series transformers are used for the ammeters and the current coils of the wattmeter. The voltage coils of this wattmeter are fed from one pair of 3000-100-volt, ¼-kw transformers, stepping down from 2600 to 86.7 volts. This transformer ratio, 30-1, was used in place of 26-1, as it permitted the use of standard sizes of meters. The ground detector shown in this diagram is connected to the bus-bars in the usual manner. The three Bristol recording voltmeters are fed from the secondaries of the ¼-kw wattmeter transformers spoken of above.

On the transformer panel it will be noticed that the lowering transformers are connected in delta on the high-tension side through

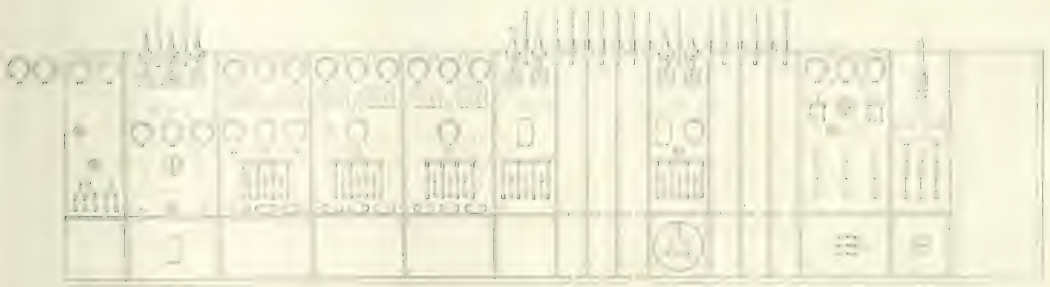


FIG. 33.—LA VERONICA SWITCHBOARD.

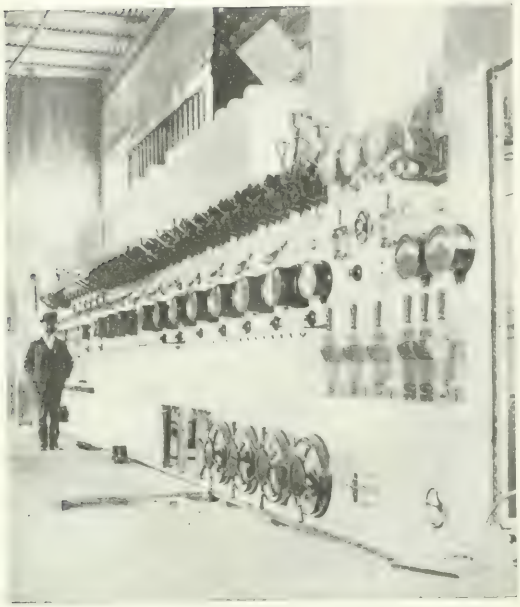
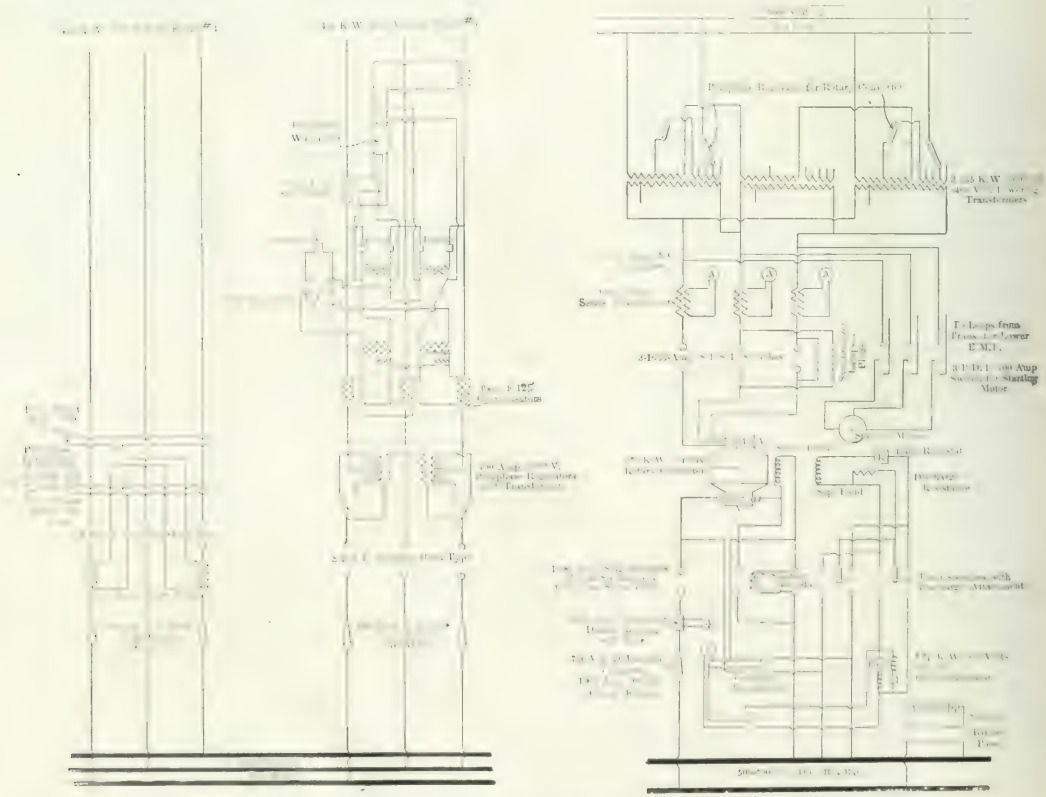


FIG. 34.—LA VERONICA SWITCHBOARD AS INSTALLED.

fused circuit breakers for disconnecting them from the 20,000-volt bus-bars. On the low-tension side hook type switches with fuses are connected between the transformers and the 2600-volt bus-bars. Two single-phase indicating wattmeters are connected by the method previously described to divide the load properly on a three-phase circuit. The ammeters on this panel are run from series transformers that differ from those used with the wattmeters, in that two of the wattmeter transformers have 2½-ampere coils and the ammeters have to be run from 5-ampere series transformers. The latest arrangement adopted by the Westinghouse Company for these wattmeters is to supply 5-ampere transformers throughout, winding one of the wattmeters with a 10-ampere coil, and using the same transformers for ammeters and wattmeters. With this arrangement one wattmeter has twice the current but only half of the number of turns that the other one has, and, therefore, in both cases the ampere turns are the same and the wattmeters divide up the load as before.

Fig. 35 shows the connection of one of the new polyphase feeders and one of the old ones, and indicates the method of wiring up the compensators, regulators, wattmeter, etc. On this feeder there are two single-pole automatic circuit breakers, three single-pole hook type switches, one polyphase recording wattmeter, one voltmeter, two compensators, an eight-point voltmeter receptacle and a polyphase regulator.

The wattmeter has its current coils fed from series transformers in the main circuit, and its voltage coils from shunt transformers connected on the line side of the regulators. The voltmeter is connected to the eight-point voltmeter receptacle in such a way as to indicate the voltage across any of the three phases at the point of distribution. This is accomplished by means of two compensators which are connected in between the shunt transformers and the receptacle in such a manner that their voltage is opposed to that of the transformers and, therefore, reduces the reading of the voltmeter by an amount proportional to the drop in the line, and the



FIGS. 35 AND 36.—FEEDER CONNECTIONS AND ROTARY CONNECTIONS LA VERONICA RECEIVING STATION

meter reads, not the voltage at the station, but the voltage at the point of consumption. The voltage of the feeder is then adjusted by means of the regulators until the feeder voltmeter registers the same as the bus voltmeter which indicates that the voltage at the point of consumption is normal.

These compensators can be set for a certain ohmic drop and a certain inductive drop, which can be calculated beforehand from the known dimensions of the circuit and the relative location of its various wires, together with the frequency and other controlling factors. As shown on the diagram, these compensators have their current coils fed from the secondaries of three series transformers so connected that each compensator receives current from two transformers.

The polyphase regulator shown on this diagram is installed for the purpose of regulating the voltage on the feeder, and can be arranged to increase or diminish the voltage of the bus and so keep the distributing voltage constant.

Fig. 36 shows the connections of the lowering transformers used for the rotary converter, as well as those of the rotary itself and its exciter. The three 135-kw lowering transformers used for this rotary have a series of loops brought out on their high-tension (2600-volt) side. These loops are connected to a regulator face plate so that the ratio of transformation can be altered from 2600-300 volts to 2600-460 volts, which will change the voltage on the direct-current side of the rotary from 500 to 750 volts. This large range of voltage is designed to enable the rotary to charge the storage battery at the period of light loads. As the load on the station increases it becomes necessary for the battery to help the alternating-current bus-bars by feeding back through the rotary, converting from direct to alternating current.

As the battery voltage drops the regulator again comes into play to keep the voltage on the high-tension side of the transformers constant at 2600 volts, while the voltage on the low-tension side is dropping from 460 to 303 volts. As will be noticed, all three of these 135-kw transformers are provided with loops, but only two of them have their loops connected to the regulator. This was done to have all the transformers identical and to enable two transformers connected in V to be used for transforming from three-phase to three-phase so that the disabling of one of these transformers would not put the rotary and storage battery out of service.

When starting up this rotary from the alternating-current side, the starting motor switch is thrown first on the lower voltage and then on the higher. The starting motor is wound with a fewer number of poles than the rotary, so that its synchronous speed is higher than that of the rotary. As the amount of slip in the motor depends on the voltage impressed at its terminals, two voltages are selected such that one gives a speed slightly above the synchronous speed of the rotary and the other a speed slightly below. By throwing the starting motor switch first to one side and then to the other, it is possible to bring the rotary exactly to synchronous speed before connecting it to the bus-bars. By means of the lamps and plugs shown, the instant of synchronizing is indicated by the lamps going out. The main switch connecting the rotary to the lowering transformers is then closed.

The main point of interest in connection with this rotary is the fact that it is arranged to convert from alternating to direct current, or vice versa. In his latter case, running from direct to alternating, unless there is some machine running on the alternating-current bus-bars, the rotary is liable to speed up, or at least not to hold the frequency constant. A heavy load taken from the alternating-current end will cause sufficient armature reaction to weaken the field, and like all direct-current motors, if the field is weakened while the voltage on the armature is maintained constant, the rotary will tend to speed up, increasing the frequency. To avoid this, the field of the rotary is connected to a special exciter mounted on the shaft of the rotary. This exciter is worked low down on the saturation curve so that a slight increase in speed will greatly increase the voltage generated by the exciter. Accordingly, when a heavy load weakens the field of the rotary and the latter tends to speed up, the exciter



FIG. 37.—TRANSFORMER HOUSE, CLOSED.



FIG. 38.—HIGH TENSION TRANSFORMER HOUSE, OPEN.

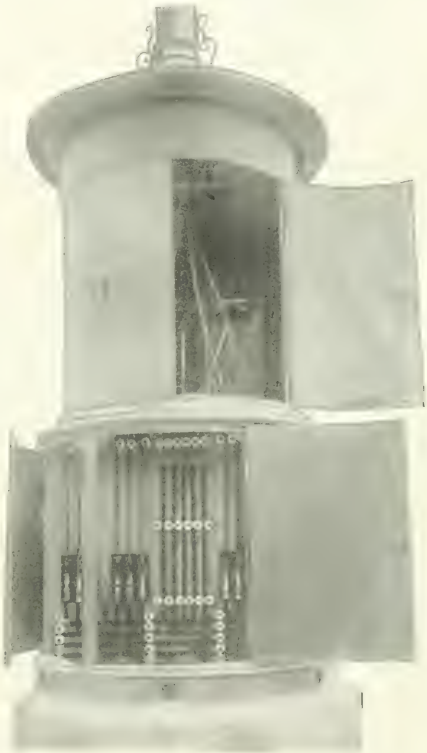


FIG. 39.—LOW TENSION TRANSFORMER HOUSE, OPEN.

also speeds up and the greatly increased voltage applied to the terminals of the rotary's field strengthens the field and holds the speed practically constant.

In starting up from the direct-current side, the method of procedure is to close the field switch that connects the shunt field to the direct-current bus-bars and to close the circuit breaker, as well as the negative switch. The armature circuit is completed through the resistance of the starting rheostat connected across the positive switch. The series field is opposed to the shunt field, and the rotary will rapidly speed up as the resistance of the starting rheostat is cut out. Then either the positive switch is closed, short circuiting the starting rheostat, or the equalizer switch is closed, cutting out both the starting rheostat and the series field—for the rotary runs as a shunt wound machine when running from the direct-current side.

One of the voltmeter plugs is put in the receptacle that connects the battery bus to one side of the differential voltmeter, and the other plug is put in the receptacle which connects the exciter to the other side. When this voltmeter indicates zero it shows that the exciter is at the same voltage as the bus-bars and then the second field switch is closed, thus for an instant running the exciter in multiple with the battery.

After opening the first field switch the field of the rotary remains connected to the exciter. The alternating-current side is then synchronized with the bus-bars in the usual manner and the three-pole switch is closed, allowing the rotary to feed back through the three 135-kw transformers to the 2600-volt bus-bars and out over the three-phase, 2600-volt feeders.

The primary distributing space voltage around the City of Mexico is 2600 volts. The distribution is by means of overhead wires in the suburban districts and by underground wires in the central part. The overhead distribution covers 11 miles and the underground 31 miles. The overhead distribution supplies motors and single-phase lighting. The primary distribution has seven feeders, of which four are used for motor work and three for lighting with reaction regulators. Figs. 37, 38 and 39 show the "kiosks" or transformer houses used around the City of Mexico. Fig. 37 shows the kiosk closed, and illustrates clearly the type of overhead construction in use. Fig. 38 shows the kiosk open. As may be noticed, the 2600-volt transformer connections are protected by fuses in glass tubes, these fuses having barriers between them. Fig. 39 shows the transformers and the secondary connections.

The secondary distribution is four-wire, two-phase, 240-volt, with a fifth wire connecting to the middle of the secondaries. This admits, first, supplying two single-phase lighting systems, 240-volt, three-wire lamps being connected on 120 volts between the outside wires and the neutral, which has a section of half of the outer wires; second, two-phase distribution for motor work, four-wire, 240-volt, without affecting the good regulation for lighting purposes. This distribution is more simple and more economical than the three-phase, 120-volt, four-wire system commonly employed.

The underground distribution has three-phase feeders, 2600 volts, supplying the three principal centers of distribution. A fourth feeder connects to all three centers. These three feeders distribute light and feed some small motors of regular output. The fourth feeder furnishes power to motors of a greater capacity than 5 hp, such as elevator motors, whose starting might affect the regulation of the circuits. It also serves as a spare cable in case of damage to one of the first ones. These cables are insulated, and being armored, are laid directly in the ground.

For many of the details of the apparatus and the actual installation, as well as the photographs of the plant, map, etc., the writer's thanks are due to Mr. Isador Sternfeld, of G. & O. Braniff & Co., the Mexican agents of the Westinghouse Electric & Manufacturing Company. Credit for the successful commercial development of the plant is due to Mr. Norman Rowe, engineer in charge throughout its construction.

Dutch Cable Scheme.

A cable despatch states that the Government of the Netherlands has submitted to the States General a telegraphic convention with Germany, providing for a joint subsidy for cables to the Dutch colonies in the Far East. It is proposed to connect the Islands of Menado and Celebes (in the East Indies, East of Borneo) with the American Philippine cable, which will be connected with Shanghai. The importance of the convention lies in the fact that through it communication may be established with Europe via America.

Synchronous Motor Stability and Overload Capacity Curves.

By F. G. Baum.

NOTHING new will be presented in this paper, the attempt being made merely to put the matter in such shape as to bring out some important factors influencing the stability and overload capacity of motors. It will be assumed that the e. m. f. waves of motor and generator are sine waves, and that the generator runs at uniform speed. By the overload capacity is meant the percentage overload the motor will carry, and not fall out of step.

A motor may be said to be stable when changes of load do not cause temporary "hunting." Changes of load must necessarily be attended by an angular swing of the motor to the new position for equilibrium for the new load. The most stable motor generally will be the one in which the angular swing for a given change in load is least.

It is well-known that the tendency of a motor to "hunt" or fall out of step (neglecting differences in the e. m. f. waves or non-uniform rotation of generator) due to changes of load depends (1) on the impedance in the circuit on the motor side of the line where the impressed pressure is maintained constant; (2) on the ratio of the reactance and resistance in the impedance referred to in (1); (3) on the excitation of the motor relatively to that of the generator.

A motor may operate without "hunting" when the load changes not



FIG. 1.—METHOD OF DETERMINING SYNCHRONOUS MOTOR CURVES.

too rapidly, and yet surge or hunt temporarily, or perhaps fall out of step, if the load is added suddenly. These surgings, even if they do not throw the motor out of step, cause a disturbance of the voltage of the entire system, and although they last for only a few seconds they are to be avoided if possible.

When a synchronous motor is carrying no load the pressure delivered to it and the back e. m. f. of the motor are practically in opposition, independent of the excitation. If a load is added to the motor, it must fall back behind the impressed pressure through such an electrical angle as will allow enough current to flow into the motor to take care of the load. The electrical angle through which the motor armature must move is, of course, proportional to the mechanical angle through which the armature must swing. To show the stability, therefore, curves are plotted between the power developed by the motor P, and the angle ϕ_{12}, between the motor pressure E_2 and the pressure E_1 delivered to the motor circuit, the latter presumed to remain constant.

The impedance on the motor side of the point where E_1 is maintained constant is made up of the resistance and synchronous reactance of the motor and the resistance and reactance of the line between E_1 and the motor. Instead of giving definite values to this impedance, we will say that the pressure consumed by the impedance when 100 per cent current flows over it is a certain percentage of the impressed pressure E_1. Changing the percentage pressure consumed by the impedance will only change the scale of the ordinates of the

curves, as will be shown. The advantage of this method is that it makes the curves obtained independent of the voltage or current capacity of the particular motor under consideration. Different motors, however, operating under different conditions will have different relations between the reactance $L\omega$ and resistance R, which make up the impedance. The same set of curves are, therefore, worked up for different values of $\theta\left(=tan^{-1}\frac{L\omega}{R}\right)=88$ degs., 80 degs. and 71½ degs. These will cover all the ordinary cases met with in practice. Intermediate values may be interpolated without much error.

The curves have been determined graphically for different values of the back e. m. f., E_2, of the motor, assuming a constant impressed pressure. This impressed pressure is always taken as 100 per cent. The method of attaining the curves is clearly shown in Fig. 1. The current line is assumed fixed, which, with a given value of θ, fixes the direction of the resultant pressure E'. Since the current in the motor is proportional to the resultant of E_1 and E_2, lengths along E' are proportional to current. If the pressure consumed in the circuit of the motor side of the point where E_1 is maintained constant is, say, 37½ per cent of E_1, then when $E'=.375\,E_1$ we have full-load current, or 100 per cent current. When $E'=.75\,E_1$ we have 200 per cent current, etc. The curves are all worked out for 37½ per cent pressure consumed by impedance when 100 per cent current is passed over it. A very simple method will be given for determining the value E' for full load current. If the impedance is all in the motor, this corresponds to a short-circuit current of 2⅔ times full-load current on normal pressure. A change in the percentage pressure consumed will, as may be easily seen, merely change the scale of the ordinates of the curves. In getting the curves a large scale of pressures was taken to get the results as accurate as possible. A protractor with about 14 inches diameter will give good results.

The mechanical power developed by the motor will be $P=E_2 I\cos\phi_2$. The current, as explained above, was determined by scaling the value of the resultant pressure. In Fig. 2 are shown the curves between P and ϕ_{12}, the angle between E_1 and E_2, for the ratios $E_2=E_1$, and $E_2=1.2\,E_1$, E_2, 8 E_1, and for $\theta=.88$ degs. This corresponds, practically, to the cases where E_1 is maintained constant at the terminals of the motor, the copper loss of the motor being about 1.3 per cent, and the reactance pressure 37 per cent. The point at which E_1 is maintained constant may be taken at the terminals of the generator if the generator capacity is large in comparison with the motor load, and the transmission line is short. The left-hand scale in Fig. 2 is used for this case.

Suppose, however, that the generator capacity is about equal to that of the motor. Then the constant value E_1 is the excitation voltage of the generator, and the impedance of the generator must be included in the motor circuit. If the generator is similar to the motor, then the resultant pressure necessary to get 100 per cent current between the

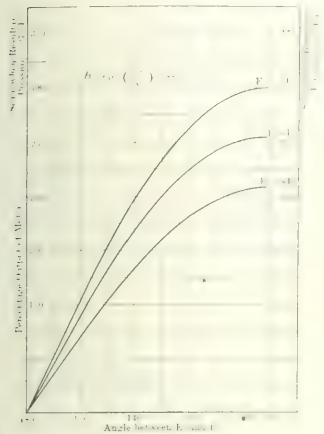


FIG. 2.—SYNCHRONOUS MOTOR STABILITY AND OVERLOAD CAPACITY CURVES.

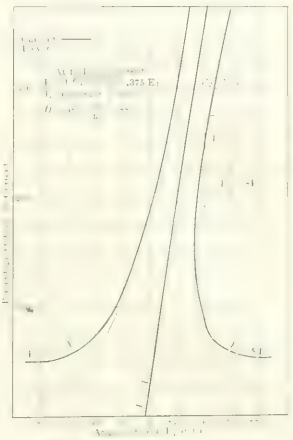


FIG. 3.—SYNCHRONOUS MOTOR CURRENT AND POWER CURVES.

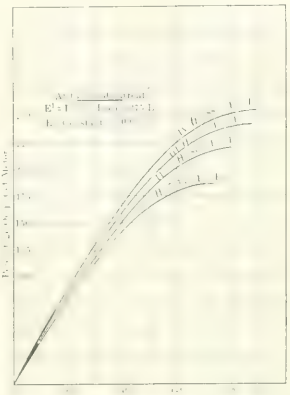


FIG. 4.—SYNCHRONOUS MOTOR STABILITY AND OVERLOAD CAPACITY CURVES.

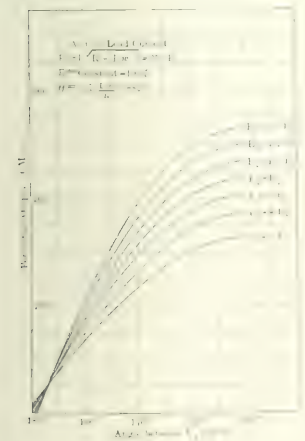
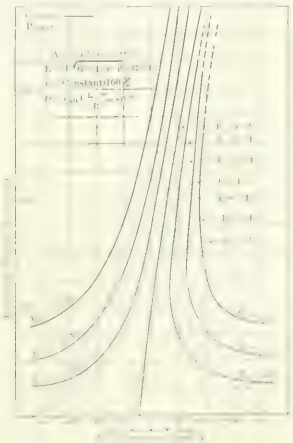
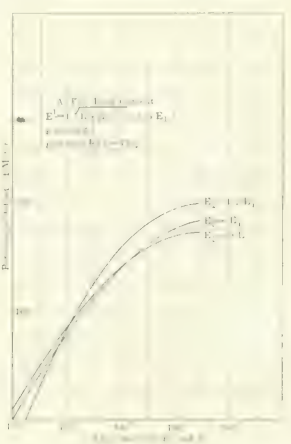


FIG. 5.—SYNCHRONOUS MOTOR STABILITY AND OVERLOAD CAPACITY CURVES.





two machines must be about $.75\,E_1$ ($=2\times.375\,E_1$). This means that we must reduce the scale of ordinates one-half. For this case the right-hand scale of Fig. 2 is used. This scale may also be used to study the parallel operating qualities of the two machines. The interchange of power for any particular electrical angular displacement between the two machines may be obtained. The corresponding mechanical angle is equal to the electrical angle divided by the number of poles.

Fig. 2 shows clearly the effect of the impedance in the circuit on the motor side of the point where E_1 is maintained constant. The overload capacity, as shown by the above example, varies inversely as the impedance. The effect of the excitation on the overload capacity is shown, as is also the effect of the excitation on the stability. The overload capacity is 0 per cent when $E_2=.8\,E_1$ is 25 per cent when $E_2=E_1$, and 50 per cent when $E_2=1.2\,E_1$. When $E_2=.8\,E_1$ the motor must swing through 75 electrical degrees, from no load to full load. When $E_2=1.2\,E_1$ the swing is 40 degs. The above is on the assumption of 75 per cent pressure consumed by impedance. For the same change in load, the tendency to shunt is shown to be greater, that is, the angular swing for a given change of load is greater near full load than at partial load. This tendency to hunt for changes of load near full load can be particularly noticed when synchronous motor generator sets or synchronous converters are operating on a street railway load, and especially on long distance transmission sys-

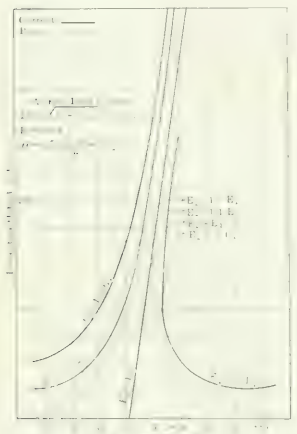


FIG. 8.—SYNCHRONOUS MOTOR POWER AND CURRENT CURVES.

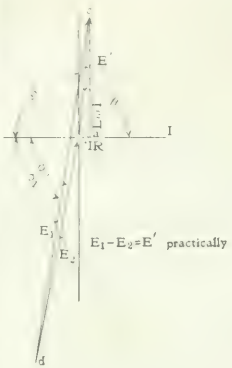


FIG. 9.—PRESSURE RELATIONS.

tems, where no provision is made for holding the pressure at the motor terminals approximately constant.

Fig. 3 shows the relation between P and ϕ_1 and I and ϕ_1, from which the power factor for any particular load may be determined. To determine the percentage current for any percentage load, move along a vertical line from the power curve to the corresponding current curve.

Fig. 4 shows the comparison of four different cases when the motor is excited equal to that of the generator. The percentage pressure consumed by the impedance for 100 per cent current is the same in each case, 37.5 per cent, but the ratio of $L\omega/R = \tan\theta$ is different. $\theta=85$ degs. corresponds to a copper loss due to the motor load of about 3 per cent. $\theta=80$ degs. to a copper loss of about 6½ per cent, and $\theta=71\frac{1}{2}$ degs., to a loss of about 11½ per cent. These losses are all, of course, on the motor side of the point where E_1 is maintained constant. We see here the advantage of large reactance compared to resistance, both as regards the angle through which the motor must swing for a given load and to get large overload capacity. The overload capacity is 80 per cent for $\theta=71\frac{1}{2}$ degs., and 150 per cent for $\theta=88$ degs. The curve for $\theta=90$ degs. will not differ much for the curve given for $\theta=88$ degs. A motor operating on a street railway load may momentarily be called upon to pull several times its normal load and, of course, if the overload capacity is smaller than the load called for, the motor must fall out of step.

Fig. 5 gives the relation between P and the angle between E_1 and [illegible] between E_1 and E_2, assuming $\theta=80$ degs., and Fig. 7 gives the curve for $\theta=71\frac{1}{2}$ degs. The curves between P and ϕ_1 and I and ϕ_1 are given in Figs. 6 and 8. To find the current corresponding to a given load, go along a vertical line from the point on the power curve to the corresponding current curve.

In practice, θ generally has a value between 80 degs. and 88 degs. The percentage pressure to overcome the reactance and resistance on the motor side of the point where E_1 is maintained constant will generally be larger than $.375\,E_1$, perhaps more generally $.5\,E_1$, for motors of moderate size.

From the curves given the importance of designing the transmission system for small copper loss, and especially of providing means by which the pressure at the terminals of the motor may be maintained practically constant, is made evident. The advantage of overexcitation of the motor and of small impedance is also apparent.

The percentage pressure consumed by the impedance on the motor side of the point where E_1 is maintained constant may be calculated from the impedance of the line and the synchronous impedance of the motor. The synchronous impedance of the motor is usually determined by running the motor as a generator and determining the excitation necessary to force full load current through the motor with the armature on short circuit. This determines the impedance with weak fields and will give a larger value than that corresponding to the working pressure. The following is a method for obtaining the percentage impedance pressure, when the motor is developing normal pressure, without disconnecting the motor from the circuit. This method may have been given before, but I do not recall having seen it.

Take all load off the motor, and set the excitation to the normal working value, E_2 being the volts corresponding. Now raise E_1 until one-half to full load current flows in the motor. The current should be as near full load as possible. Full load current may, however, distort the e. m. f. developed by the motor and cause it to hunt. If no hunting is produced full load current may be drawn. Since the load on the motor is small and the armature current large, the impressed pressure and the pressure developed by the motor are practically in opposition, and therefore the difference between E_1 and E_2 is the pressure forcing the current over the motor and line, from which the percentage pressure to give full load current may be calculated. Fig. 9 gives the pressure relations. The angle θ and ϕ_2 will generally be about equal. If it is not possible to raise the pressure E_1 because the circuit pressure must not be disturbed the following method may be used:

With the value of E_1 kept normal, lower the excitation of the motor until practically full load current is obtained in the motor. This will give a larger value for the percentage impedance pressure than we would get where the motor excited for a normal pressure, but will be accurate enough for practical purposes.

Condenser Effects With Rotating Disks.

By A. G. Dell.

BEFORE giving an account of some recent experiments on the rotating disk arrangement which has furnished the subject of several articles by the writer in these columns, a brief description of the apparatus in its present form will not be out of place.

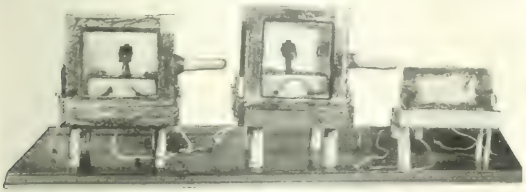
Referring to the accompanying illustrations, the second box has a spark-gap under a disk which is adjustable by means of a wire passing through rubber and seen extending out of one side. No. 1 has its spark-gap fixed, but since the photograph was taken it has been also made adjustable like No. 2. The boxes are sunk into the stands on which they rest to prevent moisture from penetrating the boxes, wood, glass, glue, putty, sealing wax, shellac, oil, rubber and woolen cloth. The sides of the boxes that do not contain glass are now covered with sheets of mica covered with shellac and the edges sealed with wax. The rubber tubes are double, and at present there is another tube on the outside not touching those shown; these are tied on the glass tube separately and sealed with wax. The legs of the boxes have pieces of cork glued on them, which may be cut off so that the disks may be leveled to suit the place on which they stand when used. Through the winter I have had no trouble, the calcium chloride contained in the boxes being but slightly active. In summer when the humidity is high and weather warm, without some outside protection to the boxes the calcium chloride becomes more active and the rotation slower.

There will be noticed a spark-gap attached to a small condenser.

I tried the effects of a spark between the condenser and each electrode under the disk, but the gap seemed to make but little difference whether opened or closed; there was possibly some slight changes in velocity, but none as to the direction of rotation. The edges only of the tinfoil appear roughly covered with wax. I have since covered the whole of the tinfoil. No. 1 has a small condenser attached under the stand. The connecting wire can be seen in the shape of a hook; it has since been removed. There are many ways the arrangement can be constructed. If the boxes were all glass and the stand also glass, the construction would be decidedly better.

With the rotating disk arrangement described, the following experiments were made with a small condenser. The condenser consisted of a piece of mica with tinfoil glued on each side, in such a manner that no sparks could pass around from one piece of tinfoil to the other, the tinfoil being covered with wax. One piece of tinfoil was earthed (which is not absolutely necessary, as the action is somewhat similar without the earth wire attached, but not quite so marked) and the other arranged so I could touch a connection thereof on the outside of the box containing the disk in the neighborhood of the spark-gap on either the + or — side. I found, when I touched the — side, the rotations were greatly increased in whichever direction the disk was rotating. The condenser in this case had no effect on the direction of rotation at starting, the effect being only on the velocity.

When the condenser was touched to the + side, the rotation was greatly diminished, but in one direction, from — to +, the velocity was slow and constant with a stiff resistance to any change of direction. I will state I tried to make it rotate from + to —, but failed



CONDENSER EFFECTS ON ROTATING DISKS.

in all instances, except one. When it was rotating from + to — with a very great velocity and the + side was touched it checked up, and reversed its direction, and maintained the slow constant velocity from — to +. Why it should have rotated with a very slow velocity from + to — in the one case I am unable to state; it may be possible I overlooked something at that time. When rotating from — to + with a great velocity, and it was touched on the + side, it slowed up to the low velocity, as described above. When a Geissler tube was inserted between the tinfoil on the one side of the condenser and the earth, the anode and cathode discharge were well developed. When the condenser was touched to the — side, the anode was next the tinfoil, when touched to the + side, the cathode was next the tinfoil.

A ground wire acted apparently in all particulars with respect to rotation as did the condenser, but when the Geissler tube was used in this case, and the discharges to reach the earth had to pass through it, the anode and cathode were somewhat alike in appearance, both filled with a violet light mixed with red. When the whole arrangement was removed from the room in which the experiments were made, and placed near the earth, a very close ground connection being made with a short wire, there was no effect, when the spark-gap on either one side or the other was touched when the wire was not connected to earth, but as soon as it was grounded and the spark-gap was touched, the same effects as above described were obtained.

A dry and a moist piece of wood or cardboard placed, one under one electrode and the other under the other of a disk, act under certain conditions in the same manner as the condenser or ground connection, but to a lesser degree.

In the above experiments where a condenser or ground connection was used on the — side, the velocity of the disk became so great that it was very difficult to tell for a certainty which was the greater, but at several trials I thought the velocity when the condenser was used was the greater. There may be more dissipation of the charges with the ground connection than with the condenser.

With the poles of an influence machine connected up to the electrodes under a disk, a pole to each electrode, I obtained the same rotations in every way as when a disk was connected to an induction coil and no condenser used in the secondary of the coil. In this arrangement there were no sparks from one electrode to the other, but opposite star-like discharges from the points under the disk were seen in the dark. The discharges appeared to be in all respects like continuous high-potential ones, and not impulses. It would seem to indicate that the same laws which govern high-potential impulsive spark discharges also govern high-potential continuous-current discharges. The two Leyden jars attached to the influence machine seemed to be without effect on account of its having to excite itself, and there being present two points under the disk, which carried off the excitations nearly as fast as produced.

Modern Electric Hoists and Cranes for Steel Works.

BY DR. A. KREBS.

DURING recent years the size and productive capacity of steel works have been increased so enormously that an urgent need has made itself felt for strong, suitable and easily operated lifting and transporting apparatus, which work rapidly and with great precision. That more and more of these apparatus are being



FIG. 1.—ELECTRIC HOISTS AND CRANES.

operated by electricity is due to the great economy incident to its use, since economy is a controlling factor in all modern appliances.

A good example of a carefully planned installation of such apparatus is offered by the new Belgian foundry, "Société anonyme des Aciéries d'Anvers," which is being erected at the mouth of the Schledt. These works take Spanish iron ore, and English coal from

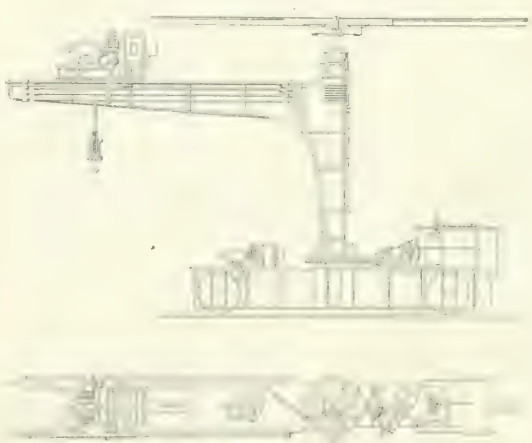


FIG. 2.—ELECTRIC CRANE.

the company's own mines, directly out of the steamships, smelt the material and then load the finished product onto vessels.

A part of the interesting installation in this foundry is shown in Fig. 1. In several parallel buildings each 20 metres in width the ingots are made ready for the rolling mills. In Fig. 1 two such buildings are shown. At the right is shown a large 40-ton crane *A*, carry-

ing a crucible which holds 30 tons. The latter is supported by two chains and is guided at the two sides by heavy vertical supports fastened to the crane, so that there cannot be any oscillation of the crucible while the crane is being moved about. This also makes it possible to manipulate accurately the crucible while the metal is being

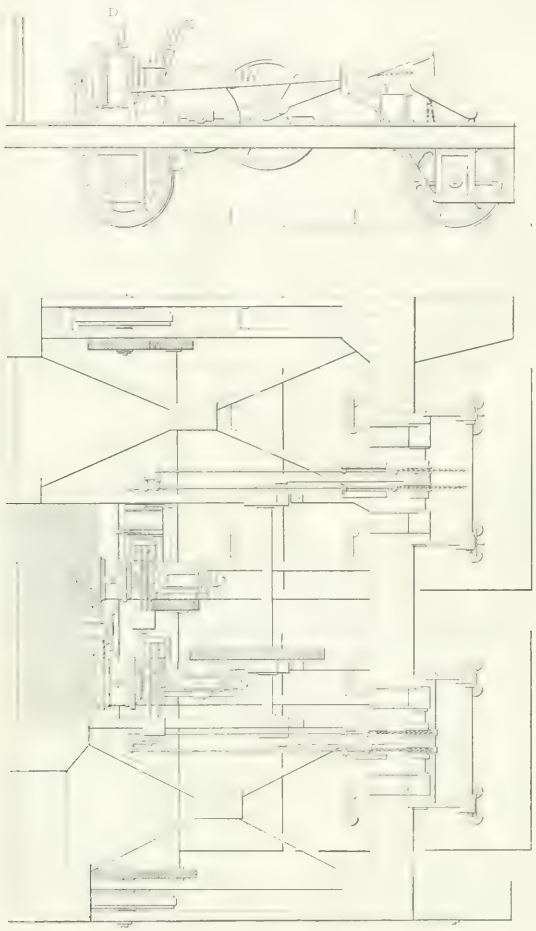


FIG. 3.—ELECTRIC HOISTS AND CRANES.

poured. A transverse beam with hooks, capable of supporting 40 tons, may be hooked to the chains, and the crane may then be used for transporting other loads. For smaller loads up to 6 tons an electrically operated windlass working at a greater speed and attached to the crane is used. The cast ingots are taken hold of by the so-called "Velocipede" crane *B* in the left building, which deposits them into the heated furnaces *C*.

This crane, shown in Fig. 2, is not equipped like most of the movable turning cranes, with a stationary unloading device, but is provided, as in the case of a traveling crane, with a traveling carriage operating along the tracks on the extension arm, and capable of supporting 3.5 tons. The extension arm turns about a heavy, forged, hollow shaft, through which the wires pass, and on account of the large diameter of 13 metres through which it can swing the crane can be used equally well in both buildings. The crane can, furthermore, be moved along the entire length of the building.

There are, therefore, four distinct movements, i. e., (1) the traveling of the entire crane; (2) the turning of the extension arm; (3) the traveling back and forth of the carriage, and (4) the raising and lowering of the load. Each movement is effected by a special motor, governed by a universal controller, by means of which several movements can be executed simultaneously. This, together with the movable carriage, insure an exact and rapid maneuvering of the crane, as for the movements in three directions, there are four means provided.

There is also in this building a so-called "cover lifting car," which raises the lids from the furnaces *C* and lays them to one side, while the "velocipede" crane, or the 7.5-ton traveling crane operating above it, place the ingots into the furnaces and removes them, transporting them, to the rollers.

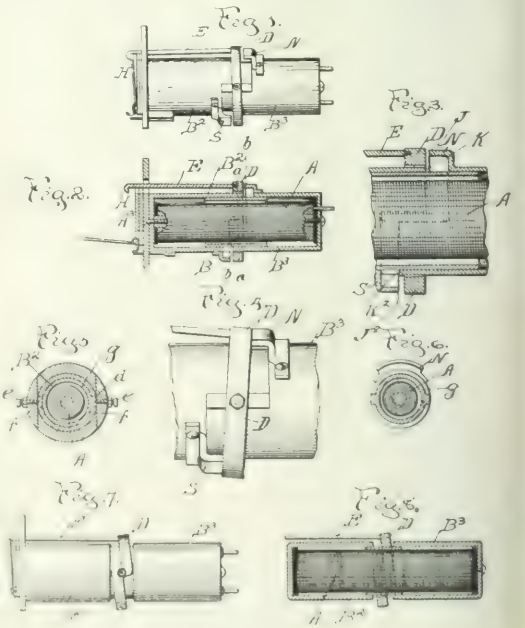
As shown in Fig. 3, there are situated in the building two parallel rows of furnaces, each of which is covered by a fireproof cover, weighing about 1500 kg. The "cover lifting car" is so arranged that it can lift off either one or two adjacent covers at the same time, as may be desired and transport the same. The operator can put the one pair of hooks out of action by moving the lever *D* to the position *E* (Fig. 3), and then the other pair lifts off and replaces the covers. In the same manner, both levers may be set in the position *E*, so that the car may pass over the covers which have been deposited behind the ovens. The lifting and traveling operations are effected by separate motors, but both operations can be carried on simultaneously. The operator's platform is so arranged that everything is in clear view, especially the levers which operate the pairs of hooks. The 7.5-ton traveling crane, spanning 19.05 metres, is operated by three motors and serves mainly as an auxiliary to the "velocipede" crane described above.

Very high speeds have been chosen for all these lifting appliances, so as to correspond to the rapidity of all the other operations in these steel works. At times the traveling speed is 100 metres per minute and the lifting speed 15 metres per minute. All lifting, turning and traveling drives are equipped with automatic, electromagnetic safety brakes; all movements are arrested at the limits by means of automatic switches.

The above equipment, including the mechanical as well as electrical portion, were furnished by the Gesellschaft für Elektrische Industrie, Karlsruhe, Baden. In addition to the above devices, the same company furnished to the above-mentioned steel works nine heavy cranes, and more than 70 electric motors having a total capacity of about 1600 horse-power, all of which are operated by 190-volt, three phase currents.

New Telephone Patents.

In contradiction of the above title there is only patent to be commented on. The sole contribution of the issue of March 18 to telephony is an invention due to Mr. Frank B. Cook, of Chicago, which



FIGS. 1 TO 8.—COOK'S ELECTROMAGNETIC APPARATUS.

he terms an "electromagnetic apparatus," and is in reality a novel form of drop or annunciator in which the object sought is extreme sensitiveness. Mr. Cook encloses his magnet coil in an iron shell

divided into two parts and pivots the armature, consisting of a ring also divided (magnetically) into two parts, between them. Thus the poles of the tubular magnets are brought into close proximity with the armature, and maximum pull and sensitiveness are obtained.

Referring to the accompanying illustrations, Fig. 1 is a side elevation of the complete drop; Fig. 2 a section of Fig. 1; Fig. 3 an enlarged section of the central portion of the drop; Fig. 4 an exterior view of Fig. 3; Fig. 5 a cross-section on the line *aa* of Fig. 1, and Fig. 6 a cross-section on the line *bb* of Fig. 1. Figs. 7 and 8 are an exterior view and section of a modified form of the improved drops. The tabular magnetic shell *B* is divided into two parts, B^2 and B^3, having pole-pieces *K* and K^2, *J* and J^2. The ring amature *D* is divided into two parts by diamagnetic pieces *ff*, through which it is pivoted by screws *ee* (Fig. 5) to diamagnetic pivot-pieces *dd*. By these means the armature is magnetically insulated from shell *B* and virtually consits of two mechanically connected armatures. The pivot-pieces *dd* are held by diamagnetic shield *g*. The poles of B^2 and B^3 are formed as clearly shown by the angular pieces *J* and J^2 and the cutting away at *K* K^2. The weight of the latch-lever *E* causes *D* to remain away from *J* J^2, as shown in Fig. 3.

When the drop is energized *K* and K^2 exert a pull immediately upon *D*, which pull is supplemented and increased by *J* and J^2. The armature is always the same distance from *K* and K^2, and always within their field. Figs. 7 and 8 shows a form of the drop in which pole-pieces *J* and J^2 are not employed, in which case it is not necessary to divide the armature into two pieces as shown in Fig. 3. The armature is always in close proximity to the poles of the magnet, and a maximum pull is attained with a minimum of current. An additional advantage of this construction is that as the coil is enclosed in a heavy metallic shell, should it be burned out the shell would protect adjoining apparatus. This form of drop would undoubtedly be sensitive, but it also would be rather expensive to make.

The Annual Report of the American Telephone and Telegraph Company.

The annual report of the American Telephone & Telegraph Company was issued to the stockholders this week, and aside from its usual importance has a further interest in being the first report to which is attached the name of Mr. Frederick P. Fish, as president. The report is for the year ending Dec. 31, 1901, and some of its figures have been more or less anticipated in data already made public. But the document as a whole presents a clear and concise statement of Bell telephone conditions at a period of unexampled activity. President Fish in submitting the figures says:

The increase in the number of subscribers to the exchanges of the companies which are licensees of this company was, for the year 1901, 219,767, exceeding by more than 50,000 the increase for the year 1900. The increase in the net output of instruments, including instruments for toll stations, was 573,194, or about 30 per cent, as against an increase of 372,311, or 23 per cent for the year 1900, the gain for 1901 being greater by more than 100,000 than that of any previous year. The increase in toll lines in 1901 was 9,372 miles of pole line and 108,666 miles of wire, the miles of toll line having more than doubled in six years, and the miles of toll line wire having nearly doubled in three years.

The increase in the use of the Bell telephone is shown by the fact that, while in 1900 the daily average of toll connections was about 148,528, and that of exchange connections about 5,668,986, the daily average in 1901 of toll connections was about 187,378, and of exchange connections about 7,531,761, the total of both toll and exchange connections in the latter year reaching 7,719,139 per day.

In these latter figures are included the toll connections of the long distance system owned and directly operated by this company. At the close of 1901 the long distance system comprised 14,886.35 miles of pole line and cable, and 198,684.26 miles of wire, a gain during the year of 2,458.72 miles of pole line and cable and 31,273.87 miles of wire.

The long distance lines extend from nearly all the important cities on the Atlantic seaboard throughout the country as far west as St. Paul, Minneapolis, Omaha, Kansas City, Little Rock and New Orleans, forming main lines over which telephonic communication between practically all of the exchange stations within the territorial limits above defined may be established.

The efficiency of these lines will be largely increased by the use of "loading coils," a new invention which has been acquired by this company, and which has already been put into use on overhead lines with satisfactory results. These loading coils are also likely to be of substantial value for the longer stretches of underground cable, and careful experiments in this direction are now under way.

The investment in line construction, equipment and supplies for the long distance system up to Dec. 31, 1901, was $19,116,209.40, an increase over the previous year of $2,964,188.68, while the gross revenue for 1901 shows an increase of 16.72 per cent over that of 1900, the increase for that year over 1899 having been 13.45 per cent. In considering this increase in gross revenue, it should be borne in mind that on July 1, 1901, a reduction of the initial message period from five minutes to three minutes was extended over the whole system with, of course, a proportionate reduction in rates.

The extensions of this long distance system during the year 1901 were materially greater than in any previous year. This development must be continued to supply, so far as possible, the public demand for service of this character.

The high standard of construction which has been set by this company and its licensees has been fully maintained, and more underground conduit and cable and more aerial cable have been installed during the year 1901 than ever before in a like period. More than half of the mileage of the exchange wires throughout the country is now underground. The erection of new buildings, specially designed for telephone purposes, and the replacement of the old type of multiple switch boards by relay boards equipped with electric lamp signals and central battery plant, to which reference was made in the last report, has continued throughout the year. At the present time practically all the principal exchanges, and many of those of minor importance, are furnished with the new equipment. This places them structurally on a permanent basis, enabling them to give proper service at a reasonable cost.

To meet the growth of business, and to provide for the necessary improvement and development of the plant, a corresponding outlay has been required. In new construction and in real estate this company and its licensees, during the year 1901, expended upwards of $31,000,000, of which about $22,000,000 was upon exchanges, more than $7,250,000 upon toll lines, and about $1,750,000 upon real estate. The funds contributed by this company for this growth have, for the most part, been obtained by an issue during 1901 of $15,550,000 of new stock and of $5,000,000 of its collateral trust 4 per cent bonds. The investment is of a permanent character, is required for the assured future development of the business, and is one which brings in an immediate return. It is believed that there can be no question as to the wisdom of such expenditures, which must be continued as may be necessary to meet the demand of the public for telephone service.

That the system may be complete and of the greatest utility, it is necessary that as many persons as possible should be so connected to it as to be able to talk or be talked to by telephone. This is not only in the interest of the small user, but even more in that of the large user, whose advantage as a telephone subscriber is largely measured by the number of persons with whom he may be put into communication. It is the duty as well as for the interest of this company, that proper facilities be supplied to the constantly increasing number seeking connection with the Bell system.

As a consequence of these outlays and of the great development of the plant, the value of the telephone service to the subscriber is largely increased. His service is better, and will continue to improve, and the number of those to whom he may talk, and the extent of territory over which he may talk, are substantially greater from year to year. At the end of 1901 there were nearly 900,000 telephone stations which could be connected to the long distance system, and consequently to each other; a gain of about 180,000 for the year. At the end of 1898 there were only about 400,000 which could be so connected.

As the business has increased, and as economies made possible by improvements in apparatus and in methods of operating have been introduced, it has become practicable to offer telephone service at varying rates, some of them far below the maximum, thus satisfactorily accommodating those needing and desiring a telephone, but whose use of it is so small that they could not be expected to pay the rates which must be charged, and properly, to the larger users whose substantially greater demand for service can be complied with only

at a greater cost to the telephone company. During the ten years last past, the average price per telephone to the Bell exchange subscribers throughout the country has been reduced so that at the present time the subscriber on the average pays but two-thirds as much as ten years ago, although he has the advantage of much greater facilities and much improved service.

The introduction of schedules of measured service rates, enabling the user to secure the service which he requires at rates determined by the number of messages for which he contracts, has been distinctly effective in enlarging the field for the telephone. This measured service rate system, which is primarily based upon the extent of use of each particular telephone, distributes the charges and cost of service among the subscribers according to the amount of service in each case; a principle analogous to that upon which the charges for postal, express, and telegraphic service are distributed. There can be no question as to the fairness and logical character of the principle. This method of charging is satisfactory to the subscribers, as well as to the telephone companies, and it is believed that it will ultimately become the standard method, at least in the larger exchanges. It is already very extensively employed.

Competition from telephone companies not associated with this company has existed for several years, and is likely to continue in some places for some time to come. While it has in some localities affected the licensees of this company disadvantageously, by reducing, for a time at least, the number of their subscribers and forcing them to meet competitive rates that are not based upon a proper recognition of the cost of doing the business or an adequate appreciation of the amount that should be set aside from earnings for maintenance, reconstruction and depreciation, the consequences of the competition to the business as a whole, have not been of serious moment. The public in each community will determine for itself whether it is for its advantage that there should be two telephone exchanges serving one body of people. It would seem as if but one conclusion on this point was possible.

In any event, the comprehensive character of the system of this company and its licensees, organized as the system is to afford uniform and adequate telephonic intercommunication throughout the country, and the intention and ability of the company and its licensees to give good service at fair rates, must insure the permanency and prosperity of their business in the future as in the past.

Although not falling within the year 1901, it may be proper to say that, since the opening of the current year, the Western Telephone & Telegraph Company has been organized, and has taken over from the Erie Telegraph & Telephone Company the controlling interest in the Cleveland Telephone Company, the Wisconsin Telephone Company, the Northwestern Telephone Exchange Company, the Michigan Telephone Company and the Southwestern Telegraph & Telephone Company, and that a controlling interest in the Western Company has been acquired by this company.

Mr. Fish reported the number of instruments in the hands of licensees under rental as 552,720 in 1892, an increase of 40,313 over the previous year, and as 2,525,606 in 1901, an increase of 573,194 over the previous year. The total miles of pole line on Jan. 1, 1902, were 110,459, and of miles of wire 716,265, showing the increases noted above. The average daily number of toll connections was 187,378, or a total per year of 60,300,000, yielding a total revenue of $10,725,600, but not including regular earnings included as American Telephone & Telegraph in the balance sheet.

The general growth and condition of the business is indicated from the following table:

BELL EXCHANGE STATISTICS.

	Jan. 1, 1893.	Jan. 1, 1901.	Jan. 1, 1902.	Increase for year.
[illegible]	812	[illegible]	[illegible]	53
[illegible]	1,189	[illegible]	[illegible]	105
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Miles of wire on buildings..	14,980	16,833	17,947	1,114
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Miles submarine wire.....	1,336	4,203	4,200	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total circuits.....	201,322	508,262	592,467	84,205
Total employees.....	9,970	32,837	40,864	8,027
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

As already stated above, the estimated number of exchange connections daily in the United States, made up from actual count in most of the exchanges, was 7,531,761, or a total per year of 2,425,000,000. The number of daily calls per station in different exchanges varies from 1 to 20, the average throughout the United States being 7 4-10.

The balance sheet submitted is as follows:

DEBTOR.

Construction, equipment and supplies	$19,116,209.40
Telephones	5,113,408.60
Real Estate	1,665,598.39
Stocks and bonds	84,339,912.43
Patent account	150,000.00
Machinery and tools	35,987.92
Cash and deposits	1,694,342.10
Bills and accounts receivable	10,972,535.41
American Bell Telephone Company	22,110,400.00
	$145,198,394.25

CREDITOR.

Capital stock	$104,650,600.00
Surplus	2,764,668.50
Bonds	15,004,500.00
[illegible]	4,047,476.94
Accounts payable	2,760,938.56
Contingent	15,970,210.25
	$145,198,394.25

The accounts payable include $1,632,154.50, being the January dividend.

EARNINGS.

	1900.	1901.
Dividends	$3,846,821.67	$4,988,207.63
Rental of instruments	2,427,037.52	2,647,907.64
Telephone traffic	3,027,171.85	3,533,446.74
Real estate	31,824.67	36,680.16
Interest	201,643.50	399,579.26
Miscellaneous	.....	995.51
	$9,534,499.21	$11,606,816.94

EXPENSES.

Expenses of administration	$746,259.48	$772,424.30
Legal expenses	85,134.07	99,138.04
Interest and taxes	1,376,199.94	1,276,559.20
Telephone traffic	1,840,847.86	2,060,409.54
	$4,048,441.35	$4,208,531.08
Net revenue	$5,486,057.86	$7,398,285.86
Dividends paid	4,078,601.25	5,050,023.75
Balance	$1,407,456.61	$2,348,262.11
Carried to reserves	$937,258.22	$1,377,650.74
Carried to surplus	470,198.39	970,611.37
	$1,407,456.61	$2,348,262.11

The foregoing is the comparative statement of earnings and expenses, furnished also by Mr. W. R. Driver, the treasurer of the company.

Slaby-Arco Wireless Telegraphy in Germany.

A [illegible] dispatch to a New York daily paper from Berlin, dated March 18, says: Emperor William has issued an order, as a result of recent tests, in which he designates the Slaby-Arco system of wireless telegraphy for exclusive use in the navy and by the coast signal stations. It is expected that the Slaby-Arco system will be exclusively used by the German merchant marine. It is said among electrical engineers here that the Government is drafting a bill to regulate wireless telegraphy and tending to uniformity of service, and that the effect of this bill will be to exclude the Marconi system from Germany. The newspapers here say that this bill will thwart Marconi's efforts, through the strong capital behind him, to monopolize the wireless telegraphy business of the world.

CURRENT NEWS AND NOTES.

CHICAGO ELECTRICAL ASSOCIATION.—Mr. Peter Junkersfeld will read a paper on the four-wire three-phase distribution of the Chicago Edison Company before the Chicago Electrical Association, April 4, at the regular meeting room, 1739 Monadnock Block.

OVERHEAD WIRE CRUSADE.—Commissioner Dougherty has given orders that the overhead wires in Manhattan be cut. The companies so far affected are American District Telegraph, Postal Telegraph, New York Telephone, Manhattan Fire Alarm, Pneumatic Fire Alarm and Electric Fire Co., all of which companies declare that they have received no word from the commissioner.

SUBWAY FOR MONTREAL.—Application is to be made to the Dominion Parliament for the incorporation of the Montreal Subway Company, to construct a subway under the river St. Lawrence, from a point in or near Montreal to the south shore, with power to use it as a railway tramway, driveway, or footway, to charge tolls, and to construct approaches and other necessary terminal facilities; also, to carry telegraph, telephone, electric light and power wires.

RATING OF WATTMETERS FOR THREE-PHASE SYSTEMS.—In curves used in illustrating Mr. Brandeis' article under the above title, published in our issue of March 15, an engraver's error appears. One of the curves has two designations, viz.: "Power Factor Curve," and "Multiplier curve *W I* readings." The latter should have been applied to the first curve on the left, running downward. The "Power Factor Curve" is the one whose direction is almost vertical from the top downward.

IOWA ELECTRICAL ASSOCIATION.—The Iowa Electrical Association will meet at the Grand Hotel, Cedar Rapids, on April 9 and 10, 1902. Among the papers presented will be those on the following subjects: "An Analysis of the Cost of Supplying Electric Current," "Good Money Thrown Away," "The Comparative Merits of Operating Open and Enclosed Street Arc Lamps," "Results of Experiences in Furnishing Free Lamp Renewals." Mr. Murray C. Beebe, chemist of the Nernst Lamp Company, will also give an address on the Nernst lamp.

INTERCEPTING "MARCONIGRAMS."—A cable dispatch from London of March 18 says: The *Globe's* naval correspondent reports that on her recent cruise along the Irish coast the Britilsh battleship *Revenge* was fitted with a wireless telegraph apparatus, and received a number of private Marconi dispatches passing between mail steamers and the shore. The correspondent says he understands that the Admiralty proposes to make an attempt to intercept wireless messages from an experiment station across the Atlantic, with the view of determining whether Marconi has perfected his syntonic system.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.—The first meeting of the above Association will be held in Chicago, as previously announced, on April 9, 10 and 11. The Sherman House is the headquarters. It is stated that some 5000 invitations have been sent out to representative telephone men in the seven Middle and Northern States specially contemplated in the plan of the organization. Mr. I. A. Lumpkin, of Mattoon, Ill., is the treasurer of the Association, and Mr. J. J. Nate, of Chicago, is the active member of the local committee conducting arrangements. Up to the time of going to press, no details as to programme, etc., have reached us, but the work of formulating it and of providing entertainment is now in progress.

A WIRELESS TELEGRAPH RELAY.—The steamer *Philadelphia*, of the American line, which arrived last week at New York, was the "repeating station" of the Cunarder *Campania*, racing with her for New York, and the Cunarder *Lucania*, bound for Queenstown. It was in latitude 42.02 to 44.30 and longitude 38.40 to 40.30 that the experiment was made, and it was satisfactory. Many messages were relayed by the *Philadelphia* in both directions. The *Campania* caught the American liner about 90 miles away, and the two ships talked awhile. Knowing that the *Lucania*, eastward bound, was somewhere in the zone, the *Campania* tried to reach her, but failed. Then she asked the *Philadelphia* to signal, and as soon as the American liner caught her the "relay system" became a fact.

WARNINGS OF FIRE BY TELEPHONE.—The San Gabriel forest reserve in California will be protected this summer by a force of 25 rangers, who will use telephones to give warning of fires. A telephone system with 50 stations is being constructed to cover the entire district. The stations are occupied by the rangers, who carry portable telephones while patrolling the reserve and can cut in on the nearest wire in case of fire. The preservation of the forests is of vital importance to the irrigating and electric power interests depending upon the San Gabriel River for their water supply. The watershed thus protected is quite extensive.

NIAGARA POWER IN TORONTO.—The bill introduced in the Ontario Legislature for the purpose of giving the City of Toronto the right to acquire and distribute electric power from Niagara Falls, has been shelved in committee. The opposition to the measure was based on the uncertainty of its effect on other towns and cities. It was therefore deemed advisable to defer action for a year in order to study the matter in all its bearings. According to our Canadian correspondent, it was feared that Toronto "would derive so much advantage from cheap electricity as to be in a position to draw industries from other communities and make the rest of the Province a desert."

THE CHICAGO TELEPHONE INVESTIGATION.—For some time a special committee of the Chicago City Council has been investigating the subject of telephone rates and the cost of telephone service. The committee seems to be rapidly drifting toward the conclusion that a measured service is the proper thing, each subscriber paying for the service he gets. An investigation of the company's records has revealed to this committee, as it must to any one, the enormous number of calls many business houses make with the flat rate unlimited service, and the comparatively low rate they pay for the service they get in proportion to other subscribers who do not use the telephone so much.

BRITISH NATIONAL LABORATORY.—A cable dispatch from London of March 19 says: The Prince of Wales will to-day open the new National Physical Laboratory. It occupies the remodeled old royal palace, called Bushey House, and new outlying buildings, at Teddington-on-the Thames. The plan originated with Lord Kelvin and the Government. The control of the new institution is vested in a committee of members of the Royal Society and other learned bodies. The three chief departments will be those of electricity, thermometry and chemistry. All will be fitted with the latest and most perfect scientific instruments.

SUPERPOSED ELECTRIC CURRENTS.—A patent dated March 18, issued to Frederick Bedell, describes apparatus to be employed in a system involving the transmission of both direct and alternating currents over the same line conductors, and the utilizing of either the direct or the alternating current, as may be desired. In a previous patent issued to the same inventor it is shown that there is less line loss for a given amount of energy carried, if an alternating current is superposed on a direct current, and this patent relates to means for utilizing at a receiving point, either the direct or the alternating current, or both, as may be desired. When such a system is employed it is obvious that the line wires will carry alternating or direct current according to the demands of the translating devices connected thereto, the resultant line current being variable and unsymmetrical in reference to the zero line, and so be either a direct or an alternating current according to the predominance of one current or the other. At the direct current receiving devices choking coils are included having a high self-induction, which will readily permit the passage of the direct current, but will effectually shut off the alternating current. The device for receiving alternating currents to the exclusion of direct currents, consists of a transformer in connection with condensers; or if condensers are not used, high resistance may be inserted in the primary, which may be made so high that only a negligible amount of direct current will flow. To avoid the effect of any direct current that may flow through the primary, the core should contain an amount of iron corresponding to the value of the direct current component of the current plus the amount corresponding to the alternating current. A description is also given of a rotary converter adapted to be operated in connection with the present sys

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The list of papers to be read at the meeting of the Electro-Chemical Society at Philadelphia, April 3 and 4, printed in our issue of last week, has received the following additions during the past week: "Electrolytic Refining of Composite Metals," by Titus Ulke; "Manufacture of Bisulphide of Carbon in the Electric Furnace," by Edward R. Taylor; "A Novel Concentration Cell," by Prof. H. S. Carhart. These additions raise the total number of papers to be read to twenty-three.

A FREAK PATENT.—A patent issued March 18 to E. C. Woodell describes an arrangement whereby a draught created by an electric heater in the base of a chimney is employed to drive a fan located in a flue connecting with the chimney, which in turn drives a dynamo. The inventor naively remarks that he would have it distinctly understood that he does not wish to limit himself to the use of an electric heater in the base of the chimney, as it is perfectly obvious that any other form of a heater may be used. He prefers, however, an electric heater connected up with a suitable number of batteries.

TUBES AND CYLINDERS BY ELECTRODEPOSITION.—In the manufacture of tubes and cylinders by electrodeposition heretofore, metal mandrels or cylinders have formed the cathode. The object of a patent issued March 18 to Elisha Emerson is to reduce the cost incident to the employment of such cathodes, a stock of which for a plant to produce a considerable variety of tubes or cylinders would be, it is stated, too costly to be commercial. In the process described, a thin sheet of metal is obtained by electrodeposition, which is formed into a tube or cylinder by uniting the edges, and then placed on a support in an electrolytic vat and further metal deposited until a required thickness is secured.

NERNST LAMP TERMINAL.—A patent issued March 18 relates ot a process for obtaining a durable contact between ordinary and electrolytic conductors. Oxides such as are employed in the manufacture of an electrolytic conductor itself are subjected to a very powerful heat, which transforms the original materials into the condition of vapors. When condensed and cooled the mass is ground to a fine powder, which is then made into contact pieces of any form desired, which may be a paste or cement, or small rods or tubes. In applying these they are placed over the ends of the incandescent bodies and of the conductors. The joints produced may be further strengthened by heating them in an electric arc, thus producing fusion between the electrolytic body, the cement and the conductor.

WIRELESS TELEGRAPHY.—The daily newspapers have devoted considerable space to some experiments in wireless telegraphy recently made near Washington, D. C., by one Nathan Stubblefield, of Lexington, Ky., but the accounts are vague as to the circuits and apparatus. In one case it is stated that instruments were established in a house near the Potomac shore and a wire led to the water, and on a steamer two or three hundred feet from the shore short sentences and parts of sentences could be heard. In some land tests "Members of the party scattered, each group being provided with a receiver and a pair of wire rods attached to twenty feet of ordinary telephone cord or wire. From this cord were hung the receiver and transmitter, such as are used on any ordinary telephone. The rods were planted in the ground at the will of those handling them, and sound was distinctly transmitted. Complete sentences, figures and music could be heard at a distance of several hundred yards from the shore station." The reports state that the instruments are of the familiar type, consisting of a transmitter and receiver, a buzzer or call bell, an induction coil for the intensification of the message, two rods of about three feet in length and a length of wire connecting two poles. The experiments appear to have been along the same lines as those conducted by Preece about ten years ago, when wireless telephonic communication was maintained over a distance of over three miles through electromagnetic induction.

CONVERTING WOOD INTO DEXTRINE, GLUCOSE AND ALCOHOL.—A patent issued March 18 to P. Magnier, of Billancourt, and P. A. Brangier, of Estrées, France, describes a process for obtaining dextrine, glucose and ethylic alcohol by what is claimed to be an inexpensive treatment of wood, wood fibre or shavings. In a preliminary process the wood, reduced to a pulp, is subjected at the temperature of the boiling point to the action of hypochlorite of calcium and hydrate of lime in water. Afterwards the material is treated, at the temperature of the boiling point, with water acidulated with mixture of about 2 per cent of sulphuric and phosphoric acids, after which the liquid and pasty substances are enclosed in a closed digester where they are subjected to a temperature of about 150 degrees C. for some time. The liquid is then neutralized by calcium or barium. If it is only desired to obtain dextroglucose there is added to the substance for the purpose of bleaching it, water charged with sulphurous acid and a little zinc. If instead of glucose alone it is intended to produce ultimately alcohol, the sulphurous acid is not added, but an electric current is passed into the liquid while under pressure, a little wort such as beet root or the like being added to obtain a maximum return. It is stated that the principle of electrolysis under pressure, which forms the essential of this process, may be applied to all non-fermentable products capable of being thereby converted into fermentable sugar, and consequently into ethylic alcohol.

AN EARLY TRANSFORMER.—Among the patents issued March 18 is one to Prof. Elihu Thomson and Edwin J. Houston under the title of "Electric Lighting System," for which the application was filed Feb. 19, 1887. The preamble states that the invention relates to an induction apparatus whereby electric currents—alternating, interrupted or varied—in one circuit may produce electric currents in a separate or independent circuit, to be utilized in the production of electric light or for other purposes, such as motive power; and that it provides a means whereby electric energy generated at one point and supplied to an electric circuit may be utilized at another point in the shape of a current of low e. m. f. for the production of electric light on a separate circuit. Furthermore, that the invention also affords a means whereby a single alternating current generated at one point and flowing in an electric circuit, may be utilized in the production of an indefinite number of lights at any other point—the character of the current operating the lights being adapted in quantity to the light apparatus, and not being necessarily of the same character or of a higher e. m. f. than the main or inducing alternating current, as would be the case if induction coils of the ordinary construction were employed. It is stated that in practice, a single varied, intermittent or reverse current is employed through the agency of coils of insulated wire to magnetize a soft iron core, by means of which varied, interrupted or reversed currents are set up in one or more peculiarly constructed coils surrounding the said core, these latter currents being employed through the agency of any suitable device to produce the light or lights required, or to perform other work. As illustrated, the core of the transformer is constructed by rolling a sheet of thin iron into a closed spiral, the sheet being preliminarily coated with varnish or some other pliable non-conducting arrangement. On this core is a winding connected with the source of alternating current, and around this winding are shown several independent secondary windings, one of which is illustrated connected with an arc lamp. It is stated that these latter coils differ from the secondary coils in the well known Ruhmkorff apparatus in that they require no special insulation, since the e. m. f. force of the current developed therein is comparatively low. The patent carries 13 claims, in which stress is laid upon the electrical resistance of each secondary being lower than that of the translating devices fed from the same, and upon the resistance of the secondary being less than that of the primary; also upon the employment of two or more secondaries, each having independent terminals. One claim is on an induction coil wound with two conductors of substantially the same gauge, one of which is connected with a source of alternating currents and the other with an electric light. Another is on a number of secondary coils of a section greater than the primary, the sum total of the currents in the secondary coils combined exceeding the current in the single primary.

LETTER TO THE EDITORS.

Destruction of Wires by Storm.

To the Editors Electrical World and Engineer:

Sirs.—I note your recent editorial with reference to the reported heavy damage to wires by the sleet and wind storms of last month. You may probably remember that some years ago I wrote an article advocating the erection of more substantial structures and wires,

and it has always seemed to me that the telegraph has arrived at that stage of importance in the business and social affairs of this country that it demands wires and supports of such a character as to be entirely proof against being disarranged by any of the atmospheric changes which may take place in any part of our country at any time, excepting perhaps cyclones and similar very infrequent and unusual visitations.

But having such a theory is one thing, and having such a substantial telegraph system is another. A chain needs to have its links all of the same strength, as a weak link determines the value of the whole chain, but a telegraph system needs to have strong links at points where there is great strain and other links modified to suit their respective surrounding existing or possible conditions.

It is impossible for me in this brief comment to give any information that would have very much value for publication, any more than a lawyer could give you an off-hand opinion in a few minutes in a very complicated lawsuit involving millions of dollars. It is obvious that the resort to metal poles all over the United States would be entirely absurd if the weakness of our telegraph system is not in the present wooden poles. It is also obvious that if the present wooden poles are not stout enough or properly arranged to withstand the strains placed upon them that it is feasible to enlarge them, and that such should be brought into consideration of the subject when finally deciding the best thing to do in the matter.

Telegraph lines are subjected to a variety of strains such as heavy gales, the maximum velocity of which yearly can be ascertained from the Weather Bureau for the various parts of the country. Also, forest fires where the lines go for hundreds of miles through forests; also snow slides where they pass through canyons, gulches and over mountains, particularly the trans-continental lines in the northern latitudes. Also, the surcharging of our wires for days at a time by static electricity conveyed to the wires in heavy sandstorms through Colorado, New Mexico, Arizona and California.* Also, by snowstorms in the more northerly States, where the atmosphere is colder. Also, washouts caused by floods, the shattering of poles and the melting of wires by lightning, which has many times destroyed them, even with earth wires upon the poles; and last, but not least, is the cutting of our wires by sleet in certain sections of the country, where a peculiar atmospheric condition prevails, such as has recently prevailed down the Mississippi Valley between St. Louis and Memphis, extending about fifty miles east from the Mississippi River, and also between New York and Baltimore, extending inland one or two hundred miles from the Atlantic.

In these districts the atmosphere seems to become filled with vapor and the temperature kept at a point varying for a degree or two (Fahr.) above and below the freezing point for two, three or more days, allowing the rain (which is being constantly precipitated to earth) in its passage, to congeal upon the wires.

This, however, very infrequently causes the wires to coat to such an extent as to break them, unless the wires were of old or inferior description. The greatest damage was done by the deposit of the ice upon the trees, the limbs becoming so burdened that they either bent down and carried the wires with them or, as in a majority of cases, were broken off and in their fall cut the wires sometimes in several places between two poles.

On the south side of the Ohio River below Louisville for about fifty miles a telephone line was entirely wiped out of existence and had to be rebuilt, but of the size and strength of poles, arms and wires I have no information.

It has been my opinion for many years that if but a small part of the large amount of money that is annually expended by the two great telegraph companies of this country was expended as interest upon a sufficient amount of capital to put up larger wires of much lower electrical resistance and greater mechanical strength upon wooden structures of sufficient strength and rigidity and distance apart to support such wires against all the maximum stress of gales and storms that are to be encountered, and if such wires were placed further apart than they are at the present time and with a better class of insulators, that it would be a most profitable investment for the proprietors of the system, besides, without the shadow of a doubt, insuring to the public practically unbroken communication at all times between at least our chief commercial centres.

My mind is staggered at the idea of trying to secure such communication by the use of underground cables on account of the great engineering difficulties which present themselves and the enormous amount of capital that would be required to carry out such a plan.

I do not think I need at this time go further into details, as you are well aware that with open wires of low resistance placed laterally far apart upon the insulators, and with our present systems we could work every wire by the quadruplex system to a capacity nearly equal to four individual wires between all the important cities. With underground cables it is doubtful if we could do much more than to work polarized duplexes, and even in this case, I think the speed of Morse signals would be greatly diminished.

Between New York and Philadelphia our wires have been intact for many years. There never was a time but the public could have its business forwarded, except during this recent breakdown by sleet to which you refer. Of course, it is obvious that a cable, if in good working order, would have prevented the complete loss of means of communication in that direction. But suppose we had nothing but underground cables, there must necessarily be links of submarine cable to connect them at the various river crossings, and such links are subject to interruption. We would be then in as bad condition as we are with the overhead system; and if the underground system gave out in an out-of-the-way place which, to my mind, it would be very liable to do, it would take a long time to get a new cable to the spot and have the trouble removed, whereas with an overhead structure in such a case as the recent widespread prostration of the wires, the trouble is readily found and easily and quickly removed.

Passing by several very important side issues which if but briefly mentioned would too greatly extend this discussion, I beg to conclude with the opinion that the character of the present telegraph lines is quite up to, if not beyond, what the proprietors have been warranted in furnishing for the transmission of public business, when we consider what burdens and restrictions are placed upon them by federal, state and municipal laws and exactions, saying nothing of the demands made by the most critical and imperious of all patrons, viz., the great commercial and financial houses of our great cities who furnish practically about 95 per cent of the telegraph business outside of the press.

There is no doubt that in many parts of our country there have been within recent years telegraph poles erected which cannot be thrown down by any storms short of cyclones, or some great flood such as inundates valleys and destroys railroads. At the same time no doubt there is a temptation to add to existing poles more wires than sound engineering laws would assign to them. This is on account of the great difficulty of securing capital, and particularly a new right of way for the erection of a new line of poles merely to hold one or two wires to meet the needs of an increasing traffic, and such poles remain practically without load for some years until business has grown large enough to fill them up with the needed wires.

It is evident that it is impossible when a pole has got filled to that limit which engineering laws would decide to be a safe one that when a new wire was needed that all such poles must be immediately taken out and new and stronger ones take their place merely to accommodate one or two additional wires when perhaps the old poles were in a good state of preservation.

I have for some time been of the opinion that upon our principal trunk lines, in addition to the supporting structures being of a much more substantial character than they are as a rule at present, the wires themselves should be greatly increased in size with the consequent increase of their strength and diminution of their resistance; and at the same time they should be placed further apart to minimize the harmful effects of lateral electro-static induction, while the insulators should be made of much better and tougher material than the very cheap fragile glass that is supplied; and, as before intimated, lines constructed upon this plan should be the strongest at such points as the strains were liable to be the greatest, and not as is now generally the case, of uniform construction throughout the entire length.

It is not likely that such a proposed substantial structure will be a guarantee of absolute immunity from interruption of communication between principal cities such as New York and Chicago, New York and Boston, New York and New Orleans, etc., but there will be no question of the desirability of reducing such interruptions to as low a percentage as possible. I am also of the opinion that by the more substantial system that I have suggested it is possible to decrease the interruptions about 90 per cent, and also decrease the cost of repair

*See *Jour. Am. Elec. S...* Vol ... page 44, Vol ...

at least 50 per cent, decreasing the batteries and currents used by about 30 per cent, increasing the phantom circuits by the use of quadruplexes by many hundreds of thousands of miles of such circuits, and by an increase in the carrying capacity of all of the present wires at least 10 per cent, probably much more.

It occurs to me in this climate that capital for telegraph purposes invested in the direction I have outlined, would be much more satisfactory in its returns than by undertaking over our great distances the tremendously expensive experiment of burying the wires in the earth.

Outside of the inevitable enormous slowing down of signals, the many great and formidable engineering obstacles to the underground system seem to me to render it entirely impracticable for supplanting the overhead wires for general telegraph purposes throughout the country.

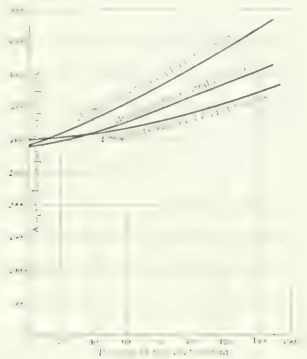
Francis W. Jones.

New York City.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Armature Interference and Brush Position.—Hobart.—The first part of a serial in which he says that in practice, regulation is a much more important factor than efficiency, and that regulation may at present be considered to limit the output. Regulation is intimately associated with the design of armature windings, of the field windings of the magnetic circuit, and of the commutator, and of very especially with the brush position. The influence of the brush position is very great, yet is often not recorded in test reports. He gives some results of tests made concerning the dependence of the regulation upon the brush position, with a four-pole 17-kw, 110-volt generator running at 700 revolutions per minute; the results are given in the

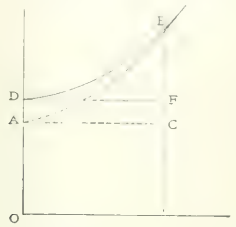


Armature Interference and Brush Position.

adjoining diagram in which the abscissas represent the per cent of full load current and the ordinates the ampere turns excitation for maintaining 110 volts. It will be seen that with a brush position of 2½ segments forward lead, an increase of 42 per cent is required in the excitation to maintain constant voltage at full load (over the excitation at no load); with the brushes in the neutral position an increase of 26 per cent in the excitation was required; and with two segments backward lead, 15 per cent sufficed, there being therefore a great improvement in the inherent regulation with decreased forward lead. When, however, the compounding is effected by a series winding in the ordinary manner, the regulation is about equally good in all three cases; this is shown by a calculation. While therefore the regulation with a compound winding, for this machine, is practically independent of the brush position, nevertheless it is evident that an unnecessarily great lead of the brushes involves additional outlay for field copper and lower efficiency as a consequence of increased losses in the field spools. Machines should therefore be designed with very low reactance voltage, not only from the standpoint of improving the commutation, but also to secure improved efficiency. He is strongly in favor of abandoning all reliance upon the magnetic field for overcoming the reactance voltage in the short-circuited coil and to rely merely on so designing the machine, that the reactance voltage of the short circuited coil is so extremely low as to exert no harmful influence whatever. This makes it practicable to set the brushes permanently at the geometrical neutral point, quite out of the way of any communicating magnetic field. This is quite different from the special case of railway and other reversible series wound motors, for in those the speed is less the greater the load, hence, on account of the decrease in the periodicity of commutation as the current increases, the reactance voltage increases by no means as rapidly as the load, and above some particular value of the load the reactance voltage actually decreases, hence the obtaining of reasonable freedom from sparking was, with carbon brushes, fairly effectively achieved in railway motors at a comparatively early date. The practice of designing dynamos to operate with the brushes set permanently at the geometrical neutral point, has the further advantage of greatly improving the inherent regulation, saving copper and improving the efficiency. He gives a set of rules concerning experimental observations on brush shifting, in testing a machine. He believes that a machine requiring, for satisfactory commutation from no load to 50 per cent overload, a forward brush position of much more than 5 or 6 per cent of the polar pitch, will in the near future be regarded as hardly a first class design.—Lond. *Elec. Rev.*, 28.

Resonance Phenomena; Tests of Induction Motors.—Benischke.—An illustrated paper read before the Elec. Society of Berlin. After some general remarks on resonance phenomena, he describes the following experiment: On a table, the feet of which are fixed to the ground by means of wax, a small motor is placed; a disc is mounted on its axle; on this disc a weight of 40 grams is fixed at a distance of 6 c. m. from the axle. When the motor rotates, there is a centrifugal force due to this weight; it can be resolved into two components, one, horizontal, tending to oscillate the table in a horizontal direction, i. e., to bend the feet of the table; the other vertical, tending to oscillate the table in vertical direction, i. e., to bend the plate of the table. These oscillations will take place, when the conditions of resonance is fulfilled, i. e., for a certain relation between the speed of the motor, the weight of the table, and the elasticity of its feet or its place. He demonstrated this by running the motor at gradually increasing speed. When a certain speed was reached, the condition of resonance for the horizontal vibrations was obtained, the amplitude of the vibrations of the table being about 5 m. m., although the centrifugal force of the weight of the disc was only 0.25 k. g. The speed was then increased with the result that the oscillations stopped. But at a much higher speed the condition of resonance for vertical vibrations was reached. If in this experiment, measurements of the speed of the motor and of the voltage were made, the following interesting result was obtained: when resistance was gradually taken out of the circuit, the voltage at the terminals increased, and so did the speed; but when the critical speed is reached, at which the table is set into vibrations and more resistance was cut out, the voltage increased still, but not the speed; in other words, while more energy was consumed, the speed did not increase. This is because this surplus energy was consumed in causing the vibrations of the table. By further cutting out resistance and thus increasing the voltage, the speed increased suddenly, the critical speed had been passed, the vibrations stopped, no more energy was then required for the vibrations. He remarks that these conditions are of importance in testing motors at no load. If the rotor of a motor is slightly eccentric, it will vibrate. Now, the iron losses in induction motors are often measured by determining the total no-load losses at different voltages and down to as low a voltage as possible; the losses are then plotted in a diagram as a function of the voltage and the curve is prolonged until it cuts the axis of ordinates; this is curve *B A* in the

adjoining diagram; *OA* is then said to be the friction loss, because at no voltage there are no iron losses. *B C*, which is the difference between the total no-load losses and the friction loss, is then assumed to represent the iron loss. But this determination always gives too large values, often larger by 100 or 150 per cent than the calculated value. This is because this method gives the friction loss too small and the iron loss too large. The watts consumed by vibrations of the rotor, and sometimes of the total motor, are neglected. These vibrations disappear at decreasing voltage. If the watts consumed



RESONANCE PHENOMENA.

for the vibrations at normal voltage, would remain constant, the curve would be *B D*, hence the correct value of the iron loss would be *B F*, which is smaller than *B C*. Mechanical oscillations are also of importance in the parallel operation of alternators. In the discussion which followed, Slaby remarked that a peculiar case of resonance causing mechanical vibrations was observed on the experimental trips on the high speed Zossen trial road; the vibrations of the car are mainly due to the rail joints; resonance was observed at a speed of 70 to 80 k. m.; later the vibrations diminished, and at a speed of 110 k. m. they could no longer be observed.—*Elek. Zeit.*, Jan. 30.

Determining the Phase Difference in Alternators with Revolving Field.—Queisser.—An article in which he starts from the well known fact that the revolving field of an alternator appears to be at rest when illuminated by an arc lamp which is supplied with current from that alternator; this fact may be used for connecting two alternators in parallel. It will always be observed that the radial axles of symmetry of the field seem to be at rest in a distinctively fixed geometrical position, in relation to the armature. He proves that this geometrical position depends directly upon the phase difference between e. m. f. and current of the arc lamp circuit. If the power factor is 0.7, there is a phase difference of about 45 deg.; then the current maximum is behind the e. m. f. maximum by one-fourth of a period; the current maximum determines directly the geometrical position in which the eye observes the field in its apparently fixed position. This phenomena may be used to easily measure at any moment the phase difference of an alternator, provided the arc which is used for lighting is directly inserted in the main circuit of the machine. For this purpose, two carbon contacts may be inserted in the main circuit of the alternator, which are generally in contact and are drawn apart only at the moment when one wishes to make a measurement; this produces an arc between the two carbons which is used directly for observing the apparent position of rest of the field and for directly reading the power factor on a calibrated scale. This method can be used to special advantage with high voltage alternators, because the loss of about 30 volts in the arc is then negligible. Or one may use an auxiliary transformer.—*Elek. Zeit.*, Feb. 6.

Voltage Drop of Alternators.—Fischer-Hinnen.—A reply to Rothert's recent criticism. He denies that the straying of the field has been neglected in Behn-Eschenburg's and Potier's methods. Potier's method is indeed only a more accurate modification of older diagrams by Rothert.—*Elek. Zeit.*, Jan. 30.

Bauch.—Another communication on this subject. The change of the straying of the field with a variation of the load, has not yet been correctly taken into account in any diagram. He suggests a diagram which is somewhat similar to the Heyland induction motor diagram. —*Elek. Zeit.*, Feb. 13.

Rothert.—A reply to Fischer-Hinnen.—He does not deny that Behn-Eschenburg's and Potier's method take the straying of the field into account; but what is not taken into account by this method is the change of the straying with the load.—*Elek. Zeit.*, Feb. 27.

REFERENCES.

Three-Phase Machines.—Linsemann.—A long illustrated and highly mathematical paper on "the elastic line of polyphase machines of large diameters." The deforming forces in electric machines are partly of mechanical origin, caused by gravity and torque, and partly due to the tendency of the lines of force, to diminish the air-gap. Gravity and torque give stable elastic forces, i. e., the increase of their deforming influence by the deformation itself can be neglected. The magnetic forces, however, form an unstable elastic equilibrium; for exact circular form they are latent; an occurring deformation makes them appear, and they then increase the deformation, so that there is a continuous increase of deformation and deforming forces. He first discusses the forces themselves and then gives the general mathematical relation between the moment of flexion and the radial deformation. A numerical example is added.—*Elek. Zeit.*, Jan. 30, Feb. 6.

Iron Alloys; A New Transformer Iron.—Gumlich.—An article in which he calls attention to the great practical and industrial importance of the investigation of Barrett, Brown, and Hadfield, which was recently abstracted at some length in the Digest. He gives a review of their work and makes some corrections in the numbers of their tables.—*Elek. Zeit.*, Feb. 6.

Surging of Alternators in Parallel.—Seibt.—A communication referring to Foeppl's article. He calls attention to the fact that in theoretical physics there are many entirely analogous problems; more especially Wien's results for electric resonance which may be easily applied to the theory of alternators in parallel.—*Elek. Zeit.*, Feb. 6.

Lights and Lighting.

Nernst Lamps.—A well illustrated description of the latest form of the Nernst lamp, put on the English market by the General Electric Company of Berlin. It is of the self-lighting pattern, with a heating coil which is automatically disconnected from the circuit as soon as the filament is sufficiently hot, an electromagnetic device of the well-known form being used for this purpose. In Fig. 1, *B* is the heating coil, *C* the filament. The series resistance for protecting the

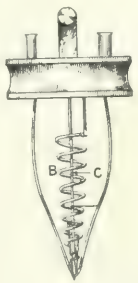




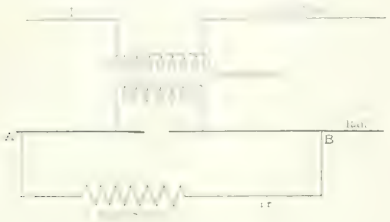
FIG. 1.—THE BURNER. FIG. 2—SERIES RESISTANCE.

lamp against damage by variation of pressure, has the form shown in Fig. 2. In wiring direct-current lamps, directions are given as to the polarity ; the positive and negative wires must be connected to the correct terminals, otherwise, it is said, the filament will soon be destroyed. The lamps are made in three sizes: for ½ amp. at from 196 to 250 volts; for 1 amp. at from 96 to 150 volts; and for 1 amp. at 196 to 250 volts.—Lond. *Elec.*, Mar. 7.

Traction.

Negative Boosters.—Krogh.—An illustrated communication referring to Kapp's paper, recently abstracted in the Digest, and discussing the applications of Kapp's method to an alternating current line. The arrangement is shown in the adjoining diagram. The primary winding of a transformer which has equal numbers of turns in primary and secondary, is connected to the trolley wire, the secondary is connected to the rail. The arrangement is intended to suck up stray currents from the earth. The arrangement is effective only when there is a shunt through the earth. He gives in form of diagrams, the theory of the arrangement which was fully confirmed by the experiment. The current *I* was 12 amp., the potential difference *E* between *A* and *B* was 40 volts. The points *A* and *B* could be

directly short-circuited without increasing the current i above 0.10 amp.; the potential difference E then became zero. The smaller the shunt resistance r, the higher was the induced e. m. f. in the transformer windings and the smaller was E'. In practice therefore this alternating current booster would be ineffective in dry weather, when



NEGATIVE BOOSTERS.

the transition resistance between rails and earth is great, and the losses in the apparatus would be due to ohmic resistance only. During wet weather, however, the transformer would be more or less magnetized, according to whether the resistance to the earth is larger or smaller. The apparatus is therefore automatically self-regulating and requires almost no attendance.—*Elek. Zeit.*, Jan. 23.

Sieber.—A communication in which he points out the general disadvantages of Kapp's negative boosters, inserted in the line. He thinks that this arrangement would be suitable only for long roads, with private roadbed and rails on wooden beams. In Kapp's example of a 20 k. m. road, operated with direct current, he would prefer to cut the overhead wire at a distance of 10 k. m. and to operate the first 10 k. m. with + 500 volts and the second with — 600 volts; no boosters would be required. This system has been successful on the Nuernberg-Fuerth road.—*Elek. Zeit.*, Jan. 30.

The Camps Bay, Cape Town & Sea Point Tramways.—A description of this South African system, under construction. The country is extremely hilly, a number of grades on the route being 1 in 12 and 1 in 9, etc. The side wire system has been adopted for the overhead equipment. The generating station is situated at Camp's Bay almost at the extreme south of the system; it contains two direct coupled 400-kw sets. The switchboard has nine panels, three of which are generator panels, so that one generator panel may be kept in reserve. The feeders are lead covered and insulated with paper and vulcanized rubber. They are laid in cast iron troughs 50 centimeters below the surface and surrounded with bitumen.—*St. R'y Jour.*, Mar. 1, and Int. Ed., Mar.

Three-Phase Currents on City Roads.—Fabre.—A long communication with reference to the recent competition of direct and alternating current on the London District railways; the decision in favor of direct current he considers strange. He gives simple mathematical calculations to prove that a suitable application of the three-phase system enables one to regain 66 per cent of the energy consumed in starting, by means of cascade-braking. As on roads like the London or Paris underground, the energy consumption is much greater during starting than during the periods of highest speed, he says that the advantages of the three phase system increase with decreasing distance between the stations; in certain cases, with direct current, the energy consumption may be larger by 50 per cent than with three-phase current. As the properties of three-phase induction motors are very similar to those of direct current shunt motors, he bases his calculations upon the latter. His results are obtained for a level road. For a road with grades the three-phase systems offers still greater advantages.—*Elek. Zeit.*, Feb. 6.

REFERENCES.

Fenders.—Kosch.—A long illustrated article on fenders for street railway cars.—*Elek. Zeit.*, Jan. 30.

Wolff and Schirp.—Some critical remarks on Kosch's article.—*Elek. Zeit.*, Feb. 13; March 6.

Rail-Joint Construction.—An article giving details concerning the methods and apparatus used in casting the new composite joint, employed on the Philadelphia street car lines.—*St. R'y Jour.*, March 1, and Int. Ed., Mar.

Wires, Wiring and Conduits.

Submarine Core.—Appleyard.—A note on submarine core. In the design of submarine core it is often of interest to determine the effect, upon the capacity and dielectric resistance, of adding or subtracting a given weight of gutta-percha, say 1 lb. per nautical mile, for core of a given type. In other words, for a submarine core of which the conductor is of fixed diameter d inches, and weight w lbs. per N. M., and of which the dielectric is of diameter D inches, and weight W lbs. per N. M., it is required to find an expression for the change in log D/d produced by adding or subtracting 1 lb. of dielectric per N. M. This change, for ordinary types, is found to be 0.0001047 divided by the square of D. The rate of change is inversely proportional to the weight of the dielectric, the conductors being constant.—*Lond. Elec. Rev.*, March 7.

Electro-Physics and Magnetism

Theory of Electrons.—Lord Kelvin.—A theoretical paper entitled "Aepinus Atomized," on the theory of electrons, or, electrions, as he calls them. According to the theory of Aepinus, commonly called the one-fluid theory of electricity, positive and negative electrifications consist in excess above, and deficiency below, a natural quantity of a fluid, called the electric fluid, permeating among the atoms of ponderable matter; portions of matter void of the electric fluid repel one another; portions of matter void of the electric fluid attract one another. Lord Kelvin suggests that Aepinus' fluid consists of exceedingly minute equal and similar atoms, called electrions, much smaller than the atoms of ponderable matter; and that they permeate freely through the spaces occupied by these greater atoms and also freely through space not occupied by them: there is repulsion between the electrions, repulsion between the atoms independently of the electrions, and attraction between electrions and atoms without electrions. Between atom and atom, electrion and electrion, an atom and an electrion outside it, the repulsions and attractions follow the law of the inverse square of the distance. But as the electrions freely permeate the space occupied by the atoms, he has to assume a special law for the force experienced by an electrion within an atom; he assumes a very simple one. While Aepinus' mobile electricity was vitreous (positive), Lord Kelvin's electrions are minute particles of resinously (negatively) electrified matter. An atom devoid of electrions acts simply as a little globe of atomic substance, possessing as an essential quality vitreous (positive) electricity uniformly distributed through it or through a smaller concentric globe. Ordinary ponderable matter, not electrified, consists of a vast assemblage of atoms, not void, but having within the portions of space which they occupy just enough electrions to annul electric force for all places of which the distance from the nearest atom is large in comparison with the diameter of an atom, or molecular cluster of atoms. He discusses mathematically the condition of equilibrium of two atoms of different diameters, containing electrions; he shows how the equilibrium and the position of the electrions is changed when the two atoms overlap, then are made concentric, and later are brought apart again; he proves that in this process there is always a tendency of the smaller atom to take electrions away from the larger atom. When pressing and rubbing together and separating two assemblages of mon-electrionic atoms of largely different sizes, the assemblage of the smaller atoms should be resinously (negatively) electrified, and the assemblage of the larger atoms vitreously (positively) electrified; this is probably the true explanation of the long-known fact that ground glass is resinous (negative) relatively to polished glass, as the process of polishing might be expected to smooth down the smaller atoms, and to leave the larger atoms more effective in the surface. He then discusses statical problems concerning the equilibrium of two or more electrions within one atom. He proves that in a monatonic gas or in any sufficiently sparse assemblage of single atoms, fixed or moving, Faraday's "conducting power for lines of electric force," or what is now commonly called the specific electro-inductive capacity, or the electro-inductive permeability, exceeds unity by three times the ratio of the sum of the volumes of the atoms to the whole volume of space occupied by the assemblage, whether the atoms be mon-electrionic or poly-electrionic, and however much the electrion, or group of electrions, within each atom is set to vibrate or rotate with each collision. Every solid, at zero of absolute temperature, is a perfect insulator of electricity under the influence of electric forces moderate enough not to pluck electrons out of the atoms in which they rest stably, when there is no dis-

turbing force. When the temperature is raised, the electrons begin to perform wildly irregular vibrations and rotations, so that some of them will occasionally be shot out of their atoms. Each electron thus shot out will quickly either fall back into the atom from which it has been ejected, or will find its way into another atom. If the body be in an electric field, a considerable proportion of the electrons which are shot will find their way into other atoms in the direction in which they are pulled by the electric field; that is to say, the body which was an infinitely perfect insulator at zero absolute temperature, has now some degree of electric conductivity which is the greater, the higher the temperature. This explains the increasing conductivity of flint glass, rare earths, etc., with increasing temperature. The electric conductivity of metals must be explained in the same way as that of glass, gutta-percha, etc., with only this difference, that the metallic atom must be so crowded with the electrons that some of them are always being spilt out of each atom by the intermolecular and electrionic thermal motions, at comparatively very low temperatures. The conductivity of a metal will rise when heated from zero of absolute temperature, reach a maximum and decrease with further increase of temperature. In fact, while some extent of thermal motions is necessary for electric conductivity, too much of these motions must mar the freedom with which an electrion can thread its way through the crowd of atoms to perform the function of electric conduction. "It seems certain that this is the matter-of-fact explanations of the diminution of electric conductivity in metals with rise of temperature."—*Phil. Mag.*, March.

REFERENCES.

Magnetic Expansion of Iron and Steel.—Shaw and Laws.—The first part of an illustrated account of experiments made with Swedish iron, mild steel, and hand steel. In this part they discuss the measurement of susceptibility and give details of the arrangement of their experiments.—Lond. *Elec.*, Feb. 21.

Rotating Hysteresis.—Hiecke.—A long communication referring to Dina's article recently abstracted in the Digest. He criticises several points in Dina's methods, and claims that his results are not conclusive.—*Elek. Zeit.*, Feb. 13.

Dina.—A reply to Hiecke's criticism. He claims that his results are correct.—*Elek. Zeit.*, March 6.

Traction Magnets for Straight and Circular Movements.—Dietze.—An illustrated paper read before the Association of German Electrical Engineers, in which he describes several types of such magnets.—*Elek. Zeit.*, Feb. 13.

Zeeman Effect.—Walker.—A mathematical paper, giving a theory which accounts for an anomaly of the Zeeman effect.—*Phil. Mag.*, Feb.

Electro-Chemistry and Batteries.

Theory of the Lead Storage Battery.—Lieg.—A paper read before the Elec. Soc. of Cologne. He denies that the so-called sulphate theory correctly represents the process in the lead accumulator. He considers the formation of sulphate in the positive and negative plates as secondary reactions. His views are based upon the fact that in automobile batteries a portion only of the acid which would be required by the sulphate theory, suffices. His views are also based upon exact measurements of the change of acid concentration in the working accumulator, and upon exact determinations of the weights of plates in various conditions of charge and discharge. In the discussion which followed, there seemed to be a general agreement that the sulphate theory is fully correct only for low current densities, and that the exact nature of the process for the current densities used at present in practice, is not yet sufficiently settled.—*Elek. Zeit.*, Feb. 13.

Units. Measurements and Instruments.

Locating Faults in Underground Networks.—Lohr.—A communication in which he says that Stott's compass method of locating faults can be used only on such underground networks on which Stott uses it, namely for cables placed in tubes with manholes in distances of 100 meters. He says that the loop method is not restricted to thin cables, but can be used wherever the resistance of the fault is small and an insulated return circuit is available, the resistance of which is not essentially greater than that of the defective cable. A large surface of the cable and earth currents are no obstacles to this method.—*Elek. Zeit.*, Feb. 6.

O. Steinmetz.—A communication in which he describes several cases from practice, in which he used the loop method to good advantage. If properly applied, he claims it to be excellent.—*Elek. Zeit.*, March 6.

REFERENCES.

Mercury Interrupter.—An illustrated description of a mercury interrupter of German manufacture. Mercury is squirted from a fixed tube against a fixed contact piece and the interruptions are obtained by means of a fan with wings of insulating material, so that the mercury is squirted alternately against the metallic contact-piece and against an insulating wing.—*Elek. Zeit.*, Feb. 6. Some remarks, by Boas, on this article, in *Elek. Zeit.*, Mar. 6.

Plug Rheostats.—Knobloch.—An illustrated description of a modification of a plug rheostat, for simplifying the arrangement in order to save time and to prevent mistakes. Besides the two ordinary rows in which the plugs are inserted, he uses a third row between the two; plugs may be inserted between this third row and any of the other two.—*Elek. Zeit.*, Feb. 13.

Galvanometer.—Begot.—A continuation of his illustrated "notes on practical electrical instrument-making." He discusses the construction and general theory of the tangent galvanometer and the electrodynamometer.—Lond. *Elec. Eng.*, Feb. 28.

Telegraphy. Telephony and Signals.

Wireless Telegraphy and Submarine Cables.—Guarini.—An article in which he says that if any comparison is to be made between submarine cables and wireless telegraphy, the latter must be considered from the point of view of what it will be, what it is capable of becoming, and not from the point of view of what it is now. He says that cables are subjected to many injurious influences and to deterioration, which do not exist in wireless telegraphy. While secrecy may be obtained by syntonization, or by indirect methods, such as proposed by Blondel, Tommasi, and Tegon, he believes that the directed wave is the only way that solves satisfactorily the problem of absolute secrecy with regard to the dispatches, and that of multi-communication in opposite directions. He claims that the effects of atmospheric electricity on wireless telegraphy receivers will not be more disastrous than they are in ordinary telegraphy. The cable companies themselves should undertake wireless telegraphy. He criticises the argument that as electricity has not dethroned gas, so wireless telegraphy will not dethrone the submarine cable; in spite of its great advantages, electricity has not dethroned gas because it is more expensive than gas; on the other hand, he claims that wireless telegraphy is not only better than cable telegraphy, but also cheaper. The coherer is destined to render great service in ordinary telegraphy, and especially in submarine cables; it can be used as a very sensitive relay, and it can render multi-communication possible, *i. e.*, it can increase the efficiency of an existing cable. He asks "the directors of the cable companies to be so good as to forsake routine for once; first to use ordinary telegraphy with a coherer and then wireless telegraphy with or without a coherer."—Lond. *Elec. Rev.*, Feb. 28.

Telautograph.—Gruhn.—An illustrated paper, read before the Berlin Elec. Society, on a new telautograph of a Dresden company, for the transmission of hand-writings and drawings. The principle is somewhat similar to that of the one of Gray, who ties the writing pencil to two strings at a right angle; when one writes, these two strings which are always stretched, are moved and each operate a switching device which sends brief beats of current into the transmission line, so that the writing is resolved into two components vertical to another. The present author also uses this principle of dissolving into two components, but his arrangement sends into the transmission line continuously direct current which, however, varies in intensity. The intensity of the current components at any moment is proportional to the distance of the point of the writing pencil from an edge of the writing paper; this is accomplished by two regulating resistances operated by the two strings fixed on the writing pencil. In the receiver, the variable currents in the two circuits deflect a small mirror, and the record is obtained by reflecting a ray of light from this mirror upon sensitive paper; the paper with the record is pulled through a very simple developing device, in which the photographical process is finished in 45 sec., so that the record comes out of the box in a finished form.—*Elek. Zeit.*, Feb. 6.

REFERENCE.

Wireless Telegraphy Apparatus.—Arco.—An illustrated article

of the wireless telegraphy installations of several German steamships with the tuned Slaby-Arco system.—*Elek. Zeit.*, Jan. 30.

MISCELLANEOUS.

Electricity in Turf Coal Manufacture.—JEBSEN.—An abstract of an illustrated pamphlet on his process used in a plant in Norway. The turf is pressed in forms and dried until it contains about 20 per cent of water; "it is then subjected to distillation in retorts heated electrically inside; the products are a gas suitable for heating purposes; a tarry turf with tarry water, useful for making paraffin, gas oil, ammonium sulphate, and methylalcohol; and a very pure turf charcoal which may be used as a substitute for charcoal of wood or for pit coal." There are five dynamos of together 400 *k. w.*, driven by turbines. There are 12 retorts, and during 210 days of the year, 100,000 lbs. of turf are worked daily.—*Zeit. f. Elektrochemie*, Jan. 16.

Death by 200 Volts Alternating.—An editorial note on a remarkable accident at the Sheffield Alhambra due to a shock of 200 volts alternating. "The victim of the fatality together with a friend amused themselves by 'skylarking' with a disused electric-light fitting at the theatre, the former seizing the bracket with both hands and attempting to wrench it from the wall. He received so severe a shock that he cried out to be pulled away; then falling on the floor he speedily expired. There were no signs of burning on his hands." The real cause of the fatality is unknown. The "possibility that death was due to a high-pressure shock, through a defective transformer, is suggested."—Lond. *Elec.*, Mar. 7.

Electricity in Dental Surgery.—RAGNIER and DIDSBURY.—An article in which they advocate the use of D'Arsonval's high-frequency electric currents for purposes of painless dentistry. The current is applied through a moulding of the part to be rendered insensitive. The interior of the moulding is covered with metallic powder and a layer of tinfoil. To confine the heat produced by the current the tinfoil is covered with a layer of asbestos paste. In 15 cases of extraction of teeth with one root there were 13 cases of complete anæsthesia.—*Arch. d'Elec. Med.*, Feb. 15; abstracted in Lond. *Elec.*, Mar. 7.

REFERENCE.

American Institute.—R. W. POPE.—An illustrated article giving historical reminiscences on the foundation and development of the Amer. Inst. of Elec. Eng.—*Elec. Age*, Feb.

New Books.

PRACTICAL CALCULATION OF DYNAMO-ELECTRIC MACHINES. A Manual for Electrical and Mechanical Engineers and a Text-book for Students of Electrical Engineering. By Alfred E. Wiener, E. E., M. E. New York: Electrical World and Engineer. 727 pages, 381 Illustrations, 130 Tables. Price, $2.50.

The second edition just issued of this work is quite a formidable volume, being a large octavo in size and containing 727 pages. The author in his preface states that in preparing a second edition it has been his aim to bring the volume up to date in every particular. With this purpose, data of the latest machines of the most prominent manufacturers were procured and compared with the information given in the book, and necessary changes made. A number of new tables were inserted; the most important of these is one which gives additional guidance in the selection of the conductor-velocity, and another which serves to check a design with respect to the relation between the armature and field.

Among additions of new matter to the book are sections on the design of double-current generators, multi-circuit arc dynamos, motor-generators, dynamometers, boosters, equalizing dynamos and the teazer system of motor control. Three appendices aggregating 43 pages have been added. The first of these gives the dimensions and armature data of various types of modern dynamos, the object being to afford to the student a means of comparing his results with the existing machines as he proceeds with a design. Appendix II contains wiring tables and wiring data necessary in determining the windings of dynamos. Appendix III gives the causes, localization and remedies of the usual troubles occurring in dynamo-electric machines, the object of this compilation being, first, to enable the designer, by calling his attention to the ordinary shortcomings, to take preventive measures in designing which will reduce the liability of trouble to a minimum; and, second, to assist the tender of the dynamo plant in going about in a systematic manner to find the cause of troubles.

This new edition is by far the most complete work in the English language on direct-current dynamo design. Aside from being a very complete treatise on the methods of design, it is also a very complete compendium of practical data compiled from commercial practice.

MUNICIPAL ENGINEERING AND SANITATION. By M. N. Baker, Ph.B., C. E. New York: The Macmillan Company. 318 pages. Price, $1.25.

This book gives a clear and concise sketch of modern scientific methods of promoting the welfare of people living in cities, and is intended for that large and rapidly growing class of persons who, either as officials or citizens, are striving to improve municipal conditions. It reviews the whole field of municipal engineering and sanitation and dwells upon the most vital points under each class of activities and interests. In many instances details from actual practice are given.

"The City and Its Needs" is the subject of the introductory chapter, which is followed by 42 other chapters classified under the following headings: Ways and Means of Communication; Municipal Supplies; Collection and Disposal of Wastes; Protection of Life, Health and Property, and Administration, Finance and Public Policy. Subjects of electrical interest are treated in various chapters. Chapter III. relates to Subways for Pipes and Wires; Chapter V., to Urban and Interurban Transportation; Chapter VIII., to Telegraph, Telephone and Messenger Service, and Chapter XVI. to Light, Heat and Power. Electrolysis of underground pipes; smoke abatement; municipal franchises and contracts, and municipal ownership constitute the subjects of Chapters XXIV., XXV., XXXVIII., and XXXIX., respectively.

This book, in the hands of those for whom it was written, cannot fail to be productive of good results, and those who read it will be impressed with the importance of all well-disposed citizens giving their personal aid and encouragement to all efforts tending to promote the welfare of the community at large.

LIGHT, HEAT AND POWER IN BUILDINGS. By Alton D. Adams. New York: William T. Comstock. 102 pages. Price, $1.

This book is evidently intended as a brief review of the problems arising in plant designing, and is quite general in its treatment of the various subjects considered. While, as a whole, the work will be found quite satisfactory, the reviewer cannot agree with the writer on several important points. The author estimates the cost of fuel per hp-hour at six-tenths of a cent. This seems low, as figures from a number of plants have shown 1 cent per horse-power per hour to be more nearly the correct figure. With electricity purchased from the street at the rate of 10 cents per kw-hour, the author estimates the cost of electric heating as equivalent to coal at $760 per ton. This is interesting but may lead to a wrong impression on the part of a casual reader, as it would indicate that electric heating for some commercial purposes is not to be compared in cost with either gas or coal. Mr. Hadaway, the well-known electric heating engineer, has pointed out that if all of the exhaust steam from a dynamo-engine can be utilized for low-temperature heating, and the current generated be employed for high-temperature heating, it is not more costly than heating by coal, and it has many advantages, as has been demonstrated in the case of hat factories, candy factories, and in other instances.

In considering the use of steam and hot water for heating the author evidently prefers the hot-water system. One reason given for this preference is that the excess heat contained in the exhaust steam from an engine during the heavy lighting load, can be stored in hot water and used during periods of insufficient supply of exhaust steam. This method does not appear practical to any extent, as a simple calculation of the amount of water required to store the heat from steam exhausted from a 50-hp engine will indicate. The author does not touch on the disadvantage of the hot-water system for large buildings, which are principally a third greater first cost, and the wear and tear of the valves, radiators and piping, caused by pumping hot water.

The author clearly recognizes the necessity for treating the light,

heat and power supply of buildings as interdependent problems, but his estimate that 30 per cent more coal is required to supply steam through an engine for heating instead of direct seems excessive. In the opinion of the reviewer from 10 to 15 per cent is more nearly correct and in one plant in New York, operating under his supervision, the amount of coal burned per day is not greater with the plant running than without.

A great deal has been said in this and in other books about the insufficiency of exhaust steam from plants during the morning hours to supply the heat. With the temperature hovering around zero the exhaust steam from a plant, in an ordinary building, is insufficient to supply the heating requirements; but in five days out of six during the heating season, the outside temperature is far above zero. Experience in a number of plants of all kinds has indicated that the exhaust steam is sufficient during these five out of six days, where all the electric lighting and power requirements of a building are supplied from the plant.

The author also leaves it to be understood that it is this question of the possibility of using the steam first in an engine and afterwards in heating that makes the isolated plant able to compete with the central electric plant. This view has been taken time and time again, and can be shown to be erroneous. The possible use of exhaust steam is an important factor in the economy of a plant, but it is the fact that the labor is but slightly varied where either steam or electricity or refrigeration or all three are supplied, that makes the isolated plant an economic possibility, combined with the fact that no rent is to be paid and that there are no abnormal fixed charges.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 17-20, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Interstate Independent Telephone Association. Next meeting, Chicago, April 9, 10 and 11, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Association of Manufacturers. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

National Electric Light Association. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Pennsylvania State Street Railway Association. Next meeting, October, 1902.

Southwestern Gas, Electric and Street Railway Association. Next meeting, San Antonio, Tex., April 18-21, 1902.

Lighting An Opera House

The electric lighting effects at the Metropolitan Opera House, New York City, on the occasion of Prince Henry's visit, were the subject of a special article in our issue of March 8. At that time, while giving a number of details of the work, we were unable to supplement them by illustrations. Before the illuminations were taken down, however, Mr. Spaulding, the manager of the National Electric Improvement Company, which controls the Elblight system in this country, was able, with the assistance of the well known photographers, Pach Brothers, to secure two or three excellent photographs, and through the courtesy of these concerns we are now able to show the



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FIG. 1.—SPECIAL LIGHTING METROPOLITAN OPERA HOUSE, NEW YORK CITY.

premises exactly as they appeared on the memorable and festive occasion when every one of the great opera stars were gathered together for the delectation of the royal visitor from Germany, and when a single seat in the orchestra cost $30. The total seating capacity of the opera house, including boxes, is 3500, which figures will give some idea of the magnitude of the auditorium, while the great curtain opening is 48 feet by 50.

In the view which we present of the auditorium the regular lighting is supplemented by strings of Elblight cable draped from the central chandelier to the walls, and carrying 1500 lamps in green and white, entwined with smilax. The other view (Fig. 2) shows the pro-



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FIG. 2.—ILLUMINATED DROP CURTAIN, METROPOLITAN OPERA HOUSE.

scenium arch and the drop curtain, the whole being about 60 feet by 60. On the night of the gala performance this was one huge mass of smilax with some 6000 lamps, green and white, of which 4500 were in the movable curtain. The total weight of the cables and lamps at this point was some three tons, and the drop curtain weighed not less than one ton.

As pointed out in our previous article, to which reference can be made for other details, it was only with such a system as the Elblight that special lighting on such a gigantic scale could be carried out with such swiftness, and removed with equal expedition.

Masurite, a New Safety Explosive.

The recent disastrous dynamite explosion in the Rapid Transit subway in New York, causing loss of life and great damage to property, has created a deep feeling of insecurity among residents along the line of this engineering work, as well as among those who live or work in close proximity to dynamite. It is therefore opportune to mention a new safety explosive now being placed on the market, known as "Masurite," which is claimed to be perfectly safe against premature explosions and can only be set off by detonation. A very interesting series of tests were given last week before a gathering of engineers and powder experts at Sands Point, Long Island, and masurite was put to almost every conceivable test to illustrate its safety in handling. For concussion tests, masurite was placed on an anvil and on stone and struck sharp blows with a hand hamer and a 16-lb. sledge. A 50-lb. iron weight was also allowed to fall 25 feet upon a 10-ounce cartridge placed on an anvil. Other tests were shooting through 12½-lb. can masurite; a can containing 10 lbs. heated in direct contact with burning coal shot through as above with mushroom bullet. In the fire tests, a red hot iron ¼ inch in diameter was run through a cartridge of masurite; a 1-inch red-hot iron rod run into a can containing about 10 lbs. of this material; 10 lbs. were thrown upon a forge fire, a bundle of parlor matches was ignited in a heap of masurite; masurite was covered with smokeless and with black powder and the latter ignited, also with the positions reversed, the powder being placed under the masurite. The electric tests were shown by allowing a series of electric sparks to pass in contact with masurite placed upon iron. Also a copper wire was heated to redness and finally melted by the electric current while in contact with it. Severe friction tests were also given; finally the detonation tests as to the explosive strength of this new article showed it to be perfectly flameless, as shown by comparisons with dynamite, which was exploded to illustrate. This one advantage of no flame makes masurite specially adapted to coal mine work. Masurite has a brown yellow color and in explosive strength is said to equal 40 per cent dynamite weight for weight.

A Solenoidal Electric Sign Flasher.

The Reynolds Electric Company of Chicago is getting ready for the market an automatic switch or "Flasher" for periodically breaking light or heavy currents, which has several novel features and should fill a new place in connection with electric signs. It is for the purpose of alternately flashing two sign circuits or making and breaking a single circuit.

Referring to the diagram in the next column there are two solenoids working on the ends of a rocking arm. These solenoids each have combined with them an oil dash pot, the solenoid itself being submerged in the oil. When the circuit is closed through one of these solenoids its core is drawn slowly down into the oil dashpot until the quick break switch which is seen in the foreground in the engraving snaps from one contact to the other. The solenoid on the other end of the rocking arm is then cut into the circuit and draws its core slowly down until the switch is thrown over to the opposite contact. The switch is, therefore, thrown alternately from one circuit to the other at intervals depending upon the speed for which it is set. The speed can be regulated by varying the length of stroke at which the switch will throw over.

In the device shown in the engraving the make-and-break is by a combination carbon and copper switch on which the arc at the time of breaking the circuit is taken by carbon, and in another form of the device a magnetic blow-out is used. This flasher is, obviously, for use only on electric signs having one or two circuits. It is intended as a simple and durable, and at the same time an economical substitute for the motor-operated flasher where it may be desired to flash two circuits only, each circuit controlling one color of lamps, or where an entire sign is wanted to be flashed on and off, or one side of sign then the other side alternately. The current that can be broken by one contact on the existing flashers is limited so that on a large sign the break must be distributed among a number of contacts. The new device not only does away with the motor, but enables the flashing of an entire sign to be done on one circuit.

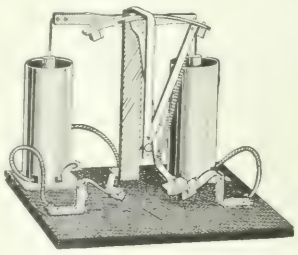
Duplex Steam and Vacuum Pump.

The accompanying illustration shows a duplex steam and vacuum pump made by Harrison Watson Company, 1708 Ludlow Street, Philadelphia. This pump is capable of lifting and forcing a constant stream of water against any pressure, and is claimed to be extremely efficient and durable, having nothing more complicated than check valves.

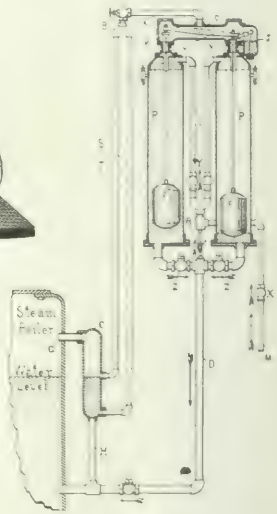
Referring to the illustration, there are two pumping tanks, *P*, a suction pipe, *M*, having two branches, *I*, provided with check valves, *Y*, and leading to each of the pumping tanks; and two branch discharge pipes provided with check valve, *Z*, uniting in a delivery pipe, *D*. Steam is conducted to each tank through the pipe, *K*, into a closed steam chest, *C*, and from the latter passes through two valve-seated passages to the tanks, *P*.

In the steam chest is a pivoted lever, *L*, having at each end a poppet valve, *V*. These valves control the passage of the steam to the tanks, and as the lever opens one of the valves it closes the other; consequently steam is admitted to but one tank at a time, and each tank alternates in its action of drawing in water by a partial vacuum formed by the condensation of steam, and expelling the same by the pressure of steam upon its surface.

To produce an automatic action there are submerged floats suspended from each of the valves, *V*. This arrangement is nearly supported when submerged, by the buoyancy of the water, but when the water flows in one tank the weight, *F*, draws down the valve, *D*, and shuts off the steam, while lever, *L*, raises the other valve and admits steam to the other tank. Condensation is effected as follows: The water in the tank under pressure passes through a discharge check valve, *Z*, up a small pipe, *R*, through one of the branch pipes, *I*, into the other tank, thereby condensing the steam, whereupon the tank is refilled with water through the pipe, *M*. When refilled a pressure is created under the valve, *V*, by the water running through the small pipe, *R*, which partially balances that of the steam on top of the valve, so that it can be raised from its seat by the lever, *L*, which occurs when the lowering of the water in the other tank causes the float *F* to draw its valve down and tip the lever, which latter is held at the extremes of its movement by a snap spring, *J*.



AUTOMATIC SIGN SWITCH.



DUPLEX STEAM AND VACUUM PUMP.

The illustration shows the pump used as a boiler feeder, and placed above the boiler, into which the water enters by gravity, so long as steam passes up the pipe, *T*. When the water passes up this pipe, it balances the weight of the water in the pump and pipe *D* so that no more water enters the boiler until its level falls sufficiently to enable steam to pass up the pipe *T*, which causes the water flowing to be siphoned out by the pipe *S*, thereby letting steam again to the pump and causing it to feed more water into the boiler. In this way a constant water level is maintained in the boiler.

The same principle may be applied to the feeding of one or more boilers in connection with a steam pump. In this case a reverse check valve is used with a flexible diaphragm.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered during the week with some freedom by brokers and the demand was fairly good. The closing rates were 4¼@4¾ per cent for 30 days to six months. In the stock market prices held firm with irregular advances in grangers and high-priced specialties. The firmness of bond prices and the presence of a steady demand for investment stocks were notable features in the market and would account for the ease with which certain high-priced specialties have advanced. The traction stocks were irregular, owing to litigation attacking the Metropolitan Street Railway deal, but Brooklyn Rapid Transit was well supported on the ratification of the blanket-mortgage plan and the small opposition shown to the scheme. This latter stock closed at 65⅝, being a net gain of ⅝ point. The sales amounted to 99,340 shares. Metropolitan Street Railway closed at 167½, the sales aggregating 28,600 shares. The highest and lowest quotations for the week were 167½ and 169¾. In the electric list General Electric continues to be, by all odds, the principal feature, having reached the extraordinary figure of 322½, closing at 321, which is a net gain of 16 points. The trading, however, was rather narrow, only 9,100 shares having changed hands. Westinghouse Electric remained about steady at previous quotations, the closing figures for common being 194 and for first preferred 198, the latter being a net loss of 1 point. Western Union closed at 90, ex-dividend. Other closing prices were: American District Telegraph, 33; American Telegraph & Cable, 85, and American Telephone & Telegraph, 170, which latter is a net gain of 9¼ points as compared with the last quotation. Copper stocks were moderately active, and Electric Vehicle preferred was dealt in for the first time in many days; on purchases of several hundred shares the price advanced ½ point to 5. Following are the closing quotations of March 25:

NEW YORK.

	Mar. 18.	Mar. 25.		Mar. 18.	Mar. 25.
American Tel. & Cable...	80	85	General Electric.....	316	322
American Dist. Tel.....	30	33	General Carriage.....	⅞	⅞
Brooklyn Rapid Transit..	66⅞	65¼	Hudson River Tel.....	—	⅞
Ches. & Pot. Telephone..	—	—	Metropolitan Street Ry..	168¼	167½
Commercial Cable.....	150	148	N. E. Elec. Veh. Trans..	—	⅝
Electric Boat.....	—	25	N. Y. Elec. Veh. Tran...	12½	12
Electric Boat pfd.....	45	47	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1½	1½	Tel. & Tel. Co. America..	—	—
Electric Vehicle.....	2	2¾	Western Union Tel.....	91¾	89⅞
Electric Vehicle pfd.....	4	5	West. E. & M. Co.....	195¼	194
			West. E. & M. Co. pfd...	194	194

BOSTON.

	Mar. 18.	Mar. 25.		Mar. 18.	Mar. 25.
Am. Tel. & Tel.....	169	168	Mexican Telephone.....	—	—
Cumberland Telephone...	—	—	New England Telephone.	145	*146¼
Edison Elec Illum.....	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....					
General Electric pfd....					

PHILADELPHIA.

	Mar. 18.	Mar. 25.		Mar. 18.	Mar. 25.
American Railways.....	—	—	Phila. Traction.....	98	98
Electric Storage Battery..	60	71½	Philadelphia Electric....	4⅞	5
Elec. Storage Batt'y pfd..	60	73½	Pa. Electric Vehicle.....	—	—
Lehigh Coal & Navigation....			Union Traction.....		

CHICAGO.

	Mar. 18.	Mar. 25.		Mar. 18.	Mar. 25.
Central Union Telephone.	—	—	National Carbon pfd....	85	91
Chicago Edison.....	170	175	Northwest Elev. com....	38	39⅛
Chicago City Ry.....	*223	—	Union Traction.....	17½	19¾
Chicago Telep. Co.....	185	—	Union Traction pfd.....	54	56
National Carbon.....	21½	25			

*Asked.

ELECTRIC STORAGE BATTERY COMPANY.—At Philadelphia on March 20, at the annual meeting of the Electric Storage Battery Company the number of directors was reduced from 15 to 9. In ratification of the recent action by directors themselves the names dropped from the Board were George A. Huhn, W. W. Gibbs, J. P. Sinnott, George H. Day, Phil. L. Dodge and D. H. Shea. The directors re-elected were P. A. B. Widener, W. L. Elkins, Thos. Dolan, George D. Widener, George Philler, Rudolph Ellis, Thos. Reagan, Herbert Lloyd and G. B. Schley. The annual statement for the year ended Dec. 31, 1901, is as follows: Total net earnings, $900,243; less dividends paid during year, $812,414; surplus, 1901, $81,829; accrued surplus to Dec. 31, 1900, $2,120,439; total surplus, $2,208,268. Current assets: Cash on hand, $106,234; accounts receivable, $1,652,062; notes receivable, $88,687; inventory account—raw material, stock and finished product, $467,043; total current assets, $2,314,027. Current liabilities: Accounts payable, not yet due, $46,982; net surplus of current assets over liabilities, $2,267,045. In his remarks to the stockholders President Herbert Lloyd said: "The large figures contained in the item of accounts receivable may be explained by the statement that nearly one-third of the sum mentioned, $1,652,062, represents the price for which we have just concluded to sell our lead property near Elvins, Mo. Although our business shows a falling off for 1901 as compared against that for 1900, the indications for 1902 are that we shall break all records. One million dollars of business has been closed since the beginning of the year, and at the present rate we shall do at least $4,000,000 during the year."

CONSOLIDATED RAILWAY LIGHTING.—The Consolidated Railway Lighting & Refrigerating Company held its annual meeting last week in Jersey City. Considerable interest attached to this meeting, as it was expected that it would settle the contest for control of the company, which has been going on for some time, through the efforts of F. C. Hollins, the broker and banker, to oust Isaac L. Rice from the presidency. The meeting demonstrated the supremacy of Mr. Rice, for, although he was able to vote only 81,000 shares at a meeting on Jan. 31 last, there were voted for him 113,000 shares at this annual meeting. This does not include the number of shares standing in his name, which were not voted. An injunction had been secured some time ago to prevent him from voting these shares, on the ground that he obtained them fraudulently, but this injunction was dissolved a few days ago. Still, Mr. Rice considered it best not to vote them. President Rice made a statement to the stockholders showing the progress being made in adoption by the railway companies throughout the United States and in foreign countries of the various devices owned by the company, which include its "axle light" system of electric car lighting for all kinds of passenger cars, its mechanical refrigeration car system, and other electrical and mechanical railway appliances. The following were unanimously elected directors of the company: Walther Luttgen, Norman Henderson, Arthur Turnbull, G. L. Boissevain, Lenox Smith, Lucius H. Beers, August G. Fromuth, Isaac L. Rice and John N. Abbott.

EVERETT-MOORE TROLLEYS.—A telegram from Chicago of March 21 says: "All the holdings of the Everett-Moore syndicate in Chicago, as well as the interest in Ohio electric roads held by the L. E. Myers Company of this city, have been sold to a syndicate headed by Tucker & Anthony, of Boston. The roads included are: The Massillon City Railway, the Canton-Massillon Interurban Railway, the Canton Street Railway, the line from Massillon to Navarre, and the Canton-Akron Railway. All roads but the last are now in operation, and that is expected to be by April 1, as far as Greentown, and to Akron and Canton by May 1. A new power house is to be built at Canton by July 1, and all the roads named will be operated as one system. Extensions are to be made by the same syndicate from Navarre to New Philadelphia. It is also said that it owns the line from Columbus to Newark. A line is now in operation between Canton and Cleveland, and the only gap between Cleveland and Columbus is from New Philadelphia and Newark. Electric cars are now running from Cincinnati to Columbus, and it is expected that within a year there will be a continuous line from Cleveland to Cincinnati. These lines are built mainly on their own right of way, and are run on fast time, in competition with the steam lines, to such an extent that they secure a good part of the traffic that formerly went to the steam lines.

BELL TELEPHONE.—The statistics of the annual report of the American Telephone & Telegraph Company appear elsewhere in our pages this week. It shows a great development, and is indeed a revelation of the illimitable possibilities of the telephone, for the activity of the opposition has but stimulated the business. The new directorate is an indication that the company will play a strong hand this year. The number of directors was increased from fifteen to eighteen by the election of George F. Baker, Theodore N. Vail, and John I. Waterbury. The fifteen directors re-elected were Charles W. Amory, Francis Blake, Charles P. Bowditch, George L. Bradley, John H. Cahill, Alexander Cochrane, T. Jefferson Coolidge, Jr., Frederick P. Fish, J. Malcolm Forbes, Henry S. Howe, Charles Eustis Hubbard, Charles E. Perkins, Thomas Sanders, Nathaniel Thayer and Moses Williams. Mr. Baker, president of the First National Bank, represents some of the strongest financial interests in America. Mr. Theodore Vail is the man under whom the original Bell system was built up so splendidly against all opposition. Mr. Waterbury is a strong social and financial factor. He is president of the Manhattan Trust Company.

DIVIDENDS.—The directors of New York Metropolitan Street Railway Company have declared the regular quarterly dividend of 1¾ per cent, payable April 15, to stockholders of record March 31. The Big Consolidated Street Railway Company, of Cleveland, have declared the regular 1 per cent quarterly dividend, payable April 5.

WESTERN UNION BONDS.—The $1,000,000 Western Union Telegraph Company bonds maturing May 1, 1902, will be retired with the proceeds of the sale of that amount of the $20,000,000 issue authorized last year. The issue in question was voted one year ago; $10,000,000 were sold and $10,000,000 reserved for future uses. Of this amount $9,000,000 is to be devoted to additions and extensions of the company's lines, and $1,000,000 for the retirement of the bonds on May 1. Kuhn, Loeb & Company purchased the entire block of $1,000,000 subsequent to Jan. 1.

METROPOLITAN BOND ISSUE.—The New York State Board of Railroad Commissioners has approved the application of the Metropolitan Street Railway of New York City for consent to issue its refunding mortgage for $65,000,000. Of the bonds to be issued under the mortgage $54,000,000 will be for refunding other issues and $11,000,000 for equipping with underground electricity the lines now propelled by horse power. H. A. Robinson, attorney for the road, appeared in favor of the application, and there was no opposition.

NORTH JERSEY STREET RAILWAY.—The directors and officers of the North Jersey Street Railway Company have been re-elected. The annual report showed receipts from passengers $4,251,410 and from other sources $21,235. Operating expenses were $1,994,987, leaving net earnings $2,177,658 and surplus after charges $113,768. President Young said the North River tunnel would be completed and in operation within two years. The $1,000,000 to be spent in improving the road in the next year has been secured.

BROOKLYN RAPID TRANSIT.—It is stated by a director of the Brooklyn Rapid Transit Company that not more than $5,000,000 of the $150,000,000 of bonds authorized at Thursday's meeting of the company's stockholders would be issued at present. The proceeds of the sale of the first bonds, it was reported, will be used for improvements and betterments of the property, including more cars and a large new power house.

SUBMARINE CABLE DIVIDEND.—A cable dispatch from London of March 22 says: A dispatch to the *Financial News* from Frankfort says that, despite several mishaps to its cables, the German Atlantic Cable Company will pay a dividend of 4½ per cent.

MONTREAL BONDS.—The $2,500,000 Montreal Light, Heat & Power Company first mortgage 4½ per cent gold bonds offered for sale by N. W. Harris & Company were all sold last week. There was more demand for the bonds than could be supplied.

NORFOLK, VA., TROLLEY DEAL.—It is reported that the Old Dominion Street Railway has been sold for $450,000. William L. Elkins and P. A. B. Widener are mentioned as the purchasers.

Commercial Intelligence.

THE WEEK IN TRADE.—A general survey of the industrial conditions during the week, as outlined in the reports to the mercantile agencies, shows that exceptional activity in spring jobbing trade at all leading Eastern, Western and Pacific Coast markets continued. Crop advices and plentiful rains helped Southwestern trade, which shows a further increase. Industrially, the situation has been vastly improved by the settlement of the Boston tie-up, the averting of the strike of Fall River cotton operatives and the continued exceptional activity in all lines of mechanical production. Iron and steel keep to the front, but "famine" talk is still generally heard, although all energies are still strained to meet consumptive requirements, and imports of foreign pig iron are noted. Furnace stocks of iron are unprecedentedly small, but supplies of coke are going forward better and production is active, with the result that less concern is felt by consumers as to supplies. High premiums for quick delivery, however, still obtain. Pittsburg reports an enormous demand for structural materials, 25,000 tons having been sold during the week. An event of the week was the arrival of 5000 tons of Cleveland (England) pig iron for use in the Central West. Coal prices remained steady. Building activity is increasing and lumber is bought freely at all markets. Hardware, etc., is also active. The business failures for the week, as reported by *Bradstreet's*, numbered 197, as against 222 the week previous and 231 the same week last year. Copper ruled very quiet throughout the week, and nothing of special interest transpired. Transactions were very few, notwithstanding the report that manufacturers are very busy, and exports continue on a large scale. The quotations are 12@12¼c. for Lake, 11¾@12c. for electrolytic in cakes, wire bars and ingots, 11½@11¾ for cathodes, and 11¾@

VARIOUS C & C CONTRACTS.—The C & C Electric Company, 143 Liberty Street, reports receipt of a contract for 75 motors varying in size from 2-hp to 75-hp, which are intended for operating the ventilating apparatus to be installed in the new Astor Hotel, Long Acre Square, New York City. The blowers are to be furnished by the B. F. Sturtevant Company, of Boston, Mass., while the exhausters are to be supplied by the Howard & Morse Wire Works. The C & C Company has also secured a second order from Bidler & Company, of Chicago, for a 120-hp motor for power use in a manufacturing establishment there, and Wilson Bros., of the same Western city, have called for a 150-kw and a 75-kw generator which are to be direct connected to engines of 225-hp and 110-hp, respectively. The engines will be built by Ide & Son, of Springfield, Ill. The contract also requisitions for four motors varying from 3-hp to 10-hp and a switchboard, etc. This equipment will serve as general power installation in a clothing manufacturing establishment. The Flory Manufacturing Company, of Bangor, Me., has ordered an 80-hp C & C motor for operating a coal-hoisting equipment. The Kimbel Building, Philadelphia, is to be installed with eight motors of from 3 to 30-hp for driving a ventilating plant. The New Haven *Register* has sent in an order for a 45-hp series parallel equipment to run a Hoe printing press of sextuple type. The Tietgen & Lang Dry Dock Company, of Hoboken, N. J., has allotted the C & C Company a contract for a 120-hp series parallel equipment, which will be made use of for the purpose of pumping water on a large floating dry dock. The motor will be placed on the dock and is to be driven from the shore, 100 feet or so distant. This contract is said to be the first of its description ever awarded in this country.

BIG WATER-POWER PROJECTS.—Mr. R. N. King, whose offices are on the twelfth floor of the Marine Underwriters' Building, Wall and William Streets, and who was formerly president of the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, will, it is reported, shortly let contracts for various equipment to be used in connection with three large water-power projects in which he is primarily interested. One of the projected plants will have a capacity of no less than 25,000 horse power, and will involve an estimated expenditure of over $2,000,000. This plant it is proposed to construct for the purpose of furnishing general power for the city of Omaha. It is intended to build the power house at a junction of the Loup and Platte Rivers, located about thirty-five miles from the western city. The working head will be about 110 feet. The enterprise involves the construction of twenty-six miles of canal. New York and Boston capitalists are said to be interested in the project. The two other water-power schemes in which Mr. King is interested will mean the erection of 10,000-hp and 9000-hp plants.

WILLARD STORAGE BATTERIES.—The firm of Sipe & Sigler, Cleveland, Ohio, manufacturer of the Willard storage battery, has been succeeded by the Willard Storage Battery Company, Messrs. Sipe and Sigler having dissolved partnership and embarked in other lines. The business will be continued under the active direction of Mr. T. A. Willard, inventor of the battery, and the new company is especially desirous of refuting the impression which seems to prevail in certain quarters that the manufacture of the Willard battery is to be abandoned. The new company will continue to occupy the factory established by the old firm and the business will be expanded as rapidly as possible, particular attention being paid to large installations. New machinery and equipments are being installed and the well known high quality of this product will be improved by the adoption of new processes of manufacture.

MAKING STEEL ELECTRICALLY is one of the outcomes of the great development of the hydro-electric plant at Massena, N. Y., and carries one step further the new electro-metallurgical arts growing up around such places as Niagara, Massena, Sault Ste. Marie, etc. The formation is announced of the Massena Electric Steel Company, to operate under the patents of the Electric Steel Company, of 52 William Street, New York City. The officers are: W. B. Hutchinson, president; M. B. Conley, vice-president; Burnell Colson, secretary; T. T. Seelye, treasurer. The capital stock is $500,000. It is the intention to put up a 100-ton electric furnace.

THE PITTSBURG REDUCTION COMPANY, through A. V. Davis, its secretary and manager, has just closed a deal whereby 30 acres of land in two sections have been purchased for the site of a big plant in East St. Louis, Mo., where 500 men will be employed in the manufacture of aluminum wire. The land is in tracts of 10 and 20 acres. Work is to begin on the construction of the plant about April 1. The promoters of this enterprise first inspected sites at Buffalo, N. Y.; Little Rock, Ark., and elsewhere before accepting the East St. Louis site.

HARTFORD CARPET FACTORY.—It is stated that a new factory at Thompsonville, Conn., for the Hartford, Conn., Carpet Corporation will have a 4000-hp electric generating plant for light and power, and will use electric motors very extensively. The corporation will be in the market for apparatus.

DESK LIGHTS, ETC., FOR EUROPE.—The A. A. McCreary Company, Electrical Exchange Building, New York City, is reported to have received recently some good-sized contracts for desk lights and reflectors for shipment to London, Eng., the City of Mexico, and Palermo, Sicily.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended March 14: Azores—4 pkgs. material, $60. Argentine Republic—24 pkgs. material, $680; 11 pkgs. machinery, $1,938; 1538 pkgs. conduit pipe, $1,455. British Australia—50 pkgs. material, $2,107; 50 pkgs. machinery, $2,504. Bilboa—2 pkgs. material, $200. Berlin—1 pkg. material, $120. British Guiana—15 pkgs. material, $1,162. British East Indies—107 pkgs. machinery, $4,757; 15 pkgs. machinery, $623. Brazil—129 pkgs. material, $4,572; 5 pkgs. copper wire, $1,159; 4 pkgs machinery, $326. British West Indies—4 pkgs. material, $101. Cuba—68 pkgs. material, $687. Central America—10 pkgs. material, $90. Copenhagen—9 pkgs. machinery, $120; 1 pkg. material, $61. Dutch West Indies—6 pkgs. material, $128. Dutch East Indies—2 pkgs. material, $70. Genoa—7 pkgs. material, $43; 23 pkgs. machinery, $5,000. Hamburg—16 pkgs. material, $696. Havre—6 pkgs. machinery, $137; 27 pkgs. material, $1,253. Hayti—2 pkgs. material, $50. Ipswich—7 pkgs. wire, $258. Liverpool—276 pkgs. machinery, $25,052; 17 pkgs. material, $686; 18 pkgs. wire, $2,400. London—293 pkgs machinery, $6,956; 96 pkgs. material, $3,403. Leeds—1 pkg. material, $35. Mexico—68 pkgs. material, $4,075; 40 pkgs. machinery, $6,000. Manchester—6 pkgs. material, $1,500; 8 pkgs. wire, $159; 8 pkgs. material, $476. Naples—2 pkgs. machinery, $200. New Castle—22 pkgs. machinery, $3,250. Offenbach—1 pkg. machinery, $45. Peru—14 pkgs. material, $685. Rotterdam—4 pkgs. material, $120; 2 pkgs. machinery, $170. Santo Domingo—1 pkg. material, $30. Southampton—20 pkgs. material, $3,700. Schiedam—1 pkg. machinery, $45. U. S. Colombia—4 pkgs. material, $19. Uruguay—3 pkgs. machinery, $48. Venezuela—36 pkgs. material, $455.

THE H. W. JOHNS-MANVILLE COMPANY has secured a number of contracts for the installation of its materials recently, among which are the following: The Hygeia Refrigerating Company, Elmira, N. Y., where a complete line of insulation with fire felt covering is being installed. The modern hospital maintained by Messrs. Arnot-Ogden is being fitted up with Asbesto-Sponge moulded covering. The Lestershire Manufacturing Company, Endicott, N. Y., which will be the largest tannery in New York State when completed, is being installed with Asbestocel coverings. The St. Louis branch of the company reports an order for the William J. Lemp Brewing Company, of St. Louis, whose entire boiler plant is being remodeled and the new boilers will be covered with Asbesto-Sponge felt. The fittings which will be of a sectional nature and the entire work will cost in the neighborhood of $3,000. This branch of the company now has also under way the covering of the pipes in the power house of the St. Louis Transit Company, Second and Salisbury streets, the covering used being Asbesto-Sponge felt also. The last order received from the St. Louis Transit Company was for the power house at Park and Vanderventer avenues. The total cost of these two power plants will be close on to $30,000. The New Orleans branch of the company reports having received a contract from the Tennessee Coal, Iron & Railroad Company for covering steam pipes in connection with its rail mill plant at Ensley, Ala. This branch also secured a contract from Armour & Co. for covering brine, steam, exhaust and hot water pipes from 10 inches to 1 inch.

OTIS ELEVATOR REPORT.—President Baldwin's report on the affairs of the Otis Elevator Company for the year ending Dec. 31 shows net earnings of $842,096, out of which dividends on preferred were paid of $267,538 and $274,557 was set off to depreciation. The reserve fund shows $700,000, and the plant account stands at $10,520,891. President Baldwin says: The business for the year 1901 has been satisfactory. The large amount of building operations throughout the country has made the demand for the company's product during the past year larger than at any time in the history of the company, and the outlook is most encouraging. While the net earnings apparently justify some recognition of the common stockholders in the way of dividends on the common stock, the directors are of the opinion that the ultimate best interests of the company and all its shareholders will be subserved by carrying the surplus of $300,000 to working capital account. The expenditure of large amounts of money in betterments and in expanding the operations of the company in various ways since the organization, has necessitated, in the judgment of the directors, that working capital should be increased until such time as it is sufficient to meet the demands of the business. From present indications it will be necessary to continue this policy for the present, or the adoption of some measure looking to an increase of capital, in which latter event the directors will make some recommendation for the consideration of shareholders.

ALLIS CHALMERS — [illegible] the following: We are informed that the contracts on the order books of the Allis-Chalmers company justify the firm in expecting the most successful year in its history. Owing to the mixed nature of the orders taken, the firm is never in a position to decline orders, because while some departments of the works will be rushed and loaded down with work, others are scarcely busy. It is stated that there are orders on the books that cannot be completely filled within two years, while other orders can be received for delivery within a short time. The engines for the central power house of the New York Rapid Transit Subway Company are at present occupying the attention of the company's engine departments. The Allis-Chalmers Company has notified employes of their various plants that a 5 per cent increase will be made in their wages, beginning April 1, and that the working hours will be reduced to 55, the plan being to run ten hours per day for five days in each week, and five hours on Saturday, thus giving the men a Saturday half-holiday.

MEAD CONVEYING MACHINERY CONTRACTS.—John A. Mead & Company, of Rutland, Vt., whose New York offices are in the Bowling Green Building have secured a contract from the Edison Electric Illuminating Company, of Topeka, Kan., for a coal and ash handling equipment of 45 tons per hour capacity for an extension of its plant. The Topeka Company have also let contracts to Babcock & Wilcox for additional boiler equipment and a generator to be supplied by the General Electric Company. The Mead people have also been awarded a contract, valued at nearly $150,000, for three large exhausting and reloading plants for the Quincy Copper Company. Pickand & Company, of Pittsburg, have ordered two unloading plants for their Marquette, Mich., branch. These equipments have a capacity for handling 2000 tons of coal daily. The Chicago & Northwestern Railway, at Escanaba, is to be equipped with two reloading and rehandling towers, and the Copper Range Railroad at Houghton, Mich., has called for a tower capable of handling 1000 tons of coal per day.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY closed a contract last week, through its Eastern District office, in Philadelphia, Pa., Mr. Paul W. Bossart, manager, to furnish and install Kellogg switchboard apparatus for the Keystone Telephone Company in its third district exchange building in West Philadelphia. The Kellogg Company has previously been awarded contracts for switchboard apparatus for the first and second district exchanges of the Keystone Company. The First District is in operation, and the second is now being installed. Contracts have also recently been closed through the same agency for full exchange equipments, including the latest improved central energy multiple switchboards and telephones for independent exchanges in Troy, N. Y., Lansingburg, N. Y., and Ballston, N. Y., aggregating an ultimate capacity of about 5000 lines.

A BIG STEEL CAR PLANT.—According to the *Railroad Gazette*, the American Car & Foundry Company will build a new steel car plant at Berwick, Pa., to be a duplicate of the plant recently built at Detroit, which is probably the finest steel-car shop in the world. The company expects to have in the new shop a number of improvements which will make it even superior to the one at Detroit. The main car-erecting shop at the new plant will be 730 feet long and 185 feet wide. All machinery in the plant will be electrically driven and the best labor-saving devices and machinery will be used. The American Bridge Company has the contract for the buildings, and the Westinghouse, Church, Kerr & Company are doing the engineering. The plant will have a capacity of 10 to 20 steel cars a day.

GOULD STORAGE BATTERIES.—Among the recent contracts secured by the Gould Storage Battery Company of New York City is an installation of 255 cells, with a plate capacity of 100 kilowatts and a tank capacity of 140 kilowatts for the Kutztown & Fleetwood Street Railway Company, of Allentown, Pa. The same road has also ordered a battery of 244 cells with a capacity of 100 kilowatts and a tank capacity of 125 kilowatts, to be used as a floating battery on the system.

NEW SWITCHBOARDS.—Contracts for the installation of new switchboards in the plants of the Lynn Gas & Electric Company at Lynn, Mass., and the North Adams Gas Light Company at North Adams, Mass., have been secured by S. B. Condit, Jr., & Co., Boston. The former is a 17-panel board, while the latter will contain 6 panels. Both boards will be equipped with Elden oil switches and circuit breakers of the Condit manufacture.

WIRE FOR ST. LOUIS FAIR.—Mr. Henry Rustin, chief electrical and mechanical engineer of the St. Louis World's Fair, makes the announcement that 1200 tons of copper wire will be required in the construction of the electric light system. This means that there will be 2400 miles of wire used. But 300 tons, or 600 miles of wire were used at the Pan-American, or about one-quarter the amount required at St. Louis.

NIAGARA POWER CONTRACT.—At Lockport, N. Y., on March 24, the Common Council voted, Mayor Huston casting the deciding ballot, to enter into a contract with the Niagara, Lockport & Ontario Power Company for a water supply at $50,000 a year for ten years, provided the company build a power canal from the Niagara River, developing 100,000 horse power.

BALL ENGINES.—The Harvard Brewing Company, Lowell, Mass., has recently installed an electric plant. The Ball Engine Company, Erie, Pa., furnished the engines, which are direct connected to General Electric generators.

General News.

THE TELEPHONE.

NEW DECATUR, ALA.—The Wm. J. & Frank E. Bell Telephone Company, of Chicago, is making arrangements to put in a telephone system. The company is reported to have already obtained several hundred subscribers in both the Decaturs. It will cut under the Bell rates as they now stand.

WASHINGTON, D. C.—In the Senate a bill has been introduced to grant to the Telephone Company of America the right to construct and maintain conduits for telephone and telegraph lines and to operate a telephone exchange system and telegraph lines in the District of Columbia. The company is required by the bill to place in operation not less than 10,000 telephones within eighteen months from the date of the passage of the bill. The company is incorporated under the laws of Delaware.

PEKIN, ILL.—The Central Union Telephone Company is making extensive improvements in its exchange in this city.

IVESDALE, ILL.—Farmers' Mutual Telephone Company, capital, $5,000, has been incorporated by M. E. Hairshberger, E. E. Lesch, and J. E. Duggan.

RUTLAND, ILL.—The La Salle & Marshall Counties Telephone Company has certified to an increase of capital stock from $10,000 to $30,000, and of change of name to the Central Illinois Telephone Company.

CARLINVILLE, ILL.—The Macoupin Telegraph & Telephone Company has elected the following-named officers: President, Joseph B. Liston; secretary, A. F. Loehr; treasurer, Charles G. Heinz; directors, C. Westermerer, jr., of Carlinville, and E. J. Huff, of Girard. Several out-of-town companies were represented by officers, and propositions for connections were made with the Macoupin Company. The Chesterfield Company, which is now constructing a line from Medora and Chesterfield to Comer, desires to connect with the line at Comer; a short line from Fayette desires connection, and the Kinloch Company, of St. Louis, also desires a franchise through the county, giving it an outlet to the balance of the county and into St. Louis.

PERU, IND.—The Wabash Home Telephone Company is arranging to build its line to this city.

TELL CITY, IND.—The Perry County Home Telephone Company has obtained a franchise in this city and has petitioned the County Commissioners for the right of way throughout the county.

INDIANAPOLIS, IND.—The Luther Telephone Company, of Luther, Ind., has been incorporated with a capital of $5,000. The company will establish an exchange at Luther and extend its lines throughout Whitley, Huntington, Wabash and Kosciuko counties. The directors are M. L. Pray, Melvin Zent and John J. Swartz.

MONTICELLO, IND.—The White Circuit Court has enjoined the auditor and treasurer of Jasper County from collecting a tax assessed against the Jasper County Telephone Company by the State Tax Board. An appeal has been taken to the Supreme Court, where the whole plan of taxation of telephones will be reviewed by that Court. There is at present quite a contention between the State Tax Board and the local assessors as to the right to assess telephones, and the Court's decision will enlighten both factions.

EVANSVILLE, IND.—By reason of the expiration of the present telephone franchise a group of telephone companies are now applying for a franchise and numerous contracts have been filed with the Council. The Board of Works has shifted the responsibility to the Council, and the latter is divided in opinion as to the best thing to do. Some favor granting franchises to the Cumberland and to the Stromberg-Carlson companies, others are in favor of a municipal system. The merchants oppose a dual system, and the laboring people are demanding a municipal system.

EMMETSBURG, IA.—A movement is on foot to organize a rural telephone company for Palo Alto County, the system to be owned by the farmers.

HAMBURG, IA.—At the meeting of the City Council permission was given to the Iowa & Missouri Telephone Company, to establish an exchange in this city.

CARROLL, IA.—The Green County Telephone Company, with a capital stock of $100,000 has been organized and has purchased C. G. Cockerill's Jefferson Telephone Company.

BAXTER, IA.—Baxter Telephone Company, capital, $10,000, has been incorporated by C. C. Graham, P. F. Earley, J. F. O'Brien, H. S. Downs, L. D. Ozman, R. L. Arnold, and L. A. Hager.

IOWA FALLS, IA.—The Hawkeye Telephone Company, which operates exchanges in this city, Hampton and Eagle Grove and about 120 miles of toll lines, will be succeeded by the Central Telephone Company, of Iowa, with headquarters in this city. The new company is capitalized at $80,000 and half of the stock will be owned by capitalists in La Porte City and the balance in this city, Hampton and Eagle Grove. The new company will start in with over 900 telephones in use in Iowa Falls, Hampton and Eagle Grove, while new exchanges will be established on the toll lines. Two hundred new telephones will be installed at once.

WEST POINT, KY.—About twenty citizens will soon put in operation a new exchange under the name of Riverside and Barrallon Telephone Company.

LOUISVILLE, KY.—An opinion handed down in Louisville gives judgment [illegible] Company against the Cumberland Co[illegible] Company, the suit [illegible] the Home Company to erect poles and wires on Frankfort Avenue.

SNOW HILL, MD.—The Pocomoke Telephone Company, of Worcester County, has been incorporated with a capital stock of $15,000.

MARQUETTE, MICH.—The Marquette Telephone Company will rebuild its overhead line at Lake Linden next summer.

SEDALIA, MO.—The following gentlemen: G. W. Schweer, Windsor; W. B. Scruggs, Harrisonville; N. L. Gollaway, Halden; C. E. Bells, Fayette; S. T. O'Neill, Clinton; H. H. Wilcoxson and O. M. Jusbol, Carrollton; O. C. Sinder, Kansas City; H. H. Simpson, Pilot Grove, and C. E. Thew, Sedalia, representing independent telephone companies of Missouri, met at Sedalia on March 11 to discuss ways and means of increasing the independent companies' business and consider the cutting of rates.

PLATTSMOUTH, NEB.—In the case of the Nebraska Telephone Company against the Plattsmouth Telephone Company, in which the former sought to obtain a permanent injunction to prevent the latter from putting up poles and stringing wires on the same side of the street in Louisville, the Court decided to the effect that a subsequent company can occupy the same side of the street and project its poles up between the wires of a rival company, and further, that a city can require electrical companies of the same class to occupy the same side of the street, in order to avoid the annoyance to the public of having poles in many places.

ALBANY, N. Y.—The Attica, Bennington & Cowlesville Telephone Company, of Attica, Wyoming County, N. Y., has been incorporated with a capital of $1,500; directors, W. I. Eastwood, L. M. Kittsby and John Beechler, of Bennington.

ALBANY, N. Y.—The Home Telephone Company, of this city, has awarded the contract for the construction of its new exchange in this city. The building will cost $28,000. The switchboard will have a capacity of 7200 lines, and will cost $30,000. It will be made in Chicago.

PILOT MOUNTAIN, N. C.—The Farmers' & Merchants' Telephone Company has a short telephone line running south about one-half mile. This is connected with no other line, yet, strange to relate, users of the telephones can talk to Mayodan, 40 miles away. No telephone line connects the two points.

ATTICA, OHIO.—The Attica Telephone Company has increased its capital stock from $2,500 to $10,000.

WILMINGTON, OHIO.—The Clinton Telephone Company, a Delaware corporation, with $50,000 capital stock, has qualified to do business in Ohio. Headquarters will be at Wilmington.

UPPER SANDUSKY, OHIO.—The Home Telephone Company has just arranged for telephones in the homes of 125 farmers, in different parts of the county, which will be connected with the local exchange.

LEBANON, PA.—The capital of the Valley Telephone Company, of Lebanon, has been increased from $30,000 to $50,000.

KIMBALL, S. D.—The City Council of Kimball has granted to the Brule County Telephone Company a franchise for a local telephone system.

FAIRMONT, S. D.—The Fairmont Co-operative Telephone Company has been incorporated, with a capital stock of $5,000, by C. E. Ruppert, George Alley, and others.

NASHVILLE, TENN.—A charter has been granted to the Holston Water & Electric Power Company in Sullivan County. Jas. Gamon, E. K. Crymble and others are the incoporators.

PORT ARTHUR, TEX.—The City Council has granted a franchise to the Southwestern Telegraph & Telephone Company of Texas.

HANCOCK, WIS.—The Union Telephone Company has increased its capital from $12,000 to $30,000.

FAYETTE, WIS.—The Iowa & Lafayette County Farmers' Telephone Company, capital, $10,000, has been incorporated by T. J. Van Matre, E. D. Parkinson, and T. B. Andrews.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—An electric light and power plant will be installed in Cottonwood, Idaho, by D. C. Van Buren, who recently applied for a franchise.

SAN FRANCISCO, CALIF.—The Gold Hill Mining, Power & Development Company, recently incorporated by H. J. Houck, T. J. Kenney and others, intends to install an electric light and power plant in Gold Hill, Oregon.

SAN FRANCISCO, CALIF.—The Kern River Company has been incorporated, with a capital stock of $2,500,000, by Chas. T. Libley, F. W. Robinson, Harry Butler and others to operate in California. It is proposed to construct pipe lines and to generate and transmit electric power.

SAN FRANCISCO, CALIF.—The Board of Supervisors of Sonoma County, Calif., has granted an electric lighting franchise to A. Sbarboro and associates, of San Francisco. The hydro-electric plant will be installed on Sulphur Creek above Geyserville. A transmission line will be constructed as far south as Healdsburg. Electric light and power will also be supplied in Cloverdale, Geyserville and Asti. The first installation will cost $50,000.

SAN FRANCISCO, CALIF.—The Richmond Light & Power Company will add another unit to the new plant, which is lighting Richmond, the terminal of the Santa Fe Railroad on San Francisco Bay. The power house now contains a 225-horse-power Allis-Corliss engine, belted to a 275-kw General Electric three-phase, 60-cycle generator. Mr. H. J. Crocker is president of the company. While he was president of the West Side Flume & Lumber Company he installed a 150-kw three-phase General Electric generator in the company's lumber mill. Lights are supplied from this source in Carters and Tuolumne City.

GILROY, CALIF.—The Gilroy Light & Power Company, which has been incorporated by Mr. E. B. Pringle and others, will erect a pole line and distribute electric power, taken from the Standard Electric Company's transmission lines. This distributing system will extend from San Jose to Gilroy and also supply current at intermediate points. The capital stock is $75,000. The City Council of Gilroy recently granted an electric light franchise to E. D. Crawford, who is negotiating for the purchase of the local gas light company's plant. It is thought that Southern California capitalists are interested in the

project and intend to transmit current to neighboring owns and also to erect electric plants in other coast towns.

SAN FRANCISCO, CALIF.—The Pacific Light & Power Company, which has been incorporated in Los Angeles, Calif., by H. E. Huntington, I. W. Hellman, A. Borel, Chas. de Guigne, W. G. Kerckhoff, Kaspare Kohn and H. W. O'Melveny, has a capitalization of $10,000,000. It amounts to a combination of the electric light and power interests of the Huntington and Hellman people with those of the San Gabriel Electric Company represented by W. G. Kerckhoff. The Edison Electric Company of Los Angeles, however, controls several important companies that are developing water power electric plants, such as the California Power Company. The new company is incorporated to supply electricity, gas and water in Los Angeles and Southern California.

DE KALB, ILL.—The De Kalb-Sycamore Electric Company has been incorporated for the purpose of operating light, heat and power plants and traction lines, and has a capital stock of $200,000. The incorporators are W. B. Ullman, J. D. Harvey and Herbert Nicholson.

ALTON, ILL.—The Illinois Glass Company purchased an electric power and lighting plant last week, which will be installed in the new addition to the Illinois box factory to furnish electric power for all the box factory and the glass works machinery. The big plant of the Illinois Glass Company will be lighted by electricity by the new power plant. A 400-horse-power outfit has been bought, and will be installed at an expense of $75,000. It is intended to substitute electric motors to operate machinery wherever steam has been used in the past.

ELWOOD, IND.—A movement is on foot here by the merchants to install another electric lighting plant, the present service being unsatisfactory.

MUNCIE, IND.—The City Council has granted a 35-year franchise to the Muncie Electric Light Company, C. M. Kimbaugh, president. The company will also put in a heating plant.

CRAWFORDSVILLE, IND.—This city is tired and disgusted with municipal electric lighting, and the Board of Works is trying to lease the plant for a term of ten years to the Crawfordsville Electric Traction Company.

RICHMOND, IND.—The City Council has fixed the rate for the light to be furnished by the new municipal plant at 8 cents per kilowatt hour, with discount under certain conditions. S. E. Gard has been chosen superintendent of the plant.

NEW ORLEANS, LA.—The Nicaragua Electric Company, which it is said will build a plant in New Orleans and also has in contemplation a plant in Nicaragua, has been chartered. The capital stock is $100,000. Gustav Lehman, sr., and others are interested.

CUMBERLAND, MD.—A contract for an electric light plant has been awarded to the Ramsey Electrical Manufacturing Company, of Pittsburg.

DETROIT, MICH.—Public Lighting Commissioner Davis favors installing additional machinery in the municipal station; sufficient to take care of 400 lights.

FLINT, MICH.—The Clayton-Litchfield Company, of Detroit, has applied for a franchise for city and commercial lighting in Flint; also for a hot water heating system.

GRAND RAPIDS, MICH.—The consolidation of the Muskegon River Water Power Company and its recently acquired holdings with the Edison Light Company, of Grand Rapids, Mich., is officially confirmed. The Muskegon River Water Power Company was organized about a year ago for the purpose of acquiring and developing water power rights in Muskegon River. Within the past two months the Muskegon River Company has acquired by purchase the West Michigan Electric Company, of Lowell, the Lowell Water & Light Company and the Peninsular Light, Power & Heat Company. It was the purpose of the Muskegon River Company to get into Grand Rapids to find a market for the vast water power available in the Muskegon River. With this idea in view, it negotiated with the Edison Light Company previous to its purchase of the Peninsular Company and the others, and finally secured control. A new company is to be organized with a capital of $1,500,000. The new company will arrange as rapidly as possible to erect dams in Muskegon River for the generation of about 25,000 horse-power, and its principal business will be to furnish light and power to this city.

BEVIER, MO.—At the March meeting of the Board of Aldermen it was decided to re-submit the proposition, at the general election in April, to bond the city for the purpose of putting in an electric light plant. The same proposition was defeated last December by 23 votes short of a two-thirds majority necessary to carry.

ST. LOUIS, MO.—The early consolidation of the Imperial Electric Light, Heat and Power Company and the Citizens' Electric Lighting & Power Company is anticipated by the stockholders of the two corporations. The matter will be brought up at the stockholders' meeting, May 16, and plans long in preparation are almost perfected. The Imperial Company has a 7,000 horse-power plant at Tenth and St. Charles Streets and the Citizens' Company has built a conduit system throughout the city and proposes to build a $1,000,000 plant. The merged corporation will be one of the strongest and largest in the country, and will furnish the power for the World's Fair, by a contract which has been let to the Citizens' Company.

ST. LOUIS, MO.—A statement of the earnings of the Missouri Edison Electric Company for the month of February shows that the company was better off without than with the city lighting contract, or, at least, that there was that much of an increase in earnings over the corresponding month of 1901, when it had the city lighting contract, which paid $300,000 a year, or $25,000 a month. The gross receipts for the month were $70,847.33 from which is deducted the expense of operation, $37,450.43, made up of the following items: General expenses, $9,970.67; station operations, $16,090.43; maintenance of lines, $11,389.33. This deduction leaves $33,396.90, from which is taken bond interest for the month, amounting to $17,166.66, leaving the net gain for the month $16,230.24, as against the net gain for February, 1901, of $690.51. The net gain over bond interest for February, 1900, with the city lighting contract was $13,385.42.

WINSTON-SALEM, N. C.—A 1000-horse-power generator at the Yadkin River plant of the Fries Power Company has been burned out. It will cost $1,500 and two weeks' time to repair the damage.

SIDNEY, N. Y.—The Standard Light, Heat & Power Company, of Sidney, has been granted a franchise for Unadilla and Bainbridge and will supplement its water power plan with a 300-horse-power engine. Mr. E. O. Allen is engineer of the company.

DILLION, OHIO.—The Dillion Electric Light & Power Company, of New York, has been incorporated at Dover, Del., to operate in this place, with a capital of $100,000.

COLUMBUS, OHIO.—The John R. Morgan Engineering & Construction Company, a new concern, will equip their large shops with the latest and best machine tools electrically driven.

READING, PA.—The Philadelphia & Reading Railroad is equipping its new shops with Connersville blowers driven by direct-connected motors.

AUSTIN, TEX.—An electric light plant has just been inaugurated in the town of Acambay, Mexico. The machinery was purchased in the United States.

THE ELECTRIC RAILWAY.

NEW DECATUR, ALA.—J. T. Cross and associates have been granted a franchise for building an electric railway.

LOS ANGELES, CALIF.—Senator Clark has acquired control of the Los Angeles Traction Company, the only street railway system in this city in competition with the Huntington lines.

SAN FRANCISCO, CALIF.—The Southern Pacific Railroad Company is installing electric train lighting apparatus, the generating sets being located in the baggage cars. It is said that the expense will be about $500,000. A careful study of the various systems of lighting cars was made by the company's electricians before arriving at a decision.

SAN FRANCISCO, CALIF.—The United Railroads, of San Francisco, has been incorporated with a capital stock of $40,000,000. The directors are Geo. E. Starr, G. H. Whitfield, W. M. Abbott, Geo. K. Ford and Chas. P. Gale. The amount subscribed was $197,400. Subscriptions of stock were opened at once and several millions were subscribed the first day, largely by stockholders of the Market Street Railway Company, which is to be acquired by the new corporation. The other street railways that will be absorbed in the consolidation to take place on or before March 28 are the San Francisco & San Mateo Electric Railway, the Sutter Street Railway and the Sutro Railroad lines.

CHICAGO, ILL.—The Western Illinois Traction Company, of Monmouth, has been incorporated; capital, $10,000. Incorporators, W. W. McCullough, W. B. Young and S. S. Hallam.

RUSHVILLE, ILL.—The Board of Supervisors has granted a franchise to the Newcomb & Western Electric Railway Company to construct an electric railway from the North line of Schuyler County to this city and from here to Beardstown and Mount Sterling.

GOSHEN, IND.—The citizens of this township have voted a $30,000 subsidy in aid to the Ft. Wayne & Goshen Electric Railway.

ELKHART, IND.—The Michigan Hydraulic & Electric Company, of Coldwater, Mich., is seeking a franchise in this city for an electric railway.

MUNCIE, IND.—The City Council has granted the Hartford City & Ft. Wayne Electric Railway a franchise to enter the city over certain streets.

JASPER, IND.—The Vincennes & Jasper Electric Railway has been granted a fifty-years' franchise and right of way in Dubois County along the Vincennes and New Albany State road.

NOBLESVILLE, IND.—The Commissioners have granted to the Union Traction Company of Indiana a franchise for a right of way across the highways in Hamilton County and through the streets of the towns of Arcadia and Carmel.

ANDERSON, IND.—The Merchants' Traction Company, organized and incorporated with a capital stock of $100,000 to build an electric railway between this city and Middletown, has elected the following officers: President, R. H. Williams; vice-president, J. W. Davis; secretary, A. R. Clark; treasurer, John Rawlins. The company has obtained franchises in both cities.

MT. STERLING, KY.—A franchise has been granted to the Bluegrass Traction & Electric Company, of Lexington, to run an electric road through the streets of this city.

ELKTON, MD.—The Newark, Elkton & Eastern Shore Electric Railway Company was incorporated with the following incorporators: Joseph H. Steele and Charles S. Elliason, of Chesapeake City, and John G. Williams, Albert Constable and Joshua Clayton, of Elkton. The company will construct a freight and passenger line from the Delaware State line, near Newark, Del., to Chesapeake City, via Elkton, and the electric road now being constructed from Wilmington, Del., to Newark, it is reported, will be extended down the Eastern Shore via Elkton and Chesapeake City. The capital stock of the company is $100,000. The Maryland Legislature will be applied to for a charter.

KALAMAZOO, MICH.—A franchise has been applied for here by the Michigan Hydraulic & Electric Company, which has been organized with a capital of $1,000,000 to build an interurban railway from Kalamazoo to Elkhart, Ind. This road will complete a chain of electric railways connecting Chicago and all of Northern Illinois and Indiana with Grand Rapids and all the important lake shore towns up to Muskegon. A. J. Roat, of Kingston, Pa., is president of the company and Robert Van Scheick, of Scranton, Pa., is secretary.

GRAND RAPIDS, MICH.—The Grand Rapids & Chicago Railway Company filed articles of incorporation with the Secretary of State of Michigan on [illegible] to build an electric railway between this city and Chicago by way of Allegan, South

Haven and Benton Harbor, with a branch from Allegan to Kalamazoo. The line and branches will be 125 miles in length, and it will connect with interurban lines now reaching Chicago. The incorporators are William H. Patterson, George Hefferan, Charles B. Kelsey and Samuel A. Freshney, of this city, and John S. Graybill, of Lancaster, Pa.

ALBANY, N. Y.—The Hudson River Traction Company, capital, $1,100,000, has been incorporated at Trenton, N. J. The company is authorized to construct and operate street railways. The incorporators are Samuel B. Lawrence and Henry C. Everdell, of New York, and George B. Hanford, of East Orange.

COLUMBUS, OHIO.—The Market Street Railway Company has increased its capital stock from $25,000 to $500,000.

LIMA, OHIO.—The steam lines paralleling the Western Ohio Railway have made a reduction in rates to meet those of the electric line which has just commenced operations.

AKRON, OHIO.—The Summit County Commissioners have granted a franchise to Daniel Gindelsperger, and others, of Cleveland, for their proposed new line from Cleveland to Akron.

CANTON, OHIO.—The Stark Railway Company has completed the buildings for its power station and is installing the equipment. It is expected cars will be in operation between Alliance and Sebring in about two months.

CONNEAUT, OHIO.—Work of surveying for the Conneaut & Eastern Railway has been started near Erie. A number of bridges will have to be built for the road which will complete the through line between Erie and Cleveland.

TOLEDO, OHIO.—The Toledo Scenic Railway & Amusement Company, capital stock, $60,000, has been organized with Frank James, president; Frank H. Chapman, vice-president; J. W. Gunnels, secretary-treasurer and general manager.

WAPAKONETA, OHIO.—The Western Ohio Railroad Company offers to establish its car shops, repair shops and barns in this place if the village will furnish six acres of land and secure suubscriptions for $50,000 of the company's mortgage bonds.

TOLEDO, OHIO.—Auditor Godfrey has announced an increase of $3,140,390 on the taxable valuation of the Toledo Railways & Light Company. Heretofore, the company has paid taxes on about $700,000. The county treasurer has brought suit to collect taxes on this valuation.

CLEVELAND, OHIO.—The Cleveland & Eastern, the Cleveland & Chagrin Falls, and the Chagrin Falls & Eastern railways have been formally transferred to the Eastern Ohio Traction Company. The new company has a capital stock of $2,500,000 and bonded indebtedness in the same amount.

FINDLAY, OHIO.—The Findlay, Kenton, Bellefontaine & Urbana Electric Railway Company has been incorporated with $10,000 capital stock by W. J. Burkett, J. M. Steen, C. H. Thorndyke, J. N. Schafer, David Joy, C. A. Bond, and H. H. Criswell, all of Findlay. Right of way is being secured.

LIMA, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company is laying rails between Lima and Westminster and expects to open this section about May 1. Considerable work is being done between Toledo and Lima, and, it is claimed, cars will be operated from Marysville to Toledo by July 1. It is said that 95 per cent of the untracked right of way has been secured.

COLUMBUS, OHIO.—A bill has been introduced in the Ohio Legislature which, if passed, will make it possible for suburban or interurban roads supplied with power from the same station to consolidate. At present there must be a physical connection between different systems before they can be consolidated. It would be necessary, under the new ruling, for both roads to secure all their power from the same station; hence, a single feed-wire connection could be used as a pretext for consolidation. It is thought that the bill was introduced by the Pomeroy-Mandelbaum syndicate, which evidently has a consolidation in view.

NASHVILLE, TENN.—The directors of the Nashville & Gallatin Electric Railway and the Nashville & Columbia Electric Railway have elected officers as follows: President, Frank Haskell, of Pittsburg; treasurer, C. W. Ruth, of Pittsburg; general manager, J. H. Conner, of Nashville; secretary and general counsel, Frank P. Bond, of Nashville.

OSHKOSH, WIS.—The interurban electric railway between this city and Fond du Lac will be built this summer if all the rights of way can be secured.

LA CROSSE, WIS.—A company, to be capitalized at over a million dollars, is being organized to construct an electric railway from La Crosse to Black River Falls via Melrose. Power for the road will be furnished by the Black River Falls water power plant. The line will be over 50 miles long.

SHAWANO, WIS.—The Shawano and Green Bay Interurban Electric Company, recently incorporated with $100,000 capital, proposes to build an electric railway from Shawano to Green Bay. All the rights of way and franchises except at Green Bay and town of Howard have been secured. The road will cost about $400,000 and is expected to be in operation by the first of next year.

THE AUTOMOBILE.

NEW YORK, N. Y.—The next automobile show in New York City will be held during the third week in January, 1903, at Madison Square Garden, under the joint management of the Automobile Club of America, the National Association of Automobile Manufacturers and the Madison Square Garden Company.

NEW INDUSTRIAL COMPANIES.

THE [illegible] STATION COMPANY, of Chicago and Detroit, has filed incorporation papers at Lansing, Mich; capital, $100,000.

THE NEW YORK GRANT INSULATOR COMPANY, Croton, Westchester County, N. Y., capital, $100,000, has been incorporated. Directors, J. P. Grant, W. A. Kissam, New York; Hugh Moore, Brooklyn.

THE WIRELESS TELEPHONE COMPANY, of America, has been incorporated, under the laws of Arizona, by J. B. Greene, W. F. Quinn and W. B. Wheltley. The capitalization is $5,000,000.

THE GENERAL TELEPHONE COMPANY has been incorporated, with headquarters in Camden, N. J., to manufacture telephone appliances. The capital is $100,000. Messrs. P. Pinitz, John W. Muir and Richard Houghton are the incorporators.

THE GARDEN CITY ELECTRICAL COMPANY, which was recently incorporated in San Jose, Calif., will conduct an electric supply house, and has a capital stock of $10,000. Amongst its objects are the distribution of electricity for light and power. An electric plant may be installed later on by the incorporators—Frank Thurber and others.

THE A. J. COFFEE COMPANY has been incorporated in San Francisco, with a capital stock of $50,000, by G. D. Greenwood, F. A. Greenwood, A. J. Coffee and F. M. Parcells. It represents the Gamewell Fire Alarm Telegraph Company on the Pacific coast and in the islands of the new possessions. Electric supply business is also provided for in the incorporation papers. Fire alarm and police telegraph systems are now being installed in Honolulu and Manila.

OBITUARY.

MR. L. PORTONG.—The Schaeffer & Budenberg Manufacturing Company, of New York, City, has sustained a severe loss in the death of its president, Mr. Ludolf Portong, on March 9.

PERSONAL.

MR. C. M. SCHWAB, president of the United States Steel Corporation, is up for membership in the Automobile Club of America.

MR. CARL E. KAMMEYER, of Chicago, has just resumed the management of the *Telephone Magazine* as its publisher in that city.

MR. CHAS. J. WELLS has resigned from another lamp concern and joined the forces of the Buckeye Electric Company, of Cleveland.

MR. EDGAR H. BERRY, recently draftsman in charge of the equipment department, Navy Yard, Brooklyn, N. Y., has resigned to join the forces of the C. W. Hunt Company of West New Brighton, N. Y.

MR. CHAS. BLIZARD, manager of the sales department of the Electric Storage Battery Company, has just returned to Philadelphia from a trip West, where the company has been taking some very heavy contracts.

MR. THOS. E. CLARK, of the American Engineering Company, of Detroit, Mich., who has of late been very active and prominent in wireless telegraph work, was in New York City during the past week on important work connected with developments in this field.

GENERAL MANAGER BRYAN, of the New York Rapid Transit Subway Company, accompanied by other officials, has made a tour of inspection of Chicago elevated roads. Messrs. L. B. Stillwell and John Van Vleck are in the party, which has also visited Milwaukee to note progress on the new Allis-Chalmers engines.

MR. S. G. BROWNE, an English electrical engineer, was in New York City this week en route for home. He has recently been engaged on some very interesting and successful work at Canso, applying relays to the longest cables there. A paper on this work is to be presented before the English Institution of Electrical Engineers.

DR. MAX VON RECKLINGHAUSEN gave an admirable popular lecture before the Quid Nunc Club at the house of the Harlem Club, on Lenox Avenue, on March 21, on recent developments in electric lighting, particularly in reference to the "Nernst and Cooper-Hewitt lamps." The lecture was illustrated by experiments and by an exhibition of these new types of illuminants.

MR. C. H. DAVIS read a paper before the Canadian Society of Civil Engineers on March 13, in which the respective merits and advantages of steam and electric railways were contrasted and compared. Mr. Davis deduced the conclusion that the effect of the frequent service and general convenience of the electric roads induced and increased the total amount of traffic to a marked degree, and this is gained only in a very small degree at the expense of the old steam roads.

MR. HENRY S. LOWD, of the British Westinghouse Electric & Manufacturing Company, Limited, who has been busily engaged at Pittsburg for several months past in connection with the placing of the machinery contracts, etc., for the British Company's new works now being hastened to completion at Trafford Park, near Manchester, will sail next month for Europe in order to assume the general managership of the English works. Mr. Lowd, who is a Brooklyn, N. Y., man, was formerly general manager of the Nicopol Mining & Metallurgical Company's works, South Russia.

MR. CLINTON PAUL TOWNSEND has resigned his appointment as examiner in the branch of electro-chemistry in the U. S. Patent Office, to enter into partnership with Dr. Eugene A. Byrnes in the practice of patent law and expert work in the fields of electro-chemistry and chemistry, with offices in Washington. Mr. Townsend is well-known to our readers for his contributions to these columns on electro-chemical subjects, in which branch he is a recognized authority, with respect both to its theoretical and commercial sides. The firm

has fitted up a testing and research laboratory for service in connection with its work.

MR. ALFRED J. THOMPSON, who in 1894 resigned from the Edison laboratory to engage in electrical engineering and contracting business in Cuba, has returned to New York and joined the ranks of the Crocker-Wheeler Company, in this city. During the Spanish regime in Cuba, Mr. Thompson did most of that Government's work there, and since the evacuation of her troops he has installed Crocker-Wheeler machines in many plants for the U. S. Government, including the municipal electrozone plant of Havana, the U. S. Government plant at Military Hospital No. 1, the Havana Iron Works, the U. S. S. "Protector" of the U. S. M. H. S., etc. Continued ill-health, however, obliged Mr. Thompson to return to a colder climate.

MR. ALEX. HENDERSON was the sole guest at the annual dinner of the Electrical Contractors' Association of New York City last week, on March 19. This interesting affair came off at "Ye Jollie Dungeon," under the management of J. C. Hatzel, F. S. Blackall and C. L. Eidlitz, and was one of the brightest and briskest affairs that the contractors have ever enjoyed, outside of strikes. Having known Mr. Henderson in the industry for twenty years, and having still some respect and affection left for him, they felt it would be safe to infringe in his favor the rule of no guests. After the dinner, there was a vaudeville entertainment, and after everybody had risen up and called everybody else blessed, the expanded contractors went home, as merry as though each had just closed the biggest plant in his memory.

A. W. McLIMONT, some time connected with the foreign department of the General Electric Company, on whose behalf he has constructed a number of railway and power transmission plants in Central and South America and who has recently acted as chief engineer of the State of Guanajuato, Mexico, has been elected president of the Federal Electric Company, whose offices are located in the Washington Life Building, Liberty Street and Broadway, New York City. Mr. McLimont has just returned from Mexico, where he has completed the erection of a three-phase plant at Linares, in which Boston capital is interested. The equipment was furnished by the General Electric Company, the Pelton Water Wheel Company and the Federal Electric Company. The project involved an expenditure of nearly $100,000.

Trade Notes.

REMOVAL.—The offices of the H. B. Camp Company have been removed to Aultman, Ohio. The name of the telegraph and shipping station is Greentown, Ohio.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just issued a neat circular showing the different styles of "A-B" arc lamps, for which it is selling agent. Full data and price on these lamps will be sent promptly upon application.

"FALCON" PANEL BOARDS.—Pamphlet No. 11 just issued by the Falcon Electric Manufacturing Company, New York, gives dimensions, etc., of "Falcon" all-copper switchboard panels, together with prices of the various sizes. These boards are made with two and three main wires, 2-wire branches, 125 volts.

CEILING FANS.—The Sterling Electric Motor Company, Dayton, Ohio, in its fan bulletin recently issued describes and illustrates its direct-current ceiling fans with speed regulator. This fan is of very attractive design and embodies many improvements in detail, which is the result of long experience in this line of business.

NEW EXCELSIOR DRY BATTERIES.—The New Excelsior Dry Battery Manufactory, 108 Greenwich Street, New York, is making an attractive offer to responsible telephone companies or other large users of dry batteries, whereby a test at no cost may be made of the Excelsior cell. Particulars are furnished upon application.

RAWHIDE PINIONS.—A sample of "Dermaglutine" rawhide, used in the manufacture of pinions, has been received from the Chas. Munson Belting Company, Chicago. The material is exceedingly tough, and judging from its general appearance it should make very durable pinions. This company makes a specialty of gear cutting to order.

NEW REGISTERING WATTMETERS.—Camille Olivetti, of Ivrea, Italy, describes in a recent circular a new type of registering wattmeter, which is manufactured for both direct and alternating currents. The wattmeter registers on a band of paper 8 inches in width, the maximum amplitude of the registered curve being 6 inches. The speed of the paper may be made 1, 2 or 6 inches per hour.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING & EQUIPMENT COMPANY, New York, through its vice-president and general manager, Mr. J. N. Abbott, is sending out a "New York Souvenir Calendar." It is a very artistic production. Photogravures of the principal buildings and points of interest in the Metropolis form the subjects of illustrations, an "appreciation" of each in prose or poetry is given, the whole making a very attractive reminder of the company distributing it.

HAMMERS.—Of all the tools found in the machine shop and factory, none is more important than the hammer. A good idea of the extent of the hammer business as conducted by a large concern, may be obtained from the catalogue issued by the David Maydole Hammer Company, of Norwich, N. Y. The Maydole hammers manufactured by this company are made from solid crucible cast steel. The different styles of hammers are illustrated in bronze colors to represent the tools as they actually appear.

THE ARNOLD ELECTRIC POWER STATION COMPANY.—The track work of the Lansing, St. Johns & St. Louis Railway, in Michigan, is illustrated and described in a bulletin issued by the Arnold Company, which obtained the complete contract for the building of this road. The descriptive matter is taken from one of the Lansing papers and makes very interesting reading, and the illustrations throughout the pages of the bulletin show that the construction work was carried on in a first-class and substantial manner.

CONTROLLERS.—A very neat and attractive pamphlet has been issued by the Electric Controller & Supply Company, Cleveland, Ohio, on its controllers, which are adapted to meet all ordinary conditions of operation. These controllers are of different patterns, each being especially made for the service required. The illustrations used are of excellent workmanship, and show very clearly the principal features of these devices. They, together with the text, are printed on heavy-coated paper, which gives a very artistic effect.

1892 CALENDAR.—We are indebted to the Bullock Electric Manufacturing Company for a handsomely bound set of its biographical calendar cards for 1902. The monthly calendar cards which this company has been issuing for several years have been highly artistic in design and execution. Those of the current year have an added value for the reason that the card for each month contains on the face a portrait of one of the founders of electrical science and engineering, and a well-written biographical sketch of the subject on the back.

ELECTRIC LIGHTING SUPPLIES.—Messrs. J. Jones & Son, 64 Cortlandt Street, New York, have just issued a very complete catalogue of their electric light supplies. The fact that the catalogue contains 174 pages and is devoted entirely to this one subject, gives some idea of the extent of this branch of the electrical business. About every article that is used in this line of work is illustrated, and price-lists are given throughout the pages. It may be proper to state that this firm carries, besides electric light supplies, a complete stock of bell, telegraph and railway supplies, each department being covered by a special catalogue.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, is making rapid progress on an order for a 1000-line lamp signal central energy multiple switchboard with double supervisory clearing out signals and other modern conveniences, including central energy telephones, and will have a complete plant in operation in the very near future. It is stated that the International Company makes, under its own supervision, direct from the crude material, every detail part, embodying many improvements, which are fully protected by its own letters patent.. A full set of special tools and machinery has been completed for the manufacture of its entire new line.

THE SAUQUOIT SILK MANUFACTURING COMPANY has recently placed an order with the Buffalo Forge Company, of Buffalo, N. Y., for eight high speed automatic engines which will be used in its works at Scranton, Pa., Philadelphia, Pa., and Bethlehem, Pa., four at the first and two at each of the latter plants. These will be of the enclosed type, running in oil, which thus presents no difficulties in the way of damage to goods by throwing oil on them. The engines will be located at various points throughout the factories and used principally as auxiliaries in the case of break-downs to the main engines, so that the separate sections of the mills may be kept running without loss of time. The decreased efficiency of small, high speed engines over a central unit will be made up for in this case by the avoidance of belting.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is introducing a secondary generator for use in the operation of annunciators, burglar alarms, call bells, door openers, electric gas lighting apparatus, gas engines, watchmen's clocks, etc. It is intended to be operated directly from the house or secondary circuit, and can be so used with perfect safety. It states that this device has been put through a series of the most exhaustive tests, and does the work of batteries, etc., in a highly satisfactory manner. It will be especially valuable to dealers having contracts for the maintenance of electric bells or other apparatus usually operated from a primary battery. It obviates the necessity of depending on weak and unsatisfactory batteries. The company has got out a very attractive pamphlet fully describing and illustrating this generator, which it will be glad to mail on application.

MECHANICAL STOKERS.—Roney stokers, manufactured by Westinghouse, Church, Kerr & Co., aside from the general recognition they have enjoyed, have been adopted by the government engineers for public works, particularly in the large power plants of the Navy Department. Brooklyn, Boston, Washington and Portsmouth Navy Yards have all adopted this type of stoker, and the United States Naval Proving Ground at Indian Head, Md., has duplicated its original order. This duplication of orders is another feature that shows the favor in which this apparatus is held. The United Railways & Electric Company, of Baltimore, has placed eight orders since the original equipment was installed, the Pennsylvania Railroad Company has placed seven, and the American Locomotive Works three, while the Lackawana Iron & Steel Company, the Republic Iron & Steel Company, the Ætna Iron & Steel Company and the Carnegie Steel Company have added to their equipments of Roney stokers every time they have enlarged their steam plants. The reputation of this apparatus has brought orders from other lands, the most notable among recent installations being one in South Africa for 500 horse-power boiler capacity and one in Mexico of similar size. Shipments of Roney stokers to England during the last year show a growing appreciation of these devices.

GENERAL ELECTRIC BULLETINS.—The latest issues of General Electric bulletins are Nos. 4279 to 4283, inclusive. The first of these is on rail bonds, which presents a type constructed on a new principle which is claimed to insure perfect and permanent contact with the rail. Another is on a two-rate meter, consisting of a constant-current recording wattmeter and a separate case containing a clock mechanism and batteries. At the hour when the predetermined low rate goes into effect, by means of the clockwork, additional resistance is automatically thrown into circuit which causes the moving element to rotate more slowly. The "Type M" system of control is the subject of another bulletin. This type is especially adapted for use on motor cars in service which requires either that the cars be operated alone, or that two or more be coupled together as a train and operated simultaneously. Bulletin No. 4282 is on the Thomson polyphase recording wattmeter for measuring the energy delivered on two-phase, three-phase or monocyclic systems, and for both balanced and unbalanced load. The last bulletin in date of issue is on the box frame type of railway motors. These motors differ from the split frame type in that the magnet frame is cast in one piece substantially in the form of a cube with well-rounded corners and large openings, one at each end, into which the frame heads carrying the armature shaft bearings are bolted.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 18, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

695,440. ELECTRICAL SWITCH; R. L. Border, Pittsburg, Pa. App. filed July 15, 1901. A pair of solenoids mounted on a pole beside the track connect mechanically with the switch tongue and are thrown into circuit at will by the motorman.

695,447. APPARATUS FOR TEACHING TELEGRAPHY; C. E. Egan, Durham, N. C. App. filed March 11, 1901. A disk-carrying contact representing telegraphic signals can be rotated by hand and thus affect a sounder to which the operator listens.

695,456. ELECTRIC RAILROAD SIGNALING; O. W. Hart, Fall River, Mass. App. filed April 9, 1901. At each signal there is a selective device by means of which any particular signal can be set from a central station.

695,478. CONDUIT; P. A. McGeorge, New York, N. Y. App. filed July 13, 1901. The sections of the conduit are separated lengthwise, the parts being interlocked by a dove-tail or wedge connection.

695,497. AUTOMATIC CUT-OUT; A. A. Seeley and C. Silet, Chicago, Ill. App. filed Oct. 10, 1901. A form of construction for that type of cut-out in which a fusible plug retains a pair of contacts normally out of connection with each other.

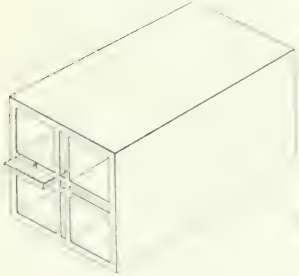
695,504. CONDUCTOR CARRIER; A. H. Stewart, Nashville, Tenn. App. filed Dec. 9, 1901. A spring motor carriage adapted to ride upon a supporting cable and carry with it a conductor wire, to facilitate the stringing of the latter.

695,506. TROLLEY; M. Stoll and J. W. Ruck, Pittsburg, Pa. App. filed June 21, 1901. Spring arms arranged above the wheel to retain it upon the conductor wire.

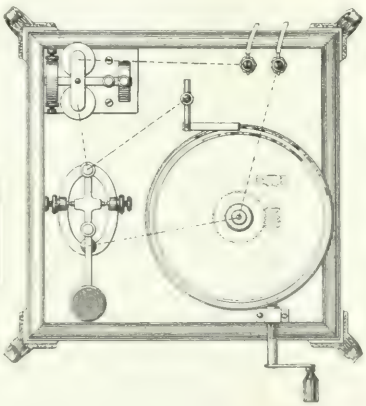
695,524. ELECTRIC GENERATOR; E. C. Woodell, Highpoint, N. C. App. filed Aug. 29, 1901. (See Current News and Notes.)

695,529. SYSTEM OF ELECTRICAL TRANSMISSION; F. Bedell, Ithaca, N. Y. App. filed July 10, 1899. (See Current News and Notes.)

695,537. PRINTING TELEGRAPH; L. Cerebotani, Munich, Germany. App. filed May 1, 1900. Details of construction.



695,504.—Conduit.



695,447.—Apparatus for Teaching Telegraphy.

695,539. ELECTROMAGNETIC APPARATUS; F. B. Cook, Chicago, Ill. App. filed Aug. 29, 1899. (See page 552.)

695,563. ELECTRICALLY OPERATED SWITCH; E. V. R. Ketchum, New York, N. Y. App. filed May 15, 1901. This is a railway in which an indicator shows when the switch has been properly thrown and in which the switch itself is operated by two solenoids reversely and controlled by an automatic circuit changer.

695,568. SIGNAL TELEGRAPH; E. Lavens and E. J. Lavens, Brooklyn, N. Y., App. filed Jan. 7, 1901. Details of a device for signaling between the bridge and engine room of a ship or other location and for showing when the signals have been properly transmitted.

695,573. PROCESS OF CONVERTING WOOD, WOOD SHAVINGS, ETC., INTO DEXTRINE, GLUCOSE AND ALCOHOL; P. Magnier, Billancourt, and P. A. Brangier, Estrées, France. App. filed Jan. 25, 1899. (See Current News and Notes.)

695,594. CONDUIT; V. H. Yarnall, New York, N. Y. App. filed Dec. 10, 1901. A terra cotta conduit in which each partition is made up of two walls slightly separated by an air space.

695,600. PROCESS OF MANUFACTURING CONTACT PIECES BETWEEN FIRST AND SECOND-CLASS CONDUCTORS; W. Boehm, Berlin, Germany. App. filed Feb. 26, 1900. (See Current News and Notes.)

695,635. PROCESS OF MAKING METAL TUBES; E. Emerson, Providence, R. I. App. filed July 28, 1899. (See Current News and Notes.)

695,648. BLOCK SYSTEM; B. C. Rowell, Chicago, Ill. App. filed Feb. 13, 1899. A step by step apparatus which controls the signals at each end of a block is actuated one step forward by an entering train and one step backward by a departing train, whereby several trains may run in succession over a block, each taking part in shifting the signal to safety but the last one alone completing the change and giving the right of way to opposing trains.

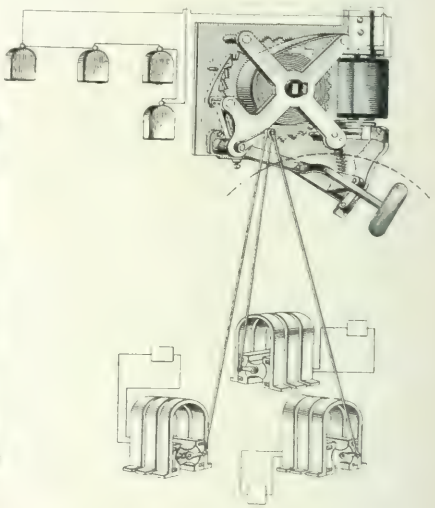
695,649. TRAIN INDICATING APPARATUS; B. C. Rowell, Chicago, Ill. App. filed Feb. 13, 1899. An automatic signaling apparatus comprising two circuits; means by which a passing train controls both circuits; and an indicator circuit made operative by the action of the train circuits in one order but remaining inoperative under the action of the train circuits in the other order.

695,655. THERMOSTAT; G. R. Sherman, Providence, R. I. App. filed June 27, 1901. Details.

695,705. INSULATED JOINT FOR ELECTRICAL CONDUCTORS; E. W. Batchelor, Hammonton, N. J. App. filed Oct. 26, 1901. Twisted and soldered terminals are wrapped with metal foil and then with tape.

695,707. ELECTRIC STORAGE BATTERY; Owen T. Bugg, Jr., New York, N. Y. App. filed July 19, 1900. One electrode consists of an amalgamized perforated zinc plate of cylindrical form and fitting snugly within the interior of a cylindrical vessel. The other electrode consists of a series of cup-shaped disks corrugated or indented, and provided with a series of radially disposed slots near the periphery. The cup-shaped plates are assembled on a stem in such a manner that the slots of one cup-shaped disk are covered by the metal between two slots of another disk, thus being formed a regular greies of pockets having outer openings for admitting the free circulation of the electrolyte. The negative element is secured to the lid of the containing vessel, which lid is of a special form.

695,710. STORAGE BATTERY; Justus B. Entz, Philadelphia, Pa. App. filed July 9, 1900. The pellets or pieces of active material such as are used in the chloride type of battery, have a cruciform so as to admit of the expansion or growth of the pellet.



695,777.—Fire Alarm Telegraph Repeater.

695,723. SIGNALING MECHANISM; R. Herman, Crafton, Pa. App. filed Aug. 5, 1901. An automatic train-operated signal including certain locking devices operative during the movement of the signal from one position to another.

695,724. ELECTRIC LOCK; R. Herman, Crafton, Pa. App. filed Sept. 28, 1901. Details of the locking mechanism used in the signal of the preceding patent.

695,726. COVERING FOR PIPES, RODS, ELECTRIC LINE CONDUCTORS, OR THE LIKE; O. T. Hungerford, Brooklyn, N. Y. App. filed Aug. 20, 1901. An insulation consisting of a compound of silica, rosin, rosin oil and paper.

695,756. ELECTRIC LAMP; W. McConnell, Brooklyn, N. Y. App. filed July 12, 1901. A searchlight fixed in the end of a portable battery case with a circuit closer on the outside.

695,777. FIRE ALARM TELEGRAPH REPEATER; L. G. Woolley, Kenton, Ohio. App. filed July 18, 1900. The hammer of the striking apparatus is connected mechanically with a number of magneto generators, each controlling a separate signal circuit so that the striking gong will distribute the signal.

695,844. INCANDESCENT LAMP; L. Thayer, Peoria, Ill. App. filed July 17, 1900. A weather-proof connection between the lamp case and socket.

695,861. ELECTRIC CONTACT DEVICE; N. C. Cotabish, Lakewood, Ohio. App. filed April 16, 1901. A trolley wheel having a removable carbon tread.

695,863. JUNCTION SLEEVE FOR ELECTRICAL CONDUCTORS; T. J. Donovan and E. G. Alderson, Nashville, Tenn. App. filed Dec. 31, 1901. A sleeve having screw-threaded caps through which the ends of the conductor enter for joining.

695,870. ELECTRIC LIGHTING SYSTEM; E. Thomson, Lynn, Mass., and E. J. Houston, Philadelphia, Pa. App. filed Feb. 19, 1887. (See Current News and Notes.)

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EXPORT AND IMPORT TRADE.

The figures which we publish elsewhere in this issue as to the course of trade are encouraging as to the continuing prosperity of the United States and the improving outlook as to larger international commercial relations. It is to be remembered that as to iron and steel, the export of which has grown notably, the home demand has become so great as to lead to rather heavy imports, but this in turn has bettered the conditions abroad. Germany appears happily to be in better shape financially and industrially, and from this time on is certain to mend. As the reception to Prince Henry showed, there is no good reason why the political and trade relationships of the two countries should not improve. In England, too, there is a more cheerful feeling, and it is to be devoutly hoped that the wretched Boer war may soon be allowed to come to a close, not alone for the sake of those on the spot, but, more selfishly, for the great interests of the civilized world.

It is a noticeable fact that with the steadiness in exports there has gone a remarkable growth in the import of manufacturers' materials, the gain being not so much in values as in quantity. The expansion of American manufacturing would seem to require a larger and larger supply of material to be worked up, not available from domestic sources; and herein at least is one means of keeping even the balance of trade, for such extraordinary lopsided balance sheets of international trade as have been exhibited during the past few years could not go on indefinitely, nor could they be wholly beneficial.

WIRELESS TELEPHONY.

In this issue we print two interesting articles on wireless telephony, one by Mr. A. Frederick Collins, and the first section of another by M. Guarini. Mr. Collins' article divides systems of wireless telephony into five classes; but up to the present time none has assumed more than experimental importance. Wireless telephony is, in a certain sense, very prevalent, and, in fact, objectionably prevalent; since inductive cross-talk from one circuit to another, is wireless telephony carried on through the air between the two circuits considered. The difficulties that beset wireless telephony are considerably greater than those which wireless telegraphy encounters. This is essentially for the reason that any kind of an impulse will serve for a telegraph signal, but, for telephony, a sequence of alternating currents, corresponding more or less closely in amplitude, phase and frequency with the vocal vibrations of the speaker, must be retained. All effective vocal frequencies are very low by comparison with the frequencies of emission of wireless telegraph waves. There is, however, always the possibility of finding some indirect means of attaining the result when the direct means is denied. Occasionally the window is a more convenient means of access than the door.

It would be interesting to learn from Mr. Collins what particular apparatus and connections he employed, by which he has been able faintly to reproduce speech wirelessly to a distance of three miles. It is to be hoped that he will describe the conditions at the proper time. While, of course, it would be very nice to have a practicable and convenient system of wireless telephony between ships at sea, yet it is at present of greater importance to develop the system of wireless telegraphy, which seems more likely to give long-range communication than wireless telephony. Long range communication at sea is the important consideration. Fast steamers may now approach

each other so rapidly in a fog, that at least twenty-mile range of communication should be possible in order to avert the danger of collision, when no direct means exists for mutual orientation. Some little preliminary time must be consumed in finding out the mutual whereabouts of the two vessels, and a short range of communication might be of little more service than a fog-bell.

The Wireless Telegraph Situation.

Things are getting a bit lively in etheric circles just now and interesting developments may be looked for. First in point of importance comes the mass of cumulative evidence that has made it reasonably certain that transatlantic signals are within a measurable distance of practical application. Aside from the corroborative experiments made in the last month or two, the attitude of the cable companies is sufficient evidence that they have no serious doubts of the reality of the results. The principal center of disbelief seems to be France, where they still seem to discredit all the evidence and regard the whole matter as an audacious fake for advertising purposes. The keen Gallic mind is prone to question the achievements of foreigners, but we fancy that a little further experience will afford convincing evidence of the reality, even in Paris. The subject, however, has now so far outgrown that kind of skepticism that the more serious features of wireless telegraphy bid fair to become a source of international difficulties. The German Emperor seems to have put his hand to the wheel in favor of the Slaby-Arco system for military and naval use, and Marconi has firmly intrenched himself elsewhere. Naturally the latter does not relish a rival in the field, and his stations will not (if they can help it) receive signals from the Teutonic aggregation. With two actual and *n* potential wireless systems in the field, each with a transatlantic working radius, we are liable to have wire tapping carried out on broad cosmic lines that quite put to shame the finest efforts of the pool-room sharps.

Of course, syntonic work is the plausible remedy, and if it can be successfully carried out would prevent for the most part at least accidental clashing of the etheric legions. As to whether it can be worked successfully there seems to be a radical difference of opinion. Marconi naturally says that his system can be rendered perfectly syntonic. Doubtless it can be in the laboratory, but plausible as the tuning scheme is, and frequently as it has been suggested, it has never yet accomplished anything on a material scale, so that its capabilities are unproved. For instance, it is far from certain that at extreme long range all frequencies will be feasible or possible, and if it should prove that under certain circumstances the range of frequency should be very limited, the chance of interference between rival stations would become certainty. In this connection it is interesting to note the recent reports of Marconi's Cape Breton station, about to be constructed. It is stated that Marconi, having raised the objection that flashes from the trolleys of electric cars would disturb his apparatus, the local authorities have guaranteed him against the near approach of these enemies for a term of years. If Marconi has developed, as he has been quoted as stating, a complete syntonic system, the precaution just noted would seem entirely superfluous. Either, then, the syntonic feature belongs to the future rather than the present—to hope rather than to actuality—or as an alternative very simple electrical disturbances can by design or even by accident cover a range of frequency that will insure interference. Whatever the facts about syntonic operation may be, we think the last suggestion is a most serious one. Whatever frequency may be chosen for syntonic operation, that frequency can be reached with fatal effect by the simple process of feeling for it. One might receive from across the street Morse sent on a given piano key, but what would be the chance of getting the message if a chap in the next room persisted in running scales *fortissimo*.

Even, therefore, granting the practicability of perfectly syntonized apparatus, it may be regarded as certain as anything can be in this world that messages could be wilfully at least interrupted in a very simple manner. Or merely suppose that an experimental station here in New York were sending impulses from apparatus intended to produce heterogeneous waves. If proper conditions for operation permit only a moderate choice of frequency to ensure sensitiveness at long range, then it would be highly probable that every syntonized station within reach would catch it often enough to render steady work hopeless. There is certainly no law against experimenting on wireless telegraphy by any one who pleases, in spite of the patents of Marconi or anybody else, and the air is one of the few things that is common property in this age of trusts. Even putting aside purely casual interference, the necessities of future war will assuredly call for the demoralization of the enemy's wireless telegraph system in the most thorough fashion possible, and Marconi's latest work indicates that the entire terrestrial orb can be set a quiver with an incoherent jumble of signals. It is a delightful prospect for an etheric row if Marconi and the Germans fall out and undertake to fight out the issue of atmospheric supremacy with their own natural weapons. But, joking aside, wireless telegraphy is near enough to commercial operation to give these questions of mutual relations no insignificant place in the public eye. It seems a long and dubious step from the quiet and privacy of the cables buried furlongs deep under the green water in the dark ooze of the ocean bottom, to circles of vibrant ether darted across a hemisphere from throbbing coils at a dozen warring stations, but the step is near at hand for good or ill, and the next few years will see the battle on.

Telephone Rates.

The meeting last week of the American Institute of Electrical Engineers was devoted to this subject. It is a good matter for discussion, has important technical and sociological bearings, and no criticism can properly be directed to such a subject considered on its own basis. It is, however, only one phase of the vast subject of telephony, considered from the standpoint of electrical engineering. It is significant of the unfortunate conditions at present surrounding telephone engineering, that on an evening specially devoted to telephony, the A. I. E. E. had before it, for discussion, papers chiefly relating to telephone rates. The same golden silence has enshrouded the development of electric telephone engineering in this country for many years, during which telephony has been a rapidly advancing art.

A great deal of excellent electrical engineering has been, and is being, accomplished in telephony, and yet but little finds its way into the records of technical literature. This appears to be an artificial consequence of a regularly pursued business policy on the part of the managers of telephone property. It is a deplorable policy, however, which is prejudicial to the best interests of the public, the technical world, and the property owners themselves. It is natural that any corporation which has carried out a long series of expensive experiments should seek to secure the exclusive benefit of the results to which the expenditure has led. There must be, in every business, some details that are properly withheld from publication. When, however, the same reticence is extended to matters of engineering which essentially lie within public purview, the reticence is neither justifiable nor profitable. It is a matter of ordinary observation that in this age of analysis, machinery, and the methods of its operation, cannot be withheld from the scrutiny of the curious. It is said that for six centuries the secret of manufacturing Greek-fire for use in naval warfare was jealously and successfully guarded in the arsenal of Constantinople. A few industrial chemical secrets are successfully preserved to-day; but no telephone apparatus or system which goes into the hands of the public can be sealed from investigation, when sufficient intelligent effort is directed to unravelling it. Consequently, all

engineering matters which cannot, by their nature, be concealed, should be clearly described, and all achievements recorded. Indiscriminate concealment is morally wrong, for it opposes civilization and progress, and the results of such a policy must inevitably work for retribution. Fortunately, each year sees improvement in this direction, and telephone engineering is finding its way gradually into public notice.

Mr. Abbott's paper contains some interesting statistics for the telephonic conditions in 21 large cities of the United States. Assuming these to be reliable, it appears that, in the large cities, on the average, one person, or unit of population, in thirty, has a telephone, so that the total number of telephone subscribers in a city multiplied by 30 should give a rough idea of the population of that city. Also, the average length of wire per telephone in the cities is about 2.2 miles. Rather more than three-quarters of all the wire in the cities is already underground. The flat rates range from $40 to $240 per annum for business telephones and from $24 to $100 per annum for residence telephones, the independent companies, where installed, being generally markedly the cheaper. For single-party measured service and one thousand calls annually, the range is from $41 to $99 in business houses and from $33 to $90 in residences. Mr. Abbott points out that, theoretically, an equitable charge should include three items, namely, (1) a flat rate, or minimum, to cover the fixed charges, and in return for the potentiality of being able to talk by telephone with all other subscribers; (2) a charge depending on the number of calls per month, and (3) a charge depending on the total time occupied in talking per month, and as an offset to the extra expense of the company in having the telephone wires engaged. The existing service-rates include the first two items, and the third item is a refinement of the service-rate that may or may not, in the opinion of different managers, be worthy of the extra cost of metering and billing.

As the final result of all inquiry on the subject of rates, it would appear, that partly through improvements in manufacture and operation, partly through service-rates, and partly through competition, the rates of telephoning have steadily fallen throughout the country, although in particular cities little or no change has occurred. Although improvements in apparatus and operation tend to reduce the cost of telephoning, yet, unfortunately, beyond a certain limit, the increase in the number of subscribers tends to increase that cost, so that the problem of economically bringing the telephone into every house becomes very difficult. Faith in the future, however, warrants the belief that at no very remote period every household but the poorest will have a telephone, with a corresponding change in ratio of telephones to population from 3 per cent to, say, 13 per cent.

Lord Kelvin and the Electron Theory.

Lord Kelvin contributes to the March number of the *Philosophical Magazine* a paper on the electron theory, of which a fairly complete abstract may be found in last week's Digest. It is most instructive to see how neatly the modern hypothesis may be twisted into a ludicrously complete confirmation of the venerable theories of Aepinus. It is a metaphysical doctrine sometimes set forth that thought swings in great slow cycles, the learning of one æon becoming the ignorance of a second, and the brilliant speculation of a third. Lucretius advanced much of the modern atomic theory hard upon two thousand years ago, and Omar Khayyam proposed a calendar even simpler and more precise than the one now current. The one-fluid theory has spanned fewer centuries than these, but it has been more fortunate in its champions. And so the cycles recur. There is already evidence of the recrudescence of the emission theory of light, and it would not in the least surprise us to see within the next year or two the whole wave hypothesis openly attacked. The late Prof. Rowland used often to exclaim: "Who will be the Kepler of the molecule?" We do not know, but we feel reasonably certain that he has not yet appeared. We are far from desiring to cross swords with so doughty a leader as Lord Kelvin, but we earnestly wish that the next man who invokes an electrically charged atom electron or electrion to explain physical phenomena, would kindly preface his hypothesis with a definite and consistent explanation of what he connotes by the expression "electric charge." If half the energy had been spent in the last few years in investigating the dynamics of electrical stresses that has been put upon hypothesis derived from them, we would know more about the constitution of matter. At the present the electron needs explanation just as badly as the atom or the molecule, and the whole subject is open to the charge that it is degenerating into metaphysics.

The Third-Rail System.

We are in frequent receipt of inquiries—most often from newspaper writers and those who strive to be learned in all new developments in every branch of human activity—regarding the literature of the third-rail system, well-known to be the latest marvel in electrical development. This class of seekers for information is distantly related to another whose members appeal to the editor for information on the best and cheapest books on the digging of pole holes, on the operation of rheostats, on the reading of wattmeters and other similarly comprehensive and recondite subjects. The third-rail seeker for information is, however, peculiar in that when baffled in his efforts to sound the profundity of the latest triumph of electricity, he is apt to ascribe his non-success to the jealousy of the technician striving to retain a monopoly of esoteric knowledge. To intimate to him that we are as helpless as if asked to quote the title of a four-volume treatise on snakes in Ireland, merely accentuates suspicion. As reparation to those who feel they have reason for displeasure at our non-responsiveness in the past, and as a reference for future inquirers, we give below, so far as pending patents and commercial considerations will permit, a statement of the more salient features and the present status of the third-rail system:

Much has been learned of the third-rail microbe from biological investigation, a check book being the favorite culture medium. It is apparently closely allied with the *bacillus tetanus,* as the experimenters frequently suffer from a peculiar variety of lock-jaw which incapacitates them from talking about the matter under consideration. There are great and irreconcilable differences of opinion regarding it among those least competent to judge, some upholding the thesis that it is in solidified form, the universal solvent of the alchemists, others as firmly maintaining that it is merely an attempt to realize the doctrine of limits by determinng the least distance at which two conductors can be placed without becoming identical. We can hardly do more than to advise those desiring to study the subject to interview those who have had experience and then to guess at the facts. If an ornate and vividly colored monograph on its profane history is desired, the seekers might interview the directors of the New York Central after taking out accident insurance. Telephoning would be safer, but as the police regulations would prevent anything like a full expression of their views, a call had better be made in person. As to experimental methods, we can give somewhat fuller information. It was found by an investigator in Boston that a bundle of brass curtain rods dropped across the rails was redistributed in a highly interesting manner. Steel car gates and crowbars may also be used for this experiment. Some of our bucolic citizens maintain that the right of way of a third-rail line makes a profitable cow-pasture, but other rural authorities hold that the lessened receipts from dog licenses will more than offset this economic advantage. Finally, as to the difference between the third rail and trolley systems, some claim it is greater and some less than the difference between tweedle-dee and tweedle-dum.

The Independent Telephone Convention at Chicago.

We are indebted to Mr. J. J. Nate, of Chicago, member of the committee for organizing the Interstate Telephone Association Convention, which will be held at the Sherman House, Chicago, on April 9, 10 and 11, for the following data in regard to that interesting event:

"Arrangements have been completed whereby railroad fares can be secured on a certificate plan at 1½ fare for the round trip. This concession has been granted from all points in Iowa, Wisconsin, Michigan, Indiana, Kentucky, Missouri and Illinois. Visitors and delegates when purchasing their tickets should call for a rebate certificate. This certificate must be presented at the committee's headquarters, Parlor "A," Sherman House, on the 10th day of April, for the signature of the proper official appointed by the Passenger Associations for the purpose.

"From acceptances thus far received in reply to invitations mailed, this telephone convention promises to be the most successful and largest ever held. An elaborate program has been prepared, and the speakers who will read papers or address the convention are some of the best informed men in the telephone field. Invitations have also been accepted by other prominent and well known men, who will address the convention on the occasion of its gathering."

Electrical Engineers of the Day—XL.

J. J. Carty.

John J. Carty was born at Cambridge, Mass., April 14, 1861. His early education was obtained in the schools of his native city. At the time he had about finished his preparatory studies for entrance to college, he was obliged, on account of a serious trouble with his eyesight, to abandon his school work indefinitely.

The telephone having recently been invented, Mr. Carty entered the service of the Bell Telphone Company, for which concern in some of its various interests he has been at work ever since, having to his credit 22 years of continuous service in its behalf in the active development of the art of telephony, at the present time being chief engineer of the New York Telephone Company.

His first work was with the Telephone Despatch Company at Boston, and while there he made a number of contributions to the art of telephony which were of unusual value and have since become a permanent part of the art. Under his direction was installed the first multiple switchboard at Boston, which was at that time the largest ever put into use. For the "express" telephone system peculiar to that city he designed and installed a switchboard which was the first metallic circuit multiple board to go into service. Some of the fundamental features of this board are present in all of the boards of to-day.

In 1887 Mr. Carty took charge of the cable department of the Western Electric Company in the East, with headquarters at New York. In this capacity he studied cable manufacture and laying, and introduced a number of improvements, having charge of all the important cable-laying projects which were carried on for some time in the eastern cities. He then took charge of the switchboard department of the Western Electric Company for the East, and under his direction were installed most of the large switchboards of that period, among which was the original Cortlandt Street multiple board. During this time he made a number of important improvements in switchboards which have since become standard practice.

He was the first to practically demonstrate how to operate two or more telephone circuits connected directly with a common battery, and about 1888 installed for the supply of operators' telephones, common battery systems in a number of central offices. From these early experiments have grown the standard common battery systems now generally employed.

Although charged with serious practical engineering problems, Mr. Carty has found time to follow to some extent his strong natural inclination for original research. He made an exhaustive investigation into the nature of the disturbances to which telephone lines are subjected and gave the first public account of his work in a paper entitled "A New View of Telephone Induction," read before the Electric Club on Nov. 21, 1889. The view put forth in the paper was revolutionary, but, nevertheless, after being checked by numbers of experimenters in this country and Europe, received universal acceptance, and is the one now adopted in all works dealing with the subject. In this paper he showed the overwhelming preponderance of electrostatic induction as a factor in producing cross talk, and proved that there is in a telephone line a particular point in the circuit at which, if a telephone is inserted, no cross-talk will be heard. The paper also gave directions for determining this silent or neutral point, and described original experiments showing how to distinguish between electrostatic and electromagnetic induction in telephone lines.

On March 17, 1891, Mr. Carty made additional contributions to the knowledge of this subject in a paper before the American Institute of Electrical Engineers entitled, "Inductive Disturbances in Telephone Circuits." This paper might better have been called "The Theory of Transpositions," because in it for the first time was made known precisely why it is that twisting or transposing telephone lines renders them free from inductive disturbances.

In 1889 he entered the service of the Metropolitan Telephone & Telegraph Company, now the New York Telephone Company, for the purpose of organizing all of the technical departments, building up its staff, and reconstructing the entire plant of the company—converting it from grounded circuits overhead and series switchboards, to metallic circuits placed underground and to the then new bridging switchboards. In carrying out this work, he selected and trained a large staff of young men fresh from college, many of whom have since attained positions of prominence in the telephone field. In the development of the personnel of his department, Mr. Carty has taken a particular pride, looking to the welfare of those already



engaged, and through his touch with prominent technical educators, adding each year to his staff from the graduating classes of our principal technical schools.

Mr. Carty's more recent work has been in connection with the reconstruction of the New York Telephone Company's plant the second time, converting it from cables and switchboards of the old type to modern cables and the common-battery switchboard, and providing for the extraordinary extensions which to-day constitute the comprehensive telephone system of New York.

Mr. Carty has been granted a number of patents, some of them fundamental in their character, of which perhaps the most important is that known as the Carty bridging bell patent. No more sudden and complete revolution in any part of the telephone art can be found than that which followed his address at the Detroit Telephone Convention in 1890 on the subject of bridging bells. From the day the address was delivered telephone engineers throughout the country began the work of removing series bells and replacing them with those of the bridging type. The improvement which this wrought in telephone service on party lines has not been exceeded by any other single advance in the art.

Mr. Carty is one of the Board of Managers of the American Institute of Electrical Engineers, a member of the Society of Arts and of the New York Electrical Society. He is an honorary member of the American Electro-Therapeutic Society, to which position he was elected as a recognition of his valuable work in the direction of more rational methods in the use of electrical currents in medicine.

A New Telephone Exchange in London.

THE Britilsh National Telephone Company has recently completed an exchange at Battersea, London, which presents several features of interest to American readers. While it was designed in conformity with American practice, it does not follow throughout any particular system, and some features have been added suggested by local experience. The lamp signal board works on the Kellogg central battery system, and is the only one of its kind in Europe. The central battery system, while along the lines of that known abroad as the Western Electric system, yet departs from it in several particulars.

The operating on the subscribers' positions is similar to the Western Electric Company's system. The calling lamp is actuated by the subscriber removing his telephone from the switch hook. There are two

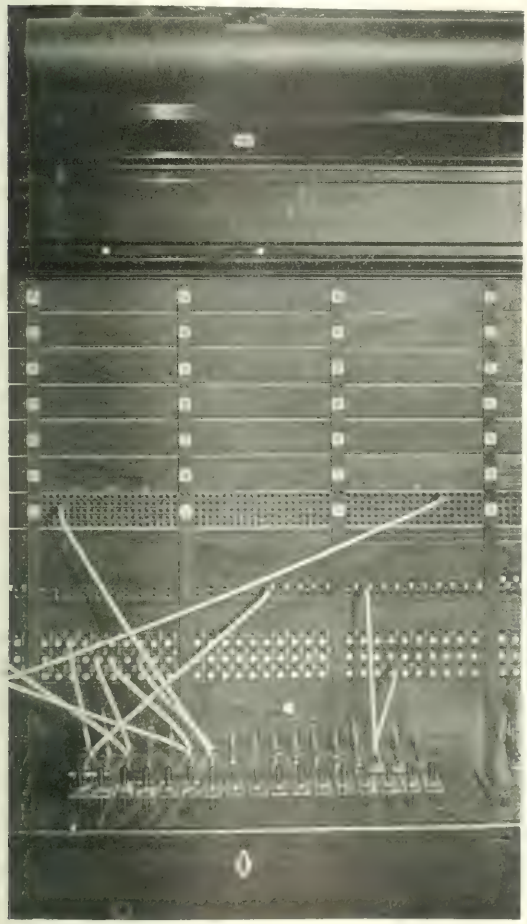


FIG. 1.—MULTIPLE PANELS AND PLUG AND KEY SHELF.

clearing lamps in front of each pair of cords, the front one actuated by the called subscriber hanging up his telephone, and the back one by the calling subscriber doing a similar action. The operator does not withdraw the plugs from the jacks until both lamps are alight.

Fig 1 shows the multiple panels and key shelf of one operator's position. Conforming to the usual practice for modern switchboards, each section is arranged for three operators, there being at present 65 subscribers allocated to each operator. This number will in all probability shortly be increased to 80, and could, if advisable, easily be increased to double that number. The subscribers' local jacks and calling lamps are placed at the bottom of the multiple panels, above these the outgoing junction jacks and above these the multiple jacks. The panels of one section on this board are capable of accommodating 5500 multiple jacks, and the board is at present fitted for 600 subscribers.

The plug and key shelf is fitted with 17 pairs of plugs and cords for each operator, thus allowing about 20 per cent of the subscribers on each position to be in connection simultaneously. In front of each pair of plugs is fitted a combined ringing and speaking key of an ingenious and simple pattern. Fig. 2 illustrates this key, the action of which is made clear in the diagram of the cord circuit connections.

Fig. 3 shows the connections of the subscribers' instrument and exchange apparatus. When the telephone is on the switch hook, the lines are bridged by a 1000-ohm magneto bell and a 2-microfarad condenser, so that while no current can flow from central battery *C* around the lines, the alternating ringing current from the exchange,

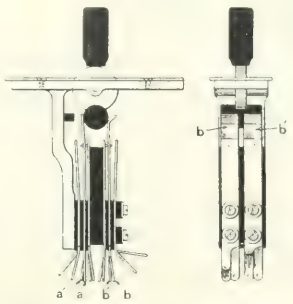


FIG. 2.—COMBINED SPEAKING AND RINGING KEYS.

which has a normal frequency of 20 periods per second, finds a path and rings the bell. On the subscriber removing his telephone from the switchhook, the transmitter, in series with an impedance coil *R*, is put across the lines, and the receiver with condenser in series shunted across *R*, which has a resistance of 25 ohms. Current now flows from the central battery *C*, through the 100-ohm relay *L*, over the *A* line, through transmitter and coil *R*, over the *B* line, and through the 100-ohm resistance coil *r* back to the battery. The relay *L* is energized and lights the calling lamp *M*, in the common connection of which is inserted the low-resistance pilot relay *PR*, which lights pilot lamp *PL*. The operating of the cut-off relay *O* will be considered in connection with the cord circuit.

A peculiarity of this board is the use of two-point jacks throughout the multiple and for the locals, the engaged test being obtained on the *B* line. This constitutes a considerable saving in expense; for example, a saving of about 40 miles of test wire is effected in a 5000 line exchange, besides the difference in the cost of the simpler multiple

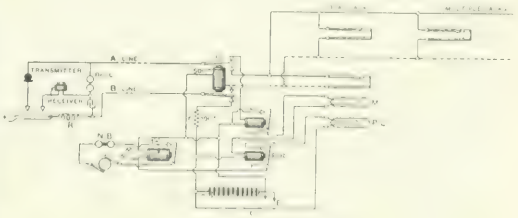


FIG. 3. ...AM OF CONNECTIONS.

and local jacks, of which about 130,000 would be required.

Fig. 4 shows the two-way plugs and the two-point jacks. The combined *B* line and test wire is connected to the bush *B* of the latter (which is made of German silver), and although the barrel *A* of the plug fits quite easily into this bush, the contact between them is reliable, as the weight on the cord keeps the barrel of the plug firmly pressed against the bush.

Fig. 5 is the cord circuit. The action can be most readily followed by examining this diagram in connection with Fig. 3. The subscriber having made a call, the operator inserts an answering plug into his local jack; a circuit is now formed through the cut-off relay *O*

(Fig. 3), which is tapped on the bush of the jacks, and thence by the barrel of the plug through the 100-ohm relay D', to battery 1 and earth. Both relays are, therefore, actuated, the relay O cutting off the calling relay, lamp, etc., and relay D' connecting up the first clearing lamp, which, however, does not light, as its circuit is broken by the 100-ohm relay D. This is actuated by the current from the battery flowing round the lines through the subscriber's transmitter and retardation coil. The operator now places the combined speaking

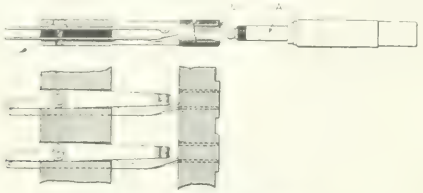


FIG. 4.—PLUG AND JACKS.

and ringing key in the speaking position, when line springs b, b' (see also Fig. 2) will be connected to her telephone.

Having ascertained the number of the subscriber required, who we will assume is a "local" subscriber (*i. e.*, one in the same exchange) she touches the tip of the calling plug on the bush of the jack connected to the required line, which, if engaged, it will be remembered, would be connected to battery and earth. Presuming the line to be engaged, current will be drawn from this battery through the outer tongue and contact of relay, E', to the special engaged test relay C of 5000 ohms resistance, and thence to earth. This relay, one of which relay and lamp, PL; a night bell relay which closes a circuit through a magneto night bell, NB, and the ringing generator; a ringing key, CR, for ringing on the call wires to other exchanges at night time; and an impedance coil of 140 ohms resistance, which serves the double purpose of reducing the current through the operators' transmitters, and keeping down the cross talk between them.

Fig. 6 shows the connections of a junction line, incoming at Battersea and operated by means of a call wire. The junction operators take 26 lines, each of which terminates on a plug. The outgoing end of the junction is also shown. The originating operator requiring a Battersea number depresses a call key, which connects her instrument to the call wire to Battersea, as shown. The operator on the incoming junction board at Battersea is continuously listening on the call wire in the day time. Her instrument, T, is shown connected to the call wire. At night time, when the traffic is not large enough to warrant continuous listening, the call wire is switched on to a relay and lamp, so that the originating operator can ring on the call wire and attract Battersea's attention. The Battersea operator having been advised of the number required picks up a disengaged plug, and gives the originating operator the number of the junction she has taken. This operator plugs into the jack terminating the junction, and actuates the relay O, which disconnects the battery B from the junction lines. The Battersea operator in the meantime tests the line required with plug P, obtaining the engaged test through the tip of the plug, one tongue and back contact of relay F', and the 5000-ohm relay E, in the manner described in connection with the subscriber's cord circuit.

If the line is disengaged the plug is inserted, and the act of insertion automatically rings the subscriber, this being effected by means of the ringing relay RR; this has two windings on it, a and b, each of 500 ohms resistance, and acts in the following manner: On the in-

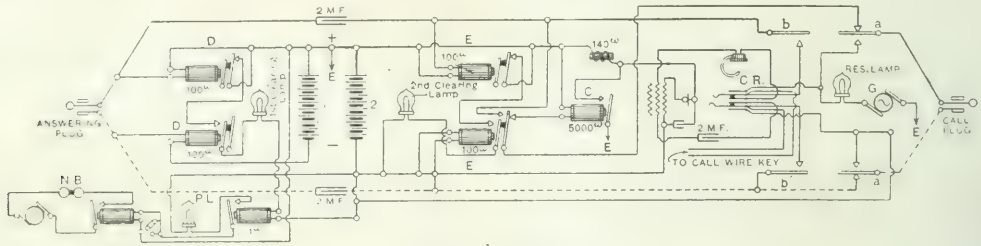


FIG. 5.—OPERATOR'S CORD CIRCUIT.

is provided per position, actuates readily with 1 milliampere, and, when closed, draws current through the primary circuit of the operator's induction coil, by this means inducing a click in her receiver. In such a case the calling plug is put into a busy-back jack, which transmits an interrupted humming sound to the subscriber, as an indication that the line is engaged.

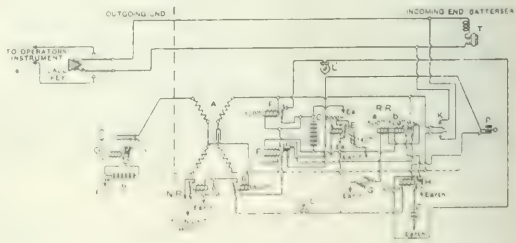
If, however, the line is free, the plug is inserted into the multiple jack, the cut-off relay is thereby actuated, also the 100-ohm relay E', which not only connects up the second clearing lamp, but also cuts off the engaged test relay C, and joins the A line through from the tip of the one plug to the other, through a 2-microfarad condenser. The operator now puts her combination key in the ringing position, the springs a, a being pressed against the inner contacts, thus disconnecting the calling plug from the remaining part of the cord circuit, and connecting the tip direct to the ringing generator G, resistance lamp and earth and its bush to battery and earth. The ringing current now passes from the generator over the A line, through the bell, and back over the B line to battery and earth. The battery is left on the line so as to maintain the cut-off relay actuated.

The wanted subscriber having answered the bell, the operator puts her combination key to the through position, and the two subscribers are enabled to converse with each other, the originating subscriber drawing current for speaking from battery 1 through the two 100-ohm relays D, D', and the called subscriber using battery 2 and relays E, E'. The two sets of relays are separated by condensers from each other.

When the originating subscriber hangs up his telephone, relay D is released, and the first clearing lamp lights; similarly, the other subscriber releases relay E, and the second clearing lamp lights. The operator does not withdraw the plug until both lamps light.

The [illegible] in the cord circuit consist of a pilot

sertion of the plug P the 100-ohm relay F' is actuated, and there is a circuit from the earthed ringing generator G round the a winding of the ringing relay RR, through its front armature and back contact, to one of the armatures and front contact of F', to the tip of the plug P, and thence through the subscriber's bell and condenser in series, back over the B line through relays F' and H to battery and earth. The subscriber's bell is therefore rung, and although the ringing current is flowing round the a winding of the relay RR, this relay is not actu-



[illegible] JUNCTION LINE OPERATED BY CALL WIRE.

ated, as it is so adjusted that the ringing current through the subscriber's bell and condenser is not strong enough to affect it. Directly, however, the subscriber takes his telephone off the hook there is a path for the battery current round the transmitter and impedance coil and through the a winding of RR, and this is strong enough to pull up RR, which is retained in this position by current from battery C, through the b winding, front contact and tongue of RR, and thence

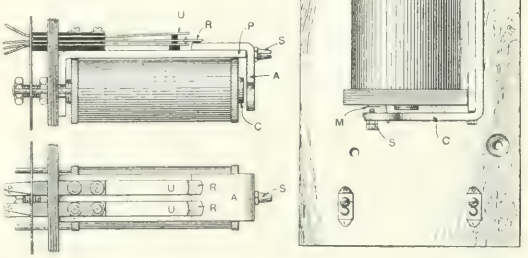
to earth, by front contact and tongue of 500-ohm relay H, which was also actuated on the insertion of the plug. The ringing current, which is interrupted at regular intervals in order to approximate to non-automatic ringing, is thus cut off, and the subscribers are through to each other.

When the Battersea subscriber hangs up his telephone, he lights the clearing lamp L' as he releases relay F. H being still retained, there is a circuit for lamp L' through back contact of F to earth, and through front contact of H to battery C and earth. The originating subscriber clears in any of the usual ways, and the originating operator withdraws the plug from the outgoing jack, releasing relay O, and thus putting the earthed battery B on to both lines of junction, so that current flows over both lines, through the center point of the junction side of translator A, through relay R and front contact of relay F' to earth, R being actuated and lamp L lighted. The Battersea operator now withdraws thee plug P, thus releasing relays H, F and F', and returns everything to the normal position. The function of the translator is to prevent the current from C flowing back over the junction lines and affecting any of the apparatus.

Fig. 7 is a view of the back of the switchboard; the clearing relays can be seen at the lower part. At the top of the board are mounted the engaged test, pilot and night-bell relays, ringing resistance lamps, and operators' induction coils and condensers. Figs. 8 and 9 shows examples of the two types of relays used. Fig. 8 shows the pattern used for the cut-off, line, clearing and junction ringing relays; the arrangement is very simple, and at the same time thoroughly satisfactory in operation. One end of the core C is brought round in front of the coil, and an L-shaped armature A is loosely supported on the pole P by a screw S which passes through the center of the armature. When the lower part of the armature is attracted towards the core, the upper part rises and is assisted in this action by the repelling force between it and the pole of the core on which it rests. It thus presses up the moving springs R against the upper contact springs U.

Relays of the type illustrated in Fig. 9 are used for the low resistance night bell and pilot relays (between 1 and 2 ohms), and for the 5000 ohm engaged test relay, which operates with a current of 1 milliampere. The principle is the same as in those previously described, but as fewer of these relays are required, they are built on larger lines and mounted on separate wooden bases. The single contact S is fastened to the lower end of the armature. The make contact M and armature C are wired to terminals A and B. D is mounted so that a fuse can be inserted between it and B, and a piece of mica is fastened between them, which is found ample protection from fire risks on account of the low voltage used (24 volts).

Fig. 10 shows the main distributing board and part of the relay rack. The former consists of a frame built of angle and strap iron, on which strips of line tabs and strips of lightning arrester and heat coil bars are mounted alternately. The overhead and underground cables are brought on to the line tabs, and thence cross-connected to the arrester bars, which consist of the well known combination of small carbon plates separated by a minute gap across which lightning and high-voltage currents generally, with a potential of over 300 volts, can pass to earth, and heat coils designed to break the circuit when heated by lower voltage currents of over 0.5 ampere. The testing of lines, both in and out, is also carried on from these strips, which thus act both as test jacks and arresters. This plan, however, is found to decrease considerably the speed of testing. The intermediate distributing board is a very similar framework, with strips of multiple and local tabs arranged in alternate vertical rows. The function of this board is to enable a subscriber's line, together with his set of multiple jacks, to be readily transferred from a local jack and line lamp, etc., on one particular position, to a similar jack, etc., on an-



FIGS. 8 AND 9.—SPECIAL AND SINGLE RELAY.



FIG. 7.—BACK OF SWITCHBOARD.

other position, in order to equalize the work per operator. It also provides a convenient place to disconnect a line temporarily for exchange fault testing purposes.

Switchboard cables from the arrester strips are connected to the

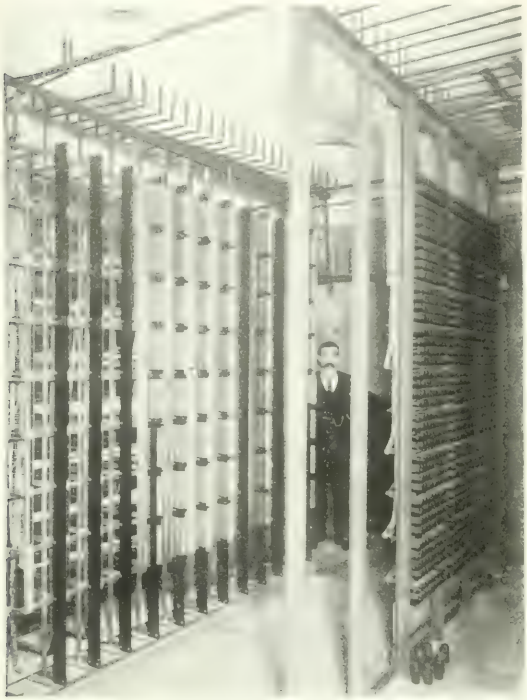


FIG. 10.—MAIN DISTRIBUTING BOARD AND RELAY RACK.

strips of multiple tabs, which again are connected to the multiple jacks on the switchboards and cross-connected to the local tabs, these communicating with the local jacks, line lamps and line and cut-off relays. The relay rack carrying the latter is the one seen in Fig. 10.



Fig. 11 is the generating room. There are two Holtzer-Cabot motor dynamos. The motors take current at 220 volts, and the output of the dynamos is 60 amperes at 30 volts. The ringing dynamotors are mounted on piers at the left-hand side of the room. One of these is driven from the 220 volt supply mains and the other from either of the two 24-volt batteries. These machines, besides supplying ringing current, carry commutators for producing the busy-back humming sound and interrupting it at the rate of about once a second in order that the note should not be confounded with induction from mains carrying alternating current. There is also a commutator for interrupting the supply of ringing current to the automatic ringing relays used on the junction lines. The power, switch and fuse board, seen at the bottom of the room, is equipped with Weston measuring instruments, including a low-reading voltmeter and wheel switch, by which the voltage of each of the 22 cells can be individually tested, also switching and regulating arrangements for the charging and ringing machines.

The individual fuses on the central panel of the board protect the operators' speaking circuits, etc. There are two sets of eleven 10-plate 180-ampere-hour chloride cells, in lead tanks which are capable of carrying a larger number of plates to allow for increase in capacity.

We are indebted to our London contemporary, *The Electrician*, for the material of this article.

Revived Rumors of Telephone and Telegraph Combination.

The old reports and rumors are being revived as to the early possibility of a consolidation of the telegraph and telephone interests of the country, i. e., the Bell telephone system, the Western Union system and the Postal Telegraph system, which would also carry with it the submarine cable network almost in its entirety. This is emphatically a large order and certainly could not be done much under $1,000,000,000, if the cables are included, or perhaps $750,000,000 without them. With respect to the reports we reprint for whatever it is worth the following from the *Boston News Bureau*, which has been quite assiduous with the *Wall Street Journal* in publishing them:

"A gentleman thoroughly familiar with the telegraph and telephone situation says that the formation of the new Western Telephone & Telegraph Company was the first move toward an amalgamation of all the telephone interests in the country working under the American Telephone & Telegraph Company patents. The recent appointment of the president of the Cumberland Telephone Company, as president of the Southwestern division of the new Western Company, and the appointment of the president of the Nebraska Company at the head of the Northwestern division of the Western Company, and the appointment of the president of the Missouri-Kansas Company at the head of the Wisconsin Company is a step of progress in the direction indicated. It is becoming more difficult yearly to finance the large telephone interests operated as separate companies, and the new charter of the Western Company is exceedingly liberal and will permit of great expansion. The bonds are so drawn that they can be called or extended by putting up of additional collateral. So there would be no difficulty in increasing the capitalization and bond issues of the Western Company by the merger of other operating Bell companies. The first to become a part of the Western Company will be the Central Union Company, followed by the Chicago, Cumberland, Nebraska, and Missouri-Kansas combinations. As soon as this can be accomplished, the foundation will have been laid for a consolidation of far greater magnitude. The closing up of the independent telephone movement in New York and Boston through the Morse transaction and the action taken at the meeting of the American Telephone Company yesterday in adding to the Bell board of management New York men of great financial strength and large holders of Western Union, will be regarded by some as the first step toward an amalgamation of the Western Union and Postal Commercial companies with the Bell interests. Mr. Mackay, of the Postal company, is a large holder of telephone stock.

"Nothing, therefore, remains but to get the three interests together and work out the basis of merger. The saving by a consolidation of telegraph and telephone interests in operations will be at least 33 per cent. At present there are three extensive lines of wire communicating facilities all over the country used only to about 75 per cent of their capacity. The amalgamation would dispense with at least two-thirds of the offices where there are three in any one city or location as one manager with assistance can handle both the telegraph and telephone, the operation of which is so nearly alike. The same is true regarding the repair and reconstruction forces. There being 25 per cent excess wire facilities no new copper wires would be required for many years."

The Telephone in Wireless Telegraphy—I.

By Emile Guarini

THE employment of the telephone as a receiver in wireless telegraphy presents the great advantages of constituting a simple receiving apparatus, easily manipulated, inexpensive and, above all, extremely sensitive. The telephone can be used as a receiver of signals—for example, those of the Morse code—transmitted by any of the forms of radiant energy, namely, sound, light, heat and electricity.



FIG. 1.—SIGNALING BY SOUND.

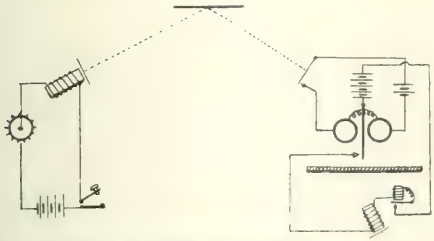


FIG. 2.—SIGNALING BY SOUND, EMPLOYING REPEATER.

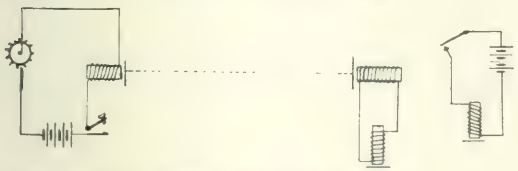


FIG. 3.—SIGNALING BY SOUND, EMPLOYING REPEATER.

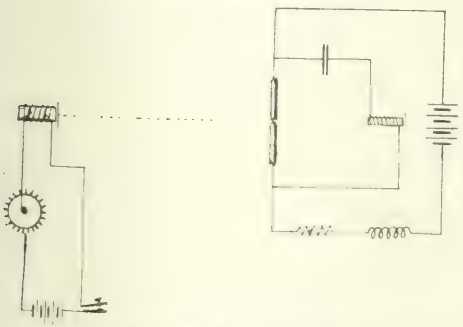


FIG. 4.—SIGNALING BY MEANS OF MICROPHONE.

WIRELESS SIGNALING BY MECHANICAL VIBRATIONS.

A very simple method of applying this means of wireless telegraphy is to agitate the air at determined intervals by means of a vibrating plate electrically operated. The vibrations may be communicated to a sensitive membrane, which will make and break the circuit of a battery and a telephone. Referring to Fig. 1, an electrical siren of of the Trouvé type may be put in circuit with a storage battery and a Morse key. If the sound waves are reflected by a surface as shown, in the telephone will be heard short or long sounds corresponding to the dot and dash of the Morse code. With proper selective telephones of the Mercadier type, multiplex signaling will be possible. With this arrangement and employing a sensitive vibrating diaphragm at the receiver, signals may be transmitted over distances almost equal to the range of sirens, particularly at sea. That is to say, over distances of more than six miles. It is doubtful, however, if it would not be better to receive the signals with the ear, the tympanum of which is a membrane difficult to equal in sensitiveness.

With the above arrangement signals may be sent over any distance by the employment of proper repeaters. Referring to Fig. 2, the vibrating diaphragm of the receiver closes the circuit of a relay, which actuates a siren. A reflecting surface concentrates the sound waves of the siren of the repeater on another repeater or on the extreme signaling station. By a similar arrangement the diaphragm of a distant magnetic telephone may be vibrated, which in turn will actuate at a further distance a telephonic receiver (Fig. 3).

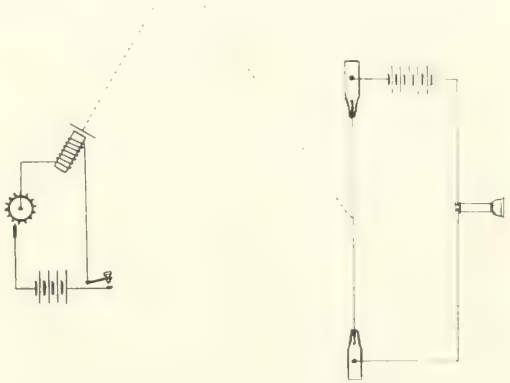


FIG. 5.—SIGNALING BY MEANS OF HEATED WIRE.



FIG. 6.—SIGNALING BY MEANS OF MICROPHONE.

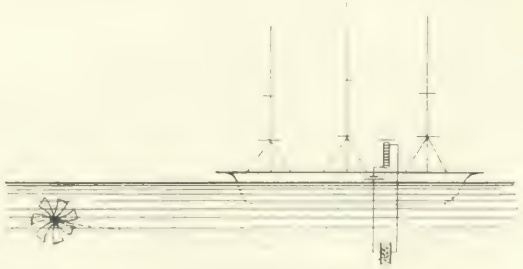


FIG. 7.—SUBMARINE SIGNALING.

Instead of producing variations in the magnetic field of the telephone, similar variations may be produced in a voltaic arc. Fig. 4 corresponds to the Duddel-Simon arrangement, by means of which signals may be transmitted over relatively great distances and received in a telephone. Signals may be also received in a telephone in circuit with a platinum wire kept at incandescence by current from a storage battery. The sound waves will produce changes of resistance in the incandescent wire, which will give rise to signals in the

change of resistance (Fig. 5). This arrangement is no other than the thermotelephone of Preece, in which the relatively feeble human voice is magnified to resemble the sound from an electric siren. The arrangement, however, which in practice gives the best result, is in-

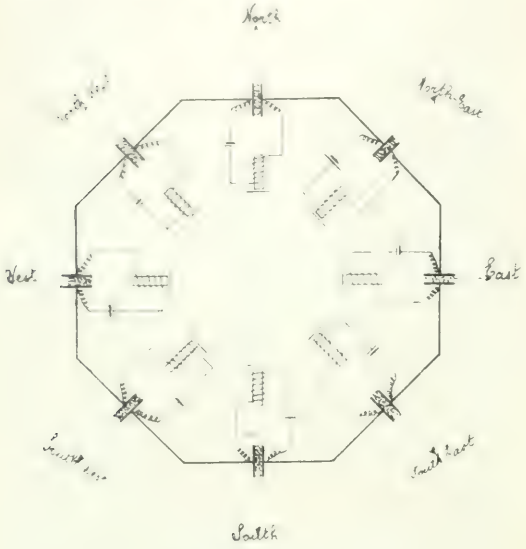
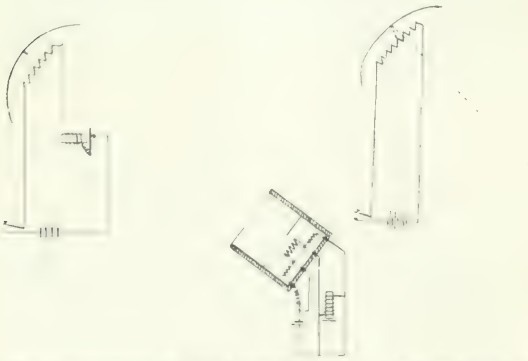


FIG. 8.—ROSSO D'ASAR METHOD.

dicated diagrammatically in Fig. 6. In this case the sound waves act on a microphone in circuit with a battery and a telephone. This



system can be of great service on railroads and at sea. Thus, for example, a microphone installed under a vessel will be affected by



the beat of the screw of an approaching boat up to four miles, according to experiments that have been made (Fig. 7).

M. Rosso d'Asar has devised a similar arrangement, which has been tested in the Italian navy. Special microphones are disposed in the

a signal, the direction may be determined from which a vessel is approaching.

WIRELESS SIGNALING BY HEAT VIBRATIONS IN THE ETHER.

This method of wireless telegraphy will be disposed of by a brief notice, as it does not seem to be susceptible of practical application.



FIG. 12.—BELL SYSTEM.

Referring to Fig. 9, a circuit includes a signaling key, a storage battery and a resistance, and a source of radiation located in the focus of a parabolic reflector. The receiver is merely a Langley bolometer, in connection with which a telephone takes the place of the galvanometer. A Melloni thermo-multiplier or a Nobile thermopile could also serve as a receiver. Another receiver for calorific signals is that indicated in Fig. 10. The transmitter is the same as that of the preceding method, while the receiver is based on a principle which has been applied in fire-alarm apparatus. It consists of a hemisphere of thin brass closed by a thin metallic diaphragm. When the hemisphere is heated the air contained dilates and presses out the diaphragm, which closes the circuit of a battery and a telephone. It is scarcely needless to say that the speed of transmission with this arrangement would evidently not be very great.

WIRELESS SIGNALING BY LUMINOUS RAYS.

This is a method of wireless signaling which has received, notably



FIG. 13.—SIGNALING BY ELECTROMAGNETIC INDUCTION.

for military purposes, a number of practical applications for transmissions as high as 100 miles. A very simple means of applying thi

system is to employ at the transmitting end a powerful luminous source, a reflector and a manipulating screen; and at the receiving end a selenium cell in circuit with a battery and a telephone. A method of applying this system for signaling over short distances is

to employ (Fig. 11) at the transmitting end an electric lamp, a source of energy, a signaling key and at the receiving end a receiving cell with or without a battery in circuit with a telephone.

Another method which is still more practical is that based upon the photophone of Bell. A pencil of luminous rays emitted by an arc lamp is reflected by a reflecting surface on the vibrating diaphragm of an electric siren, in a direction to strike a selenium cell placed in the focus of a parabolic mirror and in circuit with a battery and a telephone. When the siren operates, the pencil of luminous rays is deviated and the variation in the light striking the selenium cell produces variations of current which give rise to predetermined signals in the telephone. (Fig. 12.)

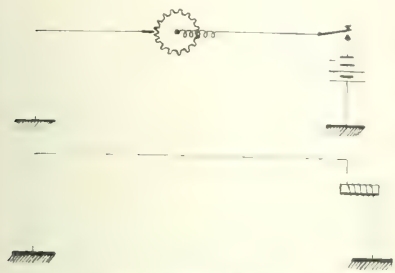


FIG. 15.—PREECE METHOD.

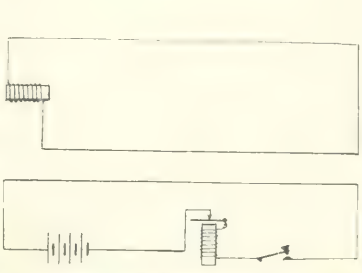


FIG. 16.—PREECE METHOD.

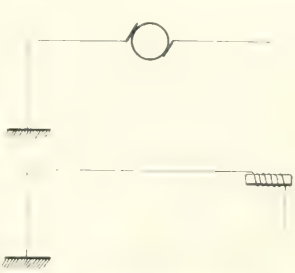


FIG. 17.—OPEN CIRCUIT METHOD.

WIRELESS SIGNALING BY ELECTROMAGNETIC VIBRATIONS IN THE ETHER.

We now come to a means of wireless signaling which, as it is well known, has given very remarkable and interesting results in practice. If by means of an electric siren (Fig. 13) operated at longer and shorter intervals by a key, variations are produced in a magnetic field—for example, by causing a metallic diaphragm to vibrate in the field—and if a telephone is placed in the field thus rendered variable, currents will be induced in the winding of the telephone and the diaphragm will reproduce the signals of the siren. It is doubtful if with this disposition signals can be sent over very great distances; by the following method, however, better results may be obtained with a simpler arrangement

In Fig. 14 are shown two parallel telegraphic lines, one including a battery and a signaling key, and the other a telephone. By manipulating the key currents pass through the ground and over the other line, where, by acting on the telephone, the signal sent will be reproduced. This arrangement, employing a galvanometer, was experimented with by Linsay and Bourbouze in 1871-1876.

If in the transmitting circuit an interrupter (Fig. 15) is introduced, for example, a toothed wheel, signaling by induction is rendered possible. This arrangement is that which Sir William H. Preece employed about ten years ago to communicate between Penarth and Flatholm over a distance of 3.1 miles. It is not even necesesary to employ a telephone diaphragm, as the signals may be received, though more faintly, by means of the "magnetic tick" due to the rapid magnetization and demagnetization of the telephone magnet. (Fig. 16.) Moreover, open circuits may be employed at both the receiver and transmitter by using capacities—for example, the earth—at one of the terminals (Fig. 17), the source of energy consisting of an alternating-current generator. In that case the currents of charge and discharge incident to the operation of the signaling key, produce corresponding currents in the receiving line, including a telephone in circuit.

Edison in his system of signaling without wires for application aboard ship, patented in 1899, also employed open circuits. Referring to Fig. 18, at each station there was a Ruhmkorff coil, in the primary of which was included a variable source of electricity and a signaling key; the secondary at one end was grounded and the other connected with a vertical antennæ having capacity at its upper end, a telephone being connected with the other end of the secondary to serve as a receiver.

Several of the above methods have been applied for signaling to and from moving trains. Thus Phelps stretched between rails an insulated line communicating with the earth by its extremities, and



FIG. 18.—EDISON METHOD.



FIG. 19.—PHELPS SYSTEM.



FIG. 20.—PHELPS SYSTEM.

FIG. 21.

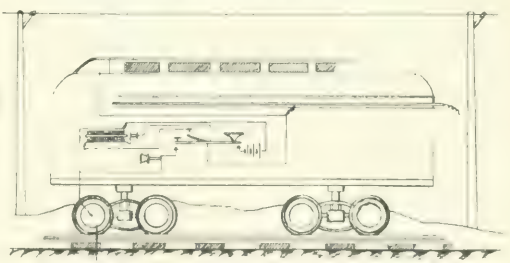


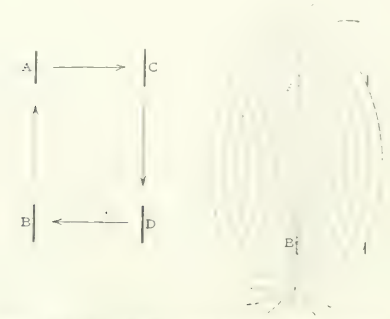
FIG. 22.—EDISON SYSTEM.

containing a battery and interrupter and a Morse key (Fig. 19). On the train there was a rectangular coil, with a telephone in circuit. To transmit from the train an inverse arrangement was employed, the transmitter taking the place of the receiver (Fig. 20). Edison modified his method above described and in conjunction with Gillilland devised a means for signaling to and from trains in motion (Fig. 22), the roof of the car, when of metal, corresponding to the capacity of the antennæ, and the circuit being grounded through the wheels and the rail. A line stretched parallel to the track served to transmit signals to and from the train

Wireless Telephony.

THE advance in wireless telegraphy has been so great and the achievements so brilliant that the art of telephoning without wires has attracted little serious attention. Occasional reports, however, show that work along this line has not been altogether neglected, although very little has been published in the technical journals.

There are at the present time five distinct methods known for transmitting articulate speech between two given points without connecting wires, besides possibly some combinations of these. The



FIGS. 1 AND 2.—DIAGRAM OF EARTH RETURN CIRCUIT.

first and oldest method is that by pure conduction through the earth or water. In this system the base lines extend parallel with each other, the length of which is usually much greater than the distance over which speech is to be transmitted; the terminals of the base lines are earthed. When a current is passed through one of them, either direct or alternating, the return circuit is joined through the earth between *A* and *B*, Fig. 1, and in virtue of the infinite cross-section of the earth, it is found by tracing and plotting, that the current-flow or stream lines assume the curves shown in Fig 2, forming



FIG. 3.—ELECTROMAGNETIC WIRELESS TELEPHONY.

a hemi-spheroid. By this arrangement speech has been sent across a space of eight miles, using base lines twenty-five miles in length. Now this is, in a measure, wireless telephony, but its limiting features prevent its employment from the standpoint of practice, though it could, no doubt be used to advantage in special cases.

It is almost of weekly occurrence that a report is published in the daily papers of some new invention or discovery for telephony without wires, and with a fanfare of trumpets it is announced that the wire system will be put out of the business. In nearly every instance the case may be traced to a re-discovery of the dual base lines, wherein the length of wires exceeds the wireless distance to be traversed.

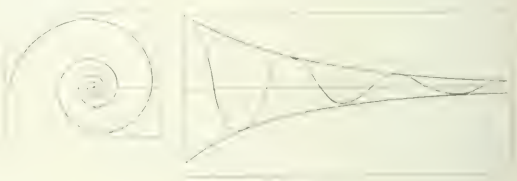
The second method, which, could it be perfected, would be ideal for wireless telephony, is the electromagnetic mode of propagation. Two closed coils of wire *A* and *B*, Fig. 3, are placed with their planes parallel to each other or with their planes horizontal, as shown. On closing the circuit in the coil *A*, it will be instantly surrounded by electricity in rotation or magnetic lines, sometimes called Faraday's tube. These curved magnetic lines spread out in circles, some of which are large enough to enclose the coil *B*. At the instant the lines from the first coil thread through the second coil, an e. m. f. proportional to the rate at which they link with the coil *B* causes a momentary current to pass through the receiver. Here no earth connection is necessary, but as in the conductivity system the limitations are reached before the practical value begins. For this reason it has found little favor with experimenters in wireless telephony.

An ingenious system for the wireless transmission of speech is by employing a beam of light from either the electric arc or the sun. The instrument is called a *radiophone* when the rays from the sun form the conducting path, or a *speaking arc* when the rays are emitted by an arc light. In the radiophone a beam of sunlight is allowed to fall on the mirror 1, Fig. 4, and is reflected through the lens 2; the conveying pencil of light falls on a mirror attached to the back of the transmitter diaphram 3, which is clamped to the mouthpiece 4. The light after reflection from the mirror now passes through a second lens 5, and is projected through space to the receiver. This latter consists of a parabolic reflector, *a*, a selenium cell, *b*, and a telephone receiver, *c*. The light is converged to a point in the focus of the reflector and impinges upon a selenium cell, *b*, in circuit with a voltaic battery, *d*, and the telephone receiver, *c*. The selenium cell is constructed by forming a grid of conducting wires between fused selenium. In the radiophone and speaking arc the transmission depends, first, on an uninterrupted line of view between the receiver and transmitter, and, second, upon the sensitiveness of the apparatus. The actual distance to which radiophonic transmission may be effected is several hundred feet.

The fourth system encroaches upon the domain of Hertzian wave telegraphy. It is well known that an alternating current of comparatively low frequency will emit electric waves; the higher the frequency and potential, the greater the dissipation of energy in the form of electric waves. To produce waves of any considerable penetrating power the frequency must be increased to a million or more per second; in other words, a disruptive discharge breaking down an air-gap, thus forming an open circuit of low resistance, has been found necessary for long-distance wireless telegraphic work. Under these conditions the current is not only alternating, but decreases periodically, reaching zero in a very small fraction of a second. The decrement of the wave may be determined by the first amplitude and the ratio of any two successive amplitudes.

The period of oscillation in polar co-ordinates is represented in Fig. 5, and also in rectangular co-ordinates in Fig. 5A.

Thus is will be seen at once that the oscillating current is incompatible with the long, smooth curves to which we are accustomed in the undulatory motion of electric currents produced by the vibra-



FIGS. 5 AND 5A.—PERIOD OF OSCILLATION.

tions of a transmitter diaphram. If the oscillator system is closed through the spark gap by an inductance coil, and the current employed is alternating, as distinguished from oscillating, then speech may be reproduced through space by means of a suitable receiver. Again, if the oscillator system remains open through the gap and the current is caused to surge to and fro in each arm of the oscillator at every reversal in the secondary of the coil, calculations may likewise be obtained by means of a telephone, although it is exceedingly difficult to determine if the results are due to rotational currents set up around the system or electric waves emanating from it. This

system offers some promise there, the distance covered in the course of my experiments has been far less than those enumerated.

The fifth system is one on which I have been engaged for the past three years, and differs from the last in that the discharge takes place in what might be termed the earth-bound ether. When a current of sufficient potential and frequency is permitted to discharge into the earth and there allowed to restore the equilibrium, the bound ether radiates waves very much the same as the Hertzian oscillator in the air; and if a suitable receiver is provided, these waves will be picked up, transformed and reproduced in articulate speech. The same apparatus may accomplish the results in free air, but to no effective distance, thus following, coincidently, the analogue of sound transmitted in media of different densities, as when a bell



FIG. 6.—FIELD EXPERIMENTS.

struck under water sends out sound waves many times as far, as when struck in free air.

By this system I was able to reproduce speech, in 1900, a distance of 200 feet; in 1901, about a mile, and, in 1902, speech could be reproduced faintly to a distance of three miles. These trials have been made in the open country. What the performance of the instruments would be in a city I cannot say, but intend to determine in a short time.

That this or any wireless system will ever take the place of the efficient wire service now in use is hardly probable, but it will, no doubt, find its special sphere just as the wireless telegraph has. As an illustration, nearly all the vessels wrecked are the result of collisions, due primarily to an unseen or misunderstood signal; if vessels were equipped with wireless telephones, the pilots would be placed on the same basis as the modern business man, instead of relying on signals that were used by prehistoric men in the stone age. Fog and darkness would be robbed of half their terrors and hundreds of lives and millions of property would be saved every year.

Independent Telephony in Michigan.

At the recent annual meeting of the Michigan Independent Telephone Association, which was held in Detroit, extensive gains throughout the State during the past year were reported by the delegates present. The Association's strength at the present time is greater in the smaller cities, the companies in many instances having more instruments than the Bell Company. In the larger places the rapid strides of the Independent people have caused the old company much distress. The number of independent telephones in some of these towns was given as follows: Northville, 136; Plymouth, 130; Allegan, 251; Burr Oak, 260; Blissfield, 152; Hastings, 362; Nashville, 141; Middleville, 132; Vermontville, 198; Reed City, 131; Cadillac, 230; Frankfort, 80; South Haven, 245; Fenton, 125; Corunna, 58; St. Johns, 230; St. Louis, 145; Bad Axe, 50. In these towns it was reported the Bell company had but one instrument.

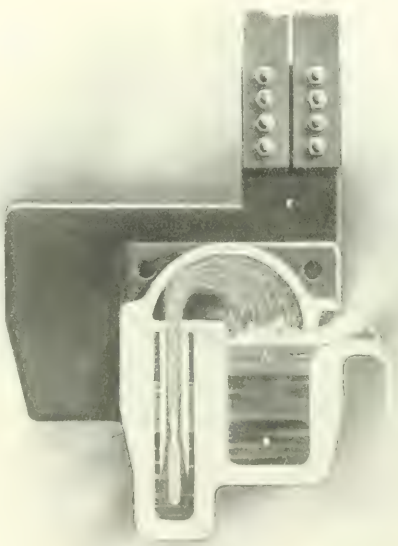
In the cities of Hart, Saginaw, Muskegon, Alma, Kalkaska and Adrian, according to a table presented, the independent telephones in service far outnumber those of the Bell company.

The Acker Electrolytic Alkali Process.

BY [illegible] PAUL TOWNSEND.

IN ELECTRICAL WORLD AND ENGINEER for June 1, 1901, the present writer commented briefly upon the Acker cell, as disclosed in recent patent specifications, and referred to the interesting parallelism between the Acker process, employing a fused electrolyte and a circulating molten cathode of lead, and the mercury cathode cells for the production of caustic solutions from brine. In respect to temperature the Acker cell operates at a higher level, and this is the sole difference between the methods; molten lead is substituted for mercury, fused salt for an aqueous solution, and steam for water as the oxidant; as product, anhydrous caustic is obtained in place of a somewhat dilute solution. By reason of this parallelism, a comparison of the processes is of the greatest interest as affording a general insight into what may be called the specific characteristics of molten electrolytes and aqueous solutions. As will be seen, the efficiencies of the two methods, whether calculated upon the expenditure of current or of energy, are nearly equal; in the matter of concentration of energy and of plant, the fused bath process possesses an enormous advantage. From a theoretical viewpoint, therefore, the industrial advantage would appear to lie with the former method, and interest centers upon the installation itself, the method and means for handling that *bete noir* of the electro-chemist, a fused electrolyte.

It has been the privilege of the writer, through the courtesy of Mr.



[illegible]

Acker, to follow his process from its infancy in the experimental plant, in Jersey City, to its final form at Niagara Falls. It is not necessary at this time to relate the improvements which have from time to time been made; but a statement of the work of prior investigators will be of interest as more clearly indicating the character of the difficulties which had to be overcome, and as defining the limits of Mr. Acker's contribution to the progress of the art.

The earliest investigator of the lead-sodium alloys on more than a laboratory scale seems to have been Dr. A. J. Rogers, who published the results of his work in the *Proceedings* of the Wisconsin Natural History Society, the *Journal* of the Franklin Institute, the *Chemical News*, and elsewhere, about 1889. Dr. Rogers' study of these alloys was based upon materials prepared by adding sodium to lead in atomic proportions and multiples, and melting under paraffin. The

characters of these alloys are accurately given, and especially he notes the rapid decomposition of water by alloys containing an excess of 20 per cent of sodium.

Dr. Rogers on one occasion prepared a considerable quantity of an alloy approximating 17 per cent. of sodium, by electrolytically decomposing fused sodium chlorid in a crucible containing 30 lbs. of the salt and a cathode of lead, a dynamo being employed, and a current of 72 amperes passed for two hours. Owing to imperfect fusion of the salt, the e. m. f. required was exceedingly high, 21 volts, but the current efficiency seems to have been fairly good, or between 75 and 80 per cent. This investigator had no thought of the possibility of the industrial production of caustic from his alloys; their chief interest to him lay in the possibility that by their use, the De Ville process, at that time the only commercial method for the reduction of aluminum, might be cheapened, but it is nevertheless true that he did make caustic soda from lead sodium alloy. Dr. Rogers was also entitled to the credit for employing a basic lining in his electrolyzing apparatus. He tried the various basic linings, including hydrated alumina well fired, some "shrunk" magnesia lining such as is used in basic steel furnaces, etc. Magnesia linings were later suggested by two workers in this field in a different form.

Disregarding a strict chronology, reference may here be made to Dr. Borchers, who has proposed to deposit sodium from its fused salts upon a flowing stream of lead, producing alloys for various industrial purposes; a current density of 3.2 amperes per square inch of cathode was deemed most suitable, the e. m. f. required, being 6 to 8 volts. A group of English inventors, Hetherington, Hurter and Muspratt, likewise suggested the production of such alloys by the electrolysis of fused caustic soda superposed upon a cathode of molten lead.

The problem was next approached by Mr. C. T. J. Vautin, and this time with the view of obtaining caustic solutions and chlorine. Sodium chloride in an externally-heated vessel, was electrolyzed with carbon anodes, and the light metal collected in a cathode of molten lead. This cathode was prolonged into a second vessel where a small surface was exposed to the action of steam from above and through the supernatent caustic, the assumption being that the alkali metal would diffuse at once throughout the body of the lead and always toward the point of removal. This assumption is of course entirely incorrect; the lead cathode crusts over almost at once with a light alloy and secondary reactions begin—the recombination of the liberated ions, and possibly the formation of sub-chlorides—with the results of loss of sodium and rise of the e. m. f. and temperature. Furthermore, the introduction of steam *above* the caustic for the purpose of oxidizing the sodium in the alloy *below* it would require that the caustic be not anhydrous, as otherwise the sodium would not be extracted. This would mean that the temperature at this point should be far below that of the bath, in fact, considerably below red heat.

Impracticable as was this plan, one of Vautin's patents contains one interesting suggestion; this was, the maintenance of the heat of the bath by the passage of the current itself which Rogers had not mentioned. It is likely, however, that the state of the art long before Vautin's experiments would have been sufficient to have led any serious investigators to employ the current for melting as well as decomposing the salt. This one point, and the basic lining due to Rogers, and also two others which are due to Acker, are the fundamental necessities of the method.

The Vautin process received a trial on a small industrial scale at Keighley, Lancashire, Eng., in 1893-1894, but was quickly abandoned. Meantime, Leon Paul Hulin, at Modane, Savoy, attacked and solved the problem, and this in a most ingenious manner. Recognizing the cause of the difficulty as the non-diffusion of the sodium through the lead, Hulin electro-deposits with the sodium that equivalent of lead which will constitute with it an alloy of the proportions desired, overcoming the lack of diffusion by avoiding all necessity for diffusion. Mixed chlorides of sodium and lead are electrolyzed with anodes of both carbon and lead, the latter connected in circuit through a rheostat to govern the proportion of the total current passing through it, and hence the proportion of lead dissolved and deposited.

In practice, for this process has until recently been in commercial operation at Cavet-Clavaux, Savoy, about 12 per cent of the total current was shunted through the metal anode. The voltage required is 7, affording, under the conditions, a current density of 700 amps. per square foot of cathode surface. The current efficiency is stated to be 69.3 per cent, while the energy efficiency falls to 41.5 per cent. The alloys obtained are leached with water, and by repeated washings the concentration of the solution may be brought to 50 per cent caustic (*sp. g.* 1.54). The lead is collected as sponge, for which the manufacture of storage battery plates affords some market.

If, as stated above, Hulin has solved the problem, Acker has factored it, resolving the double difficulty by a single bold expedient. This was the conception that a jet of steam might be introduced into the molten alloy to oxidize its sodium and at the same time to give to the lead such rapid circulation past the anodes that mechanical mixing might supplement the slow process of diffusion.



Fig. 2.—General View of the Acker Works.

The accompanying illustrations require but a word of description. The fusion pots or furnaces are of iron, cast in two parts only; a body portion *L*, for containing the electrolyte, provided with a horizontal partial partition *M*, dividing the vessel into upper and lower chambers, which communicate at one end with each other and at the other with a well *I*, wherein the steam is injected; and the cover *D*, for the well, serving the purpose of deflecting the mingled mass of molten lead, caustic and hydrogen, thrown upward by a steam jet, into a chamber *A*, where the constituents quickly separate, hydrogen burning freely at the orifice, anhydrous caustic overflowing to the individual collecting vessels, and the lead returning by conduits *B*, to pass again beneath the anodes in the upper chamber *H*. The steam pipe *J*, a thick-walled steel tube, discharges, as shown, into the casing *C*, forming a true injector, and constituting a most direct and positive means for circulating the cathode.

The anodes *G*, of which four are employed in each furnace, are graphitized carbon blocks, having a working face approximately 7½ by 14 inches, and carry 2000 amps. each, or about 19 amps. per square inch. These great carbons, prepared by the International Acheson Graphite Company, are entirely unaffected by the bath; that is to say, they undergo no corrosion or chemical action properly so called, and deteriorate only from mechanical causes, the weak point being the surface of connection with the copper rods *K*. In point of fact, the problem of a resistant anode for a fused chloride is considerably less serious than is the case with aqueous solutions, for in the molten bath there are no oxidants, nor possibility of their formation; consequently

ordinary dense carbons or carbon agglomerated with a proportion of graphite show equal resisting power with the graphitized blocks. The advantage of the latter lies in the superior facility with which they may be tooled, and their higher conductivity permits the use of a smaller cross-section. A sleeve of basic cement protects the conductors above their point of union with the anodes.

The furnaces are lined with magnesite bricks *F*, such as are used in basic steel furnaces. They are set without cement and inclined backward for stability; the electrolyte penetrates their interstices and in solidifying, combines them into a rigid wall, which seems to be entirely unaffected by the electrolyte or such of the products as come into contact with it.

Of these furnaces, 45 are now in operation with 11 more provided for. The current of 3250 e. h. p. is delivered from the Niagara Falls Hydraulic Power & Manufacturing Company at 8000 amps. and 300 volts, being transmitted directly to the factory from the power house, a distance of 1500 feet, by great aluminum cables. The Acker Company was therefore under no necessity of installing transformers. The works began operation in December, 1900, and have been in continuous operation since that time, with the exception of one week, during which no current was delivered owing to a fire in the cable tower of the power house.

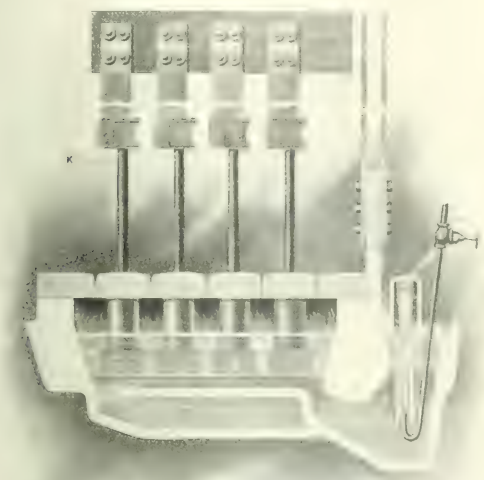


FIG. 3.—SECTION OF FUSION POTS.



FIG. 4.—SECTION OF FUSION POTS.

The e. m. f. between terminals in the fully heated furnace is 7 volts, and, as stated, the current is 2000 amps. per anode or 8000 for each furnace, each furnace absorbing therefore about 75 e. h. p. and producing an average of 581 pounds of anhydrous caustic per day, and an equivalent of chlorine which is carried direct through conduits to the bleach house. The caustic as discharged from the furnace is anhydrous, and this irrespective of the quantity of steam injected for circulation. For at the temperature employed, hydration is impossible, whatever excess of moisture be present. As it overflows from the furnace, the caustic is gray or often green from the presence of minute quantities of iron, and perhaps of manganates, and is cleared by a few hours' settling. Of course there is no boiling down and no further concentration required. The caustic, as it leaves the furnaces is probably the strongest that can be made.

The figures as given above afford data for an estimation of efficiencies; 8000 amps. should yield in 24 hours 633 lbs. of caustic, wherefore the actual output of 581 lbs. represents a current efficiency of 93 per cent. The theoretical voltage required for the decomposition of fused sodium chloride is 4.2, on the basis of which we may estimate the energy efficiency of the process as 55 per cent, when the furnaces are charged with cold salt, as is now the case.

Let us compare these figures with those of the Castner-Kellner mercury cathode process, as given in the *Engineering and Mining Journal*, Vol. 67, p. 497.

Efficiency.	*Current.*	*Energy.*
Castner-Kellner	91 per cent.	52.3 per cent.
Acker	93 per cent.	55. per cent.

Such a comparison, it should be pointed out, is not necessarily a test of relative commercial values, nor would it be such even if installation and depreciation factors were equal in both cases: for the energy theoretically required may, and in fact does, differ widely in the two cases, and hence efficiencies are calculated as percentages of different absolute quantities. In other words, equal energy efficiencies by no means represent equal current consumption for a given output of product. To separate .8502 gm. of sodium in one hour, one amp. is requisite, whether the electrolyte be fused or dissolved; but in the former case 4.2 watts are theoretically necessary, and in the latter 2.3 watts.

In the actual manufacture of alkali on a large scale by either the wet or dry process an estimate of the cost of production, which is based on the horse-power required only touches the fringe of the matter, and numerous other items, some of almost equal importance, must be considered therewith.

The disadvantage of the fused bath lies, not, as has been frequently stated, in the rapid depreciation of the plant nor in any difficulties surrounding the industrial handling of the electrolyte or its products, but in the fact that for its operation a somewhat greater quantity of current is required. Its over-balancing advantage is such concentration of this energy, that the output measured by the size of the decomposing plant, or the number of units employed, is relatively enormous, and for this reason it is also true that the total depreciation per ton of output due to this enormous concentration is very low.

It should be borne in mind that the cost of evaporating the water from a weak solution is eliminated. It is interesting to consider the future possibilities of the fused bath process. A unit employing 8000 amperes and producing nearly 600 lbs. of caustic is a comparatively small electrolytic furnace employing four anodes; therefore the process seems peculiarly adapted to working on a large scale in which still greater output per unit would be be possible. The delivery from large reverberatory furnaces of molten salt to a group of such units and the employment of the escaping hydrogen, at least in part, for melting purposes would seem to be indicated.

Train Lighting.

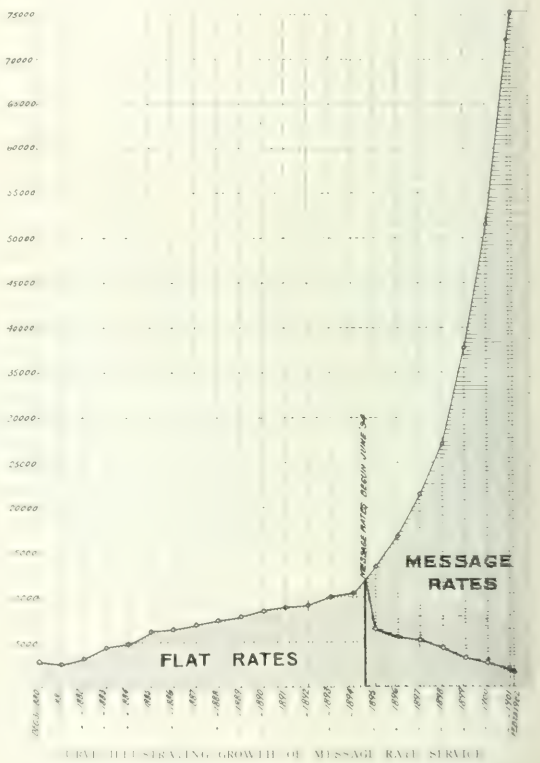
The Pennsylvania Railroad has put in service a train lighted by electricity, generated by storage batteries under each car. The present batteries will supply lights for twelve hours, and improvements are expected to be made whereby batteries can be installed that will furnish lights for twenty-four hours. It is said that all the through trains of the Pennsylvania Railroad will be furnished with these storage batteries.

The Evolution of the Message Rate Telephone Service—I.

ON Jan. 1, 1894, the New York telephone system had less than 10,000 stations in service; to be accurate, 9914 stations, and in those days a telephone service with 10,000 stations was looked upon as a very large system, of which any city might be proud. On the first day of the year 1902, after eight years of development under message rates, the system covering the same territory—no longer the whole city of New York, but the boroughs of Manhattan and the Bronx—had 72,189 stations. And the end is not yet. Indeed, telephone men set practically no limit to the development of the telephone in large cities, and it may confidently be expected that at the end of the next period of eight years the present handsome figures will look small. The extent to which the telephone habit is being spread among the people at large is indicated by the rapidly accelerating rate of growth of the system. At the end of 1899 the total number of stations in service in Manhattan and the Bronx was 37,716, an increase of over 10,000 stations for the year, which was the first that saw the net increase run into five figures; at the end of 1900 the total was 51,571, an increase of nearly 14,000, a gain of nearly 40 per cent in the number of new stations; at the end of 1901 the total was 72,159, an increase of 20,588, again nearly 40 per cent above the gain of the previous year. On March 1 last the total stations were 75,306, as compared with 37,716 on Jan. 1, 1900, so that in twenty-six months the system has almost exactly doubled. This record is unique among the telephone systems of the world, and justifies some notes on the methods by which such rapid development has been brought about, and also on those by which it has been handled concurrently with a complete change in the operating plant. For the period of greatest increase, the past three years, during which time 45,000 stations were added to the system, has also been occupied in the change from magneto to common battery working, involving the entire reconstruction of all exchanges, the equipment of every subscriber's station, including a couple of thousand branch exchanges, with new apparatus and much work of a most laborious character on the cable plant. Every detail of this work has been carried out without a moment's interruption of the continuity of the general service, while at the same time stations have been changed at an average rate of from 2500 to 3500 a month; for it is interesting to note that to gain 1500 stations net requires usually a gross gain of about 2500, about 1000 going off the system every month from the various natural causes for changing one's arrangements that arise in this uncertain life.

The real development of the New York telephone system began in 1894 with the introduction of message rates. Previous to that year the growth had been slow, if steady, as shown by the curve, only two years, 1883 and 1885, enjoying an increase of over 1000 stations. For some five years previous to 1894 the system had been going through a difficult period of development affecting the plant solely. I refer to the change from overhead single wire working to metallic circuit underground distribution. The immense outlay incident to the sacrifice of the entire overhead wire plant, and the construction of an underground cable system of distribution and of new switchboards and subscribers' equipment, necessitated a rate for unlimited metallic circuit service considerably higher than that previously in force. The subscribers, while appreciating the improvement in the service and in general conditions effected by the change to underground working, balked at the new rate; few new subscribers came on and the old subscribers clung as long as they could to their grounded circuit contracts at the old rate. Under these conditions the system naturally increased very slowly, from 7454 stations at the end of 1888, when the removal of the overhead lines was well under way, to 9914 at the end of 1893, an increase for five years of under 2500 stations. In one year of this period, 1891, the net increase was only 209 stations, a figure which at the present time would be considered hardly a respectable week's work during the dog days. The progress made in converting the subscribers from grounded to metallic circuit working during this period was steady, but necessarily somewhat slow, as the metallic circuit rate was by no means willingly accepted by the subscribers. At the beginning of 1894 there were still over 3900 grounded circuit lines in service, equivalent to about 35 per cent of the total. This large proportion of grounded circuits seriously lowered the efficiency of the whole system and impaired the service of the other 65 per cent of the subscribers, who had metallic circuit lines, but obviously did not always get metallic circuit service. In June, 1894, the first message rate schedule was adopted, having a minimum rate of $100 a year for a party line station, with 700 messages, and a minimum rate of $150 a year for a direct line station with 1000 messages.

The telephone subscriber, as such, is universally rather a difficult customer, and is inclined to look on all innovations with suspicion, as if scenting ulterior motives. The message rate plan was an absolute novelty in New York, and while at first it was looked on rather askance by many telephone users, others found it so practical and so acceptable that quick progress was made in converting the remaining grounded circuit subscribers to metallic circuit. By the end of 1895 the system was entirely metallic circuit, the 3900 grounded circuit subscribers changing over to metallic circuit at the message rates. Moreover, so quickly did the message rate system find favor among New Yorkers, that in the year 1895 the system gained 3000 stations (equal to the total gain of the previous six years) and of the 13,345 stations in service at the end of 1895, eighteen months after the adoption of the first message rate schedule, 7016, or over 50 per



CURVE ILLUSTRATING GROWTH OF MESSAGE RATE SERVICE

cent of the total, were at message rates. The success of the message rate scheme was therefore assured practically from the start, and within a very short time the message rates displaced the flat rates entirely from the company's tariff. A few old flat rate subscribers still retain their contracts because they prefer to take service that way, but, with these exceptions, which form a small and constantly diminishing percentage of the total stations, the entire Manhattan and Bronx system, aggregating at the time of writing over 80,000 stations in service and contracted for, is on the message rate basis.

The first message rate tariff was purely a tentative one, and as soon as it was found that the principle was acceptable to the New York public and promised to be instrumental in largely developing the use of the service, modifications were made in the rates, aiming at a reduction in the minimum rate, and as experience has been gained in the working of the message rate system and in the general operation of the plant and service a plan of rates and gradations of service has been evolved, which by its skilful adaptation to the conditions that obtain in New York, has been the main cause of the prodigious

telephone development recorded above—a development, be it said in all modesty, which is the wonder of telephone men all over the world. To describe in full the evolution of the New York rates from the first tariff of June, 1895, with a minimum rate of $150, to the present comprehensive tariff with its minimum rate of $48 a year in Manhattan, its special rates of $36 for Harlem service and of $24 a year for Bronx service, its low extension station rate, its private branch exchange rates, and so forth, would be too much of a tax on both reader and writer. The main outlines of the various steps by which the actual tariff has been reached will, however, be found interesting as a brief study in the evolution of popular telephone rates.

In general the governing idea has been directly opposed to the principle of the old flat rate method, which took the telephone line as the unit of charge and recognized but two classes of users—business and residence. In the first place the message rate scheme departs radically from the main principle of flat rates in adopting the *message* as the unit of charge, and departs from the secondary principle of flat rates in recognizing and providing for many different classes of users and for a widely varying demand as regards amount of service on the part of different users in the same general class. This great flexibility of the message rate principle is its cardinal virtue, and has been so skilfully availed of in the evolution of the New York tariff that practically any member of the public having use for the telephone service can get the kind and amount of service he requires at a reasonable rate.

In developing this comprehensive tariff from the starting point of 1894, 1000 messages at $150, the general lines followed have been the reduction of the minimum rate, the making of rates at both ends of the scale adapted to special classes of users and also to special localities, and the cheapening of the service generally by lowering the average rate per message as the system developed and the public increased its demand for telephone service. The first reduction was made in November, 1894, when the minimum direct line rate was reduced from $150 for 1000 messages to $120 for 700 messages, the party line rate remaining at $100 for 700 messages, making a difference of $20 a year between the direct and party line rates. Party line service, although it has always formed a feature of the facilities offered, has never been very popular in New York. The average New Yorker when he wants a thing seems to want it exclusively for himself, and would rather pay a little more than go shares with others. Consequently the demand for party line service has never been very great, and party line stations form but a small proportion of the total. An improved party line service is now furnished with selective ringing, which abolishes one of the most annoying features of the old party line, and at the present very low rates party lines are coming more into use than formerly. The second reduction, which was a substantial one and first brought the annual cost of telephone service in New York down to two figures, was made in May, 1895, a little less than a year after the inception of message rates. This schedule made the minimum rate $90 a year for 600 messages on a direct line, and $75 a year for 600 messages on a party line; further, it lowered the rates throughout the schedule, making necessary, since it has always been the company's policy to give to all actual subscribers the benefit of any general rate modification, the changing of all existing message rate contracts. By this time there were some 7000 message rate subscribers, nearly half the system being on message rates by the end of 1895, so that the work of changing all the contracts and at the same time caring for the new business and for the changes from flat to message rate, due to the revised schedule, was no mean operation. However, thanks to careful preliminary plans and organization, it was carried through without friction and with satisfaction to all concerned. In 1893 the company had added to its organization a contract department, charged with all direct dealings with the public regarding new business, and this department, under the volume of work caused by the introduction and development of the message rates, grew rapidly in size and scope until it is now one of the busiest offices in the company, with bases down town at Dey Street, up town at Thirty-eighth Street, at Harlem and in the Bronx. Starting in 1893 with a staff of five, including the office boy, it now has at the main office and at the branch offices a total staff of 96 agents and clerks. The contract agent is practically the company's selling agent. The curve of growth is an indication of the energy and ability displayed in enlarging the volume of business.

The next important step in the main rate schedule was taken in June, 1899, when the minimum rate for 600 messages was reduced from $90 to $75 [illegible]

At the same time reductions were made at various points in the schedule for larger numbers of messages. The rate, for example, for 1200 messages, which had originally been $166, and had fallen to $130, was reduced to $111. This schedule brought about a great increase in business, the growth for 1899, to half of which the new rate applied, being 10,940 stations, and for 1900, 15,287 stations, as compared with 5437 in 1898. With one modification this is the schedule in force to-day. With a view to encourage the use of the service in domestic and social life, and having regard to the small average traffic from residence stations, making them relatively cheap to operate, a special residence rate was added to the schedule. This rate gives a minimum of $66 for 600 messages on a direct line, and of $48 for 500 messages on a party line. So that at the present time you can get telephone service in Manhattan for $4 a month at your residence and for $5 a month at your place of business, rates that, say, seven years ago, few would have expected ever to see in New York, but which very probably will be improved on before another seven years roll by.

Wireless Telegraphy: Mr. Marconi's Short-Distance Work in Europe and America.

By Wilfrid Blaydes.

THE attention of the large public interested in the progress of wireless telegraphy has, for some time past, been so much directed to Mr. Marconi's long distance work that the ordinary short distance working of his system—if one may so describe its operations over distances ranging from 50 to 150 miles—is perhaps a little in danger just now of receiving something less than the consideration to which its importance and extent undoubtedly entitle it. So far, indeed, as I am aware, not even a list, with any pretension to be a complete list, of the stations engaged in such operation of the system has, as yet, appeared in the American press. I propose in the present article to give to the readers of Electrical World and Engineer some brief account of the extent to which this side of the operations of the Marconi companies has already been developed. In a future number of this journal, I shall hope to deal more exhaustively with the actual commercial position and organization of those companies.

I find, then, to begin with, that, at the present time, or rather, I should say, six weeks ago—for the extension of the system is now proceeding so rapidly that figures with regard to it soon become out of date—the stations fully equipped with and regularly working ordinary Marconi installations for wireless telegraphy over short distances—in the above definition of that term—were nineteen in number. Of these, seven are in England, one in Wales, four in Ireland, two in Canada, one in Massachusetts, one on an American lightship (Nantucket), one in Belgium, one in Germany, and one on a German lightship (Borkum). Besides these stations, others are also in operation which have been equipped from time to time by the companies, to the order of the British Admiralty. At these latter the apparatus employed is still of the old non-tuned type. The Italian Navy Department, on the other hand, has already under its control in Italy two complete installations of the latest type of Marconi apparatus. But of neither of these classes of stations, which are not worked directly by the companies, do I now write, and the big-power stations destined for transatlantic work are equally outside the scope of my present intention.

Turning, then, first, to the English stations, they are:

(1) Withernsea, a point on the Yorkshire coast not far from the Humber and the port of Hull, and favorable, therefore, for communication with ships passing up and down the North Sea.

(2) Caistor, on the Norfolk coast, a little to the north of Yarmouth, a site selected, like Withernsea, in view of the North Sea traffic.

(3) Frinton, in Essex. This station is of considerable and growing importance, chiefly by reason of the fact that in connection with it a technical school has been established where instruction is now provided by the companies for the practical training of their staff of operators. It is in the working of the system between this station and

(4) The North Foreland, that the assistants now gain their first experience of its methods. The North Foreland station is also, of course, in regular use as a ship-signaling and ordinary commercial station, being within easy call, especially, of the Belgian mail packets,

on which the system has for some time past been in successful every-day employ. The most important of the English stations are, however, the remaining three, which are in the English Channel, at, respectively, (5) Niton, Isle of Wight, (6) North Haven, at the mouth of Poole Harbor, and (7) the Lizard.

Of these, North Haven is mainly an experimental station, and some of Mr. Marconi's earlier experiments, long before his system had reached its present point of development, were there carried out. Worked in conjunction with Niton, which is quite near—only thirty miles away—and with the Lizard (200 miles), Mr. Marconi still makes considerable use of it in connection with the experimental side of his work, to which no new achievement ever leads him to attach less than the first importance. The two stations at Niton and the Lizard include within the radius of their operations practically the whole of the English Channel. The Lizard station will thus "pick up" a ship as she leaves Southampton Water, maintain communication with her throughout her trip across to Cherbourg Harbor, and not lose it until she is safely out of the Channel and is 150 or 160 miles west of Cornwall, on her voyage to New York.

Of the four Irish stations, two (8) Inistrahull, and (9) Malin Head, are operated by Lloyds for the purposes of their signalling stations at those points.

(10) Crookhaven, in County Cork, near Brow Head at the south-western extremity of Ireland, is usually the first station to get into touch with inbound, as it is the last to lose it with outward-bound Atlantic steamers. This station has also more than once been used by Mr. Marconi in connection with the earlier stages of his long-distance experiments.

(11) Rosslare, in County Wexford, and (12) Holyhead divide between them the signalling and ordinary message work between shore and ships passing to and fro in the Irish Sea and St. George's Channel.

(13) Belle Isle and (14) Chateau Bay are two stations established by the desire of the Canadian Government for signalling and general commercial purposes on the Straits of Belle Isle at the northern entrance to the Gulf of St. Lawrence.

(15) Siasconset is the station on the American mainland which was erected by the *New York Herald* for work in conjunction with the installation (16) on the Nantucket lightship.

(17) La Panne is the company's Belgian station, which the work in connection with the Belgian mail packets, plying daily between Belgium and England, would alone suffice to keep fairly busy.

(18) Borkum Riff in Germany and (19) Borkum lightship, finally, are a pair of stations similar in character to the Siasconset-Nantucket installations. They are worked by the Norddeutscher-Lloyd.

Besides these nineteen stations in regular work, the companies have actually in hand the establishment of some seven other similar installations for the use of Lloyds at their signalling stations. One pair of these is to connect the Flannan Islands with the Butt of [illegible] Morocco, at Port Said and Suez, and at Shadwan Island and Tor in the Red Sea.

Of the working of the Marconi system in this relation, that is to say, as an adjunct of the world-wide system of ship-signalling which is controlled by the corporation of Lloyds, I may, perhaps, deal in somewhat fuller detail in a subsequent article. In this place I wish merely to call attention to the fact that under the formal agreement concluded some little time ago between that corporation and the Marconi International Marine Communication Company, Ltd., the system of wireless telegraphy controlled, in respect of the class of work in question by the latter (so that, for accuracy, I should rather have written "company" than "companies" a few lines back) is adopted exclusively for use in connection with the Lloyds signal stations for a period of fourteen years, and the installations at such stations are also available for the ordinary passenger and commercial traffic of the company. The importance of the first of these provisions, in particular, may not easily be overrated. It means that for a period of at least fourteen years no ship carrying wireless telegraphic apparatus, other than the Marconi apparatus, will be allowed to communicate by wireless telegraphy with a Lloyds station in any part of the world, any more than it is able so to do with stations under the direct control of the Marconi Companies, from all communication with which such ships are, naturally, debarred altogether. Since practically no wireless telegraphic land stations have hitherto been established by those interested in other systems than Mr. Marconi's, the almost absolute monopoly of mercantile marine signalling and sea telegraphy is thus assured for some considerable time to come, at any rate, to the Marconi system, and as the directors of the Marconi Wireless Telegraph Company, Ltd., point out with very legitimate satisfaction in their last report, its instruments must accordingly now be considered the standard instruments for the ships of all nations.



Table Head, Glace Bay, Cape Breton.

(*The cross indicates the site to be occupied by Mr. Marconi's new transatlantic station.*)

I should be sorry to do an injustice to the distinguished Herr Professor Slaby, of Charlottenburg, and his collaborator Count d'Arco, and it occurs to me that I may possibly have been guilty of one in my remark just now that at present practically no other than Marconi wireless telegraphic land stations are anywhere in existence. Since writing it, I have read a report that appeared in the *New York Herald*, upon the voyage of the *Deutschland*, as that good ship the other day bore Prince Henry back from New York to the Fatherland. This has reminded me that a pole has indeed been erected at Cuxhaven for the purpose of working a wireless telegraphic system which has come to be known as the Slaby-d'Arco system.

I notice in the same report to which I have alluded that, on the occasion in question, the German Emperor, anxiously awaiting his brother on the quay, at length, thanks of the genius of the Herr Professor Slaby and Count d'Arco, did actually receive news of the *Deutschland* (which, of course, had passed up channel without being able to communicate with any of the Marconi stations) when she was [illegible] alleged to be [illegible] part. What

upon, seeing that he had time and enough to spare, his Imperial Majesty, with a sterling common sense which must appeal to us all, lied him blithely away to dine. Unluckily, however, the alleged ninety miles turned out to be, in fact, twenty, and the Emperor's dinner, and, if he be at all human like the rest of us, his temper no less, suffered accordingly some rude disturbance. One can only trust that the Slaby-d'Arco station at Cuxhaven is occasionally somewhat less erratic, not to say, humorous, in its operations. The little story, nevertheless, may possibly throw a certain light upon some recently reported tests at Kiel, during which Slaby-d'Arco messages were received over a distance also, curiously enough, alleged to be between eighty and ninety miles, whereas the utmost distance achieved by the poor, out-of-date Marconi system during the same series of tests was stated to be something over fifty miles. This, too, if I am not mistaken, in the very week when Mr. Marconi, on board the *Philadelphia*, was receiving duly authenticated messages from England over a distance of 1551 miles!

The report of this German testing of different systems at Kiel, I may as well mention, was, so far as the Marconi Companies are concerned, entirely devoid of foundation. They took no part in, nor received any notice of, any such competition, as the report suggested, and, I may hazard it as my private opinion that, in any case, they would not improbably have respectfully declined to take part in the proceedings described. Further comment on these is needless, but those holders of cable stock who may have been caused to suffer some little uneasiness by Mr. Marconi's proceedings, may perhaps be expected to direct their consideration with some relief to the wireless system of telegraphy which is associated with the names of the brilliant German professor and his noble ally.

A word or two will be in place here as to the Cape Breton station just selected. After Mr. Marconi had considered the respective advantages of several points on the coast between Sydney and Louisburg, to enable him to visit which with convenience the Dominion Coal Company courteously placed a special train at his disposal, he finally selected as being, on the whole, the most suitable for his purpose, a grassy promontory named Table Head, situated some two miles north of Glace Bay. To a considerable extent, this spot presents a favorable combination of the two classes of conditions—electrical on the one hand and engineering on the other—which have chiefly to be taken into account in the choice of sites for wireless telegraphic stations. It is accessible with tolerable ease, the regular line of the Louisburg & Sydney Railway being within a distance of two miles. A freight track, connecting with the above, and also the property of the Dominion Coal Company, at present passes within about two hundred yards of the site, and the company has furthermore undertaken to run a branch line up to the very doors of the station—no unimportant consideration where the transport of heavy machinery and apparatus is in question. There is, furthermore, an excellent water supply, and the building contractors (Rhodes, Curry & Company) expect to have the erection of the towers completed within a couple of months. Mr. Marconi leaves Mr. R. N. Vyvyan as resident engineer in charge of the installation of the plant, and, if all go well, it is expected with some confidence that everything will be completeed and the station ready for work before the summer of the present year is far advanced.

Needless to mention, the town of Glace Bay, where much interest has been taken in the matter since it was first mooted, is jubilant over the decision in its favor as the locality for the new station. The hopes of Louisburg ran high, but for various reasons they had to be disappointed. Throughout his visit to Cape Breton, Mr. Marconi received many testimonials of the hearty good will of the inhabitants. Mayors and town councils vied with each other for the opportunity of entertaining the modest, unassuming young man who has already made such a deep mark upon the scientific history of his time. Upon his arrival at Sydney from Ottawa, Mr. Marconi was, indeed, the object of something resembling an ovation from the local Italian colony, which assembled to greet him at the railway station and, despite the lateness of the hour and the persistent rain, escorted him to his hotel with a torchlight procession and ringing Italian "Evvivas."

The Pan-American Tower.

It is stated that the famous electric tower of the Pan-American Exposition has been sold to the city of Denver, whither it will be removed as soon as practicable and placed in a park there as a permanent feature.

The Independent Telephone Movement in Philadelphia.

THE city of Philadelphia has been from time to time the center of movements for the establishment of independent telephone exchanges, and the memories of many of our readers will doubtless go back to the time when in opposition to the Bell system there a Clay telephone service was in active operation. The recent revival of independent telephony due to the lapse of the controlling Bell patents has naturally been marked by action in Philadelphia, and for some months past the Keystone Telephone Company has been actively at work preparing to give service. We are now able to present some details of this work up to date.

The Keystone Telephone Company was organized in April, 1900. Its franchise was granted on April 19, 1900, authorizing the company to lay conduits, erect poles, lines, buildings, etc., and maintain and operate a telephone system in the City and County of Philadelphia. In May, 1900, Dr. Louis Duncan was employed to prepare preliminary plans and make an estimate on the probable earning capacity of the plant. On the basis of this estimate, the company decided to proceed with the work and a corps of engineers was employed to prepare de-



EXTERIOR OF EXCHANGE BUILDING, EXTERIOR

tailed plans and specifications covering the underground work, cables, lines, buildings, switchboards, instruments, etc. In February, 1901, the company's capital was increased from $2,000,000 to $10,000,000.

Work was begun on April 25, 1901. During the year 1901, the company laid 4,250,000 duct feet of underground conduit in the central portion of the city, covering 75 miles of street; built 1250 manholes, and constructed one building 95x135 feet, 5 stories high, at 135 South Second Street. This building is used as the company's general offices and exchange to supply that portion of the city lying east of Eleventh Street and south of Fairmount Avenue. This is known as the "Main" exchange. The company has also constructed a building at Sixteenth and Summer Streets, 45x120 feet, 4 stories high, for an exchange to cover that portion of the city between Eleventh Street and the Schuylkill River, and south of Fairmount Avenue. This is known as the "Race" exchange. Both buildings are of brick and terra cotta, and fire-proof construction throughout. Both exchanges are of the same capacity, 3480 lines installed, and an ultimate capacity of 7200 lines. The switchboards are of the central [illegible] & Supply Company, on specifications of the engineer of the Keystone Tele-

phone Company. The instruments are those the American Electric Telephone Company, of Chicago, made on specifications furnished by the Keystone Telephone Company.

The "Main" exchange board has been in operation about thirty days. The "Race" district board will be in operation on May 1. Both exchanges will be in operation in practically one year from the date the ground was broken. The contract for furnishing and installing all the main cables was let to the American Electrical Works, of Providence. All cables in the "Main" district are now completed, about 1000 telephones are in operation, and about 50 telephones are being added daily. We have before us the March subscriber's list



FIG. 2.—MOTOR-GENERATORS.

of some 20 closely printed pages of names. It now has upwards of 9000 five-year contracts for service.

In general, the apparatus which was installed consists of fifteen sections of multiple switchboard (each section consisting of six panels and being arranged for three operators' positions), one main distributing frame, one intermediate distributing frame, one relay rack which is used for mounting the relays in the line circuits, one relay rack for mounting the relays in the incoming trunk circuits, chief operator's desk, wire chief's desk, manager's desk, and information desk, and a complete power plant. The multiple switchboard at present consists of four trunk and eleven subscribers' sections. Each section is arranged with apparatus for three operators, and has a capacity for 7200 subscribers' multiple jacks, 240 outgoing trunk jacks with designation strips, and 300 answering jacks and answering lamps. A cable turning section is placed against the wall which separates the switchboard room from the terminal room. From this cable turning section, the switchboard sections grow in a direction from left to right. The four sections nearest to this cable turning section are incoming trunk sections. At the first position are located the trunk lines from the chief operator's desk and the wire chief's desk. The remaining eleven positions in these sections are each arranged for an incoming trunk operator with 30 plug terminated in coming trunk lines. The first four of these eleven positions have not been furnished with equipment with this installation. The remaining seven positions are each completely equipped. Arrangement has been made for switching all incoming calls received at any one of these positions to any desired position. By this arrangement, one operator can handle all of the incoming business of the exchange during the night or the slack times of the day.

The fifth to the fifteenth sections are each arranged for an equipment for three subscribers' operators with 15 pairs of connecting cords and 10 order wire circuits. Each position, excepting the last one in the fifteenth section, has been completely equipped. Each cord equipment consists of two supervisory lamps, a listening key and a two-party indicating ringing key. Each of the fifteen sections is provided with an equipment of 3420 subscribers' multiple jacks, 240 outgoing trunk jacks, 320 answering jacks and lamp jacks. The multiple lines are multiplied once in every section and the outgoing trunk lines are multiplied once in every two sections. The first and last subscriber's operator in each section is furnished with 100 answering jacks and 100 lamp jacks. The middle operator's position at each section has an equipment of 120 answering jacks and lamp jacks. One pilot lamp is located at each incoming trunk operator's position and two at each subscriber's operator's position. The lamp at the trunk operator's position lights whenever an incoming call is received at a position when the operator's telephone plug is not inserted in the telephone jack; one pilot lamp at each subscriber's operator's position lights whenever any line lamp at that position is lighted, and the other pilot lamp at the subscriber's operator's position lights at the end of conversation when the clearing out lamp which is associated with the answering cord is lighted.

The chief operator's desk is provided with circuits for calling and conversing with the superintendent or manager; for conversation between the chief operator and any subscriber and with any other desk operator, and with circuits which notify the chief operator of the rapidity and accuracy of the work of all of the exchange operators. The information desk and the manager's desk are each provided with three regular exchange lines and one line to each one of the other desks in the exchange. The wire chief's desk is provided with apparatus for testing any line in the exchange, and for determining the nature and location of any trouble which may arise on these lines. It is also provided with circuits which enable the wire chief to converse with any exchange operator, with any subscriber and with the chief operator, information operator or manager.

The terminal room adjoins the switchboard room. The terminal frame, main and intermediate distributing frames and relay rack are parallel to each other and are located as near to the switchboard as possible. The terminal frame is of a size large enough to accommodate fifty-two 100-pair cable heads, but arrangement has been made so that additional iron work can be added later and the size increased so as to accommodate cable heads for the ultimate number of lines. The present equipment consists of the complete equipment of 52 cable heads. The main distributing frame provides for an

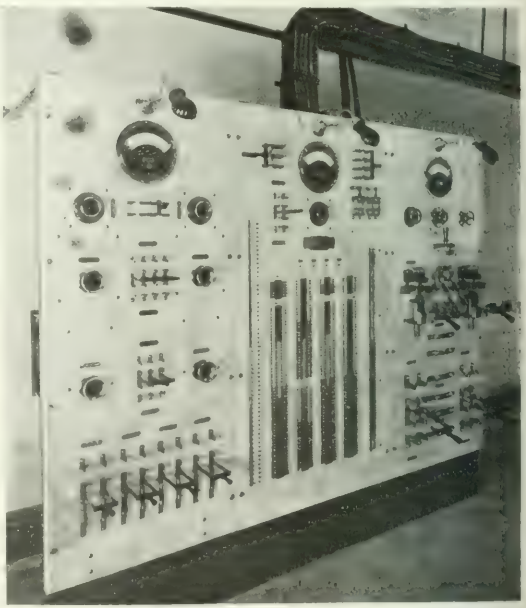


FIG. 3.—POWER BOARD.

equipment of 4480 lines with provisions for growth. The present equipment consists of terminals on both the line and switchboard uprights for 3500 subscribers' multiple lines, 540 outgoing trunk lines, 280 incoming trunk lines and 20 miscellaneous lines. The frame work for the relay rack which is provided consists of iron work for 18 bays, each having a capacity for 200 pairs of line and cut-off relays and two strips of retardation coils, which are used in connection with the outgoing trunk lines. Arrangement has been made so that the size of this rack can be increased when desired. The intermediate distrib-



Fig. 4.—Switchboard Main Exchange.



Fig. 5.—Terminal Room.

EQUIPMENT, TELEPHONE EXCHANGE IN PHILADELPHIA.

uting frame provides for a capacity for 3600 lines. The present equipment consists of the complete equipment of terminals on both the line and switchboard uprights. The trunk relay rack has a capacity for the relays required in the incoming trunk circuits for 12 incoming trunk operators.

The entire power plant, with the exception of the storage batteries, is located in the terminal room; the batteries are located in an adjoining room. Two Holtzer-Cabot special wound telephone generators have been provided for charging the storage batteries; each is run from the primary source of power, at 220 volts direct current.

Three ringing dynamotors, with "busy back" and "don't answer" attachments have been furnished. Two are wound to run on the 220-volt mains and the third is wound to run by current from the storage batteries. The ringing and charging machines are located on a machine pier made of white enameled brick. The power switchboard and fuse board are mounted in one iron frame and are made of polished marble. The power board is provided with copper switches which enable all desired changes in the power circuits to be made; Weston voltmeters and ammeters, which are capable of measuring all voltages and currents in the power circuits, rheostats, starting boxes and over-load and underload circuit breakers. All fusing of power and switchboard circuits is done on the fuse board. Under switchboard circuits are included, the circuits which include the relays in the line and cord circuits and the line lamps.

The storage battery plant consists of two sets of batteries of 11 cells each. The battery tanks are lead lined and are provided with battery plates which are capable of supplying current for the present number of equipped lines, but are large enough to accommodate plates for the ultimate capacity of the exchange.

All of the larger buildings in the city are connected direct to the underground cables. The smaller ones are connected from junction boxes on the rear building walls. The company has no poles, and it is not the intention to erect any poles except in the suburban parts of the city. The wisdom of this method of construction was proven in the recent storm, when all telephone and telegraph communication in that city was destroyed for about ten days. The Keystone Company suffered no damage whatever. All main conduits used were of the 4-multiple type with 3½-inch square hole in 3 feet lengths, laid in concrete. Lateral conduits are of creosoted wood.

The company is building an exchange at Filbert and Preston Streets, West Philadelphia. Switchboard and instruments have been ordered, as well as the conduits and all other material excepting cables, and orders for these will be placed shortly. It expects to construct during the year one exchange at Tenth and Susquehanna Avenue, one in Germantown and one in Kensington, making a total of six exchanges in Philadelphia County. The West Philadelphia exchange will have an ultimate capacity of 2880 lines and 960 lines installed. The Germantown and Kensington exchanges will be duplicates of the West Philadelphia plant. The North exchange at Susquehanna Avenue will be a duplicate of the "Main" exchange. This year's work will require the laying of about 5,000,000 feet of conduit.

The rates of the company for service are: Unlimited business telephones per anunum, $84; unlimited physicians' telephones per annum, $64; two-party line business telephones, $52; direct wire residence telephone, $48; two-party line residence telephones, $36; extension desk sets, $10. The officers of the company are well known men, whose names in some instances have been prominent in recent traction developments in Philadelphia. They are: President, Robt. H. Foerderer; vice-president, Jacob E. Ridgway; secretary and treasurer, W. H. Clark; general manager, C. E. Wilson; directors, R. H. Foerderer, Norman Grey, John M. Mack, Michael Murphy and J. E. Ridgway.

The company has a traffic agreement with the Keystone State Telephone & Telegraph Company, which gives it connection with the surrounding territory. That company is building in all suburban points around Philadelphia, and is building lines to connect with the principal exchanges in other cities. Submarine cable across the Delaware River will be completed in about two weeks, giving connection with Camden and all points in Camden and Gloucester counties, New Jersey, and the line is being surveyed to Atlantic City and Trenton to give connection with the Interstate Telephone Company, of New Jersey, who control practically all of the independent telephone plants in the State of New Jersey.

The connection with the lines of the Maryland Telephone & Telegraph Company affords relations with all of the independent companies in Maryland and Delaware.

A Telephone Evening at the Institute.

At the 163d meeting of the Institute, held at 12 West Thirty-first Street, New York City, Friday evening, March 28, 100 members and guests were present. A meeting was also held simultaneously in Chi-

The general subject of the meeting was "Telephony," and was introduced by President Steinmetz, who outlined the electrical features of long distance telephonic transmission. Mr. Arthur Vaughan Abbott, of New York City, presented a paper on "The Telephonic Status Quo." A paper by Mr. Franz J. Dommerque, of Chicago, was read by Mr. William J. Hammer, in the absence of the author. The title was, "Telephone Rates from the Engineers' Point of View." At the Chicago meeting a third paper was read by Mr. Angus Hibbard, entitled, "Telephony—1902." Abstracts of these papers follow:

THE TELEPHONIC STATUS QUO.

In the preliminary paragraphs of the paper with the above title read by Mr. A. V. Abbott referred to the policy of reticence maintained by the Bell Company with respect to the technical features of its system and the manner in which its guarded knowledge relating to the manufacture of its apparatus, which not only impeded progress but gave rise in the public mind to various suspicions. People saw only an insignificant bit of apparatus which their common sense told them could be made for a dozen dollars, for the annual use of which a charge of from $50 to $250 was made. Small wonder, then, in view of this insufficient evidence, that on the expiration of the fundamental patents, there were hosts of enterprising electricians (many of them of the locksmith and bell hanger type) who were ready to flood the market with telephonic apparatus of all kinds, good, bad and indifferent; nor that there was a public trained and educated to embrace any telephonic relief from the real or fancied oppression of a so-called grasping monopoly.

Mr. Abbott, after saying that it is no part of his paper to examine into the validity of the grounds for this state of public sentiment, maintains it exists, deeply and strongly rooted in the public mind, fixed therein by nearly a score of years of most unfortunate training; so firmly seated that in some cases independent exchanges, charging regular rates, have flourished and grown fat in the face of absolutely free service offered by the older company, in the hopes of crushing by the superior endurance of a powerful backing, their younger and seemingly weak rivals. So strong is this sentiment that to-day, though the Bell companies are nearly a quarter of a century old, and the Independent companies barely six years, the field is quite evenly divided between them as is shown by the statistics in Table I.:

TABLE I.

Item.	*Bell.*	*Independent.*
Invested capital	$320,000,000.00	$150,000,000.00
Number of exchanges	1,500	2,811
Sub-stations	1,080,000	1,198,000

During the past year about $18,750,000 has been spent on telephone apparatus, of which about 40 per cent is credited to the Independent interests, and in this field 415 new Independent telephone companies have been floated.

It is possible to-day for anyone to build a first-class telephone exchange, and with good care, shrewd and expert management, to give service that cannot be excelled at the lowest possible price. While this is possible, it is rarely done. On the contrary, a very erroneous idea prevails in the mind of most of the Independent companies as to the requirments and limitations of telephony. According to their doctrine, all one has to do is to put in a telephone (any kind of a telephone) build a line (any kind of a line), set up a switchboard (any kind of a switchboard), go away and leave it to its own devices, returning once a year to collect the dividends. The general manager of a 5,000 line Independent exchange recently remarked in answer to a question as to cost of maintenance, "*why*, we don't have any maintenance, we have a new plant." Another gentleman, president of more than one telephone company, when advised to allow $2.00 per substation per year for maintenance expense, averred that ten cents per year was amply sufficient for the purpose.

After referring to the haphazard way in which Independent companies are often organized and to the manner in which they put down a plant, and to the reckoning bound to come with a turn in our present era of prosperity, Mr. Abbott said that if only the cloud of mystery that has for so long obscured telephonic practice was dispelled, and the public taken fully into the confidence of the operating company,

much of the present friction would be obviated. People would gain not only true appreciation of the service performed for them, and so be more tolerant of tariffs, but would also acquire such a knowledge of the telephonic *modus operandi* as to vastly increase the efficiency of every telephone plant. In this respect, the Independent companies are setting an admirable example. Frequent conventions take place, at which free and open discussions of all subjects of interest are held, to which all, whether friend or foe, are equally and cordially welcomed. Each week the technical papers of the land chronicle all items of progress in so free and full a manner as to display the most striking contrast to the years of grim and forbidding silence maintained by the older organization.

Mr. Abbott says that there appear to be five results which are certain to follow from the present situation:

1. Many of the present organizations lacking in experience and strength, located in unpromising fields will go down with the first of the present. If the Bell companies heed the tendencies of the times, they may yet not only retain, but revive a fast diminishing supremacy. Failing in this respect, they will be forced to meet this just demand, either by the struggle for existence in the face of fiercest competition; or by the pressure of ordinance regulations, as has recently been witnessed in Chicago; or by such legislative action as will declare all telephone companies to be common carriers, and compel each to handle and transmit to its own subscribers any messages delivered by the other.

Mr. Abbott then takes up the subject of rates, and states that in giving service, telephone companies do three entirely separate and independent things which are incommensurable with each other, all of which every just and equitable tariff must recognize and express.

1. The telephone company supplies and maintains a certain amount of apparatus necessary to connect each subscriber with the central

TABLE II.—General Telephone Statistics.

Name of City.		Population	No. of Telephones	Per cent of Telephones	WIRE MILES. Underground	Aerial	Total	Per Telephone	TARIFF. Flat Rates. Business Telephones. 1 Party	2 Party	4 Party	Multi Party	Residence Telephones. 1 Party	2 Party	4 Party	Multi Party
									$	$	$	$	$	$	$	$
B	Baltimore....	507,000	6,300	1.25					125	100			100	78	60	
I	..	"	6,000	1.25	1 14	757	1,807	.3	48	42	32		36	30	24	
B	Boston. ...	590,892	23,106	4.1	47.00	7,400	54,400	2.3	162	141			116	102		
B	Buffalo	352,210	9,443	2.7	6.83	5,475	12,305	1.3								
B	Chicago ...	1,698,575	37,000	2.2	158,033	33,190	141,823	3.8	175				100	75	00	
B	Cleveland....	381,000	13,741	3.5	28,023	13,119	41,742	3.2	84	72			60	48		
I	..	"	9,000	2.4	9,000	4,500	13,500	1.4	48				30			
B	Columbus....	125,560	8,600	6.8	7,964	8,164	16,128	1.9	40				24			
B	Indianapolis .	169,000	4,537	2.7	9,600	12,500	22,100	4.8	40				24			
B	Kansas City..	163,000	7,200	4.4	6,500	7,500	14,000	1.05	96	75	51		72	60	42	
B	Louisville...	204,731	6,604	3.2					96	78	48	36	60	48	30	18
I	.. ....	"	5,000	2.5					48				36			
B	Minneapolis..	202,000	9,025	4.5	11,854	7,655	19,514	2.15	84	72	54	18	60	48	36	18
B	Milwaukee..	285,000	8,900	3.1	12,829	5,559	18,088	2.0	96	72	60		60	48	36	
B	Nashville.....	86,000	3,498	4.0		1,030		.29	84	48	36		54	36	24	
B	New Orleans.	287,000	6,000	2.1					120				60			
B	New York....	1,850,000	63,075	3.5	152,837	2,455	155,262	2.25	240							
B	Omaha.	102,000	3,861	3.7	3,571	1,758	5,329	1.4	96	72	48	24	66	48	30	
B	Phiadelphia.	1,400,000	23,438	1.7	72,618	7,808	80,426	3.5	160				80			
I	..								80	52			48	30		
B	Pittsburg	451,512	11,986	2.5	22,388	13,227	35,618	3.0	125	100	80		100	80	60	
B	Rochester....	162,608	4,200	2.6	11,550	800	12,350	3.0	94	64			36	24		
I	..		4,200	2.6	3,324	2,011	5,335	1.25	48				30	24		
B	San Francisco	342,000	24,135	8.5	23,500	7,100	31,665	1.4					60	60		
B	St. Louis.....	575,238	7,851	1.4	8,465	11,940	20,405	2.6	150	100			72	48		
B	St. Paul	166,000	5,715	3.5	7,350	3,303	10,653	1.9	84	72	54	18	60	48	30	18
I	..		1,314	1.8					48				30			

Name of City.		Measured Service. Business Telephones. 1 Party	2 Party	4 Party	Multi Party	Excess Calls.	Com. Bus.	Residence Telephones. 1 Party	2 Party	4 Party	Multi Party	Excess Calls.	Com. Bus.
		$	$	$	$	$	$	$	$	$	$	$	$
B	Baltimore....					.06		1000 C 72	1000 C 62	1000 C 48		.04	
I	..										365 C 18.25	.05	.05
B	Boston. ...	1000 C 90	1000 C 75	1000 C 66		.04		1000 C 90	1000 C 75	1000 C 60		.04	
B	Buffalo	1000 C 70				.06		1000 C 52					
B	Chicago ...	1000 C 92	1460 C 73		1000 C 48	.05	.05	1000 C 92	1460 C 73	1000 C 48	365 C 18.25	.05	.05
B	Cleveland....	1000 C 60	1000 C 48	1000 C 36		.03	.05						.05
I	..						.05						.05
B	Columbus....												
B	Indianapolis .												
B	Kansas City..	1000 C 72				.05	.05						.05
B	Louisville...	1000 C 74				.05						.015	
I	.. ....												
B	Minneapolis..	1000 C 72	1000 C 62	1000 C 48		.03		1000 C 60				.03	
B	Milwaukee..	1000 C 68	1500 C 60	1000 C 50		.02	.05	1000 C 48	1000 C 36			.02	.05
B	Nashville.....	1000 C 41				.05		1000 C 33				.05	
B	New Orleans.												
B	New York....	1000 C 99	1000 C 87			.08		1000 C 90	1000 C 87	1000 C 78		.07	
B	Omaha.	1000 C 72				.04		1000 C 72				.04	
B	Phiadelphia.	1000 C 78	1000 C 66			.05		1000 C 60	1000 C 60	1000 C 36		.05	
I	..												
B	Pittsburg	1000 C 70				.04		1000 C 70				.04	
B	Rochester....	1000 C 70				.06		1000 C 70				.04	
I	..												
B	San Francisco	1000 C 140	1000 C 104		365 C 18.25	.05					365 C 18.25	.05	
B	St. Louis.....	1000 C 69	1000 C 57			.04		1000 C 57	1000 C 5			.04	
B	St. Paul	1000 C 60				.03						.03	
I	..												

Note.—This table is compiled from various sources and is believed to be fairly accurate within about six months. In the first column the "B" and "I" signify Bell Plants and Independent Plants, respectively. Under Measured Service the letter "C" signifies "Calls."

monetary stringency, throwing by their ruin considerable disfavor on the financial aspect of telephony.

2. The remaining Independent companies will be forced to adjust their rates until such a point is reached as to enable them to become investments of reasonable earning power, and to this end only the most carefully designed, best constructed and shrewdest managed plants can possibly survive.

3. The rates of the Bell companies must fall until both the Bell and the Independent meet at a common level and thereafter, so far as the public is concerned, it matters little which gives service.

4. The Independent companies are weak in their lack of coherence, feeble in possessing but few exchanges in the larger towns, and almost none in the great cities, and powerless in the toll and long distance field. New York is the keystone of the telephonic arch, and when that city is captured by an Independent company, the battle will be more than half won, but judging from recent developments in this direction, that time is still in the somewhat far distant future.

5. An extensive and far-reaching tariff revision is the vital question

office. This apparatus must be furnished and cared for whether used or not, merely to give the subscribers an *opportunity* to call. The quantity and quality of this apparatus does not vary with the load, being the same whether the instrument is used once a year or 100 times a day. A flat rate annual tariff sufficient to pay interest, depreciation and maintenance on this portion of the plant is fair and just, and by recognizing varying lengths of subscribers' lines, this charge can be made exactly proportional to the requirements of each station.

2. The telephone company must maintain a corps of operators to answer subscribers' calls and to perform the necessary avocations of connecting subscribers together. This expense is directly and only proportional to the number of *times* each station calls.

3. During each conversation, battery is supplied to the subscriber's station for talking, cords, plugs, trunk lines and other common apparatus is in use, the amount and cost of which is proportional to the length of time of conversation.

Therefore, any telephone tariff to be fair to all, must recognize these three factors, and in so far as any one is omitted, and a blanket charge

substituted therefor, injustice will be done, depending on how far the service rendered to a particular station departs from the general average.

To illustrate the bearing of this proposition, Mr. Abbott gives details as to the cost of installation and service. According to previous telephonic policy, the ratio of the number of telephones to population is very low, as is shown in Table II. Consequently, the installation cost per station has been high. In large cities this has varied from $150 to $250 per station. In medium cities, of say 200,000 population or so, from $90 to $125, while even in the smallest towns it is rare to find a cost of less than $50 per station. Of the installation cost from $10 to $25 is required at the sub-station, depending upon the character and difficulty of wiring. From $15 to $50 for the switchboard, varying with the type of board, size of multiple and percentage of trunking, while the wire plant has absorbed the balance; but if by a more liberal policy the use of the telephone could be so stimulated as to raise the population ratio, to say 15 per cent, it would be possible, even in such a city as New York, to install a telephone plant at a cost not to exceed $60 per sub-station, as is shown in Table III.

Probable installation cost per station of a telephone plant, sufficient to serve 15 per cent of population:

Sub-station apparatus	$15.00
Wire plant, subscribers' lines	14.00
Wire plant, trunk lines	7.00
Switchboard apparatus, subscribers' lines	12.00
Switchboard apparatus, trunk lines	6.00
Total	$54.00

Assume now that an installation charge of $15 per year per sub-station were made against each one-party line to cover interest, depreciation and maintenance, $10 per year per station each against two-party line and $8 per year per station against each four-party line, and that a charge of one cent was made for each time the central office was called up and one-half cent for each minute of actual time that the telephone was in use. Large business houses and the best class of residences would take one-party lines. Smaller business houses and medium residences two-party lines, while the bulk of subscribers would use four-party lines; all of these being arranged with selective signals and lock-outs to secure the best quality of service.

Simply to illustrate the effect of this system of tariff, assume one-party lines to average ten calls per day, two-party lines seven and four-party lines three. Under these circumstances, one-party lines must bear a tariff of $75 per year; two-party lines $52 and four-party lines $23. According to this suggestion, the annual cost of maintenance and depreciation on plant would be cared for by the annual flat rate charge, which, for this purpose, is sufficient in a properly installed and maintained plant. The receipts from traffic would average $20 per thousand calls, while the actual expense should not be over $7 per thousand calls. The difference of $13 would be ample to pay reasonable general expenses and dividends. At each sub-station, a meter would be installed, carrying two dials, one showing how many times the exchange is called, and the other the total time expended in the use of the telephone. This meter should be in plain sight of the subscriber, so that he, at any time, could check the readings with his own watch. Such a device could be made and installed at an expense not to exceed $3 per station. Each station would be charged for exactly the service rendered, and it would be optional with all to regulate charges to suit their wishes.

Mr. Abbott adds that while it is impossible to make any one method of charging universal, the main idea should be to produce a rate that will be absolutely just, and be capable of so stimulating telephonic business as to place an instrument in every house. A scheme of this general nature would go far towards smoothing out the existing friction between the operating companies and the public.

Referring to the engineering side of the question, Mr. Abbott says that two very curious tendencies are observable. Among the older companies and the most advanced of the Independents, there is a very strong inclination to design plants with the utmost care and skill, using the widest and best experience for the purpose, and foreseeing the future as far as possible. But with the newer and less experienced of the Independents, there is a most conspicuous absence of design.

Conduit construction has settled into pretty well recognized channels, involving chiefly the use of vitrified clay pipe, particularly the multiple duct forms. Periodically, a new and improved form of duct material appears destined to supersede all others, but the tile men serenely go their way, and their output to-day is larger than ever. The construction of aerial lines is rapidly becoming systemized and proceeding under standard specifications, the tendency of which is to build the lines much more efficiently and much more solidly than in the past, and to restrict the use of open wires to three or four cross arms.

There is a notable tendency to increase the size of cable. Formally 120 pair was standard for underground work and 25 for aerial, but at present 200 pair is becoming almost universal, and even 400 pair has entered the field underground; while aerial cable has grown so that 150 pair is not unknown. For trunk lines and toll work, large conductor, low capacity cables are to the front, even to the extent of using No. 16, No. 14 or even No. 12 wire, with capacity of from .06 to .05 M. F. per mile. In switchboard practice, the common battery automatic signal board is rapidly expelling all other forms and soon will apparently reign supreme, for at present there is not a shadow of rival looming on the telephonic horizon to dispute its supremacy. While switchboards of this type are a vast improvement over those of older construction, Mr. Abbott says they still leave much to be desired, and that the entire telephonic fraternity wait with open arms the coming of the perfect switchboard. There are many who believe that a purely automatic board will offer the desired solution, but during the past decade the progress in this direction, he says, has been almost infinitesimal. A central office seems to be one of those things that needs the human element, and cannot be made purely mechanical. He adds that possibly the recently invented Faller mechanical operator may form at least a partial solution.

As to the sub-station, the transmitter, receiver and magneto have remained in *statu quo* for ten years, save that each manufacturer dresses his apparatus in a newer and possibly more fanciful design. This is strange when it is considered that actual telephonic efficiency is less than two per cent, and that a very slight improvement in this direction would be hailed with delight by all, particularly by those who do much toll work. Part of the difficulty lies in the electrical characteristics of the line, and for this Dr. Pupin's epoch-making discovery is supposed to be a panacea, but as yet results from practical experience therewith have not been reported.

As to the future, Mr. Abbott says that despite the claims for the Hertzian waves, there is nothing at present to suggest any radical discovery in the telephonic field. On the other hand, the art is gradually settling down to that inevitable and comfortable basis wherein sound financial judgment as to the expediency of a telephone plant, skilful engineering in design, the best possible construction, good business management in operation, fairness in the tariff and in the treatment of the subscriber, will be absolutely essential to produce a good balance sheet.

TELEPHONE RATES FROM AN ENGINEER'S VIEW POINT.

Mr. F. J. Dommerque, in a paper with the above title, introduces the subject by a general discussion of flat-rate and measured telephone service. The matter of rates is then taken up, and after pointing out that the more the subscribers, the higher the rates must necessarily be, he discusses the feasibility of arranging a city service on the principle of village service, thereby giving every subscriber a comparatively low rate without deteriorating the service. A plan is suggested whereby residence, trades and business districts would have separate exchanges with flat rates for calls within a given district and a toll rate for calls to another district. Such an arrangement would tend towards large offices in the center of cities and smaller offices in the residence portions. In the business districts those not employing the telephone frequently could reduce the cost of service by being connected to two-party lines.

This scheme of charging for telephone service would therefore be as follows: (1) For the business portion of cities a flat rate to all busy subscribers, and a reduced flat rate to less busy subscribers using a two-party line. Pay stations, of course, cannot be dispensed with, but should only be used in certain *quasi* public places so as to give transients an opportunity of telephoning without having to intrude upon the regular subscriber. (2) In the residence districts, flat rate for local calls with measured service for trunk calls. Here, also, two-party line service can be used probably to still better advantage than in the business portion and would double the capacity of a small residence district switchboard.

With more than one office in the business district of a very large

city, the flat rate would be different in the various offices and would be in correspondence to the average number of calls originating in the offices. A measured rate for trunk calls in addition to a flat rate for local calls should be made, only outside of the business district where the total number of originating calls is low. This trunk charge would have another beneficial effect, as it would cut the calls into busy offices down to the lowest amount and thus help to keep down the trunk expense in such busy offices, which would not be the case, if the residence district subscriber, who usually is not pressed for time, could make as many trunk calls as he pleased under a flat rate.

Mr. Dommerque points out a fallacy in the comparison of telephone charges with charges for electric light and gas service based upon service actually received. In electric light service as well as in gas service, reservoirs store the energy, i. e., accumulators in the case of electric light supply and gas tanks in the other case, take care of the peak or peaks of the load curve, while in a telephone plant we cannot store the energy developed by the operator, and must build our plant large enough for the highest peak of the load curve and therefore have, for say 22 hours of the day, a plant on our hands that is used at low efficiency. Thus the same switchboard equipment and a line has to be built for each and every subscriber whether he calls once or one hundred times a day. It is, therefore, not more than correct to charge a flat rate, allowing certain modifications as the two-party line rate and regulate the flat rate according to the plant and service required. Size of plant and number of operators being purely a function of the number of calls; the flat rate should be proportional to the number of calls.

There is another incongruity in the comparison. In electric light and gas meters the quantity of energy supplied or the time of duration of supply is measured, so that each customer pays exactly for what he receives. In measuring telephone service, no account is taken of the time or duration of conversation, but the number of calls only is recorded. It is true that for local calls, i. e., for calls between subscribers connected to one and the same switchboard, duration of conversation does not noticeably influence the operating labor and thus would not enter into the question of charge, but for trunk calls, i. e., for calls that have to be transferred from one operator to the other, it is different. For local calls, one and the same subscriber is always connected to one end of his line and different subscribers may be switched onto his line; the subscriber may use his own line as long as he pleases, as nobody else would use it anyway. In the trunk line case, *no* subscriber is permanently connected to the trunk line and therefore subscribers may be switched onto either end of the trunk line whenever the trunk line is free. Thus a trunk line (and toll and long distance lines the same) may be kept "loaded" all the time, and it is clearly visible that the duration of conversation over trunk lines is an important factor and regulates the number of trunk lines, trunk sections, trunk operators and everything pertaining to it. This circumstance is well taken care of in toll and long-distance charges. Therefore, a measured service for trunk calls seems justified and there might be also a time limit to trunk calls, but probably it would involve more labor on the operator to take account of the time than the additional income would warrant; the case of toll and long-distance lines is different, as great capital is invested in such lines, these being very long, while ordinary trunk lines are comparatively short.

As to the subject of rates, many independents made the mistake to start in with too low rates. In order to determine the correct rate that should be charged to assure the operating company a reasonable profit, all items that are involved in the annual expense should be closely calculated. The depreciation factor on the plant should not be taken too low, as there are so many unforeseen incidents such as blizzards menacing pole lines, new inventions making switchboards obsolete, etc., that may deplete the treasury in a short time. The allowance for depreciation should not be below 10 per cent on the switchboard; 15 per cent on open wire pole lines; 4 per cent. on conduits; 12 per cent on cables.

When figuring on the cost of operation, it must be taken into account that not only the salaries of operators working at the board, but also the salaries of chief operators, monitors, night operators, office managers, repair men, matron, janitor and messengers, as well as the salaries of the clerical force directly connected with the operating department, must be taken into consideration. The salaries of the officials of the company, as well as the taxes that have to be paid are to be charged under the heading of fixed charges. A reasonable amount of rent must be charged, and on this point care should be taken not to make the figure too low, as it is often found afterwards that the rent to be paid for the best location of the office is high, because the owner of the property has found out how desirable his property is and charges accordingly.

In estimating upon the cost of the aerial and underground construction, a good many local circumstances have to be taken into consideration, as the formation of the soil, whether same is favorable or unfavorable to the setting of poles, etc. In the case of underground conduits there are obstructions to overcome, the streets in many cities being filled with all kinds of pipes so that it is very hard to lay additional conduit. In the city of Chicago, an amount of $1.20 per linear foot was added to the cost of the underground conduit in a certain street on this account. As far as the maintenance of the plant is concerned, the figures should not be taken too low. Of course, on underground conduits the maintenance means very little, while on aerial lines it may be as high as $25 per subscriber per year.

The discussion was opened by Messrs. John J. Carty, and continued by E. P. Thompson, Henry G. Stott and C. P. Steinmetz. The chief discussion was that of Mr. Carty, who made a long and able address, partly in defence of the Bell regime and policy and partly in relation to the technical issues raised. He disputed the allegation of Mr. Abbott that the Bell management had opposed the publication of technical papers and data bearing on the telephone art, and said that in his own case, how far he should go in giving out information was a matter left entirely to his own judgment. He held that there was a proper amount of reserve in regard to every industry, and that some topics lent themselves more freely than others to treatment in essays and the like. As to telephonic literature, he claimed that the development by Dr. Pupin before the Institute of his theory and practice of "loading coils" for telephone lines ought not to be omitted from that category.

As to improvements in telephone apparatus, Mr. Carty denied Mr. Abbott's idea of a general apathy in the Bell attitude, and took up specific cases. Some apparatus was not changed because it was hard to improve, and the general adoption of Bell standards was evidence enough in various directions. As to bells not alone had the Bell system introduced his own bridging arrangement very largely in the last eight years, but it had again changed this type for another later one for the sake of advance and improvement. Mr. Carty also instanced the almost universal adoption by the Bell system of "common battery" switchboards in cities and the abolition of the magneto set at the subscriber's station.

Mr. Carty also devoted a little time to "analogies" in regard to telephone charges, and quoted a well known expert—probably President Hadley—as admitting that telephone rates were far harder to deal with than railroad rates. He showed that if one wanted to do so, it would be easy to find fault with the inequality of the postal system charging two cents for a letter carried three miles or 3000; or of the street car system charging a man 5 cents for riding ten blocks, but asking no more if it hauled him all the way from Harlem to the Battery. The telephone service was steadily being reduced to a scientific basis, and in that respect could hold its own with any other medium of public service.

In response to requests, President Steinmetz discussed at some length the nature of waves in telephone transmission and the work that Heaviside had suggested and Pupin had done in putting self-induction into the lines so as to leave the wave forms perfect and to improve the quality of the speech transmitted.

TELEPHONY—1902.

In addition to the above papers, Mr. Angus Hibbard read a third paper before the Chicago meeting, entitled, "Telephony—1902," which was largely a discussion of the question of rates. The recent great growth of telephone service Mr. Hibbard ascribes as being largely due to the introduction of the message rate system. Classes of such rates have been made which have been availed of by the public in ever-increasing numbers, extending even so far in some cases to the patron who may use the telephone not more than once a day. As examples of the great growth in telephone service which has followed, it is stated that in Chicago the net growth for the past year in the number of telephones exceeded the total number operated at the beginning of the year 1898; and that in the San Francisco exchange 30,214 telephones were in operation at the close of the year, [illegible] American practice in this and other respects, the engineers of the British Post Office Department have recommended as the basis of charge the payment for service by the message, and for small users, the payment for service at the time it is rendered, using so-called "slot

machines" for that purpose. They also recommend the use of the relay multiple switchboard and trunk line switching machinery of the type largely used in America.

Mr. Hibbard argued that telephone service is a natural monopoly and that great losses are entailed on a community where there is more than one exchange. An instance is given of one city in which there are two exchanges, and the statement made that if all telephones were connected with one exchange, all the benefits of the present service would be secured and there would be a saving of more than $400,000 per year to the community. Referring to telephone cables, it is stated that ten years ago conservative engineers recommended 50 pairs of wires as the greatest number advisable to be contained in one cable, but that to-day many cables are in use containing 400 pairs. Less than eight years ago electric lamps were first used for signaling purposes on subscribers' lines, and to-day not less than 500,000 such lamps are in use.

Private Branch Telephone Exchange Work on Electric Railways.

The extent to which the use of the private branch telephone exchange is being carried is hardly appreciated by those who do not come into touch with this class of work. As a matter of fact, there are in New York City more private branch telephone operators than there are operators in the regular exchanges. This speaks volumes for the convenience afforded by such a method. Probably one of the most complete systems of private telephonic communication in existence has been established in the Borough of Brooklyn, and the accompanying diagram gives a general idea of the various connections found in this method of bringing together every office, shop, yard and power station of the Brooklyn Heights Railway Company. The private exchange is located at the main office of the railway on Montague Street, and it is here only that special operators are required. A view of this exchange is given in the accompanying half-tone engraving. As will be seen, accommodation is required for two operators, and during the day they are kept busy making local and outside connections. At all times, day and night, there is at least one operator in attendance. A very complete system of bookkeeping has been inaugurated in this department for recording calls and showing the amount of business done.

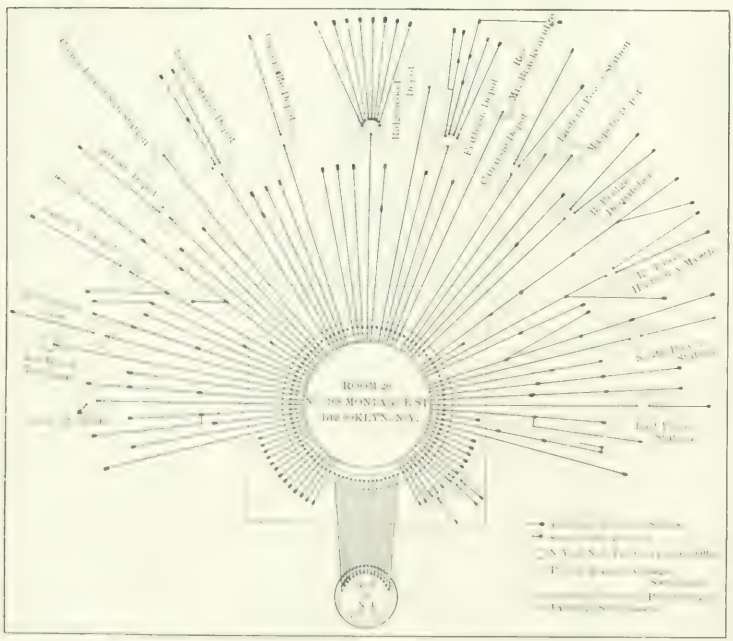


DIAGRAM OF BROOKLYN HEIGHTS RAILWAY TELEPHONE SYSTEM.

The private branch exchange has at present 147 extension stations, of which 30 are in the building where it is located and the remainder distributed all over Brooklyn. There are only 83 jacks in the switchboard, a number of the lines having several instruments at their ends on an auxiliary exchange or being used as party lines, but the work of the operator is, of course, practically the same as if it contained as many jacks as there are extension stations, or 147, as



FIG. 2.—PRIVATE EXCHANGE OF BROOKLYN HEIGHTS RAILWAY COMPANY.

above. In general only calls involving the central station, both outgoing and incoming, are recorded, but a count of the local business was courteously made last week for the benefit of this paper. It showed, under ordinary conditions, a total of 900 local calls for a single day. The average outgoing and incoming calls are respectively 450 and 600, showing that the various departments call each other up twice as often as they call outside, and that three-fifths of the calls received by them are of the local type. These calls are, of course, much more numerous during times of trouble, such as fires, snowstorms, breakdowns, etc., but the greatest increase is almost invariably on the local calls. At such times the chief operator goes to the "supervising set" at the left of the switchboard and attends personally to all the trouble calls, many of which have to be taken down on paper and repeated on account of the lines being abnormally busy. The chief operator has complete charge of the bookkeeping of the department as well as a general superintendence of the system, two other operators being constantly employed at the switchboard during the day. Between the hours of 7 and 8 each morning every wire of the exchange is tested and all telephones which do not work properly are reported immediately to the New York & New Jersey Telephone Company, which makes all repairs to lines and instruments. One of the duties of the operators is to give the correct time to the power stations, car houses, etc. A self-winding clock is placed in the exchange room for this purpose, giving standard time and controlled by the circuits of the Western Union Telegraph Company.

Although the common battery telephone system is in use in Brooklyn the railway company's exchange has not yet been arranged for its use on the private lines. It is still operated, therefore, from bat-

tery cells in the basement of the building. The great length of the private branches would render it difficult to operate the system on the battery now installed at the telephone company's central. A special power trunk is provided to supply the Brooklyn Rapid Transit exchange with current for calling central.

One point of interest to be noted on the diagram, which is reproduced from a drawing recently made for the officers of the company, is the large number of wires running to the New York & New Jersey Telephone Company's central exchange. There are fifteen of these trunks, six being used for outgoing calls and nine for incoming, except in very rare cases when the ordinary balance is materially disturbed. It is very exceptional, for this reason, to find "the line busy" when telephonic communication is desired with the Brooklyn Rapid Transit. Some of the auxiliary exchanges in the outlying districts have as many branches as the ordinary private exchange and the extension stations on these may be used for intercommunication even when the line to Montague Street is busy. There are no regular attendants at these smaller exchanges, as they are placed in offices where there is always sure to be some one present to make the desired connection. Every telephone on the system can be connected to the Brooklyn exchange, and from there to the local city or long distance lines.

The railway company rents its instruments and lines from the telephone company, a certain amount being paid each year for their use. There is no charge for local calls which do not use the trunk lines. Records are made on slips of all outside calls which are afterward summated and compared with the accounts of the telephone company. A complete check is also kept on all "foreign" or extra rate calls, and a daily statement rendered to the various departments. Private calls, where there is an extra charge are paid for by the individual making them.

Some Recent Electric Furnace Products.

By Clinton Paul Townsend.

Although the pulverization of metals in the electric furnace forms the subject of several patents issued in this country and abroad, but little is known of the practical operation of the methods or of the nature or use of the several products obtained.

The general method is simple in the extreme. A metal is heated either by the arc or by the passage of a heavy current through a column of reduced cross section, and is thereby brought to the temperature of volatilization. Vapors so produced are, in most cases, directly combustible in air, burning freely to oxide, or may be subjected to various reagents with corresponding variety in the products; or, finally, the metal may be collected directly in comminuted form in an inert atmosphere. The applications of the method embrace the manufacture of a whole series of pigments, abrasives, refined metals, and miscellaneous reagents.

In 1896, the Société Civile d'Études du Syndicat de l'Acier Gérard, of Paris, patented abroad a method designed primarily for the production of steel from pig iron by a modified Bessemer process, the principal feature of which was the comminution of the metal before subjecting it to a graduated blast of air, the effect being, as in the converter, the oxidation of silicon, sulphur, phosphorous, and carbon, and the conversion of the pig metal into steel. As one method of pulverization, the employment of the arc was suggested, the fused metal falling in a stream between the circuit terminals and collecting, after passing through an air blast in the hearth of the furnace.

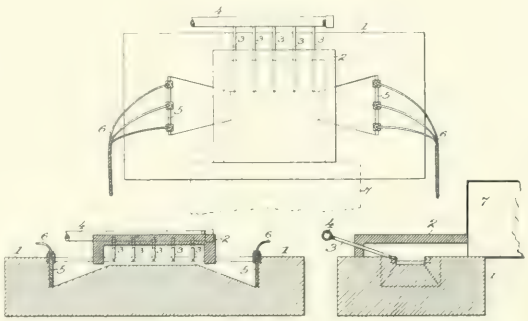
Later, a modified construction was adopted wherein a metal formed a short circuit between water-cooled terminals, and the air blast was projected against its surface at the point of maximum temperature; the vapor was thereby oxidized, and carried over to a collecting chamber forming a part of the furnace.

The substitution of other metals for pig iron suggested at once several modifications of this process, to wit.: the comminution of lead for use in accumulators; the production of litharge by the concurrent oxidation of the lead; the production of zinc as a sublimate, or, in the presence of an air blast, of zinc white; the production of rich mattes of copper, or the pulverization of this metal as a preliminary to the extraction of the contained values; the production of powders of bronze, tin, and aluminum, which enter in many ways into industrial processes; and finally the comminution of chrome—or tungsten—steels, to serve as abrasives.

An analogous procedure for the manufacture of white lead has been patented in this country to Messrs. Bailey, Cox and Hey. In this process the arc is struck from a tubular electrode to the surface of a mass of molten lead. Commingled vapors of water, carbon dioxid, and acetic acid, introduced through the hollow electrode, are presumed to react with the vaporized lead to form commercial white lead; the function of the acetic acid in this process is not clear and its use is probably merely a relic of various prior methods operating at temperatures at which the acid is stable.

Messrs. Bredig and Haber have noted in the *Berichte* a curious phenomenon, which occurs when the arc is struck beneath the surface of the electrolyte, either acid or alkaline, to a lead wire cathode, or when high cathode current densities are used under these conditions: the metal is disintegrated, appearing as a cloud in the solution, and white lead may, it is said, be produced by merely injecting air and carbon dioxid. The method is of course, not a commercial one.

Recently M. Bary, of Paris, patented a furnace for the commercial production of stannic acid. This device was figured and described in these columns Nov. 16, 1901. The molten metal is included as a resistance in the circuit, and the vapors as they escape from an orifice in the furnace cover are ignited by an air blast, and the dioxid collected. The Tin Electro Smelting Company, Limited, of Paris, which controls this patent, is also marketing a series of pulverized metals, presumably made in an analogous manner. These are, an impalpable powder of tin, known in France as Argentine, and capable of giving,



FIGS. 1, 2 AND 3.—LOMAX METHOD OF FORMING OXIDE OF LEAD AND TIN.

by simple rubbing, a burnished foil-like surface to paper: several grades of pulverized aluminum, the finest constituting the base of a new high explosive, and the coarser grades adapted for use in thermite reactions, as, for instance, the reduction of oxide of chromium, etc.; and pulverized lead, employed for the manufacture of minium, of white lead, and particularly for the production of sodium nitrite.

The latest patent of the series, issued March 25, of the current year to Clarence S. Lomax, of Everett, Mass., covers a method of forming oxides of tin and lead; the furnace used is diagrammatically shown in the accompanying figures. The hearth 1 converges both laterally and vertically to a central shallow, horizontal channel of uniform cross section, and in operation is filled to the level indicated with the molten metal. Electrical connections 5, 6, are made with the larger, and therefore cooler terminal pools, while the highly heated central portion is subjected to the air blast from tuyeres 3, 4, the oxides formed being directed by the cover 2 to a suitable collecting chamber 7. This method is distinguished from that of Bary in that the blast plays directly on the surface of the metal instead of upon vapors arising from it; the metal is not permitted to vaporize, and the whole operation takes place at a lower range of temperatures. The method is, in fact, that of Gérard, adjusted and controlled by limiting the action of the air blast to a portion of the surface which is maintained constant and at a uniform temperature.

Concerning the products of this furnace, it is said that pure dioxid of tin may be produced by the action of an air blast heated to 400° C., upon the molten metal at 1200° C.; under the same conditions, a cold air blast forms the mixture of dioxid and monoxid known as putty powder. For the production of oxides of lead, cold air is used.

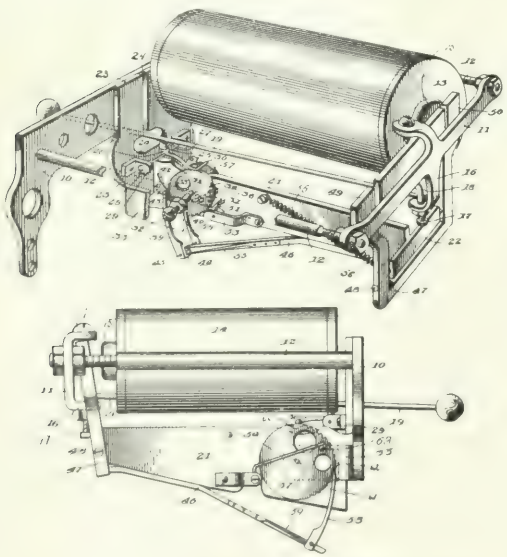
New Telephone Patents.

The issue of March 25, 1902, contains three telephone patents, all bearing more or less on mechanical additions to telephone circuits.

Mr. William D. Watkins, of San Jose, Calif., patents and assigns one-half to John W. Bolster, of the same place, a telephone selecting device, the object of which is so to control the armature of a magneto bell that it will be locked until the proper number of impulses has been sent along the line to free it and enable the bell to be rung. This object is effected by providing the hammer shaft of the bell with a lug, which is normally locked by a tumbler controlled by a disk, which has to be rotated a certain number of steps until the tumbler falls into a notch and so releases the lug.

Fig. 1 gives a fairly clear idea of the locking device, and Fig. 2 of the supplementary disk or restoring mechanism. The clapper 19 is provided with a lug 25 projecting downwardly in the path of the locking tumbler 26. When this tumbler is in the path of the lug the clapper is held from vibration. The rear arm of the tumbler lies upon the periphery of the disk 31, which has a notch 34 to receive the end of the tumbler arm when moved to the proper position. The disk is held normally with the notch out of operative position by being made heavier at one point. The disk is rotated by means of pawl 39, and engaging in ratchet tooth 40, worked by lever 46 attached to the U-shaped armature 47. Thus, if a series of impulses be sent through the magnet the armature will move the disk 31 a sufficient number of steps to carry the notch into position to receive the tumbler arm and so release the lug. The second disk 57 acts to prevent the bell responding to a small number of impulses when being actuated by a larger number of impulses. It has a notch 60 which normally lies below the end of the tumbler arm in which position it is held by the center of the gravity of the disk, being below its axis.

In operation, the first pulsation that moves 31 one step moves also 57, so that its notch is out of position to receive the end of the tumbler, and 57 stays out of such position until the final pulsation, which is continued long enough to permit 57 to return to its normal position. As this final pulsation also brings the notch of 31 into active position the tumbler arm may then drop and allow the tumbler to release the clapper. When the final pulsation is given disk 57, by means of striking upon stop 63 and lever 54, moves the retaining pawl from engagement with disk 31. The rotating pawl, however, holds disk 31 until the circuit is broken, which permits the rotating pawl to release disk 31 and the parts then return to their normal position. This device is an ingenious method of making ordinary magneto bells responsive to selective signals, but it is questionable whether the rather delicate mechanism required would stand the wear and tear of constant use.



FIGS. 1 AND 2.—WATKINS TELEPHONE SELECTING DEVICE.

Messrs. John Brownrigg and John K. Norstram, of Chicago, patent an automatic telephone system, the object of which is to provide switchboards at the central office which may be actuated automatically by any subscriber, and which are provided with a common source of power for the restoration of the parts to their normal position after the completion of the connection. The specification refers to various other applications for patents on parts of the system, which are not yet issued. This patent has particular reference to the arrangement in a complete system of a source of power for effecting the restoration of the movable contact to its normal position; the power employed may be vacuum, compressed air, hydraulic or other mechanical pressure. Referring to the diagrams of Figs. 3, *A*, *A*1, etc., designate a series of switchboards, one for each subscriber to the system. *B* is the movable carrier or contact maker. *C* is a rocking-shaft through which long-feed and short-feed movements are imparted to *B*. *D* is the magnet for rocking the shaft for long-feed movements, and *E* the magnet for imparting the short-feed or step-by-step movements to *C*, by means of the ratchet *F*. *G* is a cylinder carrying the piston or counter weight controlling *B* through cord *H*. J is the valve chest for controlling the supply of pressure to cylinder *G*, and *K* the magnet which controls the valve.

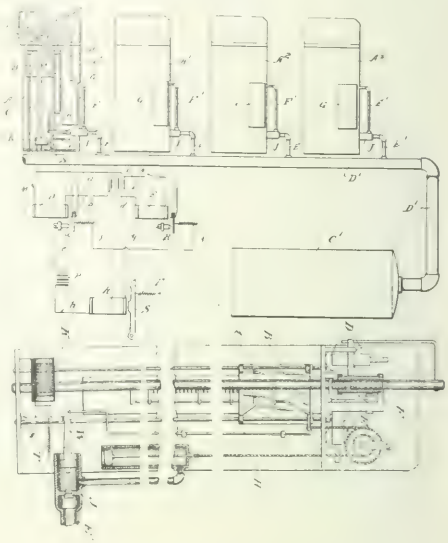


FIG. 3. AUTOMATIC TELEPHONE SYSTEM.

Referring to the diagram of electrical circuits, when the circuit-closer *M* is closed magnet *D* is energized by battery *L*, and by making and breaking at *M* the carrier *B* is moved by the rocking-shaft *C*. By circuit closer *N* magnet *E* is energized by battery *L*, effecting the short-feed or step-by-step movements to *B*. Magnet *K* may be controlled in any suitable manner. As shown, it is operated when *M* and *N* are closed simultaneously. Magnet *K*, by means of lever *S* controls the movement of the valve supplying pressure for restoring the movable carrier to its normal position, *S* working against the hook-latch *W* connected to the valve. When *B* is restored to its normal position *W* is lifted from engagement with *S* by means of the rod *B*′. *C* illustrates a reservoir for supplying the pressure to cylinders *G*. This system is apparently neither more nor less complicated than most of the automatic exchanges that have been produced, but without the specifications covering other parts of the system referred to it cannot well be judged whether the operation of the selecting mechanism would answer the requirements of an automatic switch.

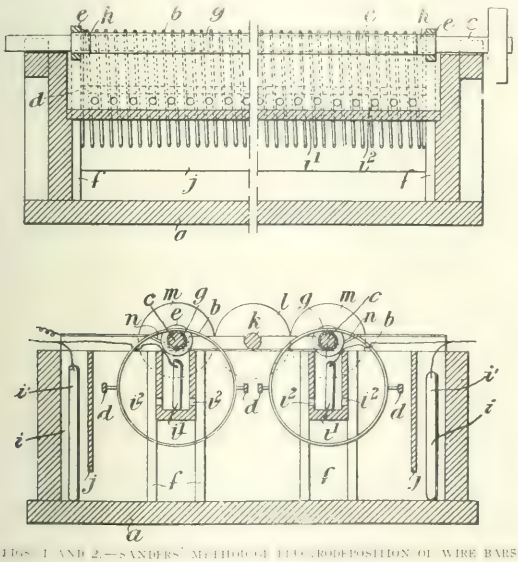
Mr. E. E. Salisbury, of Chicago, patents an automatic gravity signalphone. The invention is described as embodying improvements in automatic gravity signalphones. This being the first time one has heard of a "signalphone" it is all the greater novelty to know that such an appliance has been improved on. The mechanism covered by the patent is a device through which, by means of a contact making

segment, whose movements are controlled by those of the switch hook, a series of impulses is sent along the line whenever the receiver is taken off the hook. A detailed description of this device is scarcely necessary, as it has little place in telephony proper, it being merely a call-box with a telephone attachment.

Electro-Deposited Wire Bars.

Under date of March 25, Mr. Richard D. Sanders, of Blackheath, England, patents the device herewith illustrated, for the manufacture of compound wire bars by electrodeposition; the term compound, as used in this connection, indicates a heavy electrodeposit of metal, usually copper, upon a drawn wire base.

The wire *b*, which forms the cathode and base for the deposit, is loosely wound and hung upon the driven shaft *c*, mounted on the depositing vat *a*, the convolutions of the wire being kept apart by spacing pins *d*. To aid in giving the wire a permanent set to keep the convolutions spaced, it is sometimes flattened before winding. By rotation of the shaft, the entire coil is revolved partly within and partly above the bath, and as it revolves, it receives the electrodeposit from two series of anodes *i'*, respectively within and without the coil; each set of anodes is placed in a compartment separated from the



FIGS. 1 AND 2.—SANDERS' METHOD OF ELECTRODEPOSITION OF WIRE BARS.

depositing chamber, the external anodes by a depending partial partition *j*, and the internal series by a perforated receptacle *i*.

This general disposition is not new. Mr. Sanders' specific improvements relate to means for overcoming two defects in the older devices, such defects being first, the tendency of the coil to crowd to one or the other end of the bath, according to the direction of its revolution, and second, the roughness of the electrodeposit, due to a sparking contact with the shaft. Both the difficulties are overcome by the construction of the shaft; as indicated, the shaft itself is enveloped by a tubular non-conductor *g*, which may be a glass tube, at the ends of which are the metallic ferrules *h*, through which cathode connection to the coil is made. Outside of these ferrules are placed insulating collars *e*, forming end bearings to prevent progression of the coil during its rotation. These latter may be supplemented by vertical strips or rolls *f*, of glass, which take the thrust of the submerged portion of the coil.

As indicated in Fig. 2, a number of coils are mounted in a single vat, and driven by a series of friction wheels *m*, *l*, *m*, resting in inclined bearings *n*.

Pacific Cable.

The laying of the Australian-New Zealand section of the Pacific Cable has been completed.

Independent Telephony in Wisconsin.

The independent telephone movement in Wisconsin is one of the most important and rapidly growing enterprises in which Wisconsin capital has ever become interested. By the reports of the President and Secretary of the Independent Telephone Association, which held a meeting in Milwaukee recently, it was shown that the association has a membership of 185 companies, representing a total investment of about $3,000,000. These companies have 200 exchanges, 850 toll stations and 8000 miles of toll line. All this work has been done within six years, and the independent companies are now doing the bulk of the telephone business throughout the State. The business has developed so rapidly that the independent interests began to realize that there should be some kind of organization among them to encourage the work and co-operate in some general plan for establishing connections between the local companies. It was to make this plan an accomplished fact that the Independent Telephone Association of Wisconsin was organized, and it was to consummate the purpose of the organization that the convention selected a committee to take up the matter of long-distance construction. The plan is to connect all the lines in the States and have trunk lines running through the State to the principal commercial centres. Something in this line has already been accomplished. A six-wire copper trunk line connects West Superior and Duluth with Minneapolis and St. Paul. A similar line has been extended from St. Paul to Eau Claire and to La Crosse, and it is intended to extend this trunk line across Wisconsin to Milwaukee. The Interstate Telephone & Telegraph Company, operating in northern Illinois, has completed arrangements for connecting with the independent lines of Wisconsin at Beloit. This will give Wisconsin people communication with Illinois cities, and eventually with Chicago.

Last year the Wisconsin independent companies expended over $500,000 on construction work and gained over 6000 new subscribers.

The Milwaukee *Free Press* has prepared a map of the State showing the vast extent of the independent telephone service. The lower two-thirds of the State is very closely covered with the network of lines, but Milwaukee stands apart from the rest of the State without independent service. In fact the southeastern corner of the State presents a blank spot that tells a significant story to telephone men. Strong endeavor is being made in Milwaukee, however, to secure an independent franchise, and the matter will soon be settled one way or the other.

Current American Exports and Imports.

The manufacturers of the country are now importing more than a million dollars' worth of material for their workshops every day in the year, and are exporting more than a million dollars' worth of their finished product each day. The imports of manufacturers' materials in the eight months ending with February, 1902, were, according to a statement just issued by the Treasury Bureau of Statistics, $270,202,774, and the exports of finished manufactures during the same period were $257,907,430. Thus in 243 days of the fiscal year, manufacturers have imported 270 million dollars' worth of material and exported 257 million dollars' worth of their finished product, averaging more than $1,000,000 of both imports and exports for every day of the fiscal year up to the beginning of the present month. The importation of manufacturers' materials has been greater in the eight months just ended than in the corresponding period of any preceding year.

On the export side of the account manufacturers are showing an improved record. The Bureau of Statistics reports of exports of manufactures during both January and February show a decided increase over the corresponding months of 1901, the gain in the two months in question being more than three million dollars over the same months of the preceding year. The exports of manufactures in the 28 days of February were $31,740,842, against $30,302,592 in February, 1901. In practically all articles except iron and steel there has been a complete recovery from the temporary check in exports of manufactures noted a few months ago. Copper exports, for instance, in February of this year were $4,210,861, against $3,155,774 in February, 1901; though for the eight months the total still stands 8½ millions below that of the same period of the preceding fiscal year. Iron and steel exports show a marked improvement, the total for the

month of February being $7,358,296, against $7,959,218 in February, 1901, and $8,549,157 in February, 1900. For the eight months ending with February the exports of iron and steel manufactures are $64,668,424, against $81,575,685 in the corresponding months of the preceding year.

Chicago Electrical Association Endorses Metric System.

At the meeting of the Chicago Electrical Association, March 7, it was voted to appoint a committee to express to the proper Congressional authoritiles the endorsement by the Association of any action which would tend to a general use of the metric system. In compliance with this action the committee, consisting of Messrs. J. R. Cravath, W. B. Hale and H. M. Wheeler, transmitted to the House Committee on Coinage, Weights and Measures, through Prof. S. W. Stratton, director of the National Bureau of Standards, the following resolution:

"Whereas, the Chicago Electrical Association is informed that your committee is considering the advisability of adopting the metric system for use in the United States, the Chicago Electrical Association, representing largely the electrical interests of Chicago, most heartily endorses any action tending to the general use of the metric system and assures your committee of its cordial support."

Institute Nominations and Elections.

At the meeting of the board of directors of the American Institute of Electrical Engineers on March 28 the following nominations were made for the offices becoming vacant on May 20, in compliance with the constitution: For president, Charles F. Scott, of Pittsburg; for vice-presidents, C. O. Mailloux, Bion J. Arnold, Schuyler S. Wheeler; for managers, Townsend Wolcott, Gano S. Dunn, E. H. Mullin, Charles A. Terry; for treasurer, George A. Hamilton; for secretary, Ralph W. Pope.

The following list of Associates were elected: Edwin David Bevenue-Miller, electrician, Natal Government Railways, Durban, Natal, South Africa; Hugh Auchincloss Brown, general utility engineer, Crocker-Wheeler Company, Ampere, N. J.; Dana Ripley Bullen, salesman, General Electric Company, Boston; Frank Vail Burton, office salesman, Western Electric Company, New York City; Eugene B. Clark, chief electrician, So. Works, Illinois Steel Co., Chicago, Ill.; Frank C. Cosby, salesman, Westinghouse Electric & Manufacturing Company, New York City; James Edward Davidson, superintendent, Port Huron Light & Power Company, Port Huron, Mich.; William Amzi Dick, designing electrical engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Percival Elliott Fansler, post-graduate student, Purdue University, Lafayette, Ind.; Frederick Perry Fish, president, American Telephone & Telegraph Company, Boston; Frederick Jackson Folk, chief electrician, New York & Queens Electric Light & Power Company, Brooklyn, N. Y.; Oliver Remick Grant, student, Columbia University, New York City; Elwood Grissinger, engineer, the Cataract Power & Conduit Company, Buffalo, N. Y.; Clarence Mortimer Hall, teacher of physics and electricity, Manual Training School, Washington, D. C.; Charles Hodge, salesman, Westinghouse Electric & Manufacturing Company, New York City; Charles William Hogan, photometric expert, Columbia Incandescent Lamp Company, St. Louis, Mo.; Woolsey McAlpine Johnson, electro-metallurgist, Oxford Copper Company, New Brighton, S. I.; Percy Henry Knight, district engineer, Westinghouse Electric & Manufacturing Company, San Francisco, Calif.; Alphonsus Joseph Miller, laboratory assistant, Western Electric Company, New York City; Edwin J. Murphy, assistant engineer, General Electric Company, Lynn, Mass.; Addams Stratton McAllister, assistant in physics, Cornell University, Ithaca, N. Y.; William Henry McGrath, electrical engineer, with Stone & Webster, Boston; Ellis Laurimore Phillips, engineer, Westinghouse, Church, Kerr & Company, New York City; Alfred Lawrence Pierce, superintendent, general manager and electrical engineer, Borough Electric Works, Wallingford, Conn.; Claiborne Pirtle, sales agent for North Carolina General Electric Company, Greensboro, N. C.; Albert Augustus Radtke, instructor of electrical engineering and physics, Rhode Island College of Agriculture and Mechanic Arts, Kingston, R. I.; Louis Embree Reynolds, chief electrician, Independent Light & Power Company, San Francisco, Calif.; Walter S. Rugg, engineer, Westinghouse Electric & Manufacturing Company, New York City; Charles E. Scribner, engineer, Western Electric Company, Chicago, Ill.; Edson Oliver Sessions, construction engineer, General Electric Company, Toledo, Ohio; Edgar F. Sherwood, superintendent of traffic, New York Telephone Company; William Nelson Smith, electrical engineer, Westinghouse, Church, Kerr & Company, New York City; Harry B. Spencer, clerk in draughting department, General Electric Company, Lynn, Mass.; Linden G. White, superintendent electrical department, Columbus Edison Electric Light Company, Columbus, Ohio.

The Telephone in Gas Works.

At the annual meeting of the Ohio Gas Light Association, held last month, Mr. L. W. Wells brought before the members the following suggestion as to practice involving the use of the telephone in gas work, in connection with a steam whistle. He said:

Usually at a gas works, especially in or near the retort house, there is much noise, and a call from the ordinary telephone bell cannot be heard at times by the workmen, and in consequence much time

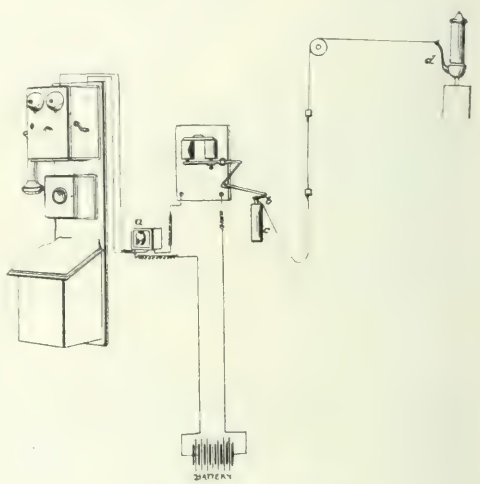


DIAGRAM OF CONNECTIONS.

is lost at the uptown office in communicating with the works. The device illustrated in the drawing in connection with the telephone is the result of an effort to shorten the time in getting someone to the telephone. When a call is made from the central station, the drop *A* falls, releasing the trip on which the weight is hung at *B*, causing the weight *C* to fall, which opens the valve at *D*, thus blowing the steam whistle until the telephone is answered; at the same time the device is readjusted, ready for the next call by the party answering. No battery power whatever is used, only when the drop *A* is down.

Telephones on Electric Street Cars.

The daily papers have recently published accounts of tests made in Grand Rapids, Mich., by Benson Bidwell and his son, Chas. F. Bidwell, of an electric street car telephone. Parallel with the trolley wire and about 6 in. from it on both sides, are strung copper telephone wires. A double trolley maintains connection between the overhead wires and the telephone on the car, and at a point along the line is a private exchange through which connection may be made on the cars with the local exchange of the Citizens' Telephone Company. The operator at the sub-exchange can ring up the different cars along the line by the use of a code of long and short signals. It is therefore possible to reach any car in any part of the city, and *vice versa*, any subscriber of the Citizens' Company may be reached from any car. It is claimed that this system works satisfactorily whether the car is in motion or not, and that inductive effects, due to the proximity of the trolley line, are eliminated by the method of running the telephone wires equidistant and parallel to the trolley wire.

Extraordinary Development at the "Soo."

Without question one of the most active scenes of engineering development at the present time in the United States is the "Soo" district, at the point on St. Mary's River where Lake Superior empties into Lake Huron, and where two large industrial towns on the American and Canadian sides have already sprung up. At this point the river has a fall of about 19 feet at the Rapids in a distance of 3000 feet, developing at least 175,000 horse power. Part of this energy hitherto wasted has already been utilized on the Canadian side, and at the present moment two other kindred enterprises are being pushed. While the development will be in sharp contrast to that at Niagara, owing to the slight head of water at the "Soo" as compared with an average of about 200 feet at the great cataract, the two enterprises compare in magnitude and each presents unique features. Data was recently given in these columns as to the new work at Niagara on the Canadian side, for which three of the largest generators in the world are being built. A contrast is presented by the plans for the "Soo," where for the new work now to be carried out, the Stanley Electric Manufacturing Company, of Pittsfield, Mass., has been awarded a contract for no fewer than 40 generators, etc., the impulse wheels to drive which are already in place. The building in which these machines will be installed is itself over a quarter of a mile long and three stories in height, and the power canal which will divert water from the Rapids to the wheels, has also been dug and finished, 210 feet wide, 20 feet deep and three miles long. This development is on the American side of Sault Ste. Marie.

The amount of power to be developed will, it is stated, approximate 100,000 horse power, and this extraordinary plant will unquestionably be by far the largest hydro-electric equipment under one roof in the world. The current will be utilized by the Clergue syndicate, which is backed mainly by Philadelphia capital, for the rolling mills, pulp mills, electro-chemical works and other industries of the Consolidated Lake Superior Company, and concerns of a similar character, while it is believed that a large part of the current will also be transmitted to Canada. The electrical contract is now being carried out and the apparatus will be installed forthwith. It is curious to think that the same water thus used so much higher up on the chain of lakes should again yield its energy at Niagara. The current generated will be three-phase, 30 cycles.

CURRENT NEWS AND NOTES.

PROMPT MEDICAL SERVICE.—By the Kaiser's desire, fully fitted up ambulance trains have been placed at seventy-five German railway stations, and telephonic communication has been made with local doctors, so that any accident can be immediately dealt with.

INSTITUTE'S ANNUAL CONVENTION.—Secretary Pope announces a slight change in the date of the annual convention of the American Institute of Electrical Engineers, at Great Barrington, Mass. The convention will begin on Wednesday, June 18, instead of June 17, as originally planned, and will continue June 19 and 20, and probably the 21st.

WIRELESS TELEGRAPH CONFERENCE.—A cable dispatch of March 29 says: "Prof. Slaby's recent proposal for an international conference to regulate wireless telegraphy already is engaging the attention of Germany, the authorities of which country are now drafting a circular note to be presented to the United States, Great Britain and France, proposing a congress for the purpose of agreeing upon means to prevent a monopoly of wireless telegraphy on the high seas."

TO PENSION TELEGRAPHERS.—A meeting of telegraphers employed by the Western Union and Postal Telegraph companies was held recently in New York City to consider a pension fund. The meeting was the outcome of a letter written by Andrew Carnegie, once a telegrapher himself, to W. C. Connolly, jr., of the Telegraphers' Association, Pittsburg, in which Mr. Carnegie advises the telegraphers to start a pension fund for old or invalid telegraphers. The meeting voted in favor of the idea.

BALTIMORE & OHIO THIRD RAIL.—The Baltimore & Ohio belt line in Baltimore, between Camden station and Waverly, has been equipped on the third-rail system. The old overhead equipment will be removed as soon as all the electric locomotives have been altered to suit the new conditions. At Camden and Mount Royal stations the third-rail is automatically disconnected from the source of electric supply, when it is not in use by trains.

POSTAL WIRELESS TELEGRAPHY.—A special from Washington of March 26 says: "Senator Mason to-day gave notice of an amendment he will offer to the Post Office Appropriation bill, appropriating $150,000 to connect the Post Offices at Washington, Baltimore, Wilmington, Philadelphia, New York, Albany, Buffalo, Cleveland, Detroit, Toledo, and Chicago by a line of wireless telegraphy or wireless telephony." Senator Clay appears to have offered a similar amendment for $150,000 for wireless telegraph experiments.

ENGLISH ELECTRICAL UNDERTAKINGS.—It would appear that at present there are in Great Britain upwards of 1500 electrical undertakings owned by companies or municipalities. Their aggregate capital issued in shares, debentures, loans, etc., since 1890, is detailed below. It will be observed from the following that, regardless of reports of depression in England, the increase of capital last year exceeded all previous ones: 1896, £61,109,525; 1897, £69,209,478; 1898, £84,742,020; 1899-1900, £105,977,719; 1900-1901, £123,030,600; 1901-1902, £165,807,474.

GERMANY-CHINA CABLING.—The German post authorities have concluded an agreement with the German & Marine Telegraph Company, the Indo-European Telegraph Company, and other cable companies concerned in the transmission charges between Germany and China. The new charge, which came into force March 15, amounts to 47 cents per word, as compared with $1.43 hitherto. The only condition is that the telegram be written either in German or English. The telegram will be dispatched to all parts of China without delay in transmission or increase in tariff.

RAILROAD WIRES UNDERGROUND.—With regard to the reports that the Pennsylvania Railroad will put its wires underground as a result of the severe damage inflicted this winter on its overhead wires, Mr. C. M. Sheaffer, superintendent of telegraphs of the company writes us as follows: As regards the statements in the newspapers of the intention of this railroad to put in wires underground between Jersey City and Philadelphia, I would say that no such decision has been made. The question has been discussed, as in fact it has been for several years past whenever we have had any similar trouble like that due to the storm of a month ago, but the excessive cost of any such installation has always prohibited its getting any further than discussion. In this particular instance we may do something in the way of putting some of our wires on our most congested lines underground for short distances, but I doubt very much if anything like the installation of a conduit for so long a distance as from Jersey City to Philadelphia will be done.

TELEPHONE SERVICE ON THE OVERLAND LIMITED.—It is announced that the overland limited trains on the Chicago & Northwestern Railway, which give the fast service between Chicago and San Francisco over the Northwestern, Union Pacific and Southern Pacific roads, will be provided with telephones for the use of passengers while the trains are standing in the depots at Chicago, Omaha and San Francisco. So many of the travelers on the overland limited are business men whose time is valuable, it is argued that a few minutes' use of the telephone before leaving the cities named would be acceptable. A special wire from the train shed to the main exchange offices will be run and particular attention will be paid to giving calls over this wire quick attention. It is also intended to give particular attention to this service by getting connections that happen to be busy so that the service will be of the utmost advantage. It is anticipated that the service will not be used much for long-distance telephoning, but rather for talking in the passenger's home city immediately before leaving. Besides aiding in the transaction of important business en route that otherwise might have to be done by telegraphing, it is expected that the telephone will prove valuable to passengers who forget articles.

GERMANS BUYING CABLES.—A cable despatch from Berlin of March 25 says: The German Atlantic Cable Company has arranged to buy the Emden-Vigo line of the German Sea Telegraph Company. The shares of this latter company are largely held in London, and partly by the Eastern Telegraph Company, Limited.

HIGH VOLTAGES IN THE CENTRAL STATES.—The Union Traction Company of Indiana, in the extensions of its large electric interurban railway network around Anderson, Ind., will employ 32,000-volt transmission lines for distributing electrical energy. The Economy Electric Light & Power Company, of Joliet, Ill., on its 35-mile transmission for operating the Bridgeport pumping station in Chicago will employ a similar voltage.

WIRELESS TELEGRAPHY.—An item from Washington states that there have been fifty-seven patents granted by the Patent Office here on wireless telegraph instruments and their parts, since the first one granted to A. E. Dolbear, Oct. 5, 1886. Thomas A. Edison was the third patentee of this class, and has one patent granted Dec. 3, 1901. G. Marconi followed in July, 1897, and has taken out a total of eleven patents, the last one being dated June 11, 1901. Nicola Tesla has seven, following Marconi closely.

REGULATION IN MASSACHUSETTS.—Last week Mr. Albert E. Pillsburg, for the Associated Gas Companies, and E. W. Burdett, for the Massachusetts Electric Lighting Association, appeared before the legislative committee on taxation in opposition to a bill requiring associations and corporations supplying water, steam heat, light, power, gas, electric light, telegraph and telephone service to be licensed and to pay 1 per cent of their gross receipts as a tax and an additional tax of ½ of 1 per cent on any excess of annual dividends over 6 per cent. The only person who advocated the bill was its author, Representative Davis, of Salem.

RÖNTGEN RAYS IN MEDICINE.—At a recent meeting of the Harvard Medical Society of New York City, Dr. W. J. Morton read a paper on the treatment of malignant growths by Röntgen rays. A report of several cases thus treated was given, and Dr. Morton summed up as follows as to the effects of the treatment: 1. Relief from excruciating pain and constant suffering. 2. Reduction in the size of the new growth. 3. Establishment of the process of repair. 4. Removal of odor, if present. 5. Cessation of the discharge. 6. Softening and disappearance of lymphatic nodes. 7. Disappearance even of lymphatic enlargements. 8. Removal of the cachetic color and appearance of the skin. 9. Improvement in the general health. 10. Cure, up to date, of a certain number of malignant growths. A cablegram last week reported that Dr. Addyman, in a lecture delivered that week in London, said he had cured a bad case of cancer by the action of Röntgen rays.

HOTEL FACILITIES.—At the new Hotel Astor, on Long Acre Square, New York City, a novel device has been perfected by the proprietor, Mr. Muschenheim for removing the soiled china, linen, etc., from the dining rooms noiselessly and automatically, whereby the waiters do not have to leave the room. Wherever convenient, in each dining room is placed an electric conveyer, which is an endless chain of shelves, moving very slowly and noiselessly. The waiter simply steps to the nearest conveyer and leaves his dishes on the shelf passing at the time. The conveyer carries the dishes directly to the cleansing room. It is expected that this device will enable the waiters to spend 20 per cent more time in the dining room, besides aiding them to get the dishes out of sight immediately, thus doing away with one of the most objectionable features in restaurants. The cost of the hotel, including the ground and the furnishings, will be about $5,000,000. It will have an elaborate electrical plant.

WIRELESS TELEGRAPHY IN ALASKA.—Capt. Morse, chief signal officer of the Department of California, has received orders from the War Department to open negotiations for the installation of a system of wireless telegraphy between army stations in Alaska. There are four routes mentioned. Route "A" is to be between Fort Davis, at Nome City, and some point on Stuart Island, 90 miles distant. Route "B" is the preferable alternative of route "A," and is to extend from Davis to Fort St. Michael on St. Michael's Island, approximately 108 miles distant. Route "C" is to extend from Rampart to Winter Hours, on Tanana River, or some other convenient and suitable place near the mouth of Delta River, 136 miles distant. Route "D," the preferable alternative of route "C," is to extend from Fort Gibbon to some point on the Tanana, which is 165 miles distant. The station at the latter place must be at or near the mouth of Delta River or at Bates Rapids, and must be at some point accessible to boats.

ATLANTIC CABLE RATES.—Representative Corliss, of Michigan was given a hearing before the House Committee on Judiciary last week on his resolutions directing the Attorney-General to institue proceedings against the Commercial Cable Company for alleged combination with other companies. Mr. Corliss declared that there had been a deliberate violation of the laws against combination, and that the effect was to advance the cost of cable messages on the Atlantic 12½ cents word. He said the matter had not been brought to the attention of the Attorney-General so far as he knew. Mr. Littlefield made the point that if this was the case the Attorney-General could not be remiss in not acting on it, and Congress was not warranted in giving him directions. Considerable sharp sparring was indulged in as to the amount of evidence Mr. Corliss could produce, after which the committee went into executive session and unanimously reported against the resolution on the ground that Mr. Corliss had not presented a case calling for the action proposed.

LONDON TO PARIS.—A cable dispatch from Paris of March 30 says: "From London to Paris in five hours" may be realized within two years, thanks to a syndicate of Americans whose representatives are now here consulting daily with the authorities of the French Northern Railway. The Northern Railway, whose Calais branch boasts of having the fastest trains in the world, has been trying for years to stir up the two English London-to-Dover lines to shorten the time of the trip. The English argument always has been: "We hold the shortest route, anyhow; why go to the expense of this quickening of the service." The American syndicate mentioned has secured the support of powerful English politicians, and at the next session of the British Parliament a bill will be introduced authorizing a new electric line from London to Dover. The promoters of this enterprise promise to cover the distance in forty-five minutes. The estimated cost of the new road is $25,000,000, on which amount the enormous traffic expected will pay 20 per cent, it is calculated, from the first.

INDUCTION MOTOR AS A GENERATOR.—It is well known that an induction motor can be run as a generator if it be supplied with alternating impulses from an external source. In a patent issued March 25 to B. G. Lamme a method is described whereby an induction machine may be operated in connection with a synchronous motor. The synchronous motor is connected with the circuit to be supplied by the induction generator; when the latter is to be started up, the synchronous motor is first speeded up and run as a generator a sufficient length of time to effect the building up of the field of the induction generator. The power applied to the shaft of the motor may then be discontinued, or the latter run as a motor, when its counter e. m. f. will afford the exciting impulses necessary for the induction generator. During the time that the synchronous motor is run as a generator it will fix the alternations of the system; but when it is run as a motor the alternations of the system will depend upon the speed of rotation, the number of poles and the slip of the induction generator.

TELEPHONY IN SWEDEN.—With regard to the use of the telephone in Sweden, an article in the London *Pall Mall Gazette* says: "Almost everybody in Sweden, and particularly in the City of Stockholm, turns naturally to the telephone, and if one is away from home and suddenly recalled one naturally telephones home to see whether the servants are in or out. The apparatus used is very simple, and the ear and mouth pieces are so connected, and the cord is so long, that you can sit comfortably in your chair and talk. In the house in which the British chaplain at Stockholm resides (a block of ten flats) there are no fewer than ten Allmänna and four Riks telephones installed. It is rumored in Stockholm that an amalgamation of the Allmänna and Riks (Government) telephone is contemplated in the near future. On the Stockholm Bourse the Allmänna shares of 100 kroner are now quoted at 525 kroner. The number of Allmänna telephones in use in Stockholm is at present over 23,000, and outside the city about 4500; and that the instrument is found of increasing value will be seen from the fact that in 1900 there was an increase of 2785 instruments."

THE LONDON CENSUS just taken shows an increase of 16.6 per cent in the number engaged in electrical work in London.

CANADIAN NIAGARA POWER.—On March 24 the first sod on the work of the Ontario Power Company was turned in the Queen Victoria Park at Niagara Falls, Ont. Water will be conveyed in an open canal and conduits to the Horseshoe Falls, at which point it will descend to the power house at the base of the cliff. The initial development will be 125,000 horse power.

TEST OF RAILWAY SYSTEM.—Forty students from the electrical and mechanical classes of Purdue University, Lafayette, Ind., are to conduct an efficiency test at the Anderson power station of the Union Traction Company, of Indiana. The test will be conducted under the direction of A. S. Richey, electrical engineer of the Union Traction Company, and Professor W. E. Goldsborough, professor of electrical engineering at Purdue. The tests will be very complete, and will begin with the coal and extend to the delivery of power at the car axles along the entire system, which embraces 160 miles of track.

TWO-SPEED ALTERNATING CURRENT MOTOR.—In a patent issued March 25 to Benjamin G. Lamme, Pittsburg, Pa., on an application filed July 14, 1900, a two-speed alternating-current fan motor is described. The laminated stator has at considerable intervals two pairs of slots—there being four sets of such slots in the case of a 4-pole motor. The inner slots contain one winding in series and the outer slots another winding in series. The rotor is of the usual squirrel-cage type. For maximum speed the coils are so energized as to produce four poles alternating with each other as is usual. By manipulating a switch the coils are so connected as to cause all four of the poles to have the same sign, in which case consequent poles are produced in the intervening space; the motor then corresponds to an 8-pole motor and its speed is halved.

CAMPAIGN AGAINST THE WORD "HELLO."—The *Chicago Tribune* has been moved to the following facetious remarks about the effort to oust the "hello" from telephonic conversation in one of Chicago's aristocratic suburbs: "It is well that Evanston, which is to Chicago as Boston is to America, has plenty of leisure. Otherwise the campaign which the north shore advance agents of refinement have instituted in Cook County against the telephone 'hello' would not have succeeded, as it is authentically reported to have done. No Evanston good society people any longer say hello over the telephone and they never did say it anywhere else), because it is a vulgar word, as one of them informs an inquisitive world. But for the present, at least, when Evanston is using its long-distance wires to Chicago, it would better stick to the old style for talk like this: 'Good afternoon, good afternoon, Central, I want Stock-Yards. Good afternoon, good afternoon. Good afternoon, is this Stock-Yards? Good afternoon, Stock Yards, good afternoon,' would be apt to evoke not the morally innocuous, though vulgar, response of commerce, but the same syllables reversed, which so arranged are not merely vulgar but also sinful."

UNDERGROUND ROADS IN PARIS.—A special cable dispatch March 29 to the *New York Tribune* says: The Parisians are so much pleased with the electric metropolitan railway scheme that the municipal authorities have arranged for the gigantic development and extension of the system. Six new lines were planned some time ago, which excavation and building are already proceeding. It is now proposed to construct seven more underground electric railways, and a concession has also been granted for a private line, which is to pass in the form of a parabola across Paris from north to south, thus linking in all fourteen new metropolitan electric lines. Paris, which has the advantage of being a round city, and not an oblong one like New York, will thus be traversed by numbers of electric routes in all directions and will present the appearance of a skilfully prepared grape-fruit, with fibres and cuttings radiating from the center and intersecting with other fibres forming concentric circles within its rind. The estimated cost of the seven new lines is $37,000,000, which is at the rate of $1,120,000 a mile. The city of Paris is already authorized by Parliament to issue a preliminary loan of $33,000,000 for the metropolitan construction and permission will soon be obtained for a second loan of $35,000,000 for the same object. A calculation based on the traffic of the existing lines shows that the total number of passengers in a year on the whole metropolitan system when completed will be 352,000,000, which will yield the city a net annual profit of $4,000,000, which is deemed amply sufficient to justify the issue of a municipal loan of $120,000,000, a sum considerably more than is necessary for the construction. Some people are beginning to wonder whether the upper stratum of Paris will stand all this tunnelling. Several years must, however, elapse before the colossal scheme can be carried out.

MULTIPLE CONTROL SYSTEM.—Among the patents of March 25 is one granted to H. Ward Leonard which is of much interest. The patent relates to the application of the Ward Leonard system of motor control to electric traction, and a complete system of control circuits and devices is described. As is well known, the Ward Leonard system of motor control, which has been largely applied to elevator, machine tool and other work, consists in furnishing a source of variable e. m. f. to a motor supply circuit, which is done by varying the strength of the field of the supply generator. The patent relates to the application of this system to railway motors, the car being supplied either with alternating or direct current. Assuming that the line supplies polyphase currents, these currents drive a motor on the car, upon the same shaft of which is a direct-current generator which in turn supplies current for the car motors. In the case of a train only one of a number of cars may be supplied with such a motor generator, or two or more as may be desired. In any case, a line of either three or four conductors extend throughout the train and all the car motors can be controlled in an extremely simple manner from any car of the train. In the simplest form, a small exciter is attached to the shaft of the motor-generator and supplies the fields of the car motors, and the control circuit, the car armatures deriving their currents from a circuit supplied by the direct-current side of the motor-generator. In this case there are four conductors, two of which supply the motor fields and two supply the generator field. In each of the cars of the train—and if desired, at each end of each car—is a rheostat across the control line. When the train is at rest all of the rheostats are at the neutral point, and when it is to be put in motion the control of the entire train is effected by means of the rheostat at the point selected, the other rheostats remaining neutral. One arrangement is described whereby the number of train conductors is reduced to three. A description is also given of the application of the system when a direct-current source of supply is employed, in this case the same inventor's counter e. m. f. system of control being used. The patent specifications bring out the very simple nature of this method of control as applied to electric traction, which method permits the speed to be varied from the smallest to the highest rate or reversed without any sparking and with a maximum of electrical efficiency. The car motors may either be connected all in parallel, or the series-parallel method may be employed. The patent carries sixty claims.

LETTER TO THE EDITORS.

A Direct Steam-Electric Conversion Cell.

To the Editors Electrical World and Engineer:

SIRS:—Some years ago, the writer designed a homopolar electric generator which it was his intention to construct and test. Not having had an opportunity of doing so, a description is here given of the device in the hope of eliciting the opinions and criticisms of others who are interested in the production of direct current.

Fundamentally, this "homopolar cell," as it may be called, consists of a mass of conducting liquid revolving as a continuous cylindrical surface, in a uniform magnetic field, the magnetic lines of force parallel with the plane of revolution and at right angles to the direction of motion of the liquid at any given point. Under these conditions there will be an electrical difference of potential between the ends of the revolving liquid cylinder varying directly as the length and velocity of the cylinder and the density of magnetic force per unit area.

A commercial cell which fulfills the fundamental conditions can be constructed as follows:

A mass of mercury is driven by jets of steam at such a velocity that it assumes the form of a short continuous cylindrical shell or hollow cylinder inside a horizontal circular "race" or trough. The race extends around the inner periphery of a ring made up of alternate

thin rings or laminæ of soft iron and an insulating material; the two end laminæ or flanges are of thicker polished steel projecting inwardly for the double purpose of retaining the mercury and acting as positive and negative collecting rings. The laminated ring serves as one magnetic pole from which the lines of force pass radially through the mercury to the other pole, which is situated as close to the inner periphery of the mercury as the steam arrangement will allow. The electromagnet in its entirety resembles the ordinary ironclad portative magnet.

By reason of the short magnetic circuit a very high magnetic density may be employed. The mercury can readily be driven at a [illegible] per second. A single "homopolar cell" would therefore be capable of generating a voltage sufficiently high for commercial direct-current applications.

With a smooth "race" and polished collecting rings the frictional and electrical resistance losses will be low. Losses of heat energy by condensation and radiation are negligible.

A high initial and low terminal temperature of the steam may be secured, indicating a high thermal efficiency. The energy conversion will be large per unit weight and cost of cell.

To the writer the element of doubt is the efficiency of the conversion of the kinetic energy of the steam into the kinetic energy of motion of the mercury.

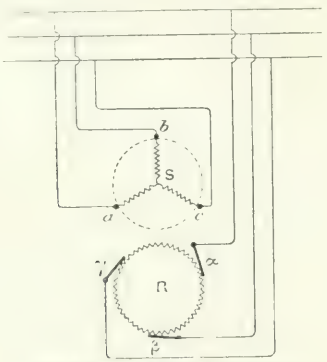
W. A. MARKEY.

SAGINAW, MICH.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Self-Exciting Shunt Alternator.—LATOUR.—After having described the invention of an induction motor with power factor equal to unity and of a self-exciting alternator by Heyland (which were noticed at great length in the Digest) *L'Ind. Elec.* gives a review of the simultaneous and independent inventions of Marius Latour. This first article deals with a self-exciting shunt alternator. As shown in the adjoining diagram, such a machine, which operates on a net-



SELF-EXCITING SHUNT ALTERNATOR.

work *L*, consists of an ordinary secondary stator *S*, which may be connected in star, and of a primary rotor *R*, provided with a direct current dynamo armature winding and a collector. The exciting currents are taken from the network and supplied to the rotor by means of the three brushes. If the exciting currents are supplied directly from the network, without an intermediate transformer, the rotor winding must be able to stand the voltage of the network without burning through. There are many analogies with a direct-current shunt dynamo. In the latter theoretically the position of the brushes must be regulated when the load is varied, in order to have the commutation taking place on the true neutral line. In the same way in his shunt alternator, the position of the brushes must be adjusted for variations of the inductive or non-inductive load, in order to keep up the synchronous running of the rotor, to which it is due that the short-circuited coils are not the seat of an induction phenomenon. If one does not change the position of the brushes when the load is suddenly changed, the frequency of the alternator decreases, and, on account of this change of frequency and the resulting slip, the change of the load does not cause a drop of the tension of the same order as is found in ordinary alternators, but the machine now operates at variable frequency. This is for his shunt alternator. But he adds here that his compound alternator keeps the frequency practically constant for a fixed position of the brushes. This shunt alternator operates sensibly synchronously. He has proved that, supposing the currents and the distribution of the flux in the rotor are sinusoidal, there is no inductance of the rotor at synchronism [illegible] perfect at synchronism. In practice, however, currents and flux are not sinusoidal; there would appear to be a possibility that the rotor is the seat of an irregular field, due to higher harmonics, but he shows that the rotor winding itself acts like a perfect "amortisseur" for these harmonics. His conclusions are also valid when the excitation is made by means of a transformer, or for special windings on the stator. The exciting currents supplied from the network to the rotor enable one to run the alternator with a power factor equal to unity. A self-exciting shunt alternator running as motor, has at the same time the advantages of the synchronous motor and of the non-synchronous motor. Its only disadvantage is a collector. But a convenient tension of excitation will always allow reducing the dimensions of the collector to small values; the energy commutated will always be small, as it represents only the true power consumed for the excitation. The main conditions for sparkless running are fulfilled.—*L'Ind Elec.*, Feb. 25.

REFERENCES.

Properties of Collector Rings.—POINCARE.—A mathematical discussion of the properties of collector rings. The theory is of importance for the understanding of Latour's and Heyland's invention of induction motors with power factors equal to unity, etc. The article is, however, too mathematical to be abstracted.—*L'Eclairage Elec.*, March 1.

Shunt Regulators.—KAHN.—A critical note on Krause's article recently abstracted in the Digest.—*Elek. Zeit.*, Feb. 20.

KRAUSE.—A brief reply to Kahn.—*Elek. Zeit.*, March 6.

POWER.

REFERENCES

Elevators.—COOPER.—An abstract of a paper read before the Inst. of Jun. Eng. on the electric passenger elevators; he describes the hoisting machinery, the controller, and various safety devices.—*Lond. Elec.*, Feb. 28.

Electric Drills.—HENBACH.—The first part of a long illustrated paper in which he gives a review of the development of the electric drill.—*Zeit. f. Elek.* March 6.

TRACTION.

Negative Boosters for Alternating Current Railways.—ZIEHL.—An illustrated account of experiments in which he examined the system proposed by Kapp, of inserting negative boosters at different places along the road, in order to diminish the earth currents. With alternating current, such a booster is a simple transformer, the two windings of which are bifilarly wound, i. e., their ampere-windings act against each other. The arrangement of the experiments is the same as that shown in the abstract of Krogh's paper, in the Digest last week. The experiments were made in the laboratory, the rails and the earth being represented by suitable non-inductive iron resistance. By varying the number of turns in one winding of the transformers and hence also the ratio of the numbers of turns of both windings, he obtained the following interesting result. According to the value of the ampere-winding acting against each other, the e. m. f. induced in the transformer winding may be positive or negative, i. e., producing or consuming volts; volts are always produced in that winding, the ampere-windings of which are overcome by

those opposed. It follows that by properly choosing the ratio of the turns of both windings, it is possible to make the earth current I either positive or negative or zero. He concludes that such transformer boosters, as they need no attendance, would be very suitable for alternating current railways.—*Elek. Zeit.*, Feb. 20.

Cost of Electric Motive Power.—Adams.—A statistical article in which he investigates to what extent differences exist in the cost of electric motive power per car mile on different roads. His statistics refers to all the roads of Massachusetts, where the average cost in 1900 was 2.04 cents per car mile. In Boston the cost was 1.36 cents; the average of all the roads outside of Boston, 2.64 cents, hence nearly twice as great than in Boston. A table gives the statistics of all roads. It shows a great variation in cost; the extremes are 1.31 cents on the Newton & Boston road and 5.71 cents on the Worcester & Webster road. A low cost is not confined to the largest systems, nor is an excessive cost peculiar to the smaller roads; although a low rate of cost of motive power is more frequent among the larger roads, probably because the larger systems more frequently adopt methods of construction and operation that lead to high efficiency than do the smaller roads. The table also shows that heavy passenger traffic cannot account for the great differences in the power rates.—*St. R'y. Rev.*, March 15.

Surface Contact System.—Paul.—A communication on the inherent disadvantages of surface contact systems with purely magnetic contact devices. The numerous accidents which have occurred with the Diatto system in Paris were due to the fact that the contact plugs remained live after the car had passed; the contact devices do not work without sparks; the contact plug is retained by permanent magnetism for some time; and it takes some time before the contact knob becomes dead. He claims this is an inherent disadvantage of all magnetic contact devices, but is avoided in those with electromagnetic contact devices, like that of Schuckert & Company.—*Elek. Zeit.*, Feb. 20.

Electrolysis by Tramway Return Currents.—Lubberger, Viggier, Michalke.—Three communications referring to a recent German abstract of a French paper of Claude (abstracted in the Digest, Sept. 15, 1900). Lubberger obtained results which agree in some points with those of Claude; for instance, the stray currents flow through the earth and only a part enters the water and gas pipes; but he disagrees with him in an essential point and says that the difference of potential between rails and pipes does not determine the danger of electrolysis.—*Elek. Zeit.*, Feb. 27.

Vigier shows that the actual conditions on a tramway are different from the conditions of the experiments of Claude.—*Elek. Zeit.*, Feb. 13.

Michalke also criticises Claude's methods; he agrees, however, that it was practically important to prove that not all stray currents in the earth enter the pipes.—*Elek. Zeit.*, March 6.

Automobiles.—A description of the electric motor cars which were exhibited at the Crystal Palace in London. Besides delivery wagons of German make, there were exhibited the new vehicles of the Brit. Electromobile Co. The frames are of channel steel construction. Two single reduction motors are used, being spring-suspended on the fixed rear axle. The Leitner battery is used. Each vehicle is equipped with three brakes; the emergency electric brake applied through the controller; the medium electric brake due to recuperation, and the pedal-operated band brakes, on drums on the hubs of the rear road wheels.—Lond. *Elec. Rev.*, Feb. 28.

REFERENCES.

Great Northern and City Railway.—A description of this road, which is one of the underground railways in London which is being built. The tunnel construction is described in detail. The tunnel during construction is lighted by electricity, and electric motors are used for operating the winding, ventilating and pumping machinery. The cars will be run in trains of 7 cars each, of which 3 cars will be equipped with motors.—*St. R'y Jour.*, March 1, and *Int. Ed.*, March.

Providence.—An article on the design of a power station in Providence, which is to have a capacity of nearly 6000 kilowatts. The description deals especially with the mechanical part of the equipment.—*St. R'y. Jour.*, March 1, and *Int. Ed.*, March.

Double Trolley Omnibus.—An illustrated description of an omnibus line, near Dresden, Germany, on which the omnibus is driven, by electricity, and takes current from two overhead wires, no rails being used, as was recently noticed in the Digest.—*St. R'y Jour.*, March 1, and Int. Ed., March.

Paris Exposition.—Tripier.—Continuations of his extremely long illustrated article on the electric railroad at the Paris Exposition in 1900. The power station is described in the greatest detail.—*L'Eclairage Elec.*, Feb. 1, 8.

Installations, Systems and Appliances

REFERENCES.

Lightning Arresters.—Klein.—An illustrated translation of the German article on horn lightning arresters with iron framing, which was noticed in the Digest.—Lond. *Elec.*, March 7.

Railway Shops.—An illustrated article on light and power at the Colorado & Southern Railway shops in Denver. There are three 85-kw. 250-volt direct current dynamos for supplying a 220-volt lighting and power service.—*West. Elec.*, March 8.

Electro Physics and Magnetism

Radio-Activity and the Electron Theory—Crookes.—A Royal Soc. paper. Electrons emanating from radio-active bodies behave like material particles and are impeded by the molecules of the surrounding medium, in contrast with ether waves, which are not thus affected except by absorption. He describes an experiment showing that the electrons from actinium partake of the properties of a fog or mist of material particles, capable of diffusing away in the free air like odoriferous particles, when not kept in by a thick metal screen. Emanations from polonium show an entirely different behavior as regards diffusibility through air, while electrons from radium and thoria behave similarly to actinium. Electrons from radium pass through aluminum and a considerable length of air, and affect a sensitive film; experiments on this point were tried with polonium, and it was found that air offered great obstructions. The electron theory explains a fact which has long puzzled experimentalists; it is well known that if a coin is laid on a sensitive plate in perfect darkness and connected with one pole of an induction coil for a few seconds and the plate then developed, an image can be obtained of the raised parts of the coin; this has generally been explained by saying that the electrified stream of air, or the brush discharge, affects the film like light; but Sanford has shown that coins embedded at the centre of a block of paraffin 2 cm. thick, where they could not send off streams of electrified air, can still be photographed by means of the induction coil; under these circumstances it is probable that electrons are the agents, as electrons will easily pass through paraffin wax from the coin to the sensitive plate, when the coin is connected with the negative pole of an induction coil, the other pole being connected with a metal plate placed below the wax block. He gives some facts in favor of Strutt's theory that positive ions as well as negative electrons flow off from a radio-active body, and that the non-deflectable and easily absorbable kind of Becquerel rays are heavy positive ions. Of the three radio-active bodies, radium, actinium, and polonium, actinium appears to emit corpuscles almost entirely of the penetrating, deflectable kind, polonium, rays of the non-deflectable, non-penetrating kind, whilst radium emits rays of both kinds; corpuscles from polonium therefore may consist of the heavy positive ions.—Lond. *Elec.*, March 7.

Electric Waves from the Sun.—Nordmann.—An account of experiments made at the station of Grands-Mulets, at an altitude of 3100 meters, to find whether the sun emits electromagnetic waves. The results were entirely negative. The sun, therefore, either does not send out Hertzian waves or they are completely absorbed by the sun's atmosphere or by the upper strata of the earth's atmosphere. Such an absorption is exceedingly probable, as we know that Hertzian waves are largely absorbed by rarefied gases.—*Comptes Rendus*, Feb. 3; abstracted in Lond. *Elec.*, Feb. 21.

Transfer of Radio-Activity.—Rutherford.—An investigation of the power of thorium and radium, of communicating a secondary radio-activity to all bodies in their neighborhood. The active rays of thorium and radium behave in every way like radio-active gases or vapors. He is of the opinion that the carriers concerned in the transfer of radio-activity are positive ions. He measures the velocity of the carriers with the aid of an alternating electric field and shows that their velocity is practically the same as the velocity of the positive ions. That the ions are positive is proved by the fact that they follow the potential gradient from a higher to a lower potential. The amount of secondary radio-activity is quite independent of the chemical nature

of the body upon which the radio-active ions are deposited. The deposit may even be chemically separated from the surface and condensed by evaporation.—*Phys. Zeit.*, Feb. 15; abstracted in Lond. *Elec.*, Feb. 28.

Chemical Effect of Cathode Rays.—Schmidt.—A paper on the fact that cathode rays are capable of decomposing substances sensitive to light. When the cathode rays, which consist of negative electrons, impinge upon a salt such as chloride of silver which consists of a positively charged silver atom and negatively charged chlorine atom, the electron can only be retained by the salt if it saturates a valency charge of the silver. The latter is then no longer able to bind two atoms of chlorine, and therefore one of them escapes to join a positive electron and to form an indifferent neutral atom of chlorine. If this theory is correct, it follows that cathode rays must reduce all compounds which contain volatile acid radicles. He has tested this conclusion and found it confirmed throughout. He succeeded in establishing cases of three different metallic valencies, comprising chloride of iron, chloride of mercury and sub-chloride of mercury. If the salts have non-volatile radicles, like the sulphates of barium and strontium, the cathode rays only produce a dissociation and only a very slight reduction, if any.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, Feb. 21.

Moving Ions as Ionizers.—Stark.—An article on the ionization of gases by ionic collisions. In a gas subjected to electric stress the positive and negative ions are set in motion in opposite directions. All along their free path they acquire and accumulate kinetic energy, and on collision with neutral molecules this kinetic energy is converted into the work of ionization. Since the negative ions are usually electrons and are in any case smaller than the positive ions, their mean free path is longer than that of the latter, and since the charges are the same in both cases the kinetic energy, and consequently also the ionizing power of the negative ions is greater than that of the positive ions. In a vacuum tube there is ionization wherever there is light. Under suitable conditions the cathode electrons produce ionization at a certain distance from the cathode, and the ions thus produced travel farther away under the influence of the electric field until they have acquired sufficient energy to produce ionization themselves, and so on. This accounts for the stratification of the positive light. He also applies the theory to the electric arc.—*Ann. der Phys.* No. 2; abstracted in Lond. *Elec.*, Feb. 21.

Rotary Fields.—Chabot.—A generalization of the theory and practice of the rotary field. The ordinary rotary magnetic fields rotate in one phase. He combines two or three rotary field rings at right angles to each other. He has constructed a model of three such circuits and suspended an electromagnet within it by means of a Cardani suspension. A similar system which he calls the receiver is placed at a distance and communicates with the first, but a needle of soft iron is substituted for the electromagnet. When the latter is excited by an alternating current the needle follows any rotation that might be imparted to the electromagnet.—*Phys. Zeit.*, Feb. 15; abstracted in Lond. *Elec.*, Feb. 28.

Visible Magnetic Tubes of Force.—Pellat.—A description of an arrangement in which cathode rays are made to trace out exactly the course of a magnetic tube of force in a vacuum tube brought into a magnetic field. At certain pressures and at certain high densities of the magnetic field, the bundle of cathode rays issuing from a plane cathode takes the shape of the tube of force having the cathode for its cross-section. The tube of force is thus traced through the tube along its whole extent, since the luminosity, due to cathode or canal rays, proceeds from the cathode in both directions. The cathode rays concerned in this phenomenon are different from those which undergo the ordinary magnetic deflection.—*Comptes Rendus*, Feb. 10; abstracted in Lond. *Elec.*, Feb. 28.

Electric Spark in Water.—Trowbridge.—An illustrated article on the brilliant discharge which can be produced even in carefully distilled water if a high e. m. f. is used. He found 500,000 volts with a large capacity to be suitable for the purposes of spectrum analysis, an additional spark gap being provided outside of the liquid. The electrodes were platinum wires inserted in long glass tubes and were placed an inch apart. It seems almost as if the brilliant light were due to the incandescence of a solid. He is inclined to attribute it, certainly in part, to the combination of oxygen and hydrogen produced by the dissociation of the water.—*Elec Rev.*, Feb. 22.

Spontaneous Ionization of Gases.—Wilson.—While it has previ- [illegible] contained in a closed vessel, even when it is not exposed to any ionizing agent, the author has measured the relative rates of production of ions under such conditions in air and certain other gases. The following were the relative ionizations found: air, 1.00, hydrogen 0.184, carbolic acid 2.64, and chloroform 4.7. Except in hydrogen, the ionization is very nearly proportional to the density of the gas.—*Proc. Roy. Soc.*, Jan. 31; abstracted in Lond. *Elec.*, Feb. 28.

Electro-Chemistry and Batteries.

Electrometallurgical Industries of Germany; Deposition of Zinc.—A statistical review. There are four sodium plants; two use the Castner process; two the Rathenau and Suter process; one plant makes sodium for the production of cyanides and sodium peroxide, caustic soda being the raw material. There are seven copper works; the total copper production of Germany has increased from 24,700 to 32,000 tons in the last ten years. Some interesting notes are given concerning the Papenburg works; while it has been generally supposed that the Hoepfner copper process is there in extensive use, it is said that only a small quantity of copper is produced there at present and that probably the production of copper at that plant will be given up, "because copper nickel matter is not available"; the original Hoepfner process as it has been used in the Weidenau trial plant, is described in detail; the process is said to have been modified later. The Elmore process, in use at Schladern for making copper tubes, is said to have reached remarkable perfection. At a Hamburg refinery about 3000 kgr. of fine gold are produced yearly by the Wohlwill process, the anodes being of raw gold, 980 fine, with impurities of platinum and silver; from the sludge about 12 to 15 kgr. of platinum are obtained. Besides this, still greater quantities of Transvaal gold, down to 850 fine, are electrolytically refined. The electrolytic zinc industry is still in its infancy; in most works the operation has ceased. He makes some interesting remarks on the electrolytic deposition of zinc from solutions. The deposition of pure solid zinc is impossible, if the solution contains many impurities. Zinc is more electropositive than hydrogen and can be obtained from neutral or slightly acid solutions only for the reason that a higher e. m. f. is required to make a hydrogen ion give off its charge at a zinc electrode, than at an electrode of most other metals (he evidently means, on account of the "Ueberspannung"). If the solution contains impurities of metals which are more electronegative, these are preferably deposited with the result that the cathode is then no longer pure zinc, but is mixed with other metals by which a hydrogen ion gives off its charge more easily than a zinc ion. The most dangerous impurity is iron. He refers to the troubles in the analytical examination of zinc by electrolysis if iron is in the solution: as long as there are much more zinc ions than iron ions, zinc is deposited; but when the ratio of the number of iron ions to that of zinc ions reaches a certain value, iron is deposited together with the zinc; the cathode then contains iron, and at this iron hydrogen ions can give off their charges more easily than zinc ions; zinc is dissolved with vivid development of hydrogen and disappears from the platinum pan. He brings this into connection with the influence of current density upon the form of the zinc deposit. When a pure zinc salt solution is electrolyzed with a pure zinc cathode, zinc is deposited and hydrogen appears only at very high current densities. If, however, the solution contains iron ions, iron is deposited preferably and at the ion deposit, thus formed, hydrogen gives off its charge preferably at low current density, and hydrogen together with zinc at medium current densities. If, however, the current density is great enough, the small iron particles on the cathode are quickly covered with zinc, so that the cathode becomes again pure zinc and no hydrogen is given off; only at very high current densities are zinc and hydrogen again deposited simultaneously. This may be the reason why from pure solutions, a good zinc deposit is obtained at low and medium current density, and spongy zinc at very high current densities; on the other hand, from impure solutions—if they exist in practice, spongy zinc is obtained at low and very high current densities, and a good zinc deposit at medium current densities.—*Zeit. f. Elektrochemie.*, March 6.

[illegible] Haycock.—An abstract of a paper read before the Manchester Literary and Phil. Soc. He draws attention to the possible use of fused quartz for making vessels in which to study the properties of substances at high temperatures, and more especially for high temperature gas thermometers. He uses a furnace requiring 300 amp at 50 volts, the arc formed

causing the quartz to melt within a minute or so. He produced thick-walled tubes of quartz, having a core of about ⅛ in. diameter, and although they were not entirely free from bubbles, their appearance was much improved by reheating under the arc.—Lond. *Elec.*, March 14.

Electrolysis of Water and Industrial Uses of Oxygen and Hydrogen.— M. U. Schoop.—An abstract of a paper read before the Elec. Soc. of Cologne, on the industrial electrolysis of water. Lead or iron electrodes are used; if iron, the electrolyte is a solution of hydroxide of potassium or sodium. It is important to prevent the dangers resulting from the mixing of the gases; for this reason diaphragms are required; they are made of porous insulating material. The hydrogen obtained by electrolysis generally contains 2 or 3 per cent of oxygen, the oxygen about 2 per cent of hydrogen; both gases also contain slight quantities of steam. The easiest and best method of testing the purity of the gases is by determining the velocity of sound in them. The chief obstacles to the commercial sale of electrolytic oxygen and hydrogen are the high price of the steel bottles and the cost of transportation. In the manufacturing plant at Cologne, the cost of producing hydrogen, including amortization of the apparatus, is about 10 cents per cubic meter. Oxygen is used commercially for therapeutic purposes, oxygen and hydrogen for the method of soldering and welding by means of oxy-hydrogen gas which he believes to be better than the electric process. Oxygen and hydrogen may also be used for lighting purposes, especially in cottages, etc.—*Elek. Zeit.*, Feb. 13.

REFERENCES.

Electrolytic Production of Soda and Bleach.—An editorial note on the success which has attended the commercial manufacture of soda and bleach by the Electrolytic Alkali Company, at Middlewitch, England, so that it has been decided to extend the works and double the output. The success is said to be the result of the successful experimental working of the Hargreaves-Bird process at Farnworth. Several illustrations of the plant are given, together with a diagram of the Hargreaves-Bird cell.—Lond. *Elec.*, March 14.—Longer illustrated articles on this subject in Lond. *Eng'in and Elec. Eng.*, March 14.

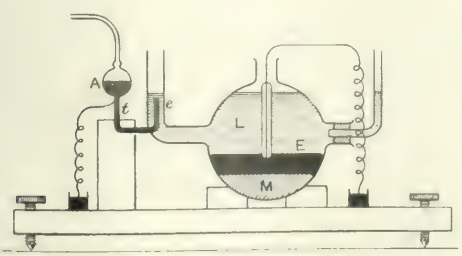
Electric Furnace.—Liebman.—An illustrated article on a modified Moissan electric furnace which is inexpensive and especially suitable for demonstration purposes, as the different methods of electric heating can be shown in it.—*Zeit. f. Elektrochemie*, Feb. 27.

Automatic Switch for Storage Batteries.—Thieme.—An illustrated description of a new automatic switch for keeping the voltage of a storage battery constant, by disconnecting or adding cells.—*Elek. Zeit.*, Feb. 27.

Parabolic Reflectors.—Rost.—An illustrated description of Cowper-Coles' electrolytic process of making parabolic reflectors for searchlights.—*Elektrochem. Zeit.*, March.

Units, Measurements and Instruments.

New Capillary Electrometer.—Boley.—A description of a new capillary electrometer of very general application. It is shown in the adjoining diagram. He has been led to the construction of this instrument because the capillary electrometer of Lippmann does not



NEW CAPILLARY ELECTROMETER.

operate with liquid saturated amalgams, as they are not sufficiently mobile in capillary tubes. The amalgam or mercury is contained in a bulb *A*, provided with a tube *t* bent twice at right angles. This tube has at the end *e* an internal diameter of about 1 m.m. and its section is polished. There the meniscus is formed so that the instrument may be called a "free drop electrometer." This meniscus is observed in the microscope. The emergent drop is surrounded by the electrolyte *L*. The tube *T*, which can be turned in its plug, serves for filling and emptying the apparatus. The electrode *E* rests upon a base of mastic *M;* on account of its large diameter of 12 c.m., it is practically unpolarizable. The instrument is easily adjustable. The meniscus should be lighted by a small source of light above it, so as to produce in the microscope "two or three black fringes parallel to the image of the summit." The microscope is set upon the fringe nearest the meniscus. For measuring e. m. f's. he uses the compensator of Bouty and a constant cell of the Clark type. With pure mercury 0.0003 volt gives an apparent depression of the meniscus of ⅛ m.m., with a magnifying power of 100. Up to 0.01 volt the depressions are exactly proportional to the e. m. f. The zero point is absolutely constant. With saturated silver amalgam, he obtained the same sensibility and about the same depressions of the meniscus; the meniscus of the amalgam is very mobile and its zero point is absolutely constant.—*Comptus Rendus*, Feb. 24; *L'Eclairage Elec.*, March 15; briefly abstracted in Lond. *Elec.*, March 14.

Determining the Instantaneous Angular Speed of Revolving Axles.—Hospitalier.—A description of a method for measuring instantaneous angular speeds, between 10 and 300 revolutions per minute, and determining variations of speed during one revolution. On the end of the revolving shaft there is pasted an inclined mirror, upon this mirror is sent a ray of light, in the direction of the shaft; the reflected ray describes a cone in the space; on a screen a luminous circle appears, being produced by a luminous point rotating on the screen in a circle with a speed which is at any instant proportional to the instantaneous angular speed of the revolving shaft. Between screen and mirror, a disk is revolved with uniform speed which has a circle of equidistant holes, say 60. Each of these holes allows the light ray to pass through only during a very short moment, and on the screen, instead of the continuous circle, a series of luminous points arranged in a circlee, is obtained. In the case of absolutely uniform speed of rotation, all these luminous points are equidistant; and variations in the angular speed produce differences in the distances between these luminous points. If only the extreme speeds are to be determined, it is sufficient to measure the maximum distance and the minimum distance between two points. The main advantage of the method is that no synchronism is required between the revolving axle and the measuring apparatus. It is only necessary that the disk with the holes is revolved with uniform speed during the experiment.—*L'Ind. Elec.*, Jan. 10.

Instrument for Maximum Demand Systems.—Hartmann.—An illustrated paper read before the Elec. Soc. of Berlin, in which he describes an instrument for automatically disconnecting a house installation from the public network when more than a pre-arranged maximum current is being taken from the mains. The instrument is essentially an automatic circuit breaker which, when the current exceeds a certain limit, alternately opens and closes the circuit, until the normal current has been restored. The purpose of this instrument is therefore to enable the installation of a limitless number of lamps, but to guarantee at the same time that not more than a certain number of lamps are lighted simultaneously, so that a flat rate may be charged, while the principles of the maximum demand system are observed.—*Elek. Zeit.*, Feb. 20.

Resonance Phenomena.—Trylski; Schlee.—Two communications referring to the paper of Benischke, recently abstracted in the Digest. Trylski notes briefly that the pointer of a Weston wattmeter always began to oscillate strongly when the frequency got a certain value between 44 and 48; he believes this was a resonance phenomenon. Schlee has also often made the same observations on wattmeters and other instruments; he also considers this to be a resonance phenomena, so that the critical point could be displaced by a change of the moment of inertia of the movable system.—*Elek. Zeit.*, Feb. 13, 27.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Slaby.—The first of several illustrated papers on "the scientific principles of spark telegraphy." He deals with oscillations in straight wires and first describes some fundamental experiments on the production of the oscillations and then gives a mathematical theory for the explanation of these experiments. From the source of high voltage the wires are charged with energy

[illegible] "flowing" energy; the condition of oscillation, started in this way, is characterized by a continuous change of energy between these two forms. The action into the distance is due to the "flowing" form of energy and follows the well known laws of induction. It follows that for the action into the distance the "flow" should be linear, so that the use of long, straight and parallel wires is the characteristic feature. In the second part of the article he discusses the oscillations in the receiving wire, under different arrangement. Incidentally he remarks that practice has shown that the available earthed conductors, like lightning rods on steeples, have been found suitable for receiving messages.—*Elek. Zeit.*, Feb. 27.

Registration of Thunderstorms.—Fenyi.—A description of the following arrangement for the automatic registration of thunderstorms. A coherer and a coil are inserted in the circuit of a cell. In the center of the coil is a magnetic needle which is deflected as soon as the coherer becomes conducting, and which then closes a registration circuit. The latter contains an electric bell whose vibration suffices to decohere the instrument. Lightning discharges produce an effect upon the instrument even from considerable distances. The coherer consists simply of two sewing needles laid one upon the other; they are said to form a particularly effective coherer.—*Comptus Rendus*, Jan. 27; abstracted in Lond. *Elec.*, Feb. 14.

Galvanometric Observations of Thunderstorms.—Landerer.—A description of the following apparatus used by him at Tortosa for observing and locating distant thunderstorms. A telegraphic line, 300 yards long, was run in a N. N. E. direction, put to earth through the water pipes of Tortosa, and joined to a galvanometer capable of showing the ten-millionth of an ampere. It was found that when the lightning flashes over the distant mountains, the spot of light undergoes a double shock. The first shock has a small amplitude and the second shock is in the opposite direction and has a large amplitude. He has observed that during the same storm the small deviations are always in the same direction, the discharge proceeding from north to south in the case of storms taking place east of the meridian, and from south to north in the case of storms in the West. This method has enabled him to record a storm 150 miles distance.—*Comptus Rendus*, Feb. 3; abstracted in Lond. *Elec.*, Feb. 28.

Miscellaneous.

Treatment of Tuberculosis.—Kaiser.—An account of experiments in which he attained some remarkable results by treating pulmonary consumption and other diseases with pure blue light, by means of an arc lamp concentrated through a lens containing methylene blue or through glasses giving blue light of equal purity.—*Wiener Klin. Wochenschr.*, No. 7; abstracted in Lond. *Elec.*, March 14.

Shocks at 500 Volts.—Some results of tests in which a large number of persons were inserted in 100 to 500-volt circuits and the current was measured. Connections were made finger to finger, finger to foot, and foot to foot. A practical result of the finger-to-foot tests is that over 90 per cent of the persons tested would be able to take hold of the trolley wire of a tramway system without harm.—Lond. *Elec.*, March 14.

REFERENCE.

Russian Electrical Engineer.—Vetterlein.—An article on the second Congress of Russian Electrical Engineers, held in Moscow, from Jan. 10 to 18, 600 members were present and 100 papers had been announced. There was also an exhibition of electrical apparatus; 33 firms were represented. The titles of a number of the papers read, are noticed.—*Elek. Zeit.*, Feb. 27.

New Books.

Annuaire Pour L'An, 1902. Publié par le Bureau des Longitudes. Paris: Gauthier-Villars. 656 pages. Price, 1.50 francs.

This invaluable little pink volume contains a wonderful assortment of facts in physics, astronomy, chemistry and sociology. When one seeks in vain for information in these subjects one may frequently find solace and solution of the difficulty in the 750 odd pages of the "Annuaire."

Several interesting and important chapters are appended to the book. One of them is on Wireless Telegraphy by Poincaré, and another on Polyphase Currents by Cornu. A third is on the applica- [illegible] grades) to practical navigation, and a fourth is on the observatory at the summit of Mont Blanc.

Poincaré points out that the elevation of the wireless telegraph mast should be proportional to the square root of the distance of communication. He attributes the gain from increase in height to the length of the wave emitted, the wave length being proportional to the mast height, and long waves can be bent around hills or over the earth's convexity, more readily than short waves.

It is a pity to see all longitudes reckoned from Paris. There ought to be but one international meridian, and nearly all countries date from Greenwich, but it is to be hoped that when Great Britain adopts the international metric system of weights and measures, France will acknowledge the courtesy by adopting the international meridian of Great Britain.

A Handbook for the Electrical Laboratory and Testing Room. By J. A. Fleming, M. A., D. Sc., F. R. S., M. R. I. Vol. I. New York: D. Van Nostrand Company. 538 pages, illustrated. Price, $5.

Since the publication of Kempe's handbook on electrical testing, no work of similar pretensions has appeared. In this country Professors Carhart and Nichols have separately published laboratory manuals, which, while most excellent in their way, are not especially adapted for work outside of academic laboratories. The needs of the telegraph engineer are met in great part by Kempe's book, but the needs of the electrical engineering profession at large have not been thoroughly considered by any writer. There has been all along a growing demand for an appropriate book on electrical testing, yet while other lines of the technical literature of the profession have been developed, this has suffered a marked neglect. The announcement of a work of this character by the veteran writer, Professor Fleming, is one of no little interest at this time. The author is so well known through his volumes on the alternate-current transformer and various papers that the character of the present work might be anticipated from the author's well recognized peculiarities. There might be expected a certain prolixity, little regard to formal arrangement, and a pronounced absence of terseness in his mathematical thought, yet, withal, not a little of solid, practical worth might be looked for. In the volume before us these anticipations are realized, though this book is much the best one by the author in point of style.

The first volume, now published, treats of the equipment of the laboratory, and discusses the subjects of electrical resistance, current, e. m. f. and power. The second volume proposes a discussion of capacity and inductance, and electric quantity and energy, including battery and meter testing; magnetic testing of iron; photometry and lamp testing, and testing of dynamos, motors and transformers, and from the matter as outlined this will be the volume especially interesting to engineers. The author's arrangement is apparently lacking in balance. As one-third of the first volume is devoted to the arrangement and equipment of the laboratory, and the remainder discusses but four additional topics, it seems that too much has been left for the second volume. It would appear in advance that capacitance, inductance, quantity and perhaps energy should have found place in the present volume, leaving the entire second one to the measurements which are especially vital to the profession.

The writer announces in the preface that he will deal "more particularly with the requirements of electrical engineers, as distinguished from electrical physicists, and it is his aim to provide "critical discussions on the intrinsic utility of the various methods of measurement given."

Taking up the work in detail, the unusually lengthy discussion of the arrangement and equipment of the electrical testing room contains much that is suggestive and of real value. The author describes in great detail and at length his own electrical laboratories at University College, London; and this description, while interesting enough if met with in a technical periodical, is undoubtedly out of place in the present book. There follows much confused discussion and description of the standard electrical apparatus of a physical laboratory, all of which has the apparent purpose of setting before the reader the determination and verification of the fundamental electrical quantities. However, the chapter contains many excellent and valuable directions for the use of such apparatus as standards of resistance, standard cells and the like. As might have been supposed, much emphasis of space and description is laid upon the Kelvin balances, though we, in this country, can scarcely partake of the

degree of enthusiasm felt for this singular apparatus by the English physicist; but perhaps we have to thank Edward Weston for a superior equipment.

Following this is a chapter devoted to the topics involved in the comparison of electrical resistances. At the very outset, this chapter raises the question of the extent to which a book on testing shall be given to the philosophical discussion of the elementary principles of electricity and magnetism. As an introduction to the measurement of resistance the author enters into a lengthy discussion of the philosophical truth of Ohm's law, and that this discussion happens to be an especially good one does not make its appearance in such a work the more fitting. In a handbook on electrical measurements the verified statement of Ohm's law only need find place. In this the writer is not consistent with the statement of his preface, for such matters belong to electrical physics rather than to engineering. But this is as a very small thing compared with what follows immediately. The author here proceeds to lay down several theorems on networks of conductors and then engages in their elaborate demonstration, which drags on through a matter of some 15 pages of very fine print, which contain such an array of determinants and algebra that none but a physicist, or an engineer physically inclined, would peruse it. As the chapter is developed into the subject of the measurement of low resistance, but few methods are given, and these are of the older type. As a matter of course only methods which have originated in England find place, and the book is distinctly a loser through the disregard of many excellent methods and apparatuses which have been proposed in this country from time to time, and especially of conductivity sets which are so largely used industrially.

Professor Fleming's book is decidedly poorer by an almost studied exclusion of American methods and apparatus. Some references are indeed made to work done here, as the Rosa curve machine, but this seems to have met with favor, or perhaps came to the notice of the author, because its description was first given before the British Association.

One of the notable features of the book is the set of numerous tables relating to resistance constants, and though the majority are properly physical tables, it is seldom that so much interesting and valuable reference data are brought together.

The chapter on the measurement of electrical current devotes ample space to the discussion of voltametry with copper and silver and contains a popular rather than a practical discussion of absolute galvanometry for the measurement of current. For a work devoted to measurements "in the so-called heavy electrical engineering" (page 1), one would anticipate an adequate description and discussion of the prevailing types of ammeters. The Weston instrument comes in for scant notice and an illustration of its case, base and terminals, which is highly edifying, while the Hartmann and Braun hot wire ammeter is described at length and theoretically discussed. The brevity here is most singular, and the stress laid upon the Hartmann and Braun instrument is most surprising, for we who have used the instrument, have found it fragile, and subject to all the annoying drawbacks of its type. Then, too, in his description of the Weston instrument the author falls into a very peculiar use of language, stating that "the instruments are made in various grades, to read from milliamperes to hundreds of amperes" (page 369). This poor attempt at Latinized English when translated evidently means that the scales are graduated in various current intervals; only one grade, so far as we know, of the Weston laboratory instruments is manufactured.

The concluding chapter is devoted to the measurement of electrical power, and one naturally turns in such cases to the section dealing with power in alternating current, and more especially, polyphase circuits. The character of the discussion that awaits the reader here may be inferred from the fact that most of the references are taken from papers and discussions by Messrs. Ayrton and Mather. Still the chapter contains much that is valuable and suggestive, though it disappoints one rather more by its omissions, than its archaic treatment. As might be anticipated, the Kelvin balance again comes in for prominent mention, though the high inductance of these instruments make them so objectionable, even if they were otherwise desirable.

The book is very notable by reason of its frequent and satisfactory references. Under many important topics a reference sequence of valuable papers is given, and these are supplemented by numerous foot-notes. The book is thus scholarly, and, within the limits of provincialism, thorough. However, the author has again obtruded upon his readers the foolish practice of the use of large, together with very small type, for the convenience of one set of readers, who not relishing much mathematics and theory, may peruse the coarse print and be comfortably oblivious toward the forbidding matter in inconspicuous type, that so voluminously interlards the book. Such a practice of printing may do for a country so wholly under the sway of systems of examination, as England is yet, but it is annoying to readers who do not appreciate the archaic humor of such practices.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 18-21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Interstate Independent Telephone Association. Next meeting, Chicago, April 9, 10 and 11, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

Iowa Electrical Assocaition. Next meeting, Cedar Rapids, Ia., April 9 and 10.

National Association of Manufacturers. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

National Electric Light Association. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Pennsylvania State Street Railway Association. Next meeting, October, 1902.

Southwestern Gas, Electric and Street Railway Association. Next meeting, San Antonio, Tex., April 18-21, 1902.

Clark Wireless Telegraph.

The accompanying illustrations relate to the Clark wireless telegraph system as installed on board the steamer "City of Detroit," by means of which signals were successfully received over a distance of 117 miles. The instruments on the operator's table inside the cabin include a coil for transmitting, two large secondary frequency coils and a high speed circuit breaker, operating at a rate of 10,000 breaks per minute, with copper disks, oxide interrupter and cooling device.

Directly on the table is mounted the operator's key and sounder for transmitting messages. When the key is depressed a dot is formed, which sends a flow of current into the primary circuit of the large coil, causing rapidly alternating pulsations in the secondary frequency coils, which pass out through the heavy cables, and oscillate across space.

Fig. 4 shows the large copper balls and cones of transmitter, located on the hurricane deck of the steamer "City of Detroit." In the circuit are the differential frequency coils, a condenser and resonating drums, with the cables leading to the mast and aerial screens.

On the receiving operator's table (Fig. 2) is located the receiving apparatus, consisting of a coherer, automatic tapper, a 2000-ohm relay, condensers and differential frequency receiving and repeating coils. A telephone receiver is bridged in on the receiving circuit across the 3000-ohm coils, the receiving apparatus being compact and detachable, and so arranged that it is portable and can be removed

from the ship to the shore if so desired. The receiving wires lead in across a double-pole, double-throw switch to the cables for receiving and transmitting, which assists in a quick change from one system to the other.

Figs. 3 and 1 show the transmitting station and receiving station at



FIG. 1.—WOODWARD AVENUE STATION, DETROIT.

the foot of Woodward Ave., Detroit, Fig. 1 shows the inventor, Mr. Clark, sending a code signal to the "City of Detroit." It also shows the transmitter with the aerial cables leading to the aerial drums and screens on top of the station, Fig. 3. This system of wireless telegraphy is controlled by the Electric Service & Appliance Company, Detroit, Mich., of which the inventor of the system, Thos. E. Clark, is president.

features consist in the use of automatic lamps; lenses capable of giving a variable horizontal dispersion; dark shutters for cutting off all the light; signaling shutters; and in the case of the 24-in. size, electric motor control of the different motions whereby the searchlight can be manipulated from a considerable distance.

The lamp employed is of the inclined pattern, and can be worked either automatically or by hand. It is made in three standard sizes, viz., 50-ampere, 75-ampere and 100-ampere. In these lamps the carbon holders are supported on a rod which has right and left-handed threads. Suitably placed outside the lamp case is a hand-wheel, by which the carbons can be moved together or apart by means of these threads. For hand control, therefore, it is only necessary to strike the arc in the ordinary way. For automatic working a solenoid is placed inside the lamp case, the exciting coils of which are in series

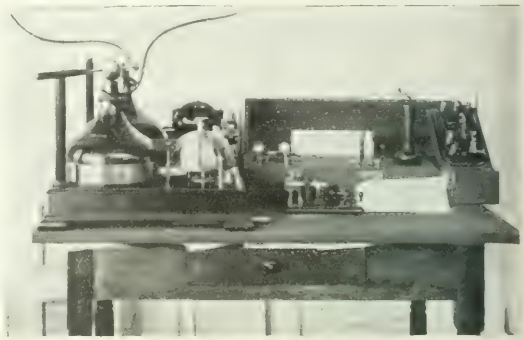


FIG. 2.—COMPLETE SET OF INSTRUMENTS ON STEAMER "CITY OF DETROIT."

with the carbons. This solenoid has an iron core which is connected with the carbon holders, the latter being arranged with a small amount of slip independent of the threads on the supporting rod. On the excitation of the solenoid the core is sucked in and so strikes the arc.



FIG. 3.—AERIAL CABLES, SCREENS, ETC.

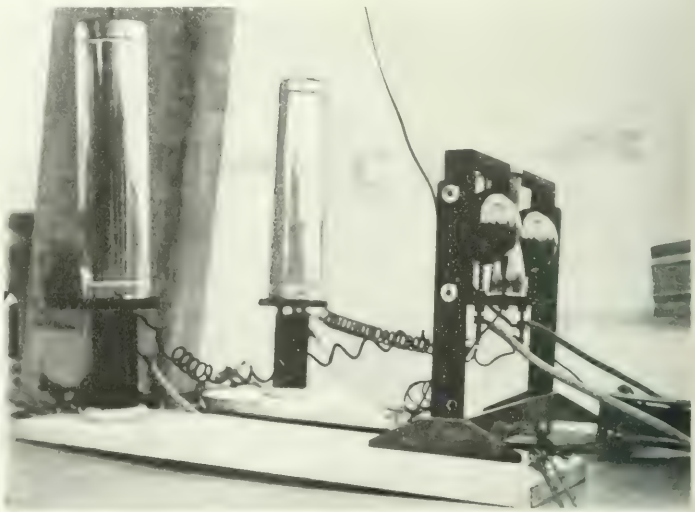


FIG. 4.—TRANSMITTER COILS AND RAILS ON "CITY OF DETROIT."

New Siemens Projectors.

A new form of searchlight lately placed upon the market by Siemens Bros. & Co., of London, has been supplied in large numbers for use on board warships. The projectors are made in three different sizes, viz., for mirrors of 16 in., 20 in. and 24 in. diameter, and their special

For the regulation of the feeding mechanism for maintaining the arc at the correct length, an electromagnet is provided. This electromagnet is wound with fine wire and connected as a shunt to the arc. When the resistance of the arc increases, due to the consumption of the carbons, the volts across the shunt electromagnet rise until, at a certain moment, the magnetization is sufficient to attract a soft iron armature controlled by a spring which carries a contact breaker. The armature therefore vibrates as long as the volts across the shunt coil are in excess. Each movement of this armature actuates the arm of

a friction clutch in connection with the supporting rod carrying the carbon holders, giving the same a twist and so bringing the carbons together, until the correct length of arc is obtained. The whole of this automatic gear can be switched out of action when desired.

This gear is perfectly steady and even in its action, and the lamp will run for several hours without attention. Screw regulation is provided so that the lamp may be adjusted in a vertical and horizontal plane, thereby ensuring correct focus.

The mirrors are of the well-known Mangin type, with focal distances of 10 in., 12½ in. and 17 in. for the 16-in., 20-in. and 24-in., respectively. The mirror cases engage with the projector barrel by means of bayonet joints, and are easily removable.

The diverging lens consists of a combination of two lenses, one formed of plano convex and the other of plano concave glass trips. Each of the two lenses is mounted in a gun-metal ring, which travels inwards or outwards upon three screws. The screws are rotated by means of a large gun-metal toothed ring worked by a hand-wheel at the side of the projector barrel, and the lenses are thereby racked towards or away from each other.

The relative positions of the lenses are such that when at their nearest point of approach the effect of the one is neutralized by the other, that is to say, the rays of light diverged by the convex lens are corrected and brought back to parallel by the concave lens.

At the point of greatest distance the dispersed rays from the convex lens intersect in the center of each strip of the concave lens, and the dispersion is therefore unhindered.

The effect is readily observed when the projector is in use, the rotation of the hand wheel causing the beam to spread out the shape of a fan, or to contract as may be required. Any dispersion up to an angle of 45 degrees can be obtained at will.

The signaling shutter is fixed outside the combination lens, and consists of vertical hinged louvres corresponding in number with the strips in the lens. These shutters are held open by means of a rod controlled by a coiled spring. The rod projects from the side of the projector and terminates in a knob. A small movement of the rod closes the louvres which open immediately the rod is released.

The apparatus is light and quick in action, even in the largest sizes, and flash signaling can be carried on with the utmost ease. In order to avoid interruption to the light the shutter is so arranged that each louvre when open is edgeways to and coincident with a joint between two of the lens strips.

The dark shutter is an essential for the satisfactory use of a projector on a warship, so that it shall be possible to obscure or turn on the beam suddenly. This cannot satisfactorily be effected by turning off or on the lamp, and it is evident that a shutter offers great advantages in this direction. To each of these projectors, therefore, is fitted an "Iris" diaphragm which opens and closes by means of a handle projecting below the projector body. The closing of this shutter instantly obscures the light and transforms the projector into a virtual dark lantern. When open the shutter falls back into a recess in the projector body.

The body of the projector is supported by sliding trunnions. It is provided with ample ventilation, the ventilator hoods being provided with lips which effectually prevent the escape of any reflected light. A focus observer is fitted consisting of a frosted glass disc, upon which an image of the arc is projected. This makes it possible to obtain an absolutely correct focus and adjustment of the arc without opening the doors, which give access to the interior of the body.

The signaling shutter, combination lens, and Iris diaphragm are severally detachable from the body, so that in the event of any one of these being injured, it can be instantly removed and the projector used without it. A plate glass front is fitted to the body behind the diaphragm for this purpose, and the sliding trunnions allow of the necessary compensation being made for balance. Locking gear is provided for each motion.

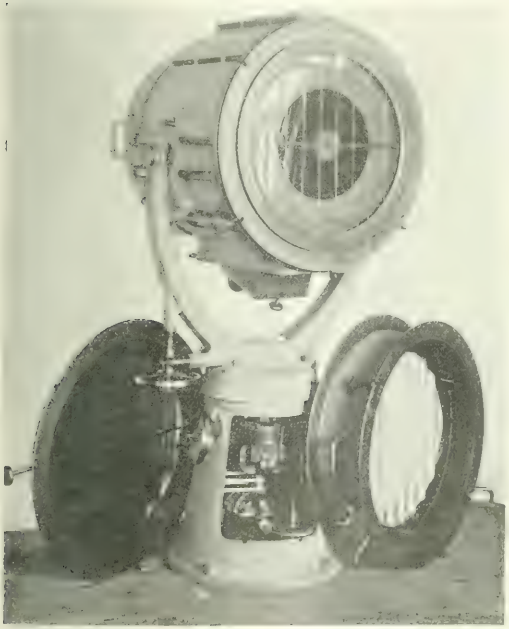


FIG. 1.—VIEW OF PROJECTOR, SHOWING DIAPHRAGM.

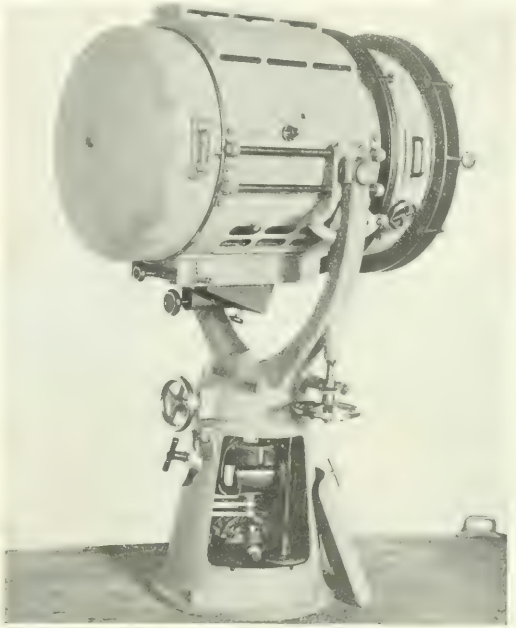


FIG. 2.—GENERAL VIEW OF PROJECTOR.

In the 16-inch and 20-inch sizes, the control is effected entirely by hand, but in the 24-inch size, both hand and motor control is fitted. The latter consists of two motors, one each for the horizontal and vertical motions. The motor for the latter is mounted upon the center spindle of the projector and travels round with it. This motor controls the vertical or tipping motion by means of a horizontal shaft and worm. The latter engages with a worm wheel which transmits the movement to the quadrant upon the body through a vertical shaft and bevel pinion.

The motor for the horizontal or slewing movement is fixed to the bottom of the hollow base and transmits the movement to the turntable through worm gear and a vertical shaft, the latter being fitted with a pinion engaging with a toothed rack upon the turntable.

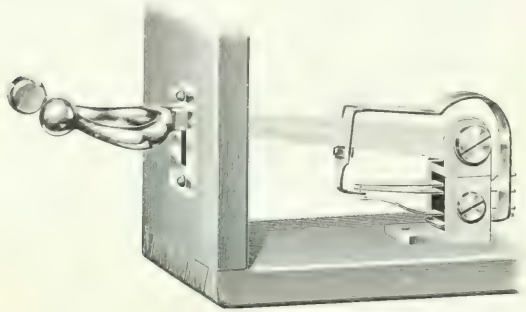
The controlling switch consists of two motor starting switches working in planes at right angles to each other, and operated by a common handle, the effect being that the projector follows the movement of the operator's hand, throwing the beam of light upwards

when the handle is elevated, and lowering the beam when it is depressed and so forth. This apparatus enables a projector to be placed in a commanding position, such as a fighting top, and at the same time to be controlled from another point of observation such as the navigating bridge or a gun casemate.

Telephone Switch Hook.

The telephone switch hook shown in the accompanying cut is being put on the market by the International Telephone Manufacturing Company, of Chicago, and is to be embodied in its complete line of central energy and generator call exchange and toll line wall telephones. The standard of the switch is constructed from a cast brass plate, forming the bottom, one side and top of the spring block holder, and also the base to which the hook is mounted. The spring block is of hard rubber, and is slotted to receive the necessary springs. The springs are firmly clamped into place by a heavy brass binding plate, fastened with a strong brass binding screw. The binding plate is insulated from the springs with a piece of heavy mica.

The springs are of heavy German silver, and are provided with platinum contacts. They are extended through the rubber block, and form the terminals for wire connections at the rear of the switch. The main spring is set into the base of the insulated block and is bent



SWITCH HOOK.

up over the back of the base over the hook, which passes through it and then extends down and back between the contact points. This arrangement furnishes one of the longest and most live switch hook restoring springs, leaving nearly 5 inches of German silver spring for tension. The shape of this spring and the manner in which it is mounted to the hook ensures a long sliding connection at the contact points, and the largest possible space between the contacts when opened by moving the hook up and down. This arrangement of the restoring spring leaves no rubbing or scraping of any part, excepting at the contact points, by a small hard rubber stud held in the slot of the spring and under the hook. The hook is insulated from the main spring. No part of the hook or base is used in the circuit.

The Wright Electrolytic Meter.

In a paper read last fall by Mr. J. R. Dick before the British Institution of Electrical Engineers it was pointed out that the electrolytic type of ampere-hour meter possesses three points of great merit—cheapness, small drop of pressure and great permanent accuracy. Unlike motor meters, they require no compensation for frictional errors and no special breaks to correspond with the law of the driving torque. In fact, a properly designed electrolytic meter has a natural straight line of registration, and will integrate any current, however small, with perfect accuracy.

The paper then enters into a description of an electrolytic meter devised by Mr. Arthur Wright, and which has entered into use in British central stations. The principle of this meter is shown in Figs. 3 and 4 and illustrations of the two types as actually manufactured, are shown in Figs. 1 and 2, the latter instrument having combined with it a Wright maximum demand meter.

The general principle of the meter rests on the deposition of mercury from a solution of mercurous salt. The various parts of the electrolytic cell are enclosed in a hermetically sealed glass tube, and advantage is, of course, taken of the fluidity of the mercury to measure the volume deposited, instead of the weight. The total resistance (including the cell in the shunt circuit) is about 40 ohms and the maximum current in it is about .025 ampere for a meter of 5-ampere capacity. The resistance in the main circuit is platinoid wire and has a value of .2 ohm.

That which differentiates this meter from those of similar type is the relative position of the anode *A* and the cathode *B*, the former being placed above the latter. The mercury of the anode is contained in a circular trough *C*, which is filled to such a height that the more concentrated solution formed by the electrolytic action falls off the convex surface of the mercury by gravity and thus automatically mixes the liquid and tends to keep it at a uniform density. The aid of gravity in thus promoting diffusion is secured by the employment of an anode feeder *D* after the manner of the well-known "bird fountain." When any portion of the mercury has been electrolyzed from the anode and the liquid sinks to the smallest extent, it is quickly restored to its normal height by a slight flow from the anode feeder, while a corresponding amount of solution replaces the mercury thus withdrawn from the feeder.

The cathode usually consists of a hollow cone of platinum carbon arranged concentric with the annular trough forming the anode. The circulation of the electrolyte is reinforced by the cathode, as the lighter liquid produced at its surface tends to rise and replace the

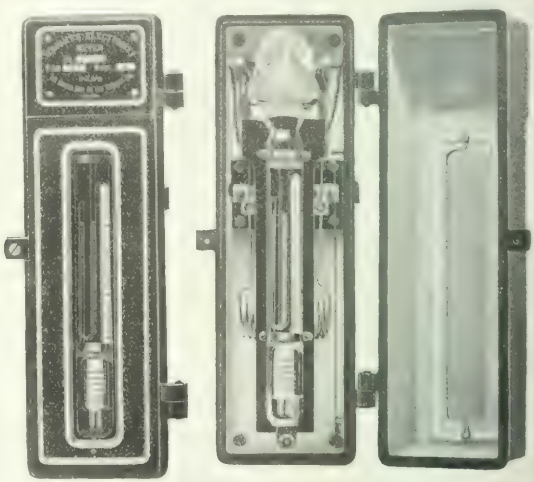


FIG. 1. WRIGHT'S ELECTROLYTIC METER.

dense solution forming at the anode. This interchange of solution goes on continuously and there is thus no need for agitation and stirring. The large surface of the anode makes the internal resistance of the cell very small, and its symmetrical relation to the cathode makes the current density equal at each point and therefore minimizes any tendency to crystallize. The gravitational effect and the large extent of activity on the surface, permit of comparatively large currents in the cell before any signs of saturation of the solution become visible. As a result there is a large factor of safety between the working current density and that causing crystallization.

As it will be seen in Fig. 3, the meter is provided with two scales, the first of which is equal to 100 kw-hours and is fixed alongside one of the limbs of the siphon or U-tube *E* (Fig. 2). The mercury that is deposited on the platinum cone drops in this tube which opens out at its upper end into a glass funnel *F*, secured to the main tube so that none of the mercury can escape flowing into it and being measured.

When a quantity of mercury calibrated to be equal to 100 kw-hours has collected in the right-hand limb, it will stand at a level somewhat higher than the top bend of the siphon tube. This difference of level is sufficient to cause the siphon to come into action, and the whole of the mercury contained in the U-tube is drawn over and falls into the lower receptacle. This is graduated in such a manner that one division of a scale is equal to the complete volume of the U-tube, and thus acts like the second dial of a clock train counting mechan-

ism. A 5-ampere meter furnished with these two scales will conveniently register up to 1200 kw-hours.

When a full record has been obtained on the meter it is reset by tilting it up on its hinge terminals, when all the mercury in the lower part of the tube will flow back into the anode chamber. A small hole

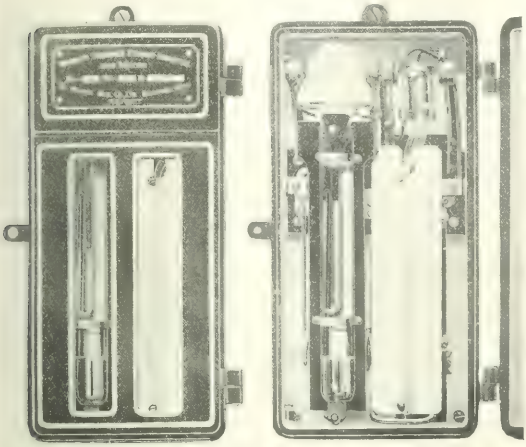
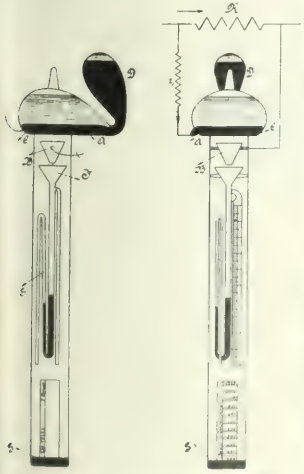


FIG. 2.—COMBINED WRIGHT ELECTROLYTIC AND MAXIMUM DEMAND METER.

is left in the glass funnel at the top of the siphon tube for the passage of the mercury. By this simple operation the meter is brought back exactly into its original condition and the cycle can recommence and be repeated indefinitely. This resetting is required only at long intervals. For example, in the case of a consumer with a 5-ampere demand on 230 volts, 1200 hours would represent at least 100 hours, all taken at the maximum load, or equivalent ordinarily to a year's consumption.

The paper above referred to gives a complete discussion of the principles of the meter and contains a number of curves compiled from data of tests, which indicate an extreme accuracy of registration. Fig. 4 shows the elec-



FIGS. 3 AND 4.—PRINCIPLE OF METER.

trolytic meter combined with a Wright maximum demand indicator in such a way that the heating resistance of the latter serves as a shunting resistance for the former, so that no further loss of pressure is entailed than with a single instrument. The paper also indicates how a single meter of this type may be used to a three-wire circuit as usually installed in houses.

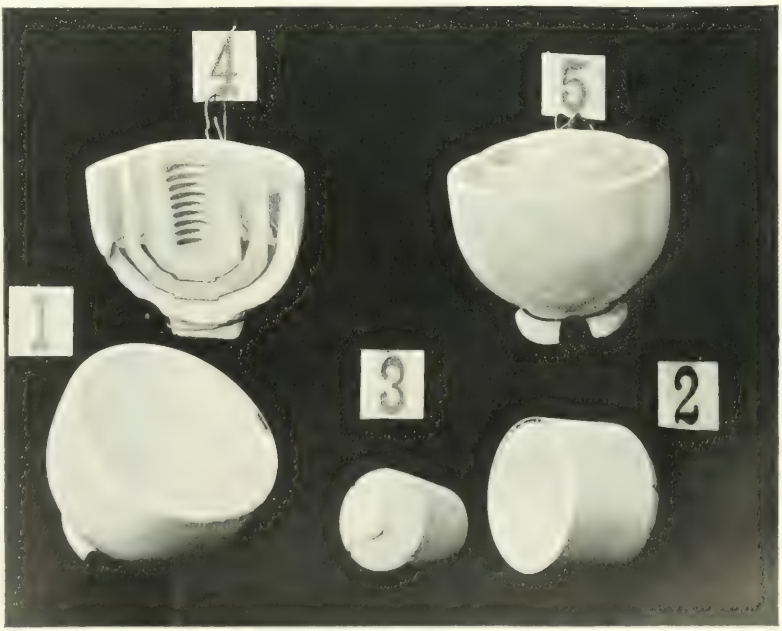
Boch's "Glaze-Filled" Insulator.

In the controversy between the advocates of porcelain and glass insulators for high tension transmission lines, it is conceded for porcelain that it has the advantage in respect to mechanical strength. The difficulty has been to make high voltage insulators of porcelain uniformly free from flaws. When that has been accomplished there can be little doubt that glass insulators can no longer claim superiority in insulating quality over porcelain ones.

R. Thomas & Sons' Company, of East Liverpool, Ohio, claim that their manager, Mr. J. W. Boch, has accomplished the task of producing a flawless porcelain insulator of superior insulating qualities as well as of great mechanical strength in his "glaze-filled" insulator. This insulator has gone into practical use during the past few years on high tension lines all over the country and has met with marked success. It is of interest therefore to know how this insulator is made, especially as Mr. Boch's patent has been recently sustained by the United States Circuit Court.

Mr. Boch's invention is primarily based upon the fact known ever since pottery was invented, that a thin piece of clay will mould and vitrify better than a thick one. For this reason Mr. Boch builds up his insulator out of two or more shells nested together. In the photo-engraving are shown separately at 1, 2 and 3, the three shells of which Mr. Boch makes up his triple petticoat insulator. The inner piece 3 is moulded with a suitable threaded socket (see Fig. 4) for the usual pin. The outer shell 1 is provided with the usual notched head for the conductor and like the intermediate part 2 is made bowl-shaped, so that the three are relatively thin shells, to be nested into each other.

In the practice usually followed by R. Thomas & Sons' Company, in making these insulators, these separately-molded parts are first dried out separately, preferably in an oven or kiln in the usual manner of drying clay articles by the process known as "biscuit firing." The separate parts are then coated with glaze all over, as by dipping into liquid glazing material, and they are then fitted into each other and



GLAZE-FILLED INSULATORS.

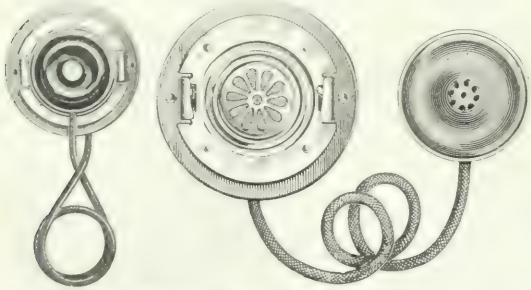
stood upside down, that is, petticoats uppermost, as in the position shown at 5. Extra glazing material is supplied at the joints, that is, in the annular channels between the petticoats.

The parts thus put together and supplied with extra glaze at the joints are now put in the sagger with the petticoats of the insulator uppermost and placed in a kiln, in which under great heat the clay

shrinks and becomes vitrified as usual and the glazing material melts and becomes of a glass-like character, flowing down into and filling all the spaces between the parts, such spaces either being there by lack of correct fit of the parts or arising during the shrinkage of the clay by the vitrification. The separately molded shells are thus welded together by seams of glass-like glaze, and this welding has been found to be of so tenacious a character that the insulators can be broken less easily along the lines of the "glaze-filled" seams than elsewhere. The completed insulator is shown at 5, while at 4 is shown one cut in two. This section clearly illustrates the three shells and the intermediate "glaze-fillings," which, needless to say, add to the electrical insulating qualities of the insulator as well as its mechanical strength.

A Push Button Telephone.

A novel invention has been recently placed upon the market by the American Push Button Telephone Company, of New York City, consisting of a complete telephone, including transmitter and receiver, which, in appearance and actuality, is not much larger than the ordinary electric push button. Fig. 1 shows the telephone when not in use. Fig. 2 shows the set with the receiver removed and exposing the transmitter. This telephone is an innovation that is worthy of notice. The compact size and neat appearance adapt it to interior work even where the decorations are of the finest, as the telephone



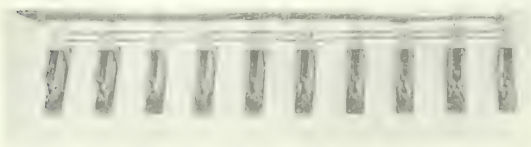
FIGS. 1 AND 2.—PUSH BUTTON TELEPHONE.

sets are furnished in all woods from plain oak to mahogany and white enamel, and all metal parts are handsomely nickeled. While principally intended for interior work, either inter-communicating, switchboard, or two-on-a-line systems, the efficiency of this device has been proven by conversations carried on easily over 500 miles.

Where electric bells are already installed, the push button can be removed and the new instrument substituted in a few minutes without disturbing the existing wires, annunciators, bells or batteries. Each telephone is covered by a guarantee for one year. Wiring diagrams are furnished with each set of telephones.

Ringing and Listening Key.

Some of the principal difficulties encountered in making a small and compact switchboard circuit changer for large exchange and toll line boards, has been to provide springs of sufficient length to leave ample space for making and breaking the connections, and yet avoid breaking the springs; also to construct it so that the contacts and springs may be conveniently inspected when fully wired and connected. With a view to avoid these difficulties and to devise one that would be electrically and mechanically right, the International Telephone Manufacturing Company, Chicago, have brought out their single cable, double mounted spring key.



RINGING AND LISTENING KEY.

and wired. The set of ringing springs and the set of listening springs are mounted one above the other. The cam lever is forked, one leg operating the ringing springs from the front in the regular manner, the other leg passing through this set of springs and operating the listening springs from the rear. The springs are of heavy German silver and of ample length to allow a large space between the contacts and leave the cam easy to operate. They are provided with platinum contacts.

The springs are set into slots in the rubber insulating blocks and are firmly clamped with a brass plate securely held by a heavy binding screw. The springs pass through the insulating block and form terminals for wire connections. All the terminals are at one end. The wires for connecting the keys are made up in one cable. This arrangement leaves the contacts and springs free and open for convenient inspection. It is stated that this key is a great departure from the construction of those ordinarily in use in the past.

Lambert Schmidt Telephone Apparatus.

The Lambert Schmidt Telephone Manufacturing Company, New York, has now under way a 500-capacity multiple switchboard, common battery type, with lamp signals and telephones for the Manhattan Railway Company, New York City. The telephones are to be located at the stations and offices along the road. It is said that many



DESK TELEPHONE.

of the instruments will be placed fully ten miles from the exchange center and average 2000 calls per day. The board will be divided up into six operators' positions in order to carry this exceptionally heavy traffic.

The United States Army, through its Signal Corps, during the past two years has ordered a large quantity of telephones and several hundred switchboards, all being of a special portable army type. These instruments are in use throughout the fortifications in this country and in Porto Rico and the Philippines. Naturally in a hot and damp climate such as the Philippines, the apparatus is laboring under exceptionally severe conditions, but the Signal Corps has yet to make the first criticism against the service rendered.

In the interior line its automatic reset intercommunicating telephones are now being made for a capacity of 20 connections, and among the interior plants may be enumerated the Waldorf-Astoria, Majestic, Manhattan, Chelsea, Sherry's, University Club, New York Yacht Club, Union Club, etc. Among the latest apparatus of this company is an all-metal desk telephone set, shown herewith. It is provided with a special double-pole receiver, a new switchhook and a new form of adjustable transmitter. The stand is made with a heavy base to give stability and is finished in nickel plate.

An Independent Telephone System for Buffalo.

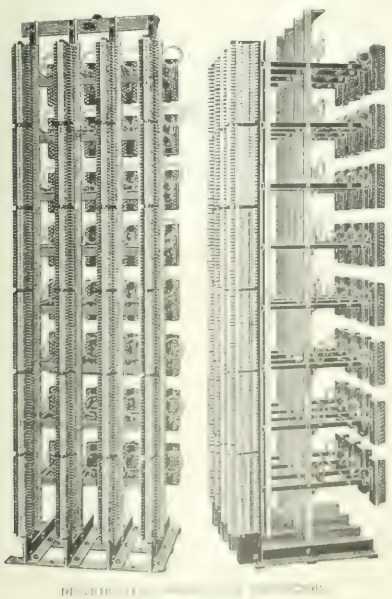
The Kellogg Switchboard & Supply Company has secured the contract for the switchboard from the Frontier Telephone Company, Buffalo, N. Y. This switchboard deserves particular attention, as the largest single multiple switchboard that has ever been built, it having a capacity of 18,000 lines. The Frontier Telephone Company was very strict in its requirements and demanded that the front of the switchboard must be so arranged that the distance from the key shelf to the top of the multiple jacks should not be higher than 35 inches, and that an operator must be able to have within easy reach 18,000 multiple jacks, besides 200 answering packs and lamps for herself and a sufficient number of outgoing and recording trunk lines. The only possible way of meeting these requirements was to put the jacks on 3/10″ centers. This will be the first jack of that size ever used in the world. The Kellogg Switchboard & Supply Company is particularly well equipped to make this installation a success, as its system requires only one spring in the jack and only two contacts in the plug. Hence, the 3/10″ jack can be built very substantially and have a higher insulation resistance than even a ⅜″ three-point jack.

The initial equipment is to consist of twelve sections, giving a present equipment of 4800 lines. In addition there is a large trunk equipment provided. The system is, of course, to be the very latest common battery relay system. The power plant will be complete in all respects, having a gas engine reserve so that there is no possibility of crippling the service. The desk equipment and all other apparatus pertaining to the exchange will also be as complete as it can be made and of the very latest design.

Combined Main Distributing Board and Office Protector.

The Sterling Electric Company has recently added to the apparatus of its manufacture a combined main distributing board and complete office protector, a view of which is shown herewith. The switchboard side of this distributing frame consists of complete protectors, heat coils and carbons in upright position, each strip having a capacity for 100, 150 or 200 pairs, usually in groups of 25 pairs each. The switchboard cable is brought to the protectors and formed and connected in the usual manner.

On the line side the line cables of any desired capacity are brought to the rear of the frame and laid up either horizontally or perpendicularly, passing through the line terminal blocks, then connecting with the terminal clips. The arrangement is such that the line side can be made in any proportion of increase over to the switchboard side without increasing the length already equipped on the switchboard side. This preserves a minimum length of jumper wires. The frame is entirely open on each side, giving easy access to all the cable and jumper wires. The horizontal openings across the back or line side are of such dimensions that jumper wires may be carried from one end of the board to the other at one movement without having to thread behind uprights, etc.



There is mounted back of each strip of protectors a maple guide block numbered to correspond with the numbering of the protectors directly in front of it. This facilitates the work and assures accuracy in the threading of the jumper wires, in making distributions. Each line terminal block is composed of a maple base with guide holes corresponding to each pair of terminal clips and made in any desired capacity, usually 25 pairs. The distributing rings are glass enameled and so placed that the jumper wires cannot draw across the corners of the iron frame. The framework is entirely of iron and of such cross section and so braced as to make it strong and rigid and being put together with bolts can be readily taken apart for packing and shipping and as readily set up for service. The frame is built for growth either to the right or to the left, as desired.

Improved Volt-Ammeters.

The accompanying cut represents a compact measuring instrument which is small enough to be carried in the pocket or tool bag and at the same time contains a high and a low reading voltmeter and an ammeter, so that it can be used for almost any desired measurement.



VOLT AMMETER

The instrument shown by the illustration reads 0 to 4 volts in tenth-volt scale divisions and 0 to 20 volts in halves and 0 to 10 amperes in fourths, but other readings and combinations are furnished. Such an instrument can be used for a large variety of measurements, especially in telephone and similar work, where it may be necessary to test a single cell of battery as well as the pressure of the entire battery and also to measure the current flowing through some apparatus or circuit.

Another use of the instruments is to roughly determine resistances of from 2 to 1000 ohms or higher, according to the range of the instrument and battery used. For this purpose the resistance of the 4-volt circuit in the instrument is made 100 ohms and that of the 20-volt circuit 500 ohms; or 1000 ohms if the reading be 40 volts. These serve as standards for ascertaining the unknown resistance by the drop of potential method.

The instruments are of the permanent magnet type, with carefully aged magnets from special imported steel. Jewel bearings are used for the pivots of the moving parts, and the scales are made separately by hand from a correct standard. The construction is the same as that of a large portable instrument except the parts are smaller.

The size is twice that of the cut. This is large enough to secure accuracy and at the same time permits the instrument to be carried in the pocket. The instruments described are made by Mr. Louis M. Pignolet, of 76 Cortlandt Street, New York.

Lighting Lake Steamers.

The Northwest Steamship Company has been making rapid progress on the interior changes of its crack passenger boats "Northwest" and "Northland." These changes, although the steamers have only been in commission four years, include new boilers of the Scotch marine type, also many changes of the interior fittings. The estimated cost reaches nearly half a million dollars. Contracts for the most of this work have been awarded. On each boat there will be duplicate generating sets for electric lighting, consisting of two horizontal tandem compound engines made by the Buffalo Forge Company, direct connected to General Electric Company marine type 75-kw generators. The engines are specially designed for this contract, the space available being limited. As the boats are to be

put in commission at the near approach of lake navigation, the builders have agreed to deliver the engines in an extremely short time.

In addition to the above, these boats are being fitted out with a complete set of the most improved ventilating apparatus for maintaining the air in all portions of the vessel uniformly cool and pure at all times. Six Buffalo steel plate fans with direct-connected General Electric motors will be installed in each steamer with an elaborate network of galvanized iron ducts for delivering the air. This plant will be, when completed, in perfect accord with the remainder of the magnificent equipments of these splendid vessels.

Clark Telephone and Switchboards.

The accompanying illustrations show the latest type of desk telephone manufactured by the Clark Automatic Telephone Switchboard Company, and a 25-point switchboard. The telephone is particularly [illegible] and differs from other types

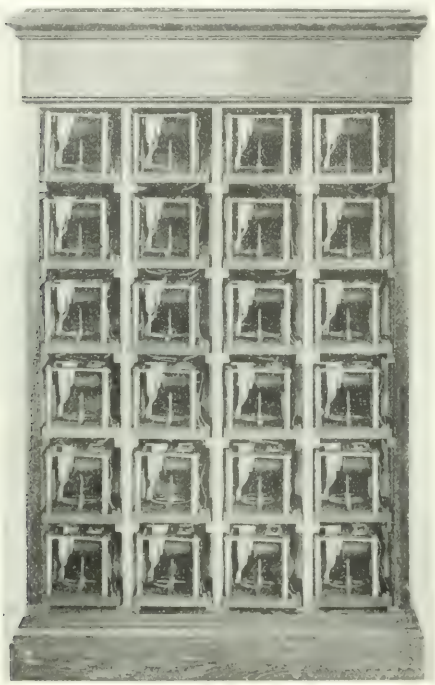


FIG. 1.—AUTOMATIC SWITCHBOARD.

made by the same company in having a push-button mounted on the side of the dial instrument, this arrangement having met with much favor.

The switchboard shown is extremely compact, requiring unusually



small space for a board to handle a comparatively large interior system. Among the qualifications of the Clark system are its great flexibility. For example, when any person is away from his usual station he can arrange to be called in any part of the building where he may be at the time, and this can be changed as often as desired by the person himself without trouble or delay. Again, any station can make as many calls as required in quick succession, no time being lost in ringing off. With this system several different persons in different parts of a building can consult together with strict privacy of communication. The automatic feature has been particularly appreciated. One user, in a book of testimonials issued by the Clark



FIG. 3.—DESK SET.

Company, says that he finds the automatic feature especially useful and desirable at night or early in the morning when there is no one at the switchboard. In another testimonial it is stated that with the automatic switchboard, calls are made as early as 4 o'clock in the morning, and during Sunday when the works are closed.

Pendant Push-Button Switches.



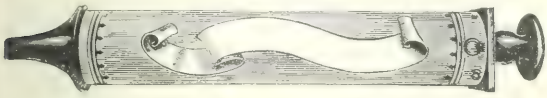
PUSH BUTTON SWITCH.

There are many uses to which pendant push-button switches are adapted for either temporary or permanent installations of incandescent lamps, multiple arc lamps or electric fans, while their small size and convenience of operation recommend them particularly for use in residences. They are quite generally used in connection with fan motors which, in such cases, may be placed in the most advantageous points regardless of accessibility. The General Electric Company's pendant push-button switches are made for 125-volt circuits of 5 and 10 amperes and for 250-volt circuits of 5 amperes. The terminals, contacts and working parts of the switches are mounted on a substantial porcelain base. The contacts for the switches are all of ample size for carrying the current required and so constructed as to withstand severe service.

The 250-volt switch is designed with two breaks in series and has knife-blade contacts. The contact surfaces are amply proportioned and the entire mechanism is substantial and thoroughly reliable. The switch is entirely enclosed by a polished brass casing which is fibre-lined and fitted with an insulating bushing at the opening for the lamp cord. The circuit is closed by pushing the rubber button which is attached to a metallic plunger inside the switch, and is snapped open by pressing the release button on the side of the switch. These buttons are threaded and screwed into their respective positions. The 5-ampere, 125-volt switch is 1⅝ inches in diameteer, the other two switches measuring 1⅞ inches in diameter.

Duster for Telephone Exchanges.

The Smith & Hemenway Company, of 296 Broadway, New York City, is introducing a cylinder dust bellows for use in printing offices, factories, machine shops, telephone or telegraph establishments, etc. This bellows has no metal mountings, thereby preventing short circuits while cleaning. For cleaning in awkward corners, pianos, organs, machine and all kinds of switchboards it is particularly useful. Any places that cannot be reached by a brush can be cleaned with a cylinder dust bellows. The compressed air forced in removes all

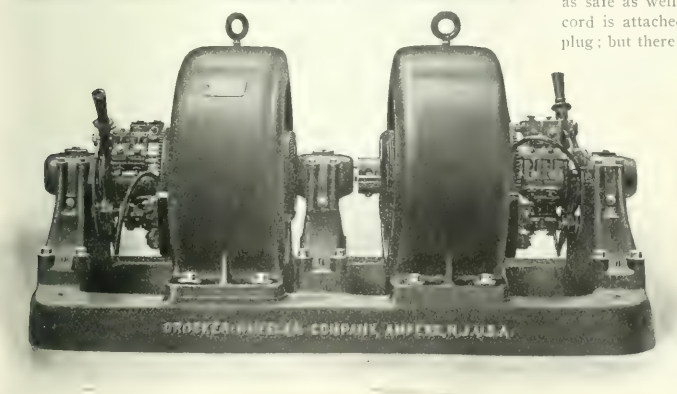


PNEUMATIC DUSTER.

particles of dust from such otherwise inaccessible places. The principal advantages of these bellows are the steady position of the point, on holding it between the fingers, the absence of metal mounting, and therefore no risk of injury to the articles to be cleaned; easy and comfortable manipulation, employment of force according to will; direction in any position; introduction to any space proportioned to the cylinder; and therefore the displacement of dust in inconvenient places without injuring the apparatus or articles to be cleaned.

Crocker-Wheeler Machines in a Telephone Exchange.

The Crocker-Wheeler Company as a manufacturer of dynamos and motors has entered the telephone field with a complete line of motor-dynamos and dynamotors. Until recently the need of such machines was small, but the centralization of energy has created a strong demand for them. To meet this, the company's engineers have given considerable study to the requirements of telephone work and as a result have placed on the market a line of motor-generators and



TELEPHONE MOTOR DYNAMO

dynamotors fully capable of complying with the needs of the modern exchange.

Among these is the battery charger, a natural outgrowth of the common battery idea. As a saving of expense and for maintaining a steady voltage, the storage battery possesses distinct advantages and is hence in very general use in central energy systems. It is seldom possible to have a commercial circuit supply charging current at proper pressure, and with practically every battery a charging outfit is necessary. To meet this demand the Crocker-Wheeler Company supplies a motor-dynamo or double field machine of any required output. The primary or motor side runs at either 115, 230, or 500 volts, the customary voltages of supply. The dynamo is wound to give whatever low voltage is best suited to the particular battery in question. The voltage is very easily regulated by control of the dynamo field, which may be of either shunt or compound winding and regulated with the ordinary field rheostat. The field is usually separately excited from the primary circuit. The accompanying illustration shows a motor-dynamo for this purpose, the motor being of 10-hp and driving a 8-kw generator. It will be noted that the machine is of compact form and graceful lines, while careful mechanical and electrical design may be assumed in machines of this source.

An objection sometimes made in the use of direct-current machines in common battery plants, is the humming caused by the brushes passing over the commutator. This is greatly reduced and almost done away with in Crocker-Wheeler machines, by the use of "noiseless coils" which utilize the magnetic inertia of the frame to smooth down the pulsations.

Closely following the battery charger in importance in a central energy exchange, is the current for ringing purposes commonly supplied by a ringer. The company manufactures these in a bi-polar type which, running at a speed of 1000 r. p. m., gives the proper ringing frequency to the alternating current of 1000 cycles per minute. They are all wound to give 75 volts, effective, on the secondary side, a standard adopted by the leading telephone companies.

This company also constructs machines combining these two services in one machine, which at times can be done conveniently. That is, in addition to the commutator on the secondary side which supplies charging current, collector rings are placed as well, which draw alternating current for ringer purposes. This is only occasionally done, for the secondary voltage must be of a certain rather high value in order to supply the proper alternating current for ringing.

A Swiveling Attachment Plug.

There have been many improved forms of electric fittings and appliances placed on the market during the past few years, but no one has seemed to think it worth while to improve attachment plugs. Owing to their great convenience, it has been necessary to use them, notwithstanding the fact that they have never been included in the list of approved fittings by the National Board of Fire Underwriters. Now, however, there has been invented and is being manufactured a swiveling attachment plug which is approved by the underwriters as safe as well as convenient. It is made all of porcelain, and the cord is attached to the cap in the same manner as in the old style plug; but there is no fuse, as none is now required. The top portion

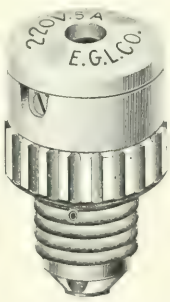


FIG. 1.—SWIVELING ATTACHMENT PLUG.

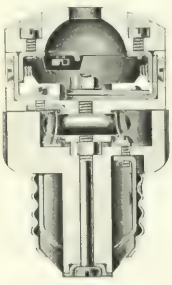


FIG. 2.—SECTIONAL VIEW OF INSIDE MECHANISM.

is held stationary so that the cord will not twist, while the lower portion is screwed into the lamp socket or receptacle by turning the corrugated porcelain part with the thumb and finger of the other hand. The difficulty and trouble arising from a twisted and tangled cord is thus avoided. Heavy lamp cord or show-window cord can be used, as there is ample space for it to be inserted and knotted.

The device is especially adapted for use with electric heating apparatus where heavy cord is generally used. It is also applicable for use with flexible armored conduit, with which, until the advent of this new plug, great difficulty has been experienced from the fact that the twisting of the conduit would result in untwisting of the plug and the opening of the circuit.

This new device is known as the Howes swiveling attachment plug, and is made by the Electric Gas Lighting Company, of Boston, Mass., who have been manufacturers of electrical appliances for the past twenty years. They will send prices and pamphlet upon request. The appliance will be on sale by all supply houses.

Combination Telephone Ringer.

We illustrate herewith a new combination recently gotten out by the Holtzer-Cabot Electric Company, Brookline, Mass., for ringing purposes in central stations, to operate in connection with a direct-current supply circuit. The apparatus delivers alternating and pulsating currents at about 80 volts and has an output of 250 watts. The pulsating current is used in party line signalling in connection with



COMBINATION TELEPHONE RINGER.

a bell constructed to respond only to the pulsating wave. The alternating current supply is used for signalling on the same circuits in connection with bells which respond only to the alternating current. The machine here illustrated is much larger than similar machines previously built by the same company, their extensive experience in this line of work having shown the desirability of machines of higher capacity than were formerly used.

New Kellogg Express Switchboard.

One of the latest types of switchboards made by the Kellogg Switchboard & Supply Company, of Chicago, is shown in the accompanying illustration. The front and rear panels are readily removable, being held in place by flush-ring catches of highly polished brass. This construction makes access to all apparatus a very simple matter. The key shelf is three-ply and hinged. The plug shelf is covered with heavy belt leather to prevent wear of the plugs. In designing this board, it was the purpose of the company to produce one that would, by its superior construction and utilization of the latest types of devices, overcome a number of objectional features found in most boards, and at the same time make it very rapid in operation. It has a capacity of 300 magneto lines, and is equipped with the Kellogg combined mechanically self-restoring drop and jack.

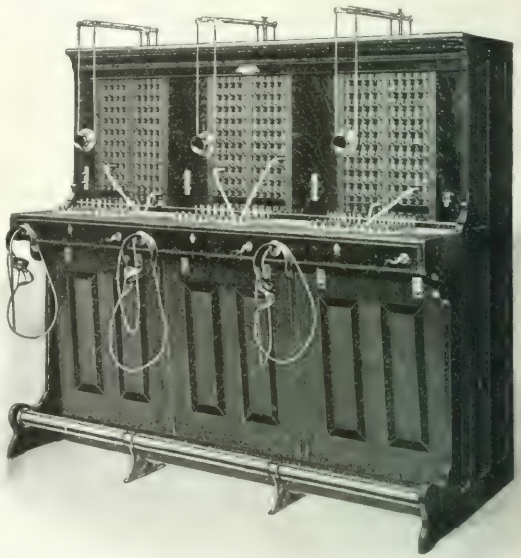
In each position is shown, just beneath the drops, the lamp transfers, five in number, with a capacity of ten in each position. These are operated by ten cells of Fuller battery. The object of these lamp transfers is to make rapid connections between subscribers whose lines terminate in positions not within easy reaching of the operator who receives the calls.

As an illustration, a subscriber asks the operator at the right for a number in the position on her extreme left; she immediately plugs into the transfer lamp, as shown in the illustration, which lights her lamp, and the corresponding lamp in the position where the connection is desired. This being a signal for the second operator, she immediately plugs into the jack corresponding to this lamp, as shown, which, being done, extinguishes both lamps, and completes the circuit between the two operators, thus enabling the first operator to give the second one the subscriber's number, who makes the desired connection. After the conversation has ended, the subscriber rings off, operating clearing-out drops in both positions, and then the operator pulls out both plugs. This operation illuminates the lamps in both positions, thus telling the first operator that the conversation has ended and the connection should be taken down, which, being done, both lamps are extinguished.

Each position is separated by a quartered-oak panel. A key is mounted on the two middle and left-hand end panels, which are so arranged that only one generator, either hand or power, can be connected in at any one time. The fourth switch, as shown on the extreme right, controls the night bell alarm, the object of which is to ring a bell whenever a drop falls, thus calling the attention of the operator.

The drops are of the tubular type, which gives a maximum of electrical and mechanical efficiency. The jack and drop are rigidly connected together by a metallic mounting strip, which makes their adjustment permanent. Any single drop or jack, or any part of one, can be readily removed from the board for repairs without the use of the soldering iron. The drop is cut out during conversation, presenting an absolutely free talking circuit. The jacks and drops are mounted five per strip, and fastened to a structural steel frame, with machine screws. The front and back are of polished hard rubber, reinforced by heavy brass, thus giving a neat appearance, combined with good insulation, and entire freedom from warping. The clearing-out drops are of the tubular type, high-wound and bridged across the cord-circuit. All the drops and jacks are mounted in a structural steel framework. The combined ringing and listening keys are very simple and well constructed. The springs are of German silver, with 99 per cent pure platinum contacts.

Each key is so arranged that the operator can ring out on either answering or connecting cord. The plugs and cords are the same as



EXPRESS SWITCHBOARD.

on large multiple boards. The plugs are reinforced by a steel-pointed tip. The board is wired on the full metallic plan, and is consequently readily adapted to common-return or grounded circuits. The operator's transmitter is the well-known Kellogg type, adapted for long-distance work, and is suspended from a nickel-plated arm, which has two adjustments, one for height, and one for distance from the board. The head telephone is provided with a 6-foot green silk cord, terminating in a plug, which may be inserted in the cut-in jack in the face of the keyboard. This cut-in jack is so arranged that when the operator's plug is withdrawn, the circuit of the operator's battery is automatically opened, as is also the operator's talking circuit. This prevents the wasting of the operator's battery when the board is not in use. The operator's hand generator is of the four-magnet type, and is mounted in the rear of the board, where it is readily accessible.

The cabling throughout the switchboard is done with silk and cotton insulated wire. All joints are soldered to their respective terminals without the use of any acid. All the line jacks and drops may be cabled down to a connecting rack at the bottom of the board and within the closing rear panels, or may be brought out direct in any length of cable, as desired.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered during the week with comparative freedom, but was not met with any particularly active demand. The closing rates were 4¼@4¾ per cent for 30 days to six months. In the stock market dullness prevailed throughout the week, due largely to the effect of higher money rates and the holidays. Heavy speculative liquidation was, however, lacking, and bear manipulation failed to unsettle prices to any extent. Better crop news and the favorable developments in the anthracite labor situation caused a rallying tendency and a somewhat bullish view of the market's immediate future. There was little activity in industrial specialties, and Amalgamated Copper was again alternately depressed and rallied. In the traction list, Brooklyn Rapid Transit closed at 64¾, a net loss of ⅞ point. Metropolitan Street Railway keeps about steady, closing at 167½. It fluctuated within narrow limits, the highest figure reached being 168½ and the lowest 167¼. The sales aggregated 9217 shares. General Electric continues its upward progress and reached 324¾ at one time during the week, the lowest figure being 319 and the closing price 322½, a net gain of 1½ points. Westinghouse Electric, common, closed at 193½, being a net loss of ½ point, and first preferred suffered a net loss of 1 point, closing at 197. Western Union made a net gain of ¼ point, closing at 90¼. A net gain of 2 points is recorded to the credit of American Telegraph & Cable, and an equal amount to American Telephone & Telegraph, the latter closing at 172 and the former at 87. Following are the closing quotations of April 1:

NEW YORK.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
American Tel. & Cable..	85	84	General Electric.....	322	321
American Dist. Tel.....	33	30	General Carriage.....	⅞	⅞
Brooklyn Rapid Transit..	65¼	63⅜	Hudson River Tel.....	—	—
Ches. & Pot. Telephone .	—	—	Metropolitan Street Ry..	167½	162½
Commercial Cable.....	148	148	N. E. Elec. Veh. Trans..	⅜	—
Electric Boat.....	25	24	N. Y. Elec. Veh. Trans...	12	12
Electric Boat pfd.....	47	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1½	1½	Tel & Tel. Co America..	—	—
Electric Vehicle.....	2¾	2¾	Western Union Tel	89⅞	90¼
Electric Vehicle pfd.....	5	4¼	West. E. & M. Co.....	194	194
			West. E. & M. Co. pfd...	194	197

BOSTON.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
Am. Tel. & Tel.....	168⅜	173	Mexican Telephone.....	2½	2¾
Cumberland Telephone...	—	—	New England Teleph...	*146¾	146¾
Edison Elec. Illum	-	-	Westinghouse Elec.....	—	—
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	100	—
General Electric pfd....	—	—			

PHILADELPHIA.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
American Railways.....	—	—	Phila. Traction.....	98	97⅝
Electric Storage Battery..	71½	76	Philadelphia Electric.....	5	4⅞
Elec. Storage Batt'y pfd..	73½	77	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	7⅝	7¼	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
Central Union Telephone.	—	—	National Carbon pfd.....	91	90
Chicago Edison.....	173	173	Northwest Elec. com. ...	39¼	39¼
Chicago City Ry.....	—	224½	Union Traction.....	19¾	18
Chicago Telep. Co.....	—	—	Union Traction pfd.....	56	—
National Carbon.....	25	24½			

*Asked.

LOCKPORT POWER PROJECT.—As noted last week, the Lockport, N. Y., Common Council has awarded a contract to the Niagara, Lockport & Ontario Power Company to supply the city with pure water to be obtained from a power canal to be constructed from the Niagara River. The company must build the canal immediately, or forfeit the contract, which calls for an expenditure of $500,000 by the city for the water supply. This is much more than the water would be worth, but it is believed that the power canal would bring many great manufacturing concerns to Lockport. It will cost millions of dollars to dig the canal. William M. Luther, of Buffalo, who is financing the project, declares that $7,500,000 has already been subscribed in New York, Chicago, Philadelphia, Pittsburg, and Cincinnati. All that the capital invested in the project has been waiting for, he declares, is the contract with the city that was awarded this month. The power canal project would rival the Niagara Falls power project, as the company must develop at least 100,000 horse power in Lockport to make its contract operative. The citizens of Lockport pleaded with the Common Council to grant the application for the contract. The Niagara River will be tapped at Lasalle, and the water will be carried eighteen miles. The company must deposit $500,000 in a local bank within three months, the money to be used to begin the work of construction. The company has a franchise granted by the State, and the promoters are now securing options on land along the proposed route.

CONSOLIDATION IN BALTIMORE.—Advices from Baltimore, Md., state that a deal is about being completed between the Susquehanna Electric Power Company and the United Railways Company, which controls all the street railways and the lighting of that city. The contract is to cover the purchase of the United Electric Light & Power Company by the Susquehanna Company and the supplying of electric power to the United Railways. It is said in United Railways circles that the purchase price of the United Electric Light & Power Company will be $1,250,000 in cash. This will be paid to the United Railways for the $2,000,000 of common stock of the Electric Light & Power Company. Parties, however, connected with the Susquehanna Company said that the two companies would not be merged. The plans of the Susquehanna Company contemplate three developments of 40,000 horse power each on the Susquehanna River above Port Deposit. This power will be brought to Baltimore for distribution by the United Electric Light & Power Company. The Continental Trust Company, of Baltimore, has the financial plans in charge.

INTERNATIONAL NICKEL.—The International Nickel Company was incorporated last week at Trenton, N. J., with a capital stock of $24,000,000, half of which is to be common stock and half preferred, the latter bearing 6 per cent non-cumulative dividends. Former Attorney-General John W. Griggs is the private counsel of the new company, and the company's New Jersey agent is the Corporation Trust Company of Jersey City. The incorporators named in the certificate are H. P. Pell, Howard K. Wood and Kenneth K. McLaren. The company is authorized to deal in nickel and all other metals. This is the development of the plans of Colonel Robert M. Thompson, president of the Orford Copper Company; Charles M. Schwab, president of the United States Steel Corporation, and their friends, looking to the control of the mining of nickel ore. The new company will hold a controlling interest in the stocks of the Orford Copper Company of Bayonne, N. J., and the Canadian Copper Company, and an interest, which at last accounts was not a controlling interest, in the Nickel Corporation of London, England.

CONSOLIDATION OF COLUMBUS LIGHTING INTERESTS.—Articles of consolidation of the Columbus Edison Electric Light Company and the Columbus Electric Company have been filed. The new company, known as the Columbus Edison Company, has a capital stock of $1,000,000, $550,000 of which is preferred stock. Stock in the consolidated company is to be distributed as follows: For each $100 of Columbus Edison Electric Company $75 of preferred and $112.50 of common in the consolidated company. For each $100 of Columbus Electric Company $16.67 of preferred stock and $25 common stock in the consolidated. Officers of the new company are Adolph Theobold, president; John Siebert, vice-president; Arthur Field, secretary; Emil Kieseweter, treasurer. The list of directors includes nine directors of the Columbus Edison Electric Light Company and two of the Columbus Electric Company.

BRITISH THOMSON-HOUSTON.—The British Thomson-Houston Company, Limited, now controlled by the General Electric Company, has just floated on the London market, through J. S. Morgan & Company, £200,000 of 4½ per cent debentures for the purpose of partly defraying the expenditure incurred in connection with the company's new plant now being completed at Rugby, on which £240,000 is stated to have already been spent.

CHARLESTON, S. C., ANNUAL REPORT.—The Charleston Consolidated Railway, Gas & Electric Company reports for the fiscal year ended Feb. 28, 1902, as follows: Gross, $549,520, an increase of $61,997; operating expenses, $334,335; net, $215,185; charges and taxes, $153,437; balance, $61,748; new installations and sinking fund, $11,422; surplus, $50,326.

CINCINNATI GAS & ELECTRIC.—C. W. Wetmore and Geo. R. Sheldon have resigned as directors of the Cincinnati Gas & Electric Company, and their places have been filled by the election of Charles P. Taft and J. B. Foraker, Jr. The North American Company has parted with its entire holdings of Cincinnati Gas & Electric.

TOLEDO, OHIO, CONSOLIDATION.—The Philadelphia Guarantee & Trust Company is considering a proposition to purchase the Toledo Street car system, and several lighting companies for $14,000,000, and has an agent in Toledo at present making an inspection.

HOUSTON, TEX., ELECTRIC.—The annual report of the Houston, Tex., Electric Company for 1901 shows: Gross, $292,475; expenditures, $253,709; surplus, $39,046.

MONTGOMERY, ALA., TROLLEYS.—It is announced from Montgomery, Ala., that J. G. White & Company, of 29 Broadway, New York, have undertaken the building of a new street railway system in Montgomery. Colonel Barry Holt and other local men of wealth procured the franchises covering the ground not occupied by the existing system and extending over some ten miles of city streets. Colonel Holt is authority for the statement that White & Company have placed the bonds, ordered rails and cars and will begin work at once. The old system has refused to sell at less than $500,000. The new company will be at once organized, the syndicate owning the franchises, agreeing to take stock in exchange.

DIVIDENDS.—The New England Telephone & Telegraph Company has declared a regular dividend of 1½ per cent, payable May 15. The directors of the Boston Suburban Consolidated Electric Companies have declared their first quarterly dividend of $1 per share. The City Railway of Dayton has declared the regular quarterly dividend of 1½ per cent upon the preferred and 1½ upon the common stock, payable April 1. The directors of the Philadelphia Company have declared the regular quarterly dividend of 1¼ per cent, payable April 21.

UNITED POWER & TRANSPORTATION.—The United Power & Transportation Company, with headquarters in Philadelphia, announces that stockholders of record March 3 shall have the privilege of subscribing for stock of the company at $35 per share in the proportion of 15 per cent of respective holdings, the privilege to expire May 1. Fifty per cent of the amount due under the subscription shall be paid on or before May 1 on which interest will be paid at the rate of 4 per cent from the time of payment to July 1 and 50 per cent to be paid on or before July 1.

JACKSON, TENN., CONSOLIDATION.—An acceptance has been received, it is said, from St. Louis capitalists by which they will purchase the electric street car system, electric light and gas plants of Jackson, Tenn. The deal involves an outlay of about $200,000. The new company will extend the car system and make other improvements.

NORTH JERSEY TROLLEYS.—It is stated that within the next twelve months the North New Jersey Street Railway Company will spend $1,000,000 in improving its system. It has ordered 60 new cars and is arranging for a new power plant of 15,000-hp to cost $400,000.

Commercial Intelligence.

THE WEEK IN TRADE.—The spring weather has favored retail distribution, which is reported as being very active East and West, with a fair business at the South. There has been on the whole less activity for iron and steel, but production and shipment have gone forward at undiminished speed. The building trades have taken a decided spurt in activity. Finished iron and steel has been active, implement and wagon manufacturers buying heavily of steel bars, which are nominally $2 per ton higher. The milder weather has somewhat relieved the strain on the coal trade, but strike talk has prevented weakness in prices. In the copper market there was some weakness and prices declined a fraction since last quotations. Very little business was transacted; consumers still show no disposition to enter the market. Lake is quoted at 12@12¼c., electrolytic and casting 12¼c., cathodes 11¼@11½c. and for casting stock 11½@11⅝c. The business failures for the week, as reported by *Bradstreet's*, aggregated 183, as against 197 the week previous, and 189 the same week last year.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended March 22: Antwerp—6 pkgs. material, $379; 4 pkgs. machinery, $250. Argentine Republic—41 pkgs. material, $387; 1 pkg. machinery, $213. British Guiana—52 pkgs. material, $2,412. Bremen—1 pkg. material, $15. British West Indies—15 pkgs. machinery, $386. British East Indies—13 pkgs. material, $1,017; 5 pkgs. machinery, $500. Brussels—2 pkgs. material, $184. Brazil—9 pkgs. material, $348. British Possessions in Africa—170 pkgs. material, $4,113; 46 pkgs. machinery, $2,221. Bristol—87 pkgs. machinery, $8,000; 1 pkg. material, $50. British Possessions (all others)—7 pkgs. material, $187. Copenhagen—1 pkg. machinery, $30. Central America—22 pkgs. material, $418. China—1 pkg. material, $100. Cuba—1 pkg. machinery, $14; 56 pkgs. material, $1,543; 40 pkgs. wire, $193. French West Indies—2 pkgs. material, $52. Glasgow—14 pkgs. material, $462. Hamburg—12 pkgs. machinery, $500; 14 pkgs. material, $910. Havre—16 pkgs. material, $220; 14 pkgs. material, $1,331. Hong Kong—17 pkgs. material, $417. Japan—80 pkgs. machinery, $3,641; 49 pkgs. material, $7,453. Korea—24 pkgs. material, $1,510. London—149 pkgs. machinery, $13,244; 73 pkgs. material, $5,585. Liverpool—455 pkgs. machinery, $13,817; 37 pkgs. material, $2,272; 140 pkgs. wire, $2,054. Leeds—12 pkgs. material, $239. Mexico—234 pkgs. material, $1,853; 9 pkgs. machinery, $4,429. Marseilles—21 pkgs. material, $315. Newfoundland—49 pkgs. material, $448. Nova Scotia—3 pkgs. machinery, $108. Philippines—21 pkgs. material, $628. Peru—8 pkgs. material, $437. Rotterdam—1 pkg. machinery, $45. Southampton—35 pkgs. machinery, $2,201. Swansea—913 bbls. copper material, $42,944. U. S. Colombia—58 pkgs. material, $544. Vienna—1 pkg. machinery, $45. Venezuela—116 pkgs. material, $2,300.

STROMBERG-CARLSON TELEPHONE.—In accordance with the news already given in these columns, the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, has now been incorporated in New York State, to take over the capital stock and assets of the Illinois corporation. The capital of the new concern is $3,000,000, and the directors are Alfred Stromberg, Andrew Carlson, Charles A. Brown, all of Chicago; Frederick Cook and Wallace B. Duffy, of Rochester. Mr. Eugene H. Satterlee, of Satterlee, Yeoman & Taylor, of Rochester, informs us that there is no intention of moving the plant to Rochester, but that it is possible an auxiliary plant will be located at that place for the purpose of making certain things which are used by the Stromberg-Carlson people, in order to relieve the great pressure on the capacity for production at the Chicago works. No change in the policy or in the practical operation of the company is contemplated. The new capital which has gone in has been furnished from Rochester.

SIMPLEX ELECTRICAL COMPANY, of Cambridgeport, Mass., has recently divided up among the men in its large factory for insulated wires and cables, a handsome bonus on a profit-sharing basis. The Mayor of the city presided at this very interesting function and Mr. Everett Morss, on behalf of the firm and family, in making an address said that the action was in no sense philanthropy, but a piece of business wisdom. The firm employs over 350 people, but the recipients were some 50, whose services had been continuous during the stipulated period of not less than two years. The amount divided up reached $3,000, and was entirely in addition to the regular wages, and of course the rate of pay, hours, etc., had all remained the same as though no profit-sharing plan had been inaugurated. The fifty men presented the Simplex Company with a handsome signed acknowledgement of the action of the corporation, whose business founded by Mr. Charles A. Morss, has become one of the notable industries of the place.

MR. J. H. VAIL, 1328 Chestnut Street, Philadelphia, announces that the Bonneville Portland Cement Works, Siegfried, Pa., has just finished installing under his specifications and supervision some important additions to its plant. An important feature of this installation is the use of motors for driving stone crushers, two large Gates crushers with bucket elevators made by the Link-Belt Engineering Company, being driven each by a 50-hp General Electric motor. The installation also includes an Armington & Sims 250-hp engine direct connected to a 150-kw Fort Wayne generator. In plants of this nature the depreciation is excessive, owing to the large amount of stone dust which is continually in the air. Mr. Vail has perfected a successful and efficient method of protecting the motors from this dust.

THE H. P. WHITE COMPANY, 1127 Appletree Street, is about to move its factory and main office to Wayne Junction, Philadelphia, opposite the Reading Railway station. It expects to be settled in its new quarters and ready for business by April 1. Its switchboard and switch business has grown so rapidly that for some time past its present quarters have been inadequate. The new factory will afford it ample facilities for turning out first class work with promptness and dispatch.

AUTOMATIC TELEPHONE ORDERS.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has among its recent export contracts one of 48 stations for the De Beers Explosive Works, Somerset West, Cape Colony, South Africa. This is another addition to an already large list of foreign orders and equipments. Among domestic orders, the company reports one from the Maine Insane Hospital, Augusta, Me., 60 stations.

STEAM TURBINES FOR ENGLAND.—The order for the plant for the Metropolitan Railway Company, Limited, to the British Westinghouse Electric Company will include three three-phase units of 3500-kw each, with 50 per cent overload capacity, two of the sets for steady use and one as standby. These are to be driven by Westinghouse-Parsons steam turbines. Three exciters are also included.

GREENFIELD, MASS., POWER TRANSMISSION.—The Greenfield Electric Light Company will develop a water power on the Deerfield River by building a dam and power house for 1500 horse power. The current will be transmitted five miles to the company's network in Greenfield. Mr. A. C. Rice, consulting hydraulic and mechanical engineer, State Mutual Building, Worcester, Mass., has the matter in hand.

ORDER FOR BOILERS.—Mr. J. S. Mitchell, secretary of the Weston, W. Va., Electric Light & Power Company, informs us that they have made a contract for two 125-hp water tube boilers with the Erie City Iron Works, of Erie, Pa.

AXLE CAR LIGHTING.—Mr. J. N. Abbott, vice-president and general manager of the Consolidated Railway Electric Lighting & Equipment Company, 100 Broadway, New York City, reports that after two years' crucial test, the Atchison and Pullman companies have accepted as entirely satisfactory the 115 "Axle Light" equipments used in Atchison service, and all private Pullman cars are now being equipped with the same electric car lighting system. They are also applying their lighting equipment extensively upon the cars of the Missouri Pacific, St. Louis & San Francisco, Chicago Great Western, Pennsylvania lines west of Pittsburg, Grand Trunk and other railways, as well as upon the private cars of many railway officials. The company either sells these equipments outright or installs and maintains them on a rental basis at no greater cost per car per annum than railway companies pay for gas, everything included. It would seem that the system and the method of introduction have great possibilities before them.

GILBERT WILKES & COMPANY, of Denver, Colo., report the sale of four carloads of Wagner transformers to the Denver Gas & Electric Company; one 40-hp Bullock teaser equipment to the Denver *Post*; two 20-hp Bullock motors to the Vulcan Iron Works, of Denver; one 10-hp, three 15-hp, and five 20-hp Wagner alternating current single-phase motors and three 40-kw, 60-cycle transformers, to the Idaho Springs Mining, Milling & Reduction Company, Idaho Springs; two 90-hp Bullock motors to the Denver Engineering Works; two 10-hp Wagner single-phase motors to the Billings, Mont., Water Works Company. The Denver Gas & Electric Company, which bought last September two 600-kw Bullock alternators, has now bought one 400-kw belted power generator, one 600-kw three-phase belted alternator and one 1500-kw, 60-cycle, three-phase direct connected alternator.

CROCKER-WHEELER TELEPHONE EQUIPMENT.—The battery chargers and ringers manufactured by the Crocker-Wheeler Company are meeting with success in the hands of the various telephone companies using them, and the demand is constantly increasing. Recent orders have been entered from the Bell Telephone Company of Buffalo, Pennsylvania Telephone Company of Harrisburg, Charlotte Telephone Company, American Telephone & Telegraph Company, New York & Pennsylvania Telephone & Telegraph Company, Iowa Telephone Company and the Pacific States Telephone & Telegraph Company. The Western Union and Postal Telegraph companies are also numbered among extensive buyers of Crocker-Wheeler dynamotors and motor-dynamos.

GASOLINE ENGINE PLANT.—Daboll & Crandall, civil engineers, 94 State Street, New London, Conn., are installing for the Groton, Conn., Electric Company a small village plant which will be operated under the same roof as the water pumping plant. They hope to run with water wheels a considerable portion of the year, and are putting in also a Westinghouse 80-hp gasoline engine for auxiliary power. As the water plant only requires power for a few hours each day, it is designed to use the same power for lighting at night. The plans are not quite complete, but the plant will probably start in with 150 incandescent street lights and 1000 commercials. Mr. H. W. Hobbs, of the Hawks Electric Company, Boston, is the electrical engineer of the plant.

STANDARD ELECTRIC COMPANY.—The Standard Electric Company, of Erie, Pa., has recently been organized for the purpose of manufacturing electric machinery for all purposes, and also to do a general repair business. Carson J. Sturgeon, Wm. Tozer and W. J. Ferguson are the interested parties and are practical men in this line of work. They are prepared to bid on electric motors and dynamos for delivery in quick time. They have a line of patterns covering all sizes up to 50 horse power and are in position to bid on work at once.

EQUIPMENT FOR HARTFORD STREET RAILWAY PLANT.—Westinghouse, Church, Kerr & Company, of 26 Cortlandt Street, New York City, have been awarded a contract by the Hartford Street Railway Company, of Hartford, Conn., for a 1600-hp Westinghouse Cross Compound Corliss engine and a Westinghouse street railway generator, having a capacity of 105 kw. This equipment is intended to be installed in the Hartford concern's enlarged plant, now under construction.

A NEW TRANSMISSION PLANT.—The Sacramento Electric, Gas & Railway Company has purchased reservoir sites and acquired water rights for an additional electric power transmission. The site will be on one of the branches of the American River about 40 miles above the company's Folsom Power station. The distance of transmission to Sacramento via Folsom will be about 60 miles. It is estimated that 10,000 hp can be developed with an available head of 1700 ft.

EUROPEAN RAILS FOR MEXICAN TRAMWAYS.—The Mexico Electric Tramways Company, of the City of Mexico, whose entire purchases for equipment, etc., have hitherto been made in the United States, is about to place a contract for 700 tons of rails in Europe because of the better inducements being made by competitors on the other side. The rails are to be of 90-lb. weight and are intended to be used for an extension of the company's system.

POLICE TELEGRAPH SUPPLIES.—Commissioner Partridge, of the New York Police Department, has made a requisition for $170,000 for extra telephone and telegraph supplies. It is a notorious fact that the signaling systems of both the police and the fire alarm services in Greater New York need a lot of money spent upon them to bring them up to modern ideas of efficiency and to make them equal to the demands of the rapidly increasing population.

SHAW CRANE FOR SAN FRANCISCO PLANT.—The Shaw Electric Crane Company, of Muskegon, Mich., whose New York offices are at 85 Liberty Street, has obtained a crane contract for the new Market street power station at San Francisco. The crane will have a capacity of 30 tons and is to be equipped with a three-ton auxiliary hoist. The span will be 47 feet. The equipment is to be operated by three motors having an aggregate of 55 hp.

THE WINTON MOTOR CARRIAGE COMPANY, Cleveland, is having plans prepared for what it claims will be the largest automobile factory in the world. A twelve acre site adjoining the National Carbon Company's plant has been secured, and the main building will be nearly 900 feet in length. Gasoline engines will furnish the power. A large lighting plant will be installed.

MORE MACHINE TOOLS FOR JAPANESE ARSENAL.—The Garvin Machine Company, whose establishment is at Spring and Varick Streets, New York City, has secured a machine tool order through the Japanese house of Takata & Company, of 10 Wall Street. The equipment is intended to be installed in the new Japanese Government arsenal about to be built at Maizura.

DAYTON-CINCINNATI TROLLEY.—Dr. Samuel F. George, president of the Dayton, Fort Wayne & Cincinnati electric line, claims to have negotiated all the bonds of the company, and financed the building of the road in New York City. The road will be rapidly pushed towards completion; J. G. White & Company will construct and the General Electric Company equip the road.

SUB-STATION EQUIPMENT FOR CALIFORNIA.—The General Electric Company will supply the Los Angeles and Redondo Railway Company with the equipment for three substations. There will be eight motor-generator sets, besides transformers, switchboards, etc. Electric power will be taken from one of the Southern California transmission lines.

THE ST. LOUIS FAIR.—All the electric wires on the World's Fair grounds will be carried in a subway, the contract for which was to have been let by the Director of Works April 1. The subway must be finished by June 1, 1902, and a penalty of $100 per day is imposed for delay. Details of the subway have already appeared in these pages.

BRILL EQUIPMENT FOR ENGLAND.—The J. G. Brill Company, of Philadelphia, is about to make shipment of 42 truck frames, etc., to Bournemouth, one of the principal seaside resorts on the south coast of England, the electric traction system of which place will be largely installed with American equipment, etc.

BALL ENGINE ORDERS.—The Pacific Coast Oil Company, Point Richmond, Calif., has purchased an engine for electric service from the Ball Engine Company, Erie, Pa. The Casper Electric Company, Casper, Wyo., is installing for driving a dynamo, an engine purchased from the Ball Engine Company.

PUSH-BUTTON TELEPHONES.—The American Push-Button Telephone Company, of New York City, reports a great demand for its device and has received orders in March for over 9500 telephones. The neatness and the handiness of the apparatus are creating considerable popularity for it.

THE ROSSITER-MAC GOVERN ELECTRICAL COMPANY has filed articles of incorporation in St. Louis, Mo. The capital is $5,000, the incorporators being Clinton L. Rossiter, Frank MacGovern, Arthur B. Shepley, Thos. K. Skinker and Charles R. Skinker.

LIGHTING PLANT WANTED.—A lighting plant will be required for the shops to be erected at Upper Sandusky, Ohio, for the Marion Machine & Tool Company, formerly of Marion, Ind.

EXPORTS FROM SAN FRANCISCO.—The exports of electrical materials and apparatus from the port of San Francisco for the month of February reached a valuation of $5,796.

PROPOSALS will be received at New Baltimore, Mich., until April 12 on an electric lighting plant, including generator, engine, switchboard, transformers and lamps for the new city plant.

PRATT & WHITNEY COMPANY, Hartford, Conn., will erect a new small tool department, doubling its capacity, and to be operated by electric motors.

MACHINERY EXPORT TRADE, ETC.—The following table shows the exports of principal articles of iron and steel manufactures in the seven months ending with January, 1902, compared with the corresponding months of the preceding fiscal year:

Articles.	1901.	Seven months ending with January, 1902.
Pig iron (tons)	232,606	45,158
Bar iron (lbs.)	31,326,242	13,682,477
Bars or rods of steel (lbs.)	166,834,554	38,571,104
Hoop and scroll iron (lbs.)	6,584,268	2,296,574
Billets, ingots, etc. (tons)	108,619	2,249
Steel rails (tons)	199,122	132,539
Sheets and plates (lbs.)	85,514,687	18,489,620
Wire (lbs.)	88,380,282	123,137,826
Builders' hardware	$5,384,402	$5,152,714
Electrical machinery	$3,211,179	$2,963,696
Metal-working machinery	$2,789,524	$1,786,998
Pumps and pumping machinery	$1,343,116	$1,243,006
Sewing machines	$2,521,255	$2,201,165
Locomotive engines, (No.)	223	201
Typewriters	$1,568,209	$1,751,789
Nails and spikes (lbs.)	42,204,550	22,739,434
Total value of exports	$73,616,467	$57,310,128

It appears from investigation and reports that manufacturers in general have experienced no falling off in foreign orders, but have been hindered from meeting them by the heavy demands of the home market.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, Ill., reports having recently closed a contract with the Rawson Electric Company, of Albany, N. Y., for one of its latest central energy multiple switchboards consisting of six sections, with an ultimate capacity of 6000 lines. Its present equipment will consist of 2100 lines. Included in this contract is one toll board consisting of one 2-position section, also all necessary power apparatus, arrester and distributing frames and relay racks, etc. Another contract has been closed with this company for one of the Kellogg latest type central energy multiple switchboards consisting of three sections with an ultimate capacity of 4800 lines. Its present equipment will consist of 960 lines. Included in the contract is necessary power apparatus, arrester and distributing frames and relay racks, also a 2-position section toll board. The Kellogg Switchboard & Supply Company also reports having closed a contract with the Rawson Electric Company, of Cohoes, N. Y., for one of its latest type central energy multiple switchboards of 2400 lines capacity. Its present capacity will consist of 800 lines. Included in this contract is a toll board, all necessary power apparatus, distributing frames, relay racks, arrester frames, etc., all of which will be furnished by the Kellogg Company.

TO EXTEND TRANSMISSION LINES.—The Northern California Power Company has been incorporated by Antoine Borel, James Coffin, Edward Coleman, E. E. Shotwell and H. H. Noble, with a capital stock of $2,000,000. Among its purposes are to absorb the Keswick Electric Light & Power Company, of which H. H. Noble is president, and provide for a bond issue of $2,000,000. The funds realized from the sale of the bonds will be devoted to enlarging the capacity of the Keswick Company's hydro-electric transmission plant, near Shingletown, Shasta County, and extending the system considerably. The Tehama Electric Light & Power Company, of Red Bluff, has been purchased and its plant utilized as a sub-station. The transmission lines will be extended farther down the Sacramento Valley. The Keswick transmission plant has an electric development of 3000 horse power and a water power development of 4500 horse power, there being 3 water wheels, each of 1500 horse power. At this site 12,000 horse power can be developed and there are additional sites available.

TROLLEY WIRE FOR SYDNEY, N. S. W.—The National Conduit & Cable Company, Times Building, Park Row, New York, have secured a contract, valued at nearly $100,000, for trolley wire, to be used in the construction of the Sydney City & Suburban electric traction system, Australia. The contract was obtained through R. W. Cameron & Company, of 23 South William Street, New York. As already mentioned in these columns, the initial equipment for the Sydney power station, representing an expenditure of some $800,000, was allotted to the General Electric Company, and it is proposed to extend the station shortly, at an estimated cost, with equipment, of about $500,000. It may be well to state that the tenders now being invited by the municipal Council of Sydney for the equipment, etc., of electricity supply works have no reference to further contracts for the Sydney electric traction system which is being built by the New South Wales Government Railway and Tramway Commissioners, and not by the municipality of that Australian city.

SHEDD OSCILLATING FANS ABROAD.—The Shedd Electric & Manufacturing Company, of 136 Liberty Street, New York City, reports having entered into arrangements with Drake & Gorham, electrical engineers, of 66 Victoria Street, London, S. W., for the representation of their interests in Great Britain for a period of one year. It has lately been in receipt of a large number of orders and inquiries from abroad, and is afraid it has already struck the limit of its producing ability for the season of 1902. The company has given to Mr. J. Frank Eline, of Baltimore, Md., the sole agency in that city for the "Comfort" oscillating fan, which was recently described and illustrated in these pages. The Federal Electric Company, whose offices are in the Washington Life Building, 141 Liberty Street, has recently ordered over 100 Shedd fans for shipment to various Mexican and South American points.

ELECTRICAL EQUIPMENT FOR JAPANESE COLLIERY.—The Hokkaido Colliery & Railway Company, of Hokkaido, Japan, is to be furnished with some $30,000 worth of American electrical equipment, etc., for mining purposes. The principal item appearing in the contract calls for two compound condensing engines of 400-hp capacity each, which will be built by McIntosh, Seymour & Company, of Auburn, N. Y. The generators, it is reported, will be of English manufacture. The J. R. Van Dyck Company, Electrical Exchange Building, New York, has been allotted an order for the oil filtering apparatus. The filters will be made by the Pittsburg Gage & Supply Company. These contracts were secured through H. Becker & Company, of 35 South William Street, New York, which concern succeeded to the business of Heyn, Brockelmann & Company, of Japan.

LARGE POWER PLANT ORDER.—It is stated that important contracts for a power plant, to cost $500,000, have been given out by the Pittsburg, McKeesport & Connellsville Electric Railway, to be built at New Haven, Pa. The Westinghouse Electric & Manufacturing Company will furnish three generators, each of 1850-hp capacity. The pumping and condensing plant, with a capacity of 6,000,000 gallons daily, will be installed by Henry R. Worthington, of New York. There will be three vertical Allis engines installed by the Allis-Chalmers Company, of Milwaukee, Wis. The boiler plant will consist of two batteries, each containing six boilers with a total steam generating capacity of 6000 horse power. In addition to the coal and ash handling machinery, there will also be a 30-ton electric crane for handling heavy machinery.

WESTERN ELECTRIC FACTORIES.—An addition to the Chicago factory facilities of the Western Electric Company is announced. The concern is arranging for the erection of three additional buildings upon the property at Polk Street and the river. One of these buildings will be occupied by the wood working department for telephone boxes. The building will be three stories, 96x157 feet, entirely of fireproof material. The second building will be used for shipping purposes, will have a floor area of 8400 square feet, and a third will contain the machinery for wire stranding and will cover an area of 12,000 square feet.

BIG ASTOR HOTEL PLANT.—The Astor Hotel to be built at Fifty-third Street and Fifth Avenue is to be equipped for general light and power purposes with a 1500-hp plant. The engines will be manufactured by the Harrisburg Foundry and Machine Works, while the generators are to be built by the Western Electric Company. There are to be two engines of 450-hp each, direct connected to two 300-kw generators and the same number of 300-hp each, direct connected to 200-kw generators.

INCANDESCENT LAMP CONTRACT.—The contract for supplying the eleemosynary institutions and other State buildings of Texas with 10,000 incandescent electric lamps has been awarded to Teagarden & Schumate, electric supply dealers of Austin, Tex. Their bids were: Highest grade Columbia incandescent lamps, guaranteed one hundred hours, 4 to 25 candle-power, 16 cents each; 8 to 16 candle-power, 18 cents each, and 32 candle-power, 25 cents each.

THE WELLMAN-SEAVER ENGINEERING COMPANY, of Cleveland, has changed its name to the Wellman-Seaver-Morgan Engineering Company, and has enlarged its scope to include the manufacture of machinery of all kinds and other iron and steel products. Rapid progress is being made in the company's large plant in Cleveland and a portion of it is now in operation.

LARGE ORDER FOR CASTINGS.—The Craig Shipbuilding Company, of Toledo, has received a very large order for special castings from the Westinghouse Electric & Manufacturing Company, to be supplied at the rate of twenty tons per day.

NEW POWER PLANT.—The Cleveland, Frog & Crossing Company, Cleveland, Ohio, is making important additions to its plant and is preparing to erect a new power plant.

General News.

THE TELEPHONE.

MONTGOMERY, ALA.—The State is constructing a telephone line to connect the penitentiary at Wetumpka with the State farms at Speigners. The line will be 25 miles in length.

TUSCALOOSA, ALA.—The Southern Bell Telephone Company has purchased the Tuscaloosa Telephone Company's system and will hereafter operate it as part of its own.

ALMA, ARK.—The Alma Telephone Company has been organized, with a capital of $2,500. Mr. Jacob Yoes is president, W. C. Yoes secretary and James J. Yoes treasurer.

FORT SMITH, ARK.—The Choctaw Telephone Company has completed its line from Denison to South McAlester, and will now build to Bokchito, east of Caddo, and parallel the line of the Arkansas and Choctaw to the Kansas City Southern and then north to Fort Smith.

TEXARKANA, ARK.—The Texarkana Telephone Company, of Texarkana, capital stock $150,000, has been incorporated for the purpose of constructing and operating telephone exchanges and telephone toll lines in the States of Texas, Louisiana and Arkansas. Incorporators: F. M. Mamott, of Delaware, Ohio; W. P. Harrison and Fred. E. Harrison, of Cincinnati, Ohio; P. J. Eubanks, of Columbus, Ohio; B. M. Kuhl, Hiram Glass and J. Huckins, of Texarkana, Ark.

SAN FRANCISCO, CALIF.—A local telephone company has been organized in Pomona, Calif., with John Law, D. W. Parker and F. L. Palmer as directors.

AUBURN, GA.—The Auburn Telephone Company has been incorporated, with a capital stock of $400, by T. O. Hein and others.

HARRODSBURG, GA.—The Mercer Telephone & Telegraph Company is being organized for the purpose of establishing a system here. Among those interested are L. H. Carter, of Lawrenceburg, and Philip Ponge, of Louisville, Ky.

LINCOLNTON, GA.—Messrs. C. L. Groves and Reid Nash, of Lincolnton, will construct a telephone line between Lincolnton and Washington, Ga.

ATWOOD, ILL.—Atwood Mutual Telephone Company, capital $4,000, has been incorporated by A. V. Pounds, W. E. Means and C. B. Moore.

BENSON, ILL.—The Benson Telephone Company, capital, $10,000, has been incorporated by S. L. Peterson, J. E. Eckhart and R. Parks.

CHICAGO, ILL.—The law firm of Blum & Blum has commenced injunction proceedings in a Chicago court against the Chicago Telephone Company, declaring that the charging of more than $125 a year, the franchise rate, is illegal and against public policy.

CHICAGO, ILL.—The Talbot-Frost Telephone Company has been incorporated at Dixon, with a capital stock of $2,500. The incorporators are J. O. Fouts, C. B. Root and A. L. Cruzen.

CURTIS, ILL.—A new telephone line is being built between Sweetwater and Greenview. Several of the intervening farmers are having private lines put up.

HOOPESTON, ILL.—The Hoopeston City Council granted a new telephone franchise to J. E. Whitman.

ONARGA, ILL.—The Onarga telephone exchange is now in a fair way to become the largest in the county. There are already 182 instruments, and there are to be added six more farmer lines with 39 instruments, and about one dozen more in this town, which will swell the total to 232.

TOULON, ILL.—The Toulon Mutual Telephone Company has been incorporated with a capital of $500. The incorporators are Frank Berfield, Emery S. Buffum and George E. Sadler.

VIENNA, ILL.—Vienna Mutual Telephone Company, capital $2,500, has been incorporated by James H. Carter, W. S. Crum and Charles H. Gray.

ALEXANDRIA, IND.—The Delaware & Madison Telegraph and Telephone Company has been given a thirty-three year franchise by the Alexandria City Council.

EUREKA, IND.—The Luce & Ohio Township Telephone Company has increased its capital stock from $10,000 to $50,000.

FLORA, IND.—About one hundred local business men and neighboring farmers have organized the Farmers' Mutual Telephone Company, with a capital stock of $25,000.

FT. WAYNE, IND.—The Indiana Electrical Investment Company, of this city, gave a banquet recently to the Logansport Telephone Company stockholders and the Cass County Construction Company, to celebrate the completion of the independent telephone system at Logansport, which already operates 950 telephones. The same company is constructing the new telephone system at South Bend.

INDIANAPOLIS, IND.—The Citizens' Mutual Telephone Company has been incorporated, with a capital stock of $200. It will erect and operate a telephone exchange in the town of Newport. The directors are C. P. Potts, H. V. Nixon, E. B. Huxford, J. A. Hughes and B. H. Davis.

INDIANAPOLIS, IND.—Two telephone companies filed articles of incorporation during the past week. The Big Lick Telephone Company, of Madison County, capital stock, $2,000. The directors are George Boram, James Cunningham, John Bennett and John Brock. The company will build farmers' lines in Madison County. The Whitesville Co-operative Telephone Company, of Whitesville, capital, $1,000; directors, D. H. Davidson, S. W. Gorley, J. A. Landus, A. L. Byers and G. W. Conn. The company will construct an exchange at Whitesville and build lines into the country districts.

INDIANAPOLIS, IND.—The Central Union Telephone Company has done away with the four-party-line lock-out service in the business districts at $40 a year, but the company makes a four-party non-lock-out contract at $2.50 a month, or $30 a year. The merchants [illegible] to raise the rates. The company has also refused to issue any more $10-toll books for $7.50 for toll line service on long-distance lines. These books gave merchants a 25-per-cent reduction. The company is now making a four-party-line service contract in the residence district at $1.50 a month.

LAFAYETTE, IND.—The merchants of this city are taking steps to secure free telephone service with towns, cities and farmers throughout the county. They claim that Frankfort and Crawfordsville, cities of adjacent counties, are extending free service into Tippecanoe County to the detriment of Lafayette merchants. They ask that the Lafayette Telephone Company co-operate with the People's Co-operative Company, which is now operating in the county, and with other companies so as to give free service. If not willing to do this, then the Council will grant a franchise to a company that will.

NEW ALBANY, IND.—An exchange will be established by the Cumberland Telephone Company at Georgetown, this county, and the subscribers, over one hundred in number, will have the use of all the lines to every part of the county.

NEWCASTLE, IND.—R. R. Faulkner has purchased the franchise, equipment, etc., of the Newcastle Telephone Company.

RISING SUN, IND.—The Ohio River Telephone Company, capital $45,000, has been incorporated to operate in Dearborn, Ohio, Switzerland, Jefferson and Ripley counties. The incorporators are William M. Green and Calvin R. Green, of Rising Sun, and William M. Green, jr., of Vevay.

BRADGATE, IA.—The Humboldt County Telephone Company, capital $10,000, has been incorporated by W. S. King, George Fletcher, S. F. Boyden, M. A. McCray, W. C. Hoag, Jerome Tilton, W. O. Brown, George E. Kelsey, George V. Jarvis, F. M. Lee, Clark Brown, J. V. Overholser and W. S. Wallace.

BUFFALO, IA.—The Rural Telephone Company will construct a line from Linwood to Buffalo.

CEDAR RAPIDS, IA.—The Cedar Rapids & Marion Telephone Company has filed an acceptance of the ordinance passed by the Council extending and enlarging the franchise.

CLOUD, IA.—A company has been organized to build a telephone line connecting Newbern with Knoxville.

COLLETT, IA.—A telephone line is to be built from Birmingham via Collett to Libertyville.

COLLINS, IA.—The Collins Telephone Company, capital stock, $10,000, has been incorporated.

DES MOINES, IA.—At the close of March the Mutual Telephone Company issued a report showing a net increase in the number of subscribers of about 170. During January there were 46 new telephones put in, in February 57, and orders now on file make the total 166 subscribers in three months, or an average of 600 a year. The Mutual now has 2,100 subscribers. The Mutual Telephone Company has placed an order for several thousand feet of new cable to be used in the construction of an extended underground conduit system.

GRINNELL, IA.—The Long Distance Cipher Telephone Company, capital stock $500,000, has been incorporated by C. B. Morse, C. W. H. Beyer and C. H. Brown.

IOWA CITY, IA.—The Pleasant Valley Telephone Company will build a line to Lone Tree.

JOHNSONVILLE, IA.—It is reported that the Farmers' Mutual Telephone Company will extend its line south to Johnsonville.

MEDIAPOLIS, IA.—Articles of incorporation of the Mediapolis Telephone Company have been filed. O. H. Walker is general manager, and W. V. Lloyd secretary and treasurer.

MILTON, IA.—The Union Telephone Company has been organized. It will run from Milton to Keosauqua.

MT. PLEASANT, IA.—Another telephone exchange will be established here, a new company having been recently organized, with a capital stock of $50,000.

MOVILLE, IA.—The Moville Town Council has granted a franchise for a local telephone exchange to a syndicate of local business men.

RED OAK, IA.—The Red Oak, Salem & Hawthorne Mutual Telephone Company has been organized. Jacob Rose is president.

ROCK RAPIDS, IA.—The Lyon County Telephone Company, capital stock, $10,000, has been incorporated by W. C. Wyckoff, and others.

ROLAND, IA.—The Roland Mutual Telephone Company, capital $5,000, has been incorporated. E. Rice is president, H. E. Myran secretary and H. C. Deua treasurer.

WINFIELD, IA.—At a meeting of the stockholders of the Winfield Telephone Company $3,000 more stock was put on the market. This stock is to be sold for the purpose of building the lines southwest to Mt. Union.

TISHOMINGO, I. T.—Articles of incorporation have been filed by the Tishomingo International Telephone Company, capitalized at $50,000. Nack Wolfe, Ben J. H. Colbert, Cornelius E. Folly, Daniel M. Hailey and Leon H. Roberts are the incorporators.

WELLSVILLE, KAN.—A franchise was granted the Wellsville Telephone Company to establish and operate a telephone system in Wellsville.

BOREING, KY.—Mr. John Woodward has purchased the Pineville, Ga., telephone exchange and will connect it with the Barboursville system.

FRANKFORT, KY.—Articles of consolidation of the Old Kentucky Home Telephone & Telegraph Company, the Mt. Sterling Telephone Company, the Winchester Telephone Company and the Winchester and Lexington Telephone Company, which had a combined capital stock of $13,650, have been filed. The new company is to be known as the Old Kentucky Home Telephone & Telegraph [illegible]

LOUISVILLE, KY. [illegible] to organize a company to construct a telephone line from Paris, Tenn., to Paducah, touching at Hazel, Harden, Murray and Benton.

PADUCAH, KY.—The People's Independent Telephone Company, capital $150,000, has been incorporated.

PARIS, KY.—A franchise has been granted to the Fayette Home Telephone Company, of Lexington, to operate an exchange at this place.

LAKE CHARLES, LA.—Captain C. J. Rauch is interested in establishing a telephone line between Leesburg and Lake Charles.

POCOMOKE CITY, MD.—The Telephone Company of Pocomoke City has been incorporated by Dr. William H. Waters, Emerson G. Polk, Isaac H. Merrill, William S. Schoolfield and Robert J. Lambdin. Extensive improvements and changes are being made in the exchange and on the line.

BOSTON, MASS.—The New England Telephone & Telegraph Company has purchased the Kearsarge Telephone Company, of Concord, N. H. The New England Company had previously purchased the Merrimac County Telephone Company, thereby eliminating all competition in Merrimac County, N. H.

ALMA, MICH.—The Union Telephone Company, at its annual meeting, elected the following officers: President, Stanley E. Parkhill, of Owosso; vice-president, J. P. Gibbs, of Ithaca; secretary, Thomas Brownley, of St. Johns; treasurer, G. L. Ward, of Alma. The capital stock was increased from $250,000 to $400,000.

DETROIT, MICH.—The Michigan Telephone Company has decided to establish an exchange at Milford.

DETROIT, MICH.—The Council has passed the ordinance granting rights to the Co-operative Telephone Company.

DETROIT, MICH.—The Valley Telephone Exchange, in this city, has grown to such proportions that the service is being handicapped by lack of facilities. New cables and switchboards will be installed.

DETROIT, MICH.—The Wayne Circuit Court has granted a mandamus requiring the Michigan Telephone Company to extend to the remaining subscribers of the Detroit Telephone Company, which was absorbed by the Michigan company, its full service and connections. For a time after the absorption the Michigan company extended its full service to the subscribers of the Detroit company. Michigan rates were cut to the same figure as charged by the Detroit company, and most of the subscribers to the latter company then put in Michigan telephones. Several months ago, when the Michigan company installed a new switchboard and raised its rates, the few remaining Detroit company subscribers were cut off from full service and given connections only with each other. The court holds that in buying out the Detroit Telephone Company the Michigan company bound itself to the terms and conditions of the ordinance under which the Detroit company operated.

MARQUETTE, MICH.—Manager Fred H. Smith, of the Michigan Telephone Company, says that his company is preparing to do a large amount of work on its lines in the Soo during the coming summer. Estimates on work amounting to $3,000 have been prepared, and if they are adopted by the company the work will be begun at once.

STOCKBRIDGE, MICH.—The telephone line between Trist and Munith has been incorporated for $2,000 under the name of the Trist Telephone Company. Andrew Reithmiller is president.

RENVILLE, MINN.—The matter of a farmers' telephone system is being agitated in Redwood County, and a committee is investigating the feasibility of establishing a system.

BOLIVAR, MISS.—The Bolivar Telephone Company has been incorporated with a capital stock of $10,000. Mr. Fred Clark is president; J. G. Collier, vice-president; D. J. Allen, jr., secretary, and W. T. Winston, treasurer.

JACKSON, MISS.—The telephone companies operating in the State will in future have to make reports of their property valuations for assessment by the Railroad Commission, as is done by other concerns, subject to the supervision of that body. This is rendered necessary by a law passed at the recent session of the Legislature, changing the method of assessing these corporations, which were previously left entirely to the county assessors. There are numerous local independent telephone systems in the State that will have to comply, but the system most extensively affected will, of course, be the Cumberland Company.

MERRILL, MISS.—The Merrill & Leakesville Telephone Company has been incorporated, with a capital stock of $500.

NEVADA, MO.—The Nevada Telephone Company, of Nevada, Mo., has been incorporated with a capital stock of $25,000, all paid up. The incorporators are A. B. Cockrill, L. M. Thompson, J. L. George and others.

BUTTE, MONT.—The Postal Telegraph & Cable Company has won its suit against the Oregon Short Line Railroad Company to obtain the right of way for a pole and wire line from this city to various points in Montana and to Oregon and Utah. The Postal Company has the right of way through Idaho and Utah.

KEARNEY, NEB.—A new telephone company has been started at Shelton, Neb., with a capital stock of $10,000, and to be known as the Farmers' Home Telephone Company. It is composed of the farmers in Shelton and Gibbon townships and will begin operations at once. The incorporators are William Smith, Albert Allen, Jacob Stearley, W. H. Maurer, and Joseph Buck, Jr.

OSCEOLA, NEB.—The Board of Village Trustees has granted a franchise to the Golden Rod Telephone Company, of Wahoo, to operate a telephone exchange in the village and to charge not more than $1.50 per month for business telephones and $1 for residences.

WEEPING WATER, NEB.—The City Council has granted franchises to both the Nebraska Telephone Company and the Plattsmouth Telephone Company. An exchange will be put in this spring.

NEWBURGH, N. Y.—The Citizens' Telephone Company, capital, $10,000, has been incorporated; directors, George Hardy, C. L. Wenzel, and G. R. Mitchell, of Newburgh.

REIDSVILLE, N. C.—The Reidsville Telephone Company has been incorporated, with a capital stock of $20,000, for the purpose of enlarging the Reidsville exchange and the building of several long-distance lines.

PILOT MOUNTAIN, N. C.—The Farmers' & Merchants' Telephone Company is building a six-mile line to Ararat.

WELDON, N. C.—The Bell Telephone Company will build a direct line between Huntsville, Ala., and Chattanooga, Tenn.

MANDAN, N. D.—The Mandan Telephone Company has been incorporated by C. E. V. Draper, Hattie Draper, P. Tobin and T. R. Brewer.

MINOT, N. D.—The Minot Light & Telephone Company has been incorporated by J. J. Barclay, F. C. Clark and L. M. Davis.

CANTON, OHIO.—Fifty-three of the sixty physicians here have boycotted the Bell Telephone Company. They have ordered their instruments out. The trouble started over an attempt to raise rates.

DEFIANCE, OHIO.—The Grocers' & Butchers' Association has declared war against the Central Union Telephone Company, because the company has announced an increase of rates for business and residence service.

FINDLAY, OHIO.—Manager Duval, of the Home Telephone Company, announces that the company is about to expend $60,000 in improvements.

JOHNSTOWN, OHIO.—The Johnstown Telephone Company has been incorporated, with $30.000 capital stock, by Dayton Bishop, C. W. Coe, Mark Coe, G. L. Beam and Dwight L. Sapp. The Johnstown & Croton Telephone Company, capital $30,000, has also been incorporated by C. H. Bishop, C. W. Coe, Mark Cook, Frank L. Beam and Dwight E. Sapp.

LODI, OHIO.—The Star Telephone Company will install additional instruments and string new cables in this place. A new exchange will be installed in the village of Spencer.

MARION, OHIO.—The Marion County Telephone Company has increased its capital stock from $5,000 to $10,000. Fred E. Guthery is president and Frank Crow secretary.

MOOREFIELD, OHIO.—The Moorefield & Caculli Telephone Company has been incorporated, with $2,000 capital stock, by J. S. Wallace, W. W. Kirkpatrick, S. J. Hanefeld, A. Blockburn, H. C. Wallace and E. D. Moore.

NEWTON FALLS, OHIO.—The Newton Falls Telephone Company is installing a new board built by the North Electric Company, Cleveland. The system will be improved.

NORTH LIMA, OHIO.—The Beaver Township Telephone Company has organized and will commence construction work in the near future.

SPRINGFIELD, OHIO.—The Common Pleas Court here has decided against the Central Union Telephone Company in a case where it attempted to remove a telephone because subscriber would not pay a higher rate than that usually required. The court held that the company had no right to discriminate in rates.

TROY, OHIO.—The Troy Home Telephone Company and the Piqua Home Telephone Company have gone into the American Home Telephone Company, which has recently been formed with $3,000,000 capital stock to combine plants in Richmond and Elkhart, Indiana; Troy, Piqua, Port Clinton, Tiffin and London, Ohio; Huntington, W. Va., and Herkimer and Rome, N. Y.

WAPAKONETA, OHIO.—W. H. Fledderjohann and others have purchased the exchange at Ada, Ohio, paying $50,000. The purchase includes the toll lines connecting the exchange. The same people have incorporated a company at Bellefontaine, Ohio, with $250,000 capital stock. When completed, the property will include exchanges in ten towns in that vicinity, with about 500 miles of toll lines.

GUTHRIE, OKLA.—The Missouri & Kansas Telephone Company is preparing to spend $1,000,000 this year to improve its system. Almost one-half the sum will be expended in Kansas City. The bulk of the balance of the money will be spent in Lawrence, Wichita, Topeka, Kansas and Oklahoma points. New buildings are to be put up at some places, and all are to be provided with more or less new equipment. At the same time, the company is going to extend as rapidly as possible its service to farmers and ranchmen. It has several hundred farm houses in Missouri, Kansas, Oklahoma and the Indian Territory, already connected up and its agents are at work increasing this part of the [illegible]

SHAWNEE, OKLA.—The Long Distance Telephone Company, which was incorporated here last February, has 360 subscribers in Shawnee, 85 miles of toll line in operation and 180 miles in course of construction. Its rates are $2.50 per month for business subscribers and $3.50 for two residences. Mr. James F. Noble is president and E. D. Nims secretary and treasurer. The switchboard has a capacity of 400 lines, Kellogg, Stromberg-Carlson and Sterling apparatus being used.

HANOVER, PA.—The local telephone syndicate, composed of S. L. Johns, Harry N. Gitt, George D. Gitt and Thomas J. O'Neill, has purchased the lines of the Boyds Telephone Company, of Maryland. This syndicate now owns all the telephone lines in Northern Maryland and several in the Virginias and Southern Pennsylvania.

NORRISTOWN, PA.—The Montgomery Telephone Company, which was recently organized, contemplates making some early extensions to its system. Mr. J. H. Schultz is president and Amos H. Schultz secretary.

CHARLESTON, S. C.—The Southern Independent Telephone Association was formed here at a meeting of representatives of independent telephone companies from North and South Carolina, Georgia, Florida and Virginia. F. V. L. Turner, of Atlanta, was elected president; W. G. Barien, Tampa, vice-president, and Paul Langdon, of Augusta, secretary and treasurer.

HENDERSON, S. C.—Final connections have been made between Greenville and Kinston, giving long-distance service to Morehead City, via the lines of the Carolina and Virginia Telephone Company. The main line, constructed to complete this connection, is about 200 miles in length and is a double metallic circuit. It now extends from Chase City, Va., to Morehead City, N. C., affording direct communication with over 5,000 subscribers in 35 exchanges. The principal points reached by the line just completed are Rocky Mount, Greenville, Tarboro, Scotland Neck, Wilson, Washington, Ayden, Kinston, Dover,

Trenton, New Bern, Mayboro and Morehead City. A cable is now being laid from Morehead City to connect Beaufort with the system.

SIOUX FALLS, S. D. [illegible] is [illegible] among the business men of Canistota to establish a local telephone system.

MEMPHIS, TENN.—The Memphis Telephone Company has increased its capital stock from $200,000 to $600,000.

SHARON, TENN.—The Cumberland Telephone & Telegraph Company has made a deal with the Weakley County Telephone Company which gives the former entire control of Sharon and Dresden, while the Weakley County Company will have control of Martin and Greenfield. All the Cumberland wires at Martin and Greenfield will run into the Weakley County boards, while all the Weakley wires at Dresden and Sharon will run into the Cumberland boards.

HILLSBORO, TEX.—The City Council has granted a franchise to an independent telephone company.

BEDFORD CITY, VA.—Arrangements have been completed for the establishment of a local telephone exchange by the Southern Bell Telephone Company.

LEXINGTON, VA.—Messrs. A. Elbart, Andrew Montgomery and others, of this place, are organizing the Rockbridge Mutual Telephone Company.

MARION, VA.—The Smyth Telephone Exchange has been incorporated here by S. W. Dickinson, president, and G. E. Goodell, secretary and treasurer.

RICHMOND, VA.—It is said the Chesapeake & Potomac Telephone Company will extend its lines from Washington County, Md., throughout Jefferson County, W. Va.

SMITHFIELD, VA.—The Smithfield and Isle of Wight Telephone companies have been consolidated under the name of the Home Telephone Company. Mr. J. W. Hollaway is president, A. S. Barrett secretary and treasurer and B. G. Gay general manager.

TACKETT MILLS, VA.—Mr. W. D. Reamy and associates will construct a telephone system at this place. The plans, however, have not yet been prepared. The contracts will be awarded later.

PROSSER, WASH.—The Prosser Telephone Company has been incorporated by Nelson Rich, D. M. Angus, John Chisholm, and W. P. Brownlow.

WHEELING, W. VA.—The area covered by the National Telephone Company is steadily increasing. Connection has been made with Akron, Ohio, and every town in Ohio within a radius of 150 miles. Bellaire will be connected within a few days when the enlarged switchboards are fully completed. A new line to Moundsville is under construction. All towns in West Virginia are now connected.

INDEPENDENCE, WIS.—The Osseo Telephone Company was granted a franchise to put in a telephone system at Fairchild.

ATHENS, WIS.—The Athens Telephone Company, capital $750, has been incorporated by Joseph Braun, George A. Kreutzer and William G. Cotansche.

KIRCHHAYNE, WIS.—The Kirchhayne & Cedarburg Telephone Company, capital $500, has been incorporated by William Fischer, sr., William Liesener and Henry Bartlett.

MILWAUKEE, WIS.—The Goodrich Transportation Company and the Barry Transportation Company are figuring to equip their fleets with wireless telegraph apparatus.

MUSCODA, WIS.—The Muscoda Mutual Telephone Company, capital $1,320, has been incorporated by F. E. Neff, H. J. Honer, N. F. Orth, Fred Kraus and James Sullivan.

WHITEWATER, WIS.—The township of Spring Prairie is to have a farmers' telephone system. It will be built by H. C. Hanckbey, president of the Walworth County Telephone Company.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Warrior River Light & Power Company has been incorporated by Robert R. Zell, J. L. Burns, A. L. Ezell, J. E. Adams and Charles J. Zell. The capital of the company is $1,000,000. This company proposes to erect a station on the Warrior River about twenty miles above Birmingham, and to utilize the water for the generation of power. The current will be transmitted to Birmingham.

EUFALA, ALA.—The City Council has under consideration two propositions for lighting the city, one from the local company with whom an agreement has not been reached, the other from the Atlanta Electric Light Company.

SELMA, ALA.—The plant of the Selma Electric & Power Company has been bought by W. D. and S. D. Pender and several Virginia and Pennsylvania capitalists. The price paid is between $75,000 and $85,000. W. D. Pender is already the president of the electric system in Norfolk and Portsmouth, Va., and Charlotte and Asheville, N. C., and has a large interest in the plant at Vicksburg, Miss.

REDDING, CALIF.—The Northern California Power Company has been formed, with a capital of [illegible] to consolidate the Kennett Electric Power Company, of this city; the Redding Water Company, the Redding Electric Light & Power Company and the Tehama County Electric Light Company, of Red Bluff. The plant of the last-named corporation was recently nearly ruined by fire, but the lines of wire are all in good shape. The company will increase the present plant of the Keswick Electric Power Company, on Mill Seat Creek. There is at present machinery at the plant for the generation of 3000 horse power, with available water right for the utilization of 12,000.

SAN FRANCISCO, CALIF.—Henshaw, Bulkley & Company are installing the electric light plant at Fort Miley, San Francisco. The generating set consists of a 7½-kw General Electric marine type engine and generator.

SAN FRANCISCO, CALIF.—A complete electric light plant is in operation at the city water works, in Winnemucca, Nev. A flow of only eleven miner's inches of water is utilized under a head of 1150 feet to drive a 30-inch Pelton water wheel, direct-connected to a 75-kw General Electric generator. During the dry season the generator is operated by a steam plant.

SAN FRANCISCO, CALIF.—An electric power plant will be installed near Healdsburg, Calif., for the purpose of supplying lights for a new hotel and power for an electric railway. A dam will be built in the Russian River. The projector is C. K. Penover, a nephew of the late Calvin S. Brice. He has had plans prepared for a hotel and summer resort, on the summit of Fitch Mountain, two miles from Healdsburg. The electric road will convey tourists from the town to the base of the hill and a cog-wheel railway will carry the guests up to the level of the hotel.

SAN FRANCISCO, CALIF.—A force of men is at work in the Yosemite Valley, Calif., on the construction of the electric lighting plant that will illuminate the hotels and cottages. The power station will be located at the Happy Isles. From this point a three-mile pole line will follow the driveway to the hotel. Nearly 100 series arc lights will illuminate this road. Two 75-kw General Electric two-phase generators will be direct-connected to two double-nozzle Pelton water wheels.

SAN FRANCISCO, CALIF.—The electric transmission plant to be installed two miles north of Cloverdale, Calif., by a company organized by A. Sbarboro, of San Francisco, will soon construct its first section. It will supply electric light and power in Cloverdale and Asti. Two alternating generators will be operated under a head of 320 feet of water. Later on, the lines will be extended to Healdsburg, making the distance of transmission 22 miles. Preston and Geyseville will also be lighted from the plant, which will have a capacity of about 400 horse-power.

SAN FRANCISCO, CALIF.—The Grass Valley Consolidated Mine now has a complete electric system in operation. A Stanley 96-horse-power synchronous motor furnishes power for pumping and hoisting, both hoist and pump being belted. The hoist is operated by means of a reverse gear and friction brake. Electric lights and telephones are used throughout the workings. A 75-horse-power air compressor to be driven by an electric motor will be installed. Leon McHall, of San Francisco, is the consulting engineer. Current is obtained from the Nevada County power station of the Bay Counties Power Company's system.

LIVINGSTONIA, CENTRAL AFRICA.—This place is to be lighted by electricity. The cost of the machinery and its transportation to the mission was about $20,000. The only source of illumination hitherto has been kerosene, obtained at a cost, by the time it reaches Lake Nyassa, of $1.50 a gallon. Steam power being out of the question on account of the scarcity of fuel, the falls of the river Manchewe, near the mission, will be used for the driving of electric machinery. The machinery is now on its way. The natural waterfall will thus thrash wheat, grind the flour, and bolt it in the mill by day and at night give light to the people in their homes.

ROCKVILLE, CONN.—The Rockville Gas & Electric Company has increased its capital stock from $70,000 to $90,000.

MILLEDGEVILLE, GA.—As a result of an order from the Superior Court, the noted Furman's Shoals property has been recently sold, the Oconee Electric Light & Power Company bidding in the property at $20,000. The shoals, which are said to be the third best water power in the State, are located on the Oconee River, about three miles above Milledgeville. An electric lighting plant will be built and factories will follow as a result of the development of this magnificent water power which has been heretofore running to waste.

BELVIDERE, ILL.—The citizens of Belvidere are asking the City Council for a franchise to install an electric light and heating plant. It is proposed to put it in on the most approved plans, and be up-to-date in every respect. The new company will be incorporated and will be known as the People's Electric Light & Heating Company.

CHICAGO, ILL.—The water power generated by the drainage canal will soon be used to furnish light to a portion of Chicago. The Economy Light & Power Company announces that a lease has been closed with the Edison Company by which 2,000 horse-power of that generated at the big plant at Jackson Street in Joliet would be furnished the Edison concern. Another lease has just been concluded with the Illinois Steel Company, by which 1,700 horse-power will be furnished the Joliet plant of that concern, and a third lease for 500 horse-power for the operation of the Bridgeport pumps has been signed.

FRANKFORT, IND.—A power plant is being built at the shops of the "Clover Leaf" Railway, in this city.

LEWISTON, IDAHO.—The electric power plant which supplies lights in Lewiston is being enlarged. An additional water wheel, having a capacity of of 650 horse-power, will be installed.

WELLINGTON, KAN.—The City Council has let the contract for an electric light plant for the city to the Hodge-Welch Electrical Engineering Company, of Kansas City, for $19,000, which is to be completed and in operation by July 10. The double unit system was adopted, using two 75-kw dynamos and two 110-horse-power Corliss engines. Sixty-four arc lights for street lighting and about 1500 incandescent lights will be supplied.

DONALDSONVILLE, LA.—The town is considering the advisability of using fuel oil for the municipal power plant. Sealed bids will be invited for the work.

ALBION, MICH.—A vote will be taken on April 7 on the question of issuing bonds for an electric light plant to cost $25,000. F. W. Culver is clerk of the Board of Public Works; James Shanley is mayor.

NEW BALTIMORE, MICH. Noble, Moss & Company, of Detroit, have been awarded the $24,000 20-year bonds and $6,000 20-year electric light bonds.

KANSAS CITY, MO.—An ordinance has been introduced in the Council providing for an issue of $300,000 electric light bonds. If passed, the question will be submitted to a vote at the April election.

ALBANY, N. [illegible] & Power Company, capital $200,000, has been incorporated to operate in towns of Herkimer, Fulton and Montgomery counties. Directors: Guy R. Beardslee, Ethel Beardslee, East Creek; Charles E. Snyder, Herkimer.

AMSTERDAM, N. Y.—The Shuttleworth Bros. Carpet Company is about to put in an electric light plant.

FULTON, N. Y.—The Fulton Light, Heat & Power Company has just been incorporated to furnish light, heat and power to Fulton, Oswego, Syracuse, Phoenix, Camillus, Clay, Cicero, Elbridge, Geddes, Lysander, Salina, Van Buren, Solvay, Baldwinsville, Jordan, Liverpool, Memphis and Warner.

COLUMBUS, OHIO.—The towns of Navarre and Caledonia, Ohio, are securing estimates on the cost of municipal electric lighting plants.

COLUMBUS, OHIO.—After several attempts the electrical contractors of Columbus have succeeded in forming an organization. Curtiss Claypoole is president and Harry Correll, secretary, of the organization.

DAYTON, OHIO.—The large market house and arcade to be erected in Dayton by E. J. Barney will be equipped with large engines, boilers, lighting plant, ice machine plant and six electric elevators.

MARTIN'S FERRY, OHIO.—Seasongood & Mayer have been awarded the $8,000 4-per-cent electric light bonds.

ATHENA, ORE.—The City Council of Athena, Ore., has granted A. Gillis a franchise for an electric lighting system.

BERWICK, PA.—The American Car & Foundry Company will build a new steel-car plant at Berwick, to be a duplicate of the plant recently built at Detroit. All machinery in the plant will be electrically driven, and labor-saving devices and machinery will be used. The plant will have a capacity of 10 to 20 steel cars a day.

HARRISBURG, PA.—The Waynesboro Electric Light & Power Company has decided to enlarge its plant.

ABERDEEN, S. D.—An electric lighting plant is to be installed by the Aberdeen Gas Company.

MEMPHIS, TENN.—The Oconee Electric Light & Power Company has purchased the property on the Oconee River known as Furman Falls, and will begin at once to develop the water power on a large scale. These falls are only a few miles from Milledgeville, Ga., and are able to furnish large power, being the third largest in the State. As soon as the power is developed, it is thought probable that an electric railway will be built connecting Milledgeville, the State sanitarium, the State prison, and Allen's Invalid Home. It is also stated that the power will be used for the operation of a large cotton factory near the falls. The men behind the enterprise are Milledgeville capitalists.

SALT LAKE CITY, UTAH.—The New Comstock Mining Company, of Mohave County, Ariz., will begin at once to erect a large power plant for the purpose of working a large ledge recently uncovered. A 500 horse power electric plant will be installed, to be operated by water power. The power will be derived from the Colorado River, a Walker endless-cable current waterwheel being utilized for the purpose. This wheel is operated by the river current directly, damming or diverting the water being unnecessary.

ESSEX JUNCTION, VT.—The Vermont Electric Company will build an auxiliary water-power station above its present plant. The new station will have a capacity of about 4000 horse power and will cost, approximately, $500,000.

DANVILLE, VA.—The Dan River Improvement Company has secured more than $800,000 of its stock, and the 15 per cent cash payment has been promptly met. It is probable that a syndicate will subscribe for the remaining shares, amounting at par to something less than $200,000. A large portion of the power will be used by cotton mills.

MANASSAS, VA.—An issue of $30,000 water, electric light and street bonds has been authorized by the Town Council.

HARPER'S FERRY, W. VA.—Mr. John L. Livers has secured the contract for the erection of an electric light plant in this place and will begin construction work on April 1. He will install a 75-kw Warren alternator furnished by the Rumsey Electrical Manufacturing Company, of Philadelphia.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—[illegible] new system of street railways embracing Birmingham and outlying districts seems to be a certainty. The system will be built by the Steel Cities' Railway Company and Warrior River Power Company, which will be consolidated, with $2,000,000 capital. It is unofficially announced that arrangements have been made for floating the bonds.

NEW HAVEN, CONN.—Work has been begun on an addition to the Grand avenue power plant of the Fair Haven & Westville Railroad Company, which controls the trolley system of this city. It is being increased from a station of 2500 horse power to one of about double that capacity. By this improvement the company will be able to operate all its lines from one power house. The cost of the improvement will be $150,000.

SPRINGFIELD, ILL.—The Secretary of State has granted articles of incorporation [illegible] capital stock of $300,000.

KOKOMO, IND.—A new electric railway line is projected from this city to Brookston via Flora, Burlington and Delphi.

BRIGHTON, MICH.—R. B. Roberts, R. J. Lyon, G. W. Briggs, H. A. Nichols and others, of this place, are promoting a road to connect Brighton with South [illegible]

JACKSON, MICH.—Contract for the completion of the electric railway between Jackson and Battle Creek has been sub-let by George E. Currie, of De[illegible]

SAGINAW, MICH.—W. O. Bellaire, of Springfield, Mass., is here looking [illegible] interests. It is reported that he is arranging for a consolidation of the Saginaw Valley Traction Company, the Saginaw Electric Light Company and the Bay City Consolidated Street Railway Company.

SPARTA, MICH.—W. A. Waterhouse, of Boston, is interested in the construction of an electric railway from Grand Rapids to Newaygo and, it is claimed, construction work will start in the near future. The Newaygo Power Company will furnish power from its Croton dams.

NATCHEZ, MISS.—The board of directors of the Natchez Electric Street Railway have accepted the road from the contractors. Power is supplied by the Natchez Gas Light Company.

TRENTON, N. J.—The Hudson River Traction Company has been incorporated, with a capital of $1,500,000.

ALBANY, N. Y.—The New York City Interborough Railway Company has been incorporated, with a capital of $400,000, to operate surface street railroads in the borough of the Bronx. The directors are Robert C. Wood, William J. Fransioli, Thomas J. Bray, John H. Scoville, William B. Bryan, James Weeks, Philip Kearny, John E. Pinckney and L. C. Marston. The company, it is stated, will not be allied with Metropolitan or any other now in existence.

MOGADORE, OHIO.—The Akron-Alliance Connecting Railway Company has applied for a franchise through Mogadore.

COLUMBUS, OHIO.—Columbus people are securing right of way for a new electric railway, to extend from Columbus to Magnetic Springs by way of Dublin.

DAYTON, OHIO.—The Council at Troy has granted a franchise on Market Street to the Dayton & Troy Railway, making it possible for cars to operate in the center of the town.

BUCYRUS, OHIO.—The town of Shelby is endeavoring to induce the Buckeye Traction Company to build through that town. Practically all right of way has been secured by way of Sulphur Springs.

HAMILTON, OHIO.—The Millcreek Valley Railway Company is again blocked in its efforts to secure entrance to Hamilton. The mayor has vetoed the franchise on the ground that property owners asked him to do so.

COLUMBUS, OHIO.—The Columbus, Delaware & Northern Traction Company has placed a contract for the construction of a large portion of the line between Delaware and Marion, and work will start in the near future.

CLEVELAND, OHIO.—E. P. Roberts & Company, engineers for the Muncie, Hartford & Fort Wayne Railway, have awarded contracts for the erection of the power house, office building, car barns, repair shops, etc., to C. L. Briggs, of Cleveland.

SPRINGFIELD, OHIO.—Surveys have been completed for the Springfield & Wilmington Traction Company's line, the promoter of which is Harry Frey, of Springfield. He claims that the proposition has been financed and that construction work will start at once.

COLUMBUS, OHIO.—The Pomeroy, Rock Springs & Athens Railway Company has been incorporated to construct a line from Pomeroy to Athens, capital stock, $20,000. Incorporators: A. W. Lee, M. S. Webster, O. L. Bradbury, A. V. Howell, R. E. Stobert and Morton Webster.

ALLIANCE, OHIO.—The Akron-Alliance Connecting Railway Company has been incorporated, with $1,000,000 capital stock, by R. D. Gibby, New York; Hugh Bleakley, Charles S. Kieth, B. F. Weybrecht and Henry Shaffer, all of Alliance. The company will revive the projected Akron-Alliance electric line which was promoted several years ago. It is claimed Eastern capital has been secured.

CLEVELAND, OHIO.—The gross earnings of the Cleveland Electric Railway Company for February were $166,658.28, compared with $150,670.86 for the same month last year. The directors of the company have declared the usual quarterly dividend of 1 per cent, payable April 5. The matter of filling the vacancies on the directorate caused by the resignations of H. A. Everett and C. W. Wason was not acted upon.

CANTON, OHIO.—Officials of the Canton-Akron Railway Company met in Canton a few days ago. George W. Rounds was elected superintendent. The contract for a power house site in Canton was closed and the station will be built by the L. E. Meyers Construction Company. The same company was given a contract for extensive improvements to the Canton-Massillon Railway. It is believed the company will build the proposed line to Turkeyfoot Lake.

CLEVELAND, OHIO.—The Callinan Construction Company, of this city, has secured the contract for building the Indianapolis, Greenville & Shelbyville Railway. It will be 20 miles long, extending from Greenwood to Shelbyville, Ind. Entrance to Indianapolis will be secured under a 47-year contract over the Indianapolis, Greenwood & Franklin Railway. The chief promoters of the road are John F. Polk, Judge Hackney and Eugene A. Robinson, of Indianapolis. Contracts for material will be closed in the near future. It is not decided where the power house will be located. A contract has just been closed with the Ohio Brass Company for double trolley equipment.

DEADWOOD, S. D.—The City Councils of Deadwood and Spearfish and the Commissioners of Lawrence County have granted a joint franchise to S. W. Russell, James F. Summers and D. J. Toomey, to build an electric railway from the city limits of Lead, through Central City and Gayville to Deadwood, thence through the farming region of Centennial prairie to and through the town of Spearfish.

JACKSON, TENN.—The Jackson & Suburban Street Railway Company has purchased a number of new cars, and it is expected that considerable extensions will be made during the coming summer.

RICHMOND, VA.—The House has passed bills to incorporate the South Richmond Electric Railway Company, also the Newport News & Elizabeth City Railway & Electric Company.

LA CROSSE, WIS.—The La Crosse Street Railway Company is considering the construction of a line across the Mississippi to Pettibone Island Park.

NEW INDUSTRIAL COMPANIES.

THE EMPIRE WIRE COMPANY, New York, capital $100,000, has been incorporated. Directors: S. H. P. Pell, C. M. Garrison and R. T. Garrison, New York.

THE ELECTRIC CASH AND PARCEL CARRIER COMPANY, New York, capital $100,000, has been incorporated. Directors: E. S. Kelly, V. H. Cartwell and F. E. Holcomb, New York.

THE COLUMBIA TELEPHONE MANUFACTURING COMPANY has been organized at Ottawa, Ohio, with George W. Risser, president; William Reece, secretary and A. C. Hauck, treasurer. The above with C. H. Rice and W. F. Reed, of Ottawa, and Messrs. Mason and Nolan, of Chicago, are directors. A five-acre site has been secured as a location for the factory, which will be built at once. Temporary quarters will be selected and the plant will be removed from Chicago in the near future.

OBITUARY.

MR. D. H. DARLING.—We regret to note the sad fact that Mr. Daniel H. Darling, fifty-seven years old, a resident of Rye, died suddenly in a New York & New Haven train in the Grand Central Station, on the afternoon of March 26. Mr. Darling was the president of the United States Battery Company. He left his office during the afternoon to go to the station. On arriving, he entered a car and sat down. A few minutes later two of his friends, who were sitting near by, saw him lunge forward and slide off his seat. An ambulance was called from the Flower Hospital, but Mr. Darling died as the surgeon entered the station. Mr. Darling, who was well known and active in business, social and club life in New York City, had recently been engaged in some very important negotiations consolidating various storage battery interests.

PERSONAL.



THOMAS I. CLARK.

MR. THOMAS I. CLARK, of Detroit, the inventor of Clark's wireless telegraphy, briefly described in this issue, has been engaged in the testing of his system since October last. He has sent successful telegrams from a number of points to a number of stations. He has carried on a series of successful experiments, in all kinds of weather and at all times of the day and night. While he has met with considerable success, he has also encountered many difficult problems, which he expects to overcome. He has had stations working in Windsor, Ont., and in Detroit, and has received signals between Detroit and Windsor, Detroit and Belle Isle, Detroit and Wyandotte, Detroit and Toledo, and between Detroit and Cleveland made on the first trip of the *City of Detroit*, March 18. In regard to any reports that have gone out, the inventor says that he feels confident of the ultimate success of this system for marine purposes; and it will be a matter of only a few weeks before the system will be put in practical operation. Mr. Clark was at one time connected with the General Electric Company. He is the manager of the Electric Service & Appliance Company, of Detroit, and is the consulting engineer and manager of the electrical and construction department of the American Engineering Company, of Detroit, organized especially to develop this system for marine and railroad signaling and for general telegraphic work and for telephone purposes.

MR. C. A. COFFIN, president of the General Electric Company, has returned from his trip to England.

MR. FRED RECKENZAUN, consulting electrical engineer, etc., has removed his offices from 44 Pine Street, New York City, to the Washington Building, No. 1 Broadway.

MR. WALTER C. LUSK, formerly attached to the foreign department in the New York office of the General Electric Company, has been appointed as the company's representative in British India and the East, with headquarters in Calcutta.

MR. W. V. SWEETEN, for a number of years connected with the Western Electric Company, in New York and Philadelphia, has assumed the management of the sales department of the American Push Button Telephone Company, of New York City.

MR. W. K. PALMER, M. E., consulting mechanical and electrical engineer, New York Life Building, Kansas City, has been announced as consulting engineer for the Kansas City & Olathe Electric Railway, 18 miles in length, of which Mr. F. C. Goodwin, of Kansas City, is president.

MR. E. J. NALLY, general superintendent for the Postal Telegraph Cable Company, at Chicago, has contributed to the *Saturday Evening Post* an interesting article on telegraphy and its opportunities, addressed to young men beginning business. It is full of good points and good advice.

MR. J. ARTHUR AITON, [illegible] Commercial Cable Company, is now in New York City, and will visit the cities of Boston, Philadelphia, Cincinnati, Chicago, Cleveland and Pittsburg. The firm is well known in connection with steam piping work in England, where its work is to be found in a number of large plants.

MR. BAILEY WHIPPLE, recently connected with the Buckeye and Jandus Electric companies, of Cleveland, Ohio, is now associated with the Sawyer-Man Electric Company, with headquarters at the well-known old works and general headquarters of the company, West Twenty-third Street, near North River, New York City.

MR. GEORGE E. DEAN, representing the Parke & Lacey Company, of Melbourne, one of the largest electrical and general supply houses in Australasia, is now in the United States, with a view to making agency arrangements with various American concerns seeking a market in the Antipodes. Mr. Dean is at present in the West.

COLONEL WATANABE, military attache at the Japanese Legation, Washington, has been instructed by his government to inspect several of the more important electrical engineering and manufacturing plants throughout the United States, with a view of placing contracts, especially for arsenal equipment, in the near future. Colonel Watanabe is at present in the West.

MR. BERNARD DRAKE, of Drake & Gorham, the well-known English electrical engineers, contractors, etc., has been visiting this country and left on Saturday last on the *Campania*. The above-named firm already handles several American specialties, being an alert and progressive house, and Mr. Drake having used his time to advantage, had the satisfaction of closing up various new arrangements before he sailed.

DR. F. A. C. PERRINE, the president of the Stanley Electric Manufacuring Company, has, it appears, been the recipient of a gold medal diploma from the Paris Exposition of 1900 as a "collaborator" with the Standard Electric Company, of California, of whose plant, with a transmission of over 200 miles, he was the electrical engineer, while in California as professor of electrical engineering at Leland Stanford Junior University.

MR. R. PERCY SELLON, of the Brush Electrical Engineering Company, Limited, of England has sailed for home, after a stay of about ten days in this country, chiefly in New York. Mr. Sellon is also a director in the Otis Elevator Company in England and has had, among other things, important work in hand with those interests here. He had not visited America in some years, and was very much pleased at the rapid progress made in the electrical industries during the interval.

MR. ALBERT B. HERRICK will be located in the West at the Algonquin Hotel, Dayton, Ohio, for the next five weeks in the interest of the Dayton & Troy Railway Company, Springfield Railway Company, Indianapolis Street Railway Company, Dayton Arcade Company, and the Friend Paper Company, National Cash Register Company and Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. He will also investigate the proposed Dayton & Germantown and Dayton & Lexington roads in the interest of capitalists. This work was offered him on account of his expert work for the street railways of Dayton, Ohio, in the electrolysis case.

MR. G. T. AMMON, who for some time past has acted as auditor at the Pittsburg offices of the Westinghouse Electric and Manufacturing Company, sailed last week for Europe for the purpose of assuming the accountantship of the British Westinghouse Electric & Manufacturing Company, one of the largest concerns of its class in England. While Mr. Ammon will be the head of the bookkeeping department, he will not be, in the American sense, the auditor of the British Westinghouse Company, as all concerns registered under the English limited liability acts are required to have their accounts audited by public accountants appointed by the stockholders in general meeting.

PROF. JOSEPH W. RICHARDS, of the Department of Metallurgy, Lehigh University, lectured on March 14 before the New York Electrical Society on the electro-chemical industries of Niagara. The attendance was large to overflowing, and the lecture was heard with deep interest by the large audience. Prof. Richards reviewed the work done at Niagara, the new industrial chemical center of the country, and pointed out that there, beginning with aluminum, eight different new processes had been worked out. The lecture was admirably illustrated with lantern slides. After the lecture, Prof. Richards was highly complimented by Dr. R. O. Doremus, who gave some characteristic reminiscences of early chemical work.

SAYLES—HOWLAND.—Miss Madeline Sayles, daughter of Mr. and Mrs. John E. Sayles, was married on Easter Monday to Harold J. Howland, son of William B. Howland, publisher of *The Outlook*. The ceremony took place at the home of the bride, on Orange Road, Montclair, N. J. The Rev. Mr. Hubbell officiated. The bride was attended by her sister, Miss Mary B. Sayles, and Miss Alice E. Egbert, of Montclair, and her cousin, Miss Esther Root, of East Orange, who was the flower girl. The best man was Karl V. S. Howland, brother of the bridegroom, and the ushers were Arthur H. Underhill, of Montclair, and Harry W. Matthews, of New York. The father of the bride was long prominent in Edison and General Electric affairs and is actively engaged to-day in the electrical field in New York City.

Trade Notes.

THE CONOVER MANUFACTURING COMPANY has moved its office and [illegible] to Pittsburg Arcade, Penn Ave. No. [illegible]

[illegible] Pittsburg [illegible] Works [illegible] changed from the Carnegie Building to the Frick Building.

THE BALKWILL PATTERN WORKS, of Cleveland, Ohio, are established in a [illegible] They are prepared to produce patterns of any size and character on short notice.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing among its customers attractive pamphlets, descriptive of the Wurts and Garton lightning arresters. Those interested can obtain this printed matter upon request.

[illegible] telling about its ready-dressed mill cogs, the subject being introduced by an appropriate couplet set to music.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COM- [illegible] continually growing business. The factory has been running a double force working day and night for the last six months.

SECOND-HAND MACHINE TOOLS.—A list of good modern second-hand machine tools has just been issued in pamphlet form by the Garvin Machine Company, New York. It includes hand and engine lathes, milling machines, drill presses, forges, planers, presses, shapers, etc.

VIADUCT APPARATUS.—The veteran, Mr. A. G. Davis, president of the Viaduct Manufacturing Company, Baltimore, Md., reports that they are keeping up with the times in making central energy apparatus for its telephone customers, and making new forms of apparatus, including hotel sets, etc.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has established itself as the Western repository for many of the standard makes of wires. It has in Chicago stock for immediate shipment a full supply of Roebling's and American Steel & Wire Company's extra B. B., B. B. and special galvanized steel telephone wire.

WM. J. MURDOCK & COMPANY, Chelsea, Mass., report that the demand for the "Solid" telephone receivers has more than exceeded their expectations and all indications point to a successful year in this branch of the telephone industry. Circulars and booklet illustrative of the "Solid" receivers will be sent on application.

THE BUCKEYE ELECTRIC COMPANY of Cleveland, Ohio, has been putting a large amount of time upon the development of small candle-power lamps, particularly two and three-candle-power sign lamps and the regular four-candle-power lamp. It states that it is doing this in response to the increasing demand for small units.

MR. WILLIAM ROCHE, 42 Vesey Street, New York, is introducing a new dry cell, known as the U. S. Navy and Army Standard No. 5, for which is claimed an electromotive force of 1.52 volts and current 14 to 18 amperes. Mr. Roche states that it will not run down on the shelf in two years if kept out of the sun and in a cool, dry place.

THE STERLING ELECTRIC COMPANY announces that Mr. Frank B. Cook, formerly president, is no longer connected with nor interested in the company. The company states that it owns exclusive rights under which its entire list of unsurpassed apparatus is manufactured and will be glad to serve the telephone fraternity at the old stand as in the past.

THE WIRT ELECTRIC COMPANY, Philadelphia, Pa., has outgrown the quarters it secured last spring and is installing new machinery in an extension. Among other things which the Wirt Company is building are some very large field rheostats of the sectional tubular style which have an entirely new construction especially adapted to heavy duty and high voltages.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., has just completed an installation of its common battery, lamp signal, multiple switchboard for an equipment for 2,100 numbers at Houston, Texas; a 1,000-capacity board at Galesburg, Ill., and another at Lima, Ohio, and is just finishing a 1,000-number board at Peru, Ind. It also has contracts for similar equipments at Rockford, Ill., and Wichita, Kas.

THE FOSTORIA INCANDESCENT LAMP COMPANY, lamp and glass works, Fostoria, Ohio, main offices, Cleveland, Ohio, reports that it has succeeded in making great improvements in high candle-power lamps the past two or three months. It has been well known that high candle-power lamps have not relatively rendered as good service as the medium candle-powers. In view of this the improvement referred to above is notable.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY, of Meriden, Conn., is moving into its new quarters, having purchased a factory of the Chapman Manufacturing Company during the past month. It will take it two or three weeks to get settled down, and it will then put some new devices on the market. Its new plant is finely equipped with track facilities, artesian well, etc., and everything required for an up-to-date manufacturing establishment. It will have about twice its former floor space.

THE CONSOLIDATED ENGINE-STOP COMPANY, 100 Broadway, New York, reports business as exceedingly good just now, and sales of its "Monarch" stop are very satisfactory. This device is stated to be giving much satisfaction wherever used, protecting life and property from engine mishaps. Four of these stops have recently been installed in the Los Angeles Street Railway Company's power plant. Charles C. Moore & Company, of San Francisco, are the Pacific coast agents for the Consolidated Engine Stop Company.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, of Chicago, Ill., reports a heavy business furnishing high grade bridging telephones for country lines, where 20 to 30 telephones are placed on one single wire in multiple. It is stated that tests of this apparatus made by different telephone companies in many of the States have been extremely satisfactory, fully bearing out the guarantees made. The apparatus which is now mostly called for in this field is the 100,000-ohm generator, with laminated armature and 5-bar magnet.

BRASS GOODS.—The International Brass & Electric Company, 76 Beekman Street, New York, manufactures a very complete line of brass parts for electrical apparatus. In an illustrated sheet issued by the company the extent of this branch of its work is seen. In general the articles include connectors of every shape, switches, fans for fan motors, telegraph instrument parts and many other pieces of special design. The company does, besides, fine wire winding, gear cutting, press work, experimental work, brass turning of every description, etc.

[illegible] sued to the trade its twelfth catalogue, a handsome brochure of 48 pages and cover, well illustrated, dealing with its popular and standard Hargrave specialties, etc. The reputation of its goods has been maintained by a careful system of examination in the processes of manufacture, and the majority of its product, such as hollow angles, screw and plug bits, plug cutters, screw drivers, etc., are each tried and tested before they leave the factory. The catalogue is interesting and useful in the variety and fullness of its data as to the various lines.

HUBBARD, HALL & COMPANY, 213 West Fourth Street, Cincinnati, Ohio, are prepared to take the agency of one or two additional manufacturers. They are representing at the present time Columbia incandescent lamps, Adams-Bagnall arc lamps, besides other specialties and have just closed the agency in Cincinnati for the Benbow telephone bracket. This bracket screws into the side of the desk, having a swiveled arm firmly supporting the telephone, which arm may be swung into any position desired, bringing the telephone around in front of the desk when in use or swinging back to the side of the desk, where it is out of the way when not needed.

POWER IN CLOUDS.—Those who are interested in water powers and electric transmission will find some striking pictures in *Country Life in America* for April, in the article on the cloudlands as photographed from the top of Mt. Tamalpais at sunrise by Otto Von Bargen. The number is particularly valuable for its information and timely suggestion about gardening, floriculture, fruit-growing and kindred subjects, as well as for its "calendar" and articles that chronicle the sports and pastimes of those who love the country. The end of the first volume is celebrated with the largest number yet published, and it evidences the splendid success that the publishers claim.

CORRESPONDENCE SCHOOL COURSES.—The latest issue of the handbook of the American School of Correspondence, Boston, Mass., describes in an interesting way the plan of the school for enabling mechanics and others to improve their education without taking time from their work. The school offers courses in mechanical, electrical, steam and textile engineering, instruction being given by mail. Several pages of the handbook, showing actual work done by students, are printed in two colors, the student's work in black and the instructor's corrections in red, giving an excellent idea of the method of teaching. A number of representative letters from manufacturers, students and graduates are published, including several from such distant places as China and New Zealand.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, Providence, R. I., in a pamphlet describes the operation of its automatic telephone system. Illustrations of the various styles of instruments, and switchboards of different capacities are shown. This automatic intercommunicating system has, it is stated, been thoroughly tested and gives perfect service day and night. It is designed for town, factories, mills, mines, warehouses, hotels, private residences, steamships and offices. Among the advantages offered by this system may be mentioned the ability to make connections by the person calling, and any number of conversations may be carried on simultaneously without interference. An illustrated article on this system is published on another page [illegible]

FAN MOTORS.—The latest production of the General Electric Press is a pamphlet on fan motors, which well sustains the reputation of that press for producing the finest examples of trade literature in this country. The illuminated cover, the title page, the various sub-title pages and the numerous head pieces can all be classed as artistic productions of a kind that are rarely met with in trade publications. In the 48 pages of the pamphlet more than a score of different fan motors are described and illustrated. The final pages are devoted to small induction motors for running large ventilating fans. Other recent trade publications of the General Electric Company are three "Flyers," one on 60-ampere plug cut-outs, another on rack insulators and a third on direct constant-current enclosed arc lamps.

WITH PRINCE HENRY.—An artistic thirty-two page souvenir entitled "1,500 Miles Over the New York Central Lines with H. R. H. Prince Henry of Prussia," from Chicago, via Buffalo and Niagara Falls, to Boston, Albany, West Point and New York, has been issued by the passenger department of that railroad. It is printed in four colors, contains nineteen half-tone illustrations, two maps and a beautiful title page, with an excellent portrait of the prince. The letter press is descriptive of the German immigration to America and our trade relations with the empire. It gives the itinerary and the most interesting events of the tour. A copy of this beautiful souvenir will be sent for four cents in postage, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

ELECTRIC CRANES FOR LOCOMOTIVE WORKS.—The Niles-Bement-Pond Company's crane department has been awarded the contract for the electric traveling crane equipment to be installed in the Rogers Locomotive Works, Paterson, N. J. There will be one crane having a capacity of 100 tons, fitted with a 5-ton high-speed auxiliary hoist. This machine is to be operated by six motors having an aggregate capacity of 400 h.p. The motors will be furnished by the Crocker-Wheeler Company. The span will be 60 feet. Two 25-ton cranes with auxiliary hoist of 5-ton capacity have also been ordered. The spans will be 60 feet 7½ inches and 58 feet 1½ inches respectively. Each of these machines will be driven by four Crocker-Wheeler motors representing 50 h.p. for each crane. The cranes are to be built at the old Philadelphia Engineering shops at Philadelphia.

THE AMERICAN PULLEY COMPANY, Philadelphia, Pa., is now making wrought steel pulleys in all sizes from six inches up to 42 inches in diameter. These pulleys are not only stronger than cast iron and wooden pulleys, but they weigh only about half as much, size for size, as cast iron pulleys. One feature which commends itself is the fact that each pulley can be readily separated into halves, so that it can be put upon the shaft without taking the shaft down. It grips the shaft firmly and in the smaller sizes no key seats or set screws are required. Furthermore, the same pulley can be bushed for shafts of different sizes, and for that purpose a complete stock of interchangeable bushings is constantly kept on hand by the factory and by dealers. The American Pulley Company has published an interesting booklet about the development of wheels

and giving full information about its pressed steel pulley. This book will be sent on application to any one interested.

THE GENERAL ELECTRIC COMPANY, in its Bulletin No. 4284, has issued a valuable compilation of the prices paid for street arc lighting in the United States, giving the rates which have prevailed during the past year and are generally still in force. The towns and cities enumerated are divided up by States, and the population is given with the number of lamps, style, amperes, watts, hours per year, cost of coal coal per ton, contract price per year, cost to city per lamp-hour, and the watts per hour for 1 cent, for open and enclosed arcs. It is stated incidentally that the number off cities using the direct current series enclosed arc is 73, while in 326 other places the series alternating enclosed is in use with constant current transformers. The relative gain of the enclosed over the open arc from 1895 to 1900 is also shown graphically. The decline in the demand for the open arc is quite extraordinary.

THE IROQUOIS MACHINE COMPANY has just been incorporated as a New York company, having been organized by Mr. W. W. Gibbs. The officers are Edwin A. Smith, president, who is a prominent banker in Providence, R. I.; W. W. Gibbs, vice-president and general manager, New York; Henry C. Babcock, secretary and treasurer, Providence, R. I. The principal office is at 150 Nassau street, New York. The company will manufacture new and improved wire drawing machinery, which it claims will materially reduce the cost of producing wire. It will also manufacture a full line of automatic and plain drop hammers, swaging machines, rolling mills, roller bearings and grinding machines. Having ample capital, it has purchased the plant and business of the Universal Machine Company, located at Providence, and rented a large additional building adjacent to the same. The purchase of this running plant, and the addition named, will insure to the company's customers prompt filling of their orders. The company states that it will erect a new factory building during the coming summer.

THE MICA INSULATOR COMPANY, of New York, Chicago and London, is now putting on the market its well known Empire brand of oiled cloths and papers in rolls of 50, 100 and 500 yards' length. It is also prepared to furnish it in any special length desired. An entirely new and original process enables the manufacturer to coat the material with two very evenly distributed coats of pure linseed oil. Experience has proven that pure linseed oil refined and treated by the M. I. C. process is superior as a coating for cloths and papers, to the substitutes which usually contain adulterations, and which in a very short time will harden and crack. Empire cloth will retain its high finish and rubber-like flexibility indefinitely and may be kept in stock a long time without any deterioratiton either mechanically or electrically. It is thoroughly dried before leaving the factory, and does not contain nor does it need any wax paper between the sheets to prevent them from sticking together. The manufacturer will be pleased to furnish samples, circulars and prices to any who may be interested.

THE LARGEST ORDER FOR PIPE COVERING ever placed has been secured by the H. W. Johns-Manville Company from the Pacific Coast Oil Company (practically the Standard Oil Company), which will lay about 280 miles of eight-inch pipe from Bakersfield to Point Richmond, on San Francisco Bay, to convey its oil to the coast. As the grade is very slight, pumping stations are necessary along the line. On account of the heavy nature of the oil it must be heated to a certain temperature before it can be pumped, and to maintain this temperature of the oil in the pipes between the pumping stations a non-conducting covering is necessary, and the H. W. Johns-Manville Company is to supply the 280 miles of covering for this purpose. The materials of which the sections of covering will be made require about 100 cars for transportation, while the covering, when ready for shipment to California, will fill 200 cars. The immense facilities of the H. W. Johns-Manville Company, at both its New York and Milwaukee factories make it possible for it to successfully handle an order of this magnitude, and a number of miles of the covering were in transit to Bakersfield within a few days after the order was received.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 25, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

695,900. SYSTEM OF DISTRIBUTION FOR ELECTRIC LAMPS CONNECTED IN SERIES; Murray C. Beebe, Pittsburg, Pa. App. filed Oct. 27, 1900. Relates to means for operating a number of Nernst lamps in series, either from a constant current or a constant potential circuit. The glowers are connected in series and the heaters are in shunt to the glowers or sets of glowers; there are two impedance coils for each lamp, one of which is connected in series and the other in shunt with the heater, there being a condenser in series with the lamps.

695,913. INSTRUMENT FOR INDICATING THE PHASE AND FREQUENCY RELATIONS OF ALTERNATING CURRENTS; F. Conrad, Wilkinsburg, Pa. App. filed July 12, 1901. (See Current News and Notes.)

695,928. REMOVABLE HEATER FOR ELECTRIC LAMPS; Marshall W. Hanks, Pittsburg, Pa. App. filed March 23, 1901. Provides simple means for so supporting a heater in proximity to the glowers of a Nernst lamp that the heater may be readily removed and replaced without disturbing the glowers. The heater is mounted on a non-conducting support in guideways in such a manner as to be easily removable therefrom.

695,937. ALTERNATING ELECTRIC CURRENT GENERATING AND DISTRIBUTING SYSTEM; B. G. Lamme, Pittsburg, Pa. App. filed July 31, 1896. (See Current News and Notes.)

695,938. ALTERNATING CURRENT MOTOR; B. G. Lamme, Pittsburg Pa. App. filed July 14, 1900. (See Current News and Notes.)

695,939. METHOD OF MAKING OXIDS OF TIN AND LEAD; C. S. Lomax, Everett, Mass. App. filed July 24, 1901. (See page 599.)

695,944. SYSTEM OF ELECTRICAL DISTRIBUTION; J. S. Peck, Pittsburg, Pa. App. filed May 18, 1901. Relates to a three-wire system from the direct current side of a rotary converter, the third wire being connected to the alternating-current transformers. In order to prevent the current flowing through the balancing conductor from magnetizing the transformer cores, each of the three converter transformers has two windings, which are connected to the armature of the converter and also reversely connected to the balancing conductor of the three-wire circuit; with this arrangement currents flowing through the balancing conductor will exert no magnetic effects upon the transformer cores.

695,946. HEATER WIRE SUPPORT FOR ELECTRIC LAMPS AND METHOD OF MAKING SAME; Henry Noel Potter, Pittsburg, Pa. App. filed June 20, 1900. Nernst lamp heater rods are formed of powdered quartz and a binder, then baked and afterward fused and drawn out.

695,947. FLUID PRESSURE ENGINE; C. Robinson, Edgewood Park, Pa. App. filed April 27, 1900. An automobile engine stop in which the centrifugal force of an over-speeding engine causes an arm to be thrown out to operate a circuit closer and thus energize a magnet, which cuts off the steam.

695,951. ELECTRIC TROLLEY [illegible]. App. filed Nov. 4, 1901. A retractive device which trips and lowers the arm when the trolley rises above the wire.

695,958. MUSICAL INSTRUMENT [illegible]. App. filed June 11, 1901. [illegible] glass goblets normally rotated by power and against which rubbing devices are forced by electro-magnets controlled by a perforated music sheet.

695,962. A SYSTEM OF ELECTRICAL DISTRIBUTION; Norman W. Storer, Edgewood Park, Pa. App. filed Aug. 30, 1900. A storage-battery regulating system. An auxiliary dynamo and a storage battery are connected to the line in series with each other; an exciter for the auxiliary dynamo has one field magnet winding connected in the main circuit between the auxiliary dynamo and the translating devices, and an opposing field magnet winding connected across the main circuit between the main generator and the auxiliary dynamo.

695,971. ELECTRIC MASSAGE APPARATUS; F. B. Turck, Chicago, Ill. App. filed Aug. 12, 1901. A rubber glove contains a spray and an electrode, which respectively communicate with a reservoir of liquid and a source of electricity, whereby the operator can simultaneously treat with a shower both electric current and frictional manipulation.

695,976. TELEPHONE-SELECTING DEVICE; W. D. Watkins, San Jose, Calif. App. filed May 11, 1901. (See page 600.)

695,988. ELECTRIC RAILWAY; G. T. Woods, New York, N. Y. App. filed Aug. 24, 1900. The invention relates to railways of the sectional conductor type and consists of means for energizing successively the conductor sections.

695,991. ELECTRIC SIGNALING AND CIRCUIT CONTROLLING APPARATUS; T. J. Zoeller, Nashville, Tenn. App. filed Feb. 9, 1901. A fire alarm system in which the circuits are constantly under test and in which instantaneous commutations of the circuits are obtained.

695,995. ELECTRICAL HEATING APPLIANCE; J. F. Bachmann and A. Vogt, Vienna, Austria-Hungary. App. filed Nov. 22, 1898. An electric resistance of cylindrical shape and composed of refractory, non-conducting material and a conducting material, adapted to fit into a hollow appliance such as sad iron. The outer surface of the resistance is devoid of conductive material to prevent short-circuiting through the appliance.

695,997. TROLLEY WHEEL RETAINER; A. D. Barton, Ravenna, Ohio. App. filed Dec. 3, 1900. A pair of rollers are spring supported immediately above the trolley wheel.

699,004. ELECTRIC METAL-WORKING APPARATUS; Geo. D. Burton, Boston, Mass. App. filed Feb. 23, 1897. A receptacle for containing the substance to be treated, has perforations in the bottom to admit the electrolyte and to permit the treated substance to pass out. The cover of the receptacle is provided with a slot, through which an electrode extends, the elecrode being in contact in the electrolyte with the substance treated.

696,017. CONTROLLER FOR ELECTRIC MOTORS; E. F. Dutton, Schenectady, N. Y. App. filed Aug. 9, 1901. The controller is applied to motors used for revolving the turrets of war ships. The turret is provided with a tappet, which, at a predetermined limit of movement, trips a switch [illegible] ing resistance.

[illegible] ELECTRIC RAILWAY [illegible]. App. filed Sept. 23, 1901. Relates to a system in which the conductor sections are movable to close their own circuit, and consists of the means for mounting such sections.

696,024. ELECTRIC RAILWAY; E. W. Farnham, Chicago, Ill. App. filed Feb. 6, 1902. Mechanism to be actuated by the movement of a movable rail to place the rail in electric communication with the main conductor.

[illegible] ELECTRICAL [illegible], Germany.

[illegible] provided with a circuit interrupter, which is automatically actuated when a certain pressure has been reached.

696,055. CURRENT-LIMITING DEVICE; Samuel L. G. Knox, Schenectady, N. Y. [illegible] of the shaft of an electric railway controller is keyed a disk with a wide circumferential bearing. A shoe, adapted to engage with the surface of the disk, is normally kept from contact by a spring; when, however, too much current is passing through the controller an electromagnet causes the shoe to engage and stop the further motion of the controller in the same direction; the mechanism of the shoe is such, however, that the controller at any time may be turned in the opposite direction.

696,065. AUTOMATICALLY CONTROLLED RHEOSTAT FOR USE IN ELECTRIC MOTOR CIRCUITS; H. L. Miller, Pasadena, Calif. App. filed Nov. 7, 1901. Details of a liquid rheostat.

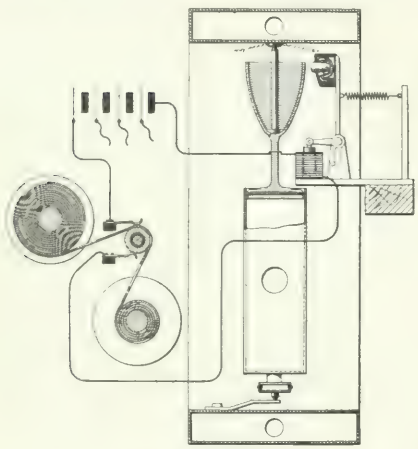
696,072. CONDUIT AND CONDUCTOR; P. A. McGeorge, New York, N. Y. App. filed July 13, 1901. A wedge is forced into the conduit by a device on the car and causes certain swinging arms to make contact with the main and return conductors in the conduit.

696,080. CONNECTOR FOR SPOOLS OF DYNAMOS; H. G. Reist, Schenectady, N. Y. App. filed Aug. 30, 1901. The connector consists of a light flat tube having a stiffening web.

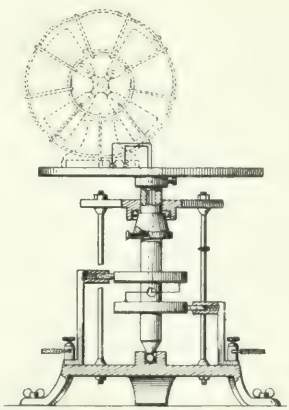
696,100. INCANDESCENT LAMP; P. M. J. Juge and A. E. Grisel, Paris, France. App. filed Sept. 8, 1900. The base of the lamp is entirely of glass and moulded into a screw-thread to receive a metallic thimble, enabling it to properly engage with a socket.

696,108. ELECTRIC GAS LIGHTER; C. A. E. Ruebel, St. Louis, Mo. App. filed Aug. 9, 1901. One of two burners, placed side by side, is equipped with sparking terminals; the gas at one burner is first lighted by the spark, then the second burner is ignited from the first, after which the first burner goes out, thus leaving the terminals cool.

[illegible] APPARATUS FOR THE MANUFACTURE OF COMPOUND



695,958.—Musical Instrument.



696,191.—Turntable for Motor Fans.

source, and upon the surface of which pattern cards are carried, which are perforated to allow spring fingers to make contact with the prism at various times to produce certain configurations on the sign.

696,171. SECONDARY BATTERY; Robt. H. Hassler, Indianapolis, Ind. App. filed Dec. 10, 1900. A grid has a series of groups of primary ribs and grooves or corrugations, the edges of each group being struck in opposite directions. By this means adjacent groups are separated along their edges, forming openings, and the units of active material on opposite sides of the plates are united to each other through the openings between adjacent groups.

696,172. CIRCUIT BREAKING DEVICE; A. J. Higgs, Colton, Calif. App. filed Dec. 22, 1900. Details.

[illegible] ELECTRIC SWITCH; N. Marshall, Newton, Mass. App. filed March 7, 1901. Details.

[illegible] ELECTRIC SWITCH; N. Marshall, Newton, Mass. App. filed March 18, 1901. A push-button switch, which requires releasing by means of a key before it can be operated.

[illegible] TURN-TABLE FOR MOTOR FANS; N. M. Powell, Quincy, Ill. App. filed Aug. 27, 1901. The fan is placed at any desired location between the center and edge of a turn table and the resistance of the air to the motion of the fan causes the table to rotate.

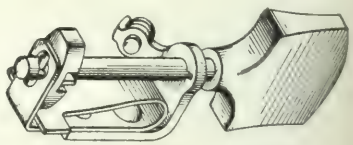
696,198. AUTOMATIC GRAVITY SIGNALPHONE; E. E. Salisbury, Chicago, Ill. App. filed Sept. 20, 1901. (See page 600.)

696,209. ENVELOPE FOR BATTERY ELECTRODES; Elmer A. Sperry, Cleveland, Ohio. App. filed May 22, 1901. Spun pyroxylin threads are woven into bands, which are then applied to a storage battery plate, being laid back and forth in a plurality of layers. Between plates thus served a corrugated perforated separator is placed, made of some material which is resilient as well as non-conductive, such as hard rubber.

696,213. ELECTRICAL CONNECTOR; G. B. Thomas, Hartford, Conn. App. filed Jan. 9, 1902. A thimble is placed over the end of the conductor to prepare the same to be inserted into a rail or other conducting body.

696,220. COMBINED EASEMENT AND POINT PROTECTOR; C. O. Anderson, Los Angeles, Calif. App. filed Sept. 7, 1901. A protecting plate to be applied to trolley wires at the ends of splicing sleeves and similar obstructions to prevent damaging the sleeve by the blow of the trolley wheel.

696,237. CONTROLLER FOR ELECTRIC RAILWAYS OR VEHICLES; J. C. Henry, Denver, Col. App. filed Dec. 14, 1899. In a series-parallel controller, where the fields and armatures are ordinarily connected in series, contacts arranged for disconnecting one of the motors from the circuit and connecting its field in parallel with the field of the other motor and subsequently connecting its armature to the circuit in parallel with the other armature.



696,261.—Incandescent Lamp Socket.

WIRE BARS BY ELECTRO-DEPOSITION; R. D. Sanders, Blackneath, Eng. App. filed [illegible] (See page 600.)

696,117. APPARATUS FOR INDICATING AND RECORDING ELECTRIC PRESSURE AND CURRENT; W. Thomson, Netherhall, Scotland. App. filed Oct. 29, 1900. The instrument consists of a plurality of double sectors converging toward one another, causing them to be brought together at one of their sides, and a marking device secured to the sides of the sectors.

696,140. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Sept. 29, 1884. A number of instruments on the same circuit are so constructed that if one is set, all the others beyond it are cut out of circuit either automatically or by hand, so that no instrument can be released to transmit its signal until after the release of all those that may have been set that are nearer the station.

696,144. CIRCUIT TESTER; A. De Khotinsky, Chicago, Ill. App. filed Aug. 1, 1901. An arm is adapted to trail over the terminals of a series of circuits and automatically test one after the other of said circuits, a record being automatically made of each test.

696,157. ELECTRODE FOR SECONDARY BATTERIES; Auguste Henri Bainville, Nanterre, France. App. filed Dec. 30, 1901. The electrode consists of a central rod, provided with radiating longitudinal plates approaching each other at intervals, the whole being enclosed by a tubular jacket of the same material; the radiating plates are pressed together at several points to form cells for the active material.

696,161. AUTOMATIC TELEPHONE SYSTEM; J. J. Brownrigg and J. K. Norstrom, Chicago, Ill. App. filed Dec. 26, 1900. (See page 600.)

[illegible] DEVICE FOR CLOSING AND INTERRUPTING ELECTRICAL CIRCUITS; S. Gleizes, Paris, France. App. filed Aug. 1, 1900. A switch [illegible] connected to one pole of the

696,238. ELECTRIC CLOCK; M. Hoeft, Berlin, Germany. App. filed July 18, 1899. Details.

696,247. MULTIPLE CONTROL SYSTEM; H. W. Leonard, New York, N. Y. App. filed Jan. 24, 1901. (See Current News and Notes.)

696,261. INCANDESCENT LAMP SOCKET; H. T. Paiste, Philadelphia, Pa. App. filed April 16, 1901. The spindle carrying the circuit bridge-piece works in a loose bearing at one end to permit the spindle to adjust itself between the two terminals to afford equal contact with both.

696,313. ELECTRICALLY CONTROLLED RAILWAY SWITCH; R. V. Cheatham, Louisville, Ky. App. filed Dec. 5, 1901. In this switch it is not necessary for the motorman to know the position of the switch tongue, inasmuch as, to continue traveling along the main line, the current should be cut off at the controller, and to go on to the branch the current should be left on.

696,330. SIGNALING APPARATUS; H. H. Grenfell, Alverstook, Eng. App. filed Aug. 5, 1901. A rotating drum carries on its surface a number of orders or signals, any one of which can be moved into view from a distance by opening and closing a circuit to impart a step-by-step motion to the drum.

696,372. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Nov. 11, 1886. The transmitter can be set to transmit any one of various signals and will commence to operate when it is released from a distant point where the signal is desired. After the transmitter begins to work, no change can be made in the nature of the signal.

696,380. ELECTRIC GLOWER LAMP; Henry Noel Potter, Gottingen, Germany. App. filed Aug. 9, 1899. Relates to the use of a stationary heater below the glower of a Nernst lamp, and a plurality of translucent globes surrounding the glower and heater, whereby the casting of shadows about the heater is substantially avoided.

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NEW YORK, SATURDAY, APRIL 12, 1902.

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MUNICIPAL OWNERSHIP.

The citizens of Chicago have just relieved their minds on the subject of public or municipal ownership. Lured and deluded by all kinds of wild promises and absurd statements as to what can be done and saved by means of municipal plants, they have voted overwhelmingly in favor of two proposals. One is that the city shall own and operate all the gas and electric lighting plants. The other is that the city shall own and operate all the street railways. Either scheme would be ambitious enough for a community which even now is in bad financial shape, but taken together they represent the extreme of civic unwisdom. Fortunately, the vote is merely a "referendum," an expression of opinion, not a mandate or a contract. There are many things that most of us would vote in favor of, but not if it involves serious financial issues. The *New York Sun*, in commenting on the situation presented, remarks very shrewdly:

"The magnificence of the majority may be due in part to the fact that municipal ownership is and long or ever must be a speculation and a dream so far as Chicago is concerned. The city is so far from having money to burn that the municipal 'ghost' is very tottering and uncertain in its walk. The stupendous debt that would have to be incurred were the city to go into the railroad, gas and electric lighting business was not before the voters as an actuality or immediate probability. But the decided expression of their opinion will encourage the numerous Democratic statesmen who believe that the municipal ownership of public utilities is a promising issue to coddle. Their troubles will begin when the scheme advances from its present gaseous state into a condition of concrete and figure-laden reality."

AMERICAN ELECTROCHEMICAL SOCIETY.

The formal organization last week at Philadelphia of the American Electrochemical Society added another to the technical bodies which nowadays are such potent factors in industrial progress and professional advancement. Few, if any, of the older professional bodies were inaugurated under auspices as favorable as this latest comer. Though the first steps toward its organization was taken but a few months ago, the Society enters upon its career with little short of 400 members, and with a record made at its first meeting which places it at once in the front rank of professional bodies, not only of this country, but of the world. Indeed, the Philadelphia meeting was of such a high order of merit that to keep future meetings up to the standard there set may become a difficult task. On the other hand, the fact that the twenty papers read at Philadelphia were, with but a few exceptions, contributed without solicitation, and in view of the gigantic strides with which the electrochemical industry is progressing, there is every prospect that the *Proceedings* of the Society will continue to present contributions of high value to the science and the industry.

Aside from the functions of the Society relating to the reading and discussion of papers, it will undoubtedly exercise an extremely beneficial influence in bringing about a much-needed professional community of ideas, and in aiding the development along proper lines of the teaching of electrochemistry. Heretofore there has been in this country no solidarity in this newest branch of electrical development, doubtless because of its sudden rise to importance, and also because of the personnel having been recruited from many diverse sources. The chemists, metallurgists, electrical engineers and others who have cast their lot with the new branch had in their earlier career little in common professionally, and these the Society will now bind together and inspire with a true *esprit de corps*. At the Philadelphia meeting it was suggested that the annual general meeting of the Society be held in connection with the annual convention of the

American Institute of Electrical Engineers. We sincerely hope that this suggestion will be given practical effect. Those who design, construct and erect the machinery for electrochemical operations will be interested in the papers read dealing with the processes, which, moreover, they can intelligently follow from their general knowledge on the subject derived when they were electrical engineering students; and electrochemists will be similarly benefited through maintaining touch with the dynamical branch of electricity and its personnel.

The twenty papers read may be classed under the head of educational, controversial, descriptions of new processes and contributions to electrochemical science. The discussion which followed the reading of Prof. Richards' paper on "A University Course in Electrochemistry" very clearly showed that this subject is in a vague condition. It was inevitable that differences of opinion should arise as to what branches the student should be proficient in previous to taking up the study of electrochemistry, for this is a problem encountered in connection with every professional course. At the present time a considerable portion of a technical course must be devoted to preparatory studies in branches which, though essential, should logically be pursued beforehand in order that the entire time of the student may be given to the science and technics of the profession which he proposes to enter. Another point brought up was a distinction between a course for an electrochemist and one for an electrochemical engineer—a distinction corresponding to that existing in electrical engineering between the designing engineer and the constructing and operating engineer. We are inclined to believe that the time is coming when no attempt will be made, as in the past, to graduate full-fledged professional men; and that the teaching in schools will be confined to the inculcation of scientific principles which will enable the graduate to enter into a professional apprenticeship in any particular branch for which he feels best adapted, or which appears to offer at the time the best opportunity. In electrical engineering proper, the situation is now ripe for such a course of education; for at present, instead of an electrical engineering graduate being considered a professional man, he is becoming more and more to be regarded merely as raw material, and there is little prospect of his advancement until after a professional apprenticeship of several years.

The papers on new processes and cognate subjects numbered seven, of which at least five dealt with processes, holding forth great possibilities, namely, the electrolytic production of caustic alkalies and chlorine, of bisulphide of carbon, of lead, of zinc, and the electrolytic refining of composite metals. Details relating to these processes will be found in our report of the meeting of the Society. Papers on what may be considered the theoretical branch of electrochemistry were eight in number. Those of most importance were one by Prof. Carhart, on a new type of concentration cell, and another by Prof. Bancroft on a promising application of the Gladstone-Tribe couple. A new type of storage cell described by Mr. Dow is interesting from the fact that it may serve as a standard of e. m. f., since it has a very definite voltage, and after current has been drawn from it the voltage immediately regains its normal value. A paper by Prof. Richards considered electrolysis by alternating current, and set forth an electrochemical explanation to account for what, when the phenomenon was first noted, appeared to be an anomaly. A study by Prof. Burgess of the electrolytic rectifier adds considerable to our knowledge of this subject and is particularly instructive from the fact that it shows that much better results may be obtained from the use of fused than from aqueous electrolytes. The youth of the new Society may be said to have been well exemplified by the polemical nature of several of the papers presented and of parts of the discussion. One paper attacked the nascent state theory, and offered both argument and data from experiments to show that it is entirely unjustified. Another made an onslaught on the "atom of electrochemistry," and a third assaulted the Nernst theory of electrolytic dissociation. In addition, an experiment was described which apparently invalidated the osmotic pressure hypothesis, and several times during the discussions the ionic theory received some sharp raps. Without entering into the merits of the several controversies we would suggest that an excellent purpose might be served by taking up in turn as subjects for discussion by the Society, the various controverted points in electrochemical theory. By distributing papers in advance presenting the opposing views, their discussion would do much toward clarifying the atmosphere, even should it not definitely decide the issues. In view of the eminent names connected with the modern theories, and the undoubted impetus they have given to investigation, with often results of extreme value regardless of the validity of the source of inspiration, they deserve the most studious consideration and courteous treatment.

Electric Resistivity of Iron.

Following closely upon a paper recently read by Professor Barrett and a collaborator, on the magnetic properties of iron alloys, before the British Institution of Electrical Engineers, comes a very interesting and important paper by Professor Barrett "On the Increase of Electric Resistivity Caused by Alloying Iron with Various Elements," read before the Royal Society, Feb. 6, 1902. The paper describes the effect of alloys of a single element with iron, as determined from 68 specimens. These specimens contained varying small quantities of carbon, aluminum, silicon, chromium, manganese, nickel, cobalt and tungsten, one metal at a time alloyed with iron. The specimens were drawn into rods about 5 mm in diameter, and their resistivities determined at about 18° C., or at ordinary temperatures. Curves are plotted in the paper, showing that in all cases, with a questionable exception as to copper, the resistivity increases with an impurity of these seven metals; and, moreover, the greater the amount of impurity, the greater the resistivity. In fact, with the exception of nickel, the graphic relation between percentage impurity and resistivity is practically a straight line from 0.25 per cent up to 15 per cent of impurity. The straight line has a very different slope, however, with different metals. Thus, with tungsten the inclination is quite gentle, representing only 2 per cent increase in resistivity for 1 per cent of impurity; whereas, with aluminum, the line is steep, representing 14 per cent increase in resistivity for 1 per cent of impurity. The steepnesses of these lines—that is, the tangents of their angles of slope, or, the increase in resistivity for 1 per cent of impurity—would seem to be roughly in proportion to the specific heat of the metal. Thus tungsten has a relatively low specific heat, and a low slope of resistivity in terms of percentage impurity; while aluminum has a relatively high specific heat, and large slope. The agreement is not very good for cobalt, nickel, and chromium, but this is possibly accounted for by the fact that the atomic weight of these metals is near to that of iron itself, and the proximity may entail some secondary interference. For carbon the rule is entirely incorrect; but, for that matter, the specific heat of carbon is also erratic, so that this substance does not fairly count. The rule is moderately well observed for tungsten, manganese, silicon and aluminum.

Since the specific heat of any of these substances is known to be approximately proportional to the atomic volume, the rule means that the rate of increase of resistivity with impurity is roughly proportional to the atomic volume of the impurity or the volume occupied by an atom of the impurity. The rule is only tentative at present, and Professor Barrett merely indicates that the proportional agreement between these two quantities appears to be more than a pure coincidence. It will be necessary to accumulate more materials, more alloys, and more observations, before any definite conclusions can be relied upon; but this is the first ray of hope that has yet shone upon the perplexed subject of alloy-resistivities, which hitherto has been murky and chaotic. The rule, moreover, implies something more, if it is correct. It also means that since the atomic volumes and specific heats are inversely as the atomic weights of elementary substances, the rate of increase of resistivity with single-metal impurity must be inversely proportional to the atomic weight of the impurity. In fact, if the reciprocals of the atomic weights of the

metals here considered be plotted as ordinates, to percentage of increase of resistivity for 1 per cent of impurity as abscissas, the points fall more nearly on a straight line through the origin than do the specific heats taken by Professor Barrett. Consequently, the rule would make increase of resistivity with impurity depend either on the atomic volume directly, or on the atomic weight inversely; which ever conception lends brighter color to the view.

It is to be hoped that the rule can be definitely proved, for it cannot fail to assist the development of any theory seeking to explain the nature of metallic conduction. From the standpoint of the dynamo and transformer designer, aluminum and silicon are the right substances to alloy in minute degree with iron; because 2 per cent of either quadruples the resistivity, and therefore quarters the eddy current loss at constant temperature; while at the same time, according to Professor Barrett's results, the permeability of aluminum-iron is notably increased. If the 2½ per cent of silicon or aluminum present in the alloy is actually useful in extracting and holding oxygen that would otherwise combine with the iron, it is only reasonable to suppose that the presence of alumina, or silica, also prejudicially affects the iron, although not to the same extent as the oxygen which these metals unite with. Consequently, if the oxygen could be entirely removed in the preparation of iron, without leaving any substance in its mass, the iron should be still softer and more permeable magnetically. It is just possible, therefore, that no really pure specimen of iron has ever yet been produced, or tested, and that such pure iron, if obtainable, might be notably superior to existing brands in freedom from hysteresis and coercive force.

The Principles of Grounding.

In another column will be found an interesting contribution to the theory of grounded circuits. The subject is one which has gradually been assuming considerable importance as high voltage systems have become more and more common, and current practice has not settled into any well-defined lines regarding it. The traditions of the past unite in abhorrence of grounding on general principles, and there has been a strong tendency to look upon the suggestion of deliberate grounding as a manifestation of acute alternating current mania, quite unworthy the attention of any sane and conservative man. Now we agree that twenty years ago when circuit meant arc light circuit an accidental ground was most unwelcome and a deliberate ground quite unthinkable. But the world moves and new ideas have to come. As high voltage lines, especially polyphase lines, have become common the question of safety precautions has grown in importance. It is now well established that grounded secondary circuits are not only advisable but well-nigh necessary to ensure safety on high-pressure alternating circuits, but even now the idea of deliberately grounding the neutral point of the main transmission system is not always well received. Yet, as Mr. Nies very clearly shows, such a procedure is advisable from almost every point of view. Even assuming the circuit to be insulated from earth, he shows that the existence of capacity as between the wires and ground renders quite illusory any hope of safety based upon perfection of line insulation. It is this feature of the matter that gives Mr. Nies' paper a special claim to consideration.

Modern high voltages, and indeed all voltages above the modest requirements of a local distribution system, involve an element of danger that should properly be conceded without argument. So do railway trains, steamships, and elevators, and the practical problem with which humanity has to deal is not how to provide means of horizontal and vertical progression which shall be as safe as staying at home, but how to guard the most useful apparatus at hand so as to avert all unnecessary risks. So it is with electric circuits. Granted the importance of high voltage, we should set to work to utilize it as safely and effectively as possible. Now suppose one is dealing with a star three-phase system worked at 10,000 volts between the phase wires and the neutral point. Is it safer to ground the neutral point or not? Grounding it makes one sure of approximately 10,000 volts between wires and ground all the time. If it remains insulated, one may get considerably less than this voltage to earth from a single contact or is reasonably sure of catching about 17,000 volts if the circuit is otherwise grounded. So far as earth contacts are concerned, grounding effectively limits the active voltage to 10,000, but that pressure has to be dealt with all the time. In the other case an earth contact may give anything from zero to the full delta voltage. The relative safety of the two cases hinges upon the probability of maintaining the line insulation. Now the merest tyro in high voltage work knows that it is well-nigh impossible to keep a long line insulated from the electrostatic standpoint. It may be excellently insulated so far as material leaks are concerned, but it should always be looked upon as grounded with respect to earth contacts. Hence, as a purely practical matter, grounding the neutral point tends upon the whole to lessen the voltage available for accidental contacts. When, however, all the voltages likely to be involved are far above those that can be safely handled, the actual danger is not greatly modified. We are strongly of the opinion that for all practical purposes all the line voltages in common use for alternating current working are substantially alike in the matter of general safety. The very high voltages require, and receive, more careful insulation to secure a steadily operative line, and in point of fact most of the troubles on transmission systems are on the secondary rather than the primary voltage.

The particular feature of high voltage systems to which Mr. Nies has drawn attention is the effect of capacity in the line upon the contact voltage between line and ground. He shows very neatly that with the line constants and voltages in common use, insulating the line as a whole from earth does not materially decrease the probable danger of a contact. To put the matter roughly, the condenser effect ensures a dangerous voltages between line and earth except in the presence of heavy grounds. This being so, one cannot avert danger by complete insulation, so that, on the whole, the probable voltage of an accidental contact is less with a grounded system than with an insulated one, even supposing complete insulation to be feasible. In this state of affairs it would seem the part of wisdom to ground freely. The practical objections to grounding arise from a somewhat increased chance of getting severe grounds from single contacts in trees and such like places which might not produce operative difficulties if the lines were approximately insulated. On the whole, however, we are inclined to the opinion that a good savage ground that is at once evident and requires attention is preferable to one that goes to work in a half-hearted sort of a way and encourages temporary neglect. Lines should be kept clear and no system gets into comfortable operative condition until they are substantially clear. Grounding the neutral point gives the advantage of a definite working condition and a known element of danger—always an advantage over uncertainty. As to grounding secondaries, there seems to be no difference of opinion, and in fact we believe that failure so to ground has been held to be negligent in case of an accident arising from contact between primary and secondary. As the general art of insulation has improved the early objections to grounding have in large measure disappeared, so that at the present time the advantages of grounding can be gained without incurring material disadvantages. It is always an advantage to deal with known and determinate conditions, and when, as Mr. Nies has shown, safety does not lie on the side of attempting perfect general insulation, grounding the neutral would seem a procedure usually desirable. Lines must be well insulated for operative reasons, but this is quite a different matter. As to personal safety, the most effective insulation is a wide gap between the person and the line.

New Lights and the New York Electrical Society.

[illegible] nical Institute, was barely large enough to hold the audience which listened to Dr. Max von Recklinghausen's lecture on "Recent Developments in Electric Lighting, particularly in reference to the Nernst and Cooper-Hewitt Vapor Lamps," before the New York Electrical Society, on the evening of Thursday, April 3. Dr. Recklinghausen led his audience by easy and interesting stages from some of the more rudimentary phenomena of artificial lighting to its latest and in many respects most wonderful developments.

After describing and showing the Nernst lamp in all its details, the lecturer noted that in the arc lamp field we have as a newcomer the Bremer arc lamp, using composition carbons and giving an extremely efficient light of a color that has nothing of the strange blue of the arc lamp.

The latest development in electric lighting, he said, is the Cooper-Hewitt lamp, the first high candle-power illuminant based on the incandescence of a vapor or gas. The Hewitt mercury vapor lamp has a negative electrode made of mercury and a positive electrode made of iron or of mercury. The lamps used by Dr. Recklinghausen in illustration ran on direct current of 115 volts, consuming 2.8 amperes; they gave about 700 candle-power each, that is, about nine times the efficiency of the incandescent lamp. They showed little or no deterioration after being used over 800 hours. The Hewitt lamps are extremely actinic and are therefore already very valuable for all photographic processes. The Hewitt light is—strange as it looks for the first time—more agreeable to the eye than any other illuminant. This is confirmed by many people who have been using it for reading, draughting and fine mechanical work.

After mentioning some important points to be considered when comparing illuminants, such as their diffusion, hygienic properties, etc., the speaker concluded by saying that the keen competition in the field of lighting has worked to a very great extent to the benefit of the general public.

Before the lecture the laboratories and other departments of the Institute were thrown open to the inspection of members and the admirable equipment of this most progressive and efficient technical school was examined with the closest interest. After the lecture a collation was given, a warm welcome being extended to the Society by Mr. Joseph Wetzler, a past president of the Society, who has been for many years secretary of the Institute and one of its hardest working supporters.

The new badge of the Society was on exhibition, and many orders for it were received by the secretary.

Electrical Engineers of the Day—XLI.

ORVILLE H. ENSIGN.

Orville H. Ensign was born in Ithaca, N. Y., on July 8, 1863. At the time of his birth his father, H. W. Ensign, was a captain of a company of United States volunteers at the front. After passing through the common schools he prepared for college at a high school and entered Cornell University with the class of '84, taking the course in mechanical engineering. Viewed from the average college standpoint, the path of young Ensign was not an easy one, for he was compelled to earn a material part of his expenses through college and at last, after two years, he gave up his university work and became entirely responsible for his own career.

Soon after leaving Cornell, Mr. Ensign become connected with the Schenectady Locomotive Works, but then had the good judgment and courage to enter a new field by accepting a position offered by the United Edison Company, of New York. Mr. Ensign elected to leave Schenectady for New York City in the belief that the electrical career was the one of the future. His first electrical work was in the installation of isolated plants, and for a while he had charge of the trouble work in isolated plants for what is now Greater New York. In the fall of 1887 he was promoted in charge of isolated plant work for the State of New York under the State agents of the United Edison Company. This position was held until the Edison General Electric Company was formed in the winter of the succeeding year, when Mr. Ensign, then a young man of 25, entered the Edison General factory at Schenectady in order to make his knowledge of electrical machinery as thorough as possible.

That was about the period which marked the beginning of street railway motor work, or at least when the Edison General Electric Company seriously began the building of street railway motors, and Mr. Ensign was placed in charge of testing in the railway motor department of the works. Here he remained for one year, when he was promoted to the position of chief inspector for the company. Mr. Ensign was the first to hold that position, and to him belongs the credit of organizing the inspection department of the works.

On account of the ill health of members of his family, Mr. Ensign was compelled to resign in 1893 and to move into the more even climate of California. He went to Redlands at once, selecting it as possessing the climate best suited to the needs of his family, and although he arrived there an entire stranger, within a week he found employment with the Redlands Electric Light & Power Company as inspector for the manufacture of the pipe line, which was being built for the original plant of the Redlands Company—the plant which has since become famous for the part which it played in the development of long-distance power transmission in America. Mr. A. W. Decker, who was of all others distinctively the pioneer engineer in electrical transmission work in Southern California, was at that time the electrical engineer of the Redlands Electric Light & Power Company, but as he died before the completion of the plant, Mr. Ensign was chosen to make the final test for the Redlands Company before acceptance. Dr. Louis Bell acted for the General Electric Company in this test, and as it marked the beginning of the first commercial polyphase transmission in the country, Mr. Ensign's experience in transmission engineering dates from the beginning.

This was in September, 1893, and in the summer of 1894 he entered the employ of the Los Angeles Railway Company, after which he started and operated the system of that company in the capacity



of mechanical and electrical superintendent. But his interest in transmission engineering work remained uppermost, and in March, 1896, Mr. Ensign re-entered the employ of the Redlands Electric Light & Power Company as superintendent, just prior to the inception of the project of the Southern California Power Company which later resulted in the epoch-making 33,000-volt, 83-mile transmission from the Santa Ana River to the city of Los Angeles. From first to last Mr. Ensign was the engineer who held the reins guiding this remarkable transmission to its successful outcome.

The property of the Southern California Power Company has since been merged with the properties of the Redlands Electric Light & Power Company and the Edison Electric Company, of Los Angeles, the whole being operated now as the system of the Edison Electric Company, and embracing practically the whole of the great San Gabriel and San Bernardino Valleys, with extensions reaching as far south as Santa Ana. This entire system, embracing almost a continuous stretch of territory running nearly 100 miles east and west by perhaps 30 miles north and south, is now being operated under the direction of Mr. Ensign as its mechanical and electrical engineer and superintendent.

In addition to the cares of administration of his present position, Mr. Ensign is now engrossed in perfecting the engineering details for Mill Creek power house No. 3, a plant of 4000 hp to operate under a 1960-ft. head, after which he will undertake the greater transmission, which his company proposes for the bringing of power into Los Angeles from the Kern River. This contemplates a transmission of some 30,000 hp over lines perhaps 120 miles in length.

The Telephone in Wireless Telegraphy—II.

(Concluded.)

By [illegible]

IN the preceding article various methods of wireless signaling were briefly outlined. We now come to Hertzian waves, the advantages of which in wireless signaling appear to the writer very doubtful. The waves can act directly on a receiver, as indicated in Figs. 23 and 24, or, still better, according to the arrangement shown in Fig. 25. M. Ruhmer, who has continued the writer's experiments, has been able to communicate with similar arrangements and antennæ 100 feet high over 1.2 miles. By means of the receiver of Fig. 23, M. Tommasina has been able (*Comptes Rendus*, Dec. 6, 1901), to follow the course of storms, but at distances evidently less than if a local circuit had been employed, controlled by a coherer.

It has often been remarked that when the waves exceed a certain frequency, a telephone no longer gives forth sound. This has been explained by ascribing it to excessively rapid changes of polarity of the magnet core. According to my view, if the waves are shorter than the length of the winding of the telephone—which winding they can affect, for example, by induction—there will be in the winding stationary waves with nodes and peaks (Fig. 26). At a given instant there may be in different sections of wire current of different signs, and the resultant may be zero, or negligible with respect to the polarity of the magnet according as the semi-wave lengths are even or odd in number. It is therefore necessary in order not to have opposing effects with at times a zero resultant, to wind the magnet as shown in Figs. 27 and 28. In this latter figure the vertical axis is the line of nodes. In winding the solenoid of Fig. 28 around the core *A*, a telephone for currents of high frequency is obtained such as indicated in Fig. 29.

In optical telegraphy when with the bare eye the distance is too great for sight, a telescope is employed; in ordinary telegraphy when the receiving current is too weak, a relay is employed; similarly, in wireless electrical telegraphy when the waves are too feeble to actuate a telephone, either on account of lack of energy at the transmitter, or on account of the waves being radiated in all directions, recourse is had to an imperfect contact; for what is a coherer or radio-conductor but an imperfect contact? It is a telescope and relay at the same time; a telescope for invisible luminous rays, and a relay of which the sensitiveness is $.1^{14}$ watt.

The following is a very simple means to apply a telephone in an arrangement which will enable a clear idea to be obtained of an imperfect contact. Following M. Turpain and others, put in circuit (Fig. 30) a circular resonator with a battery and telephone. If by means of an oscillator currents are induced in the resonator, and if the sparking distance at the micrometer indicated is adjusted for a given difference of potential, a spark passes; and as the spark is a conductor, the current of the battery is closed and the telephone gives forth a sound much stronger than if the battery were not present. Mr. Brown in an English patent (Oct. 2, 1899) applies the principle of imperfect contact in still another manner. In circuit (Fig. 31) is a telephone, a battery and a vibrator in imperfect contact with an adjustable point; an electromagnet through which an intermittent current passes, actuates the vibrator, when a feeble sound due to the resistance of the imperfect contact is heard in the telephone. The sound is

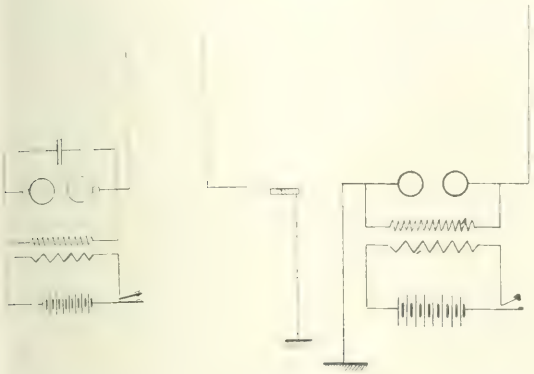


FIG. 23.—SIGNALING BY HERTZIAN WAVES.

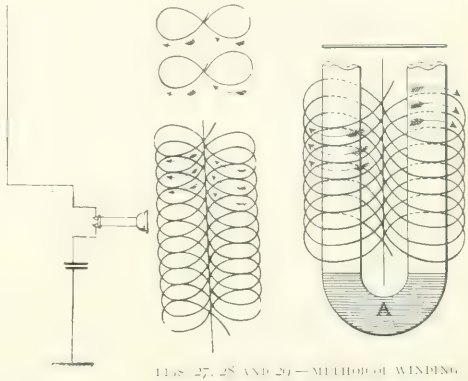


FIG. 24.—SIGNALING BY HERTZIAN WAVES.

FIGS. 27, 28 AND 29.—METHOD OF WINDING MAGNET.

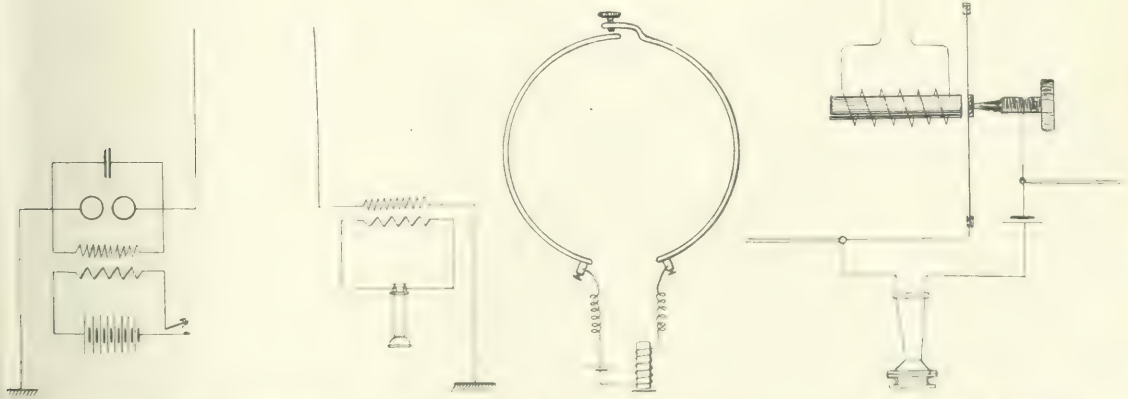


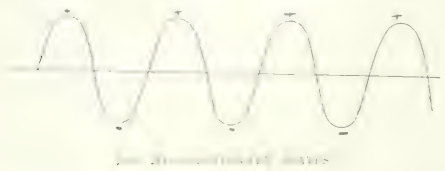
FIG. 25.—RUHMER'S METHOD.

FIG. 30.—TURPAIN'S METHOD.

FIG. 31.—BROWN'S METHOD.

strengthened to a very large extent when Hertzian waves strike the imperfect contact and diminish its resistance.

Prof. Blondel, in a sealed communication deposited with the French



Academy of Sciences, Aug. 16, 1898, having the title, "Improvements in Wireless Telegraphy," describes the arrangement indicated in Fig. 32, consisting of a vacuum tube in circuit with a battery and a

On Jan. 5, 1899, M. Tommasina announced to the Societe de Sciences Physiques et Naturelles of Geneva, that he had used the telephone as a substitute for relays. The arrangement which M. Tommasina has since employed is indicated diagrammatically in Fig. 33. It was by means of this arrangement that M. Tommasina was able to follow the course of storms over a radius of 300 miles. In a Belgian patent issued to the writer June 24, 1899, is described the arrangement of Fig. 34. Decoherence was attained by giving to the coherer a continuous motion of rotation. The transmitter employed may be one for Hertzian currents, or that of Fig. 35, which was employed in the writer's Brussels-Malines-Antwerp experiments, described in these columns Aug. 3, 1901.

Mr. A. F. Collins, in an American patent, shows the arrangement of Figs. 36 and 37, where magnetic decoherence is obtained through the employment of an arrangement similar to that described by Lodge

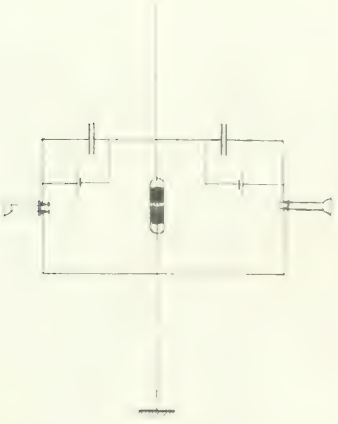


FIG. 32.—BLONDEL'S ARRANGEMENT.



FIG. 33.—TOMMASINA'S METHOD.

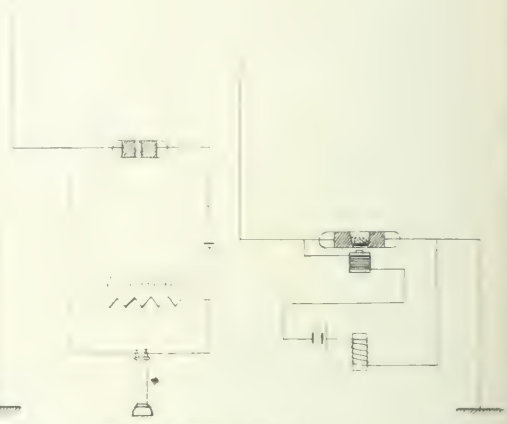


FIG. 34.—GUARINI'S SYSTEM. FIG. 36.—COLLINS' ARRANGEMENT.

telephone. In this communication Prof. Blondel also touched upon multiplex signalling and the secrecy of despatches through the use of selective telephones of the Mercadier type, or by means of purely electrical synchronism obtained by means of condensers of proper

and Murhead in 1897, consisting of an electromagnet inserted in the circuit of the battery and coherer.

M. Popoff patented Jan. 22, 1900, the arrangement of Figs. 38 and 39. That of Fig. 38 does not appear to differ from the arrangement

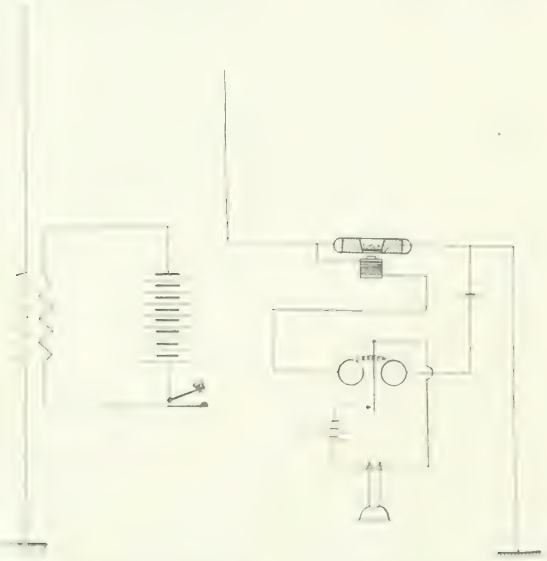


FIG. 38.—POPOFF'S METHOD.

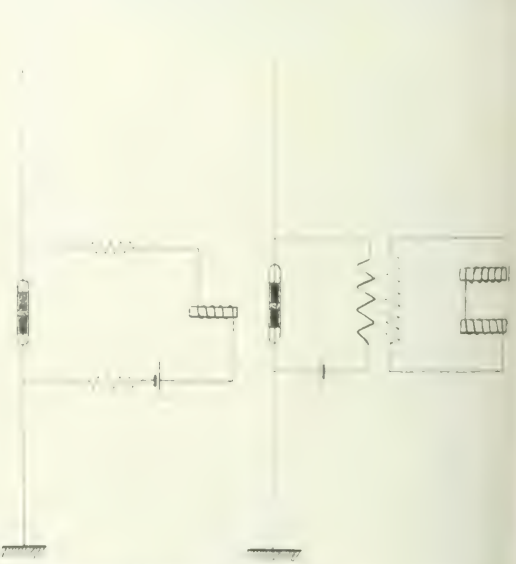


FIG. 39.—POPOFF'S METHOD.

capacity. The communication not having been opened until March, 1900, it had no influence on the patents to which we shall refer later

of M. Tommasina (Fig. 33) except by the addition of two self induction coils in the circuit of the coherer, which, however, had previously been done by Marconi. The arrangement of Fig. 39 only differs from

that of the writer by the addition of a ground connection. With the arrangement above described, MM. Popoff and Ducretet were able in Russia and France to signal over a distance which, according to information published, attained 60 miles. In July, 1901, MM. Popp and the Russian Col. Pilsondski, employed at Paris in their experiments between villas at Vesinet over a distance of 1600 feet, the arrangement of Fig. 40. With this arrangement, in which the experimenters claimed that they utilized the earth, the antennæ is replaced by a metallic disk placed on a glass plate resting on the soil. Finally, to complete an enumeration already too long, Marconi in his transatlantic experiments employed a telephone combined with a syntonic "jigger" (Fig. 41).

From the above it will be seen that wireless signalling with a tele-

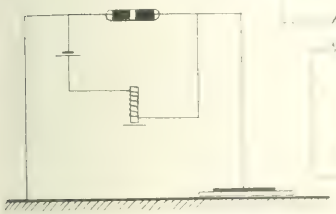


FIG. 40.—POPP AND PILSONDSKI'S ARRANGEMENT.

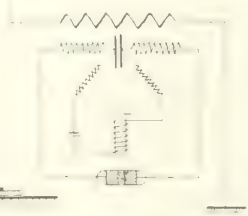


FIG. 41.—MARCONI'S APPARATUS IN TRANSATLANTIC EXPERIMENTS.

phone—an excellent receiver from every point of view and very sensitive—can be made practicable in connection with vibrations in the air or water or ether, which in the latter may be vibrations ranging from the very rapid ones of light to electromagnetic waves of low frequency. Ether vibrations which can produce perceptible effects of induction (if, in fact, luminous waves are not electromagnetic waves of very high frequency and therefore ought also to produce inductive effects) can affect the telephone directly or by means of a local battery controlled by a special and very sensitive relay—the imperfect contact. Moreover, the signals transmitted by any one of the four forms of radiant energy—sound, light, heat and electricity—can be reproduced by variations, either at the transmitter or receiver, of each of the three others.

Grounding of High Potential Systems.

By J. D. Nies.

THE present tendency in electrical practice is toward the use of high-potential alternating current, not only for cross-country, power-transmission work, but also for the distribution of electricity for lighting and power in cities. As the number of such installations in operation is already large and constantly increasing, and as these installations moreover are being brought steadily into closer contact with the daily life of larger numbers of people, consideration of them as sources of danger to life and property becomes imperative; in order that the danger, while it is unavoidable to a certain extent, may be kept at its minimum. In what follows the aim is to determine what are the causes to which the existence of danger may be ascribed, with special reference to the occasional practice of grounding the point of zero e. m. f. in such systems.

No definite rule has been laid down as to the advisability of grounding. There has not yet been reached in this matter anything like "standard practice," as, in the field of generator design, is shown by the adoption, after a process of evolution, of certain types as standard. In each individual case the practice adopted has been determined usually by the good judgment or perhaps by the mere personal opinion of the engineers in charge of the installation. The current opinion seems to be that grounding the zero-point is a practice convenient to the central stations, but that it increases the element of danger. The convenience of the practice lies in the fact that grounding the zero-point fixes the potential between conductors and ground, and thereby limits it to a known value, for which proper insulation can be provided, and other safeguards be taken; but it is the current opinion that the very fact that the conductor potentials are thereby maintained at a fixed dangerous value above earth potential, is final evidence that the danger to life is increased by the practice.

For instance, in a three-phase system, grounding the neutral introduces the working Y-voltage of the plant between each phase-wire and ground, and, upon making contact to ground, a contacting body would be subjected to this voltage. On the other hand, if we leave out of present consideration the effect of static capacity (which is too often done in consideration of this matter), any system that is not grounded is entirely free from differences of potential relative to the earth, and can be grounded with impunity through a human body; the passage of an infinitesimal current suffices to discharge the line (a condenser of zero capacity) and the potential of the point touched immediately falls to zero—which means simply a shifting of the potentials of the entire installation relatively to the earth considered as datum. Thus, if capacity were not present, grounding the zero-point would be attended by a real increase in the element of danger; but as a matter of fact, capacity always is present to a greater or less degree, and completely alters the conditions of the problem; owing to capacity, each conductor is, in effect, grounded through a condenser, and, though the conditions are not exactly the same as when one wire is grounded direct, the results are somewhat similar.

The effect of these capacity connections to earth will be to cause the e. m. f.'s of the system to group themselves about the point of zero or earth potential—the common mesh-point of the condensers—which takes the position of a geometrical mean relatively to the system e. m. f.'s. Hence, when the line conductors possess capacity there will exist differences of potential between them and the ground, even when no part of the system is grounded direct. The difference of potential between any given conductor and the ground will not disappear upon connecting it to the ground through resistance (as was noted above to be the case when capacity is not present) for the reason that the capacity acts like an elastic ligament, tending to prevent the displacement of the line e. m. f.'s relative to earth; but the difference of potential will be reduced by the passage of current through the resistance, and if the draught of current be sufficient, may be lowered to a point where it will cease to be dangerous. The action, in each case, depends upon the amount of capacity present in the several conductors, and upon the resistance of the grounding body. Dangerous shocks have been received from alternating-current lines, which were known to be free from grounds, static capacity being generally accepted as the cause. The aim of this investigation is to determine what part is played by capacity in this action, and thus to afford some

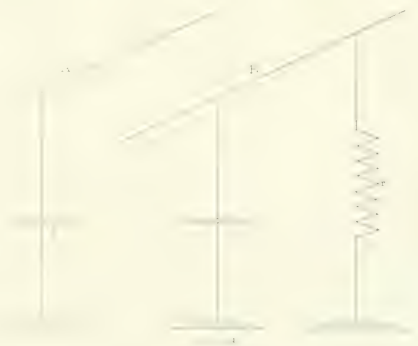


FIG. 1.—SINGLE-PHASE SYSTEM.

criterion as to whether the practice of grounding a system increases or decreases danger.

Let us first take the single-phase system. In this, as in the other cases to be considered, it is not necessary to take into account capacities measured between line and line, but only those measured between line and ground; the former constitute a local circuit merely, and do not affect the potentials of the lines with reference to external objects. The measurements must be made with all the conductors free from grounds; otherwise the result for any given conductor will be too great by the amount of the capacity existing between it and the grounded conductor or conductors. In the single-phase system, the conditions existing are equivalent to the arrangement shown in Fig. 1, in which x and z are capacity reactances meas-

ured between line and ground, and r is the grounding resistance. This is shown in diagram in Fig. 2. the construction of which is for [illegible] 1800 ohms

Current through x

From the figure,

Current through z

Current through r

$$\frac{G\,B}{r}$$

The sum of all currents meeting at a mesh-point is zero.

$$\frac{G\,B}{r} + \frac{G\,B}{r} = 0$$

In absolute quantities

$$G\,B = \frac{rz}{\sqrt{z^2 + x^2 + \left(\frac{z\,x}{r}\right)}} \qquad (1)$$

The equation in complex quantities[1] may be shown to satisfy the vector equation of a circle, the reference point [illegible] on the circumference. This equation is

$$\rho^2 - 2\,N\,\beta\,\rho = 0$$

in which ρ is the variable vector, and β the vector to the center. The

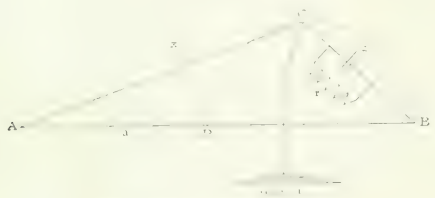


FIG. 2.—GROUNDING RESISTANCE.

vector β is minus one-half the vector to the point G, when there is no ground connection, or when $r = \infty$; and is therefore determined by the equation

$$\rho^2 - ax = 0$$

The locus of the point G is, therefore, a circle upon the line $B\,P$ as diameter.

From equation (1) by making the numerical substitutions for z, x and a, curves can be platted for any given case, showing variation of $G\,B$ with variation of r. In general, if z and x are fairly small the value of $G\,B$ will be nearly independent of variations of r, until r becomes comparatively quite small. This is illustrated in Fig. 3, where curves are platted for the case $x = z = 1700$ ohms, and a (the voltage of the system) $= 2300$ volts. In this case, a human body, assuming its resistance to be 5000 ohms, would be subjected to a potential of 1083 volts upon making contact between line-wire and ground. This is only 17 volts less than the potential would be if the system were grounded. The difference in favor of the ungrounded system is insignificant; in fact, the advantage in some cases would be reversed, as will be shown later.

Let us next take the three-phase four-wire system. The conditions existing are equivalent to the arrangement shown in Fig. 4. The corresponding diagram is given in Fig. 5, the construction being for $r =$ 1000 ohms; $a = 500$ volts; $b = 500\sqrt{3}$ volts; $x = 2300$ ohms; $y =$ 1800 ohms; $z = 2500$ ohms; $w = 2000$ ohms; Y-voltage equals 1000.

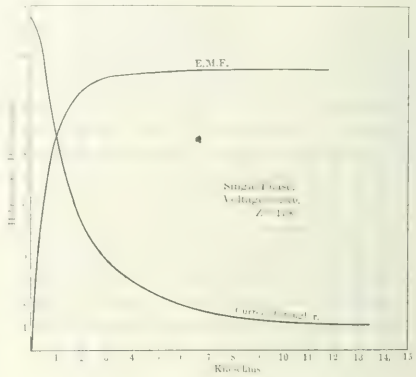


FIG. 3.—VARIATION CURVES.

Let us take $2a$ = Y-voltage.

$$N\,A = 2\,a$$
$$N\,B = -a + jb$$
$$N\,C = -a - jb$$

Current through r and z

$$I_r = G\,C\left(\frac{r + jz}{jrz}\right)$$

Current through w

$$I_w = \frac{G\,N}{jw}$$
$$G\,N = G\,C + a - jb$$
$$\therefore\ I_w = \frac{G\,C + a - jb}{jw}$$

Current through y

$$I_y = \frac{G\,B}{jy}$$
$$G\,B = G\,C + 2jb$$
$$\therefore\ I_y = \frac{G\,C + 2jb}{jy}$$

Current through x

$$I_x = \frac{G\,A}{jx}$$
$$G\,A = G\,C + 3a - jb$$
$$\therefore\ I_x = \frac{G\,C + 3a - jb}{jx}$$

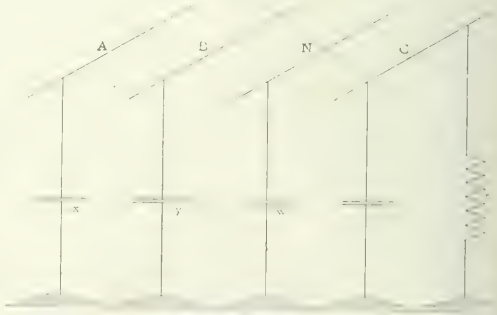


FIG. 4.—THREE PHASE, FOUR WIRE SYSTEM.

The sum of all currents meeting at a mesh-point is zero

$$I_r + I_x + I_y + I_w = 0$$

Adding the expressions obtained above for these currents, and re-

[1] It must be noted that the equation is not, strictly, a vector equation. In any expression in complex quantities, as $x + jy$, the second member is not a vector, but a quaternion, giving the value of r in terms of a unit vector along the reference line $A\,B$. This unit vector is k in the system of quadrantal versors i, j, k, in which j is the unit vector at right angles to the plane. Hence the equation should be written

$$r = [illegible]$$

or $r = (x + jy)k$, in other words, the factor k must be introduced before the vector formulæ can be applied. In this particular case (Fig. 2) the multiplication into k is unnecessary, since the radius of the locus-circle and the line of reference are coincident.

ducing, we get an expression for the potential upon a grounding body,

$$GC = -z\left[\frac{avc + 3zvc - zbc + 2awc}{wya + zya + 3zwc + awc + bwc + 3wyz}\right]$$

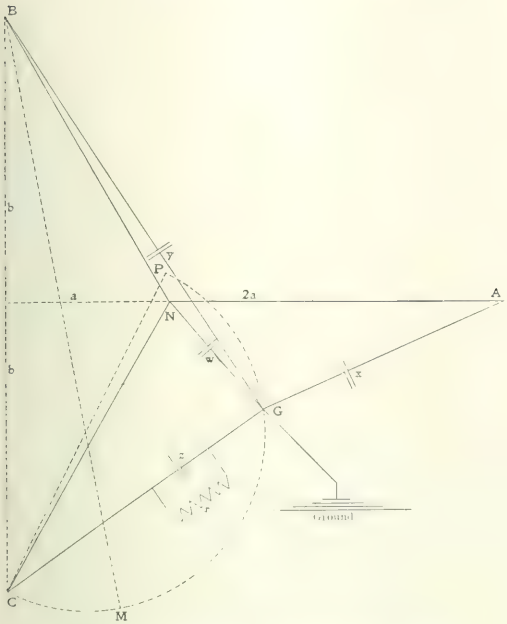


FIG. 5.—DIAGRAMS OF THREE PHASE FOUR WIRE SYSTEM.

Replacing by constants

$$GC = -\frac{k - jl}{m + jn}$$

$$\tan\omega = \frac{ln - km}{kn + lm}$$

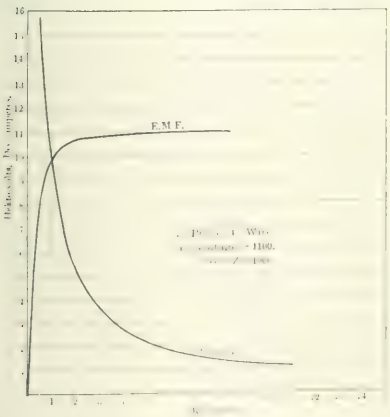


FIG. 6.—CURVES THREE-PHASE, FOUR-WIRE SYSTEM.

In absolute quantities

$$GC = z\sqrt{\frac{l^2(v^2 + 3z^2 + \dots + 2zv\dots}{(avc + \dots + \dots + \dots)^2}\left(\frac{\dots}{\dots}\right)} \qquad (2)$$

If $x = y = z$

$$GC = \frac{(Y\text{—voltage})}{\sqrt{1 + \left(\frac{wz}{r(3w + z)}\right)^2}} \qquad (3)$$

If $w = x = y = z$

$$GC = \frac{(Y\text{—voltage})}{\sqrt{1 + \left(\frac{z}{4r}\right)^2}} \qquad (4)$$

By a proof similar to that used in the preceding case, it may be shown that the locus of the point G is a circle upon CP as diameter; the vector CP is the vector from C to the point of zero potential

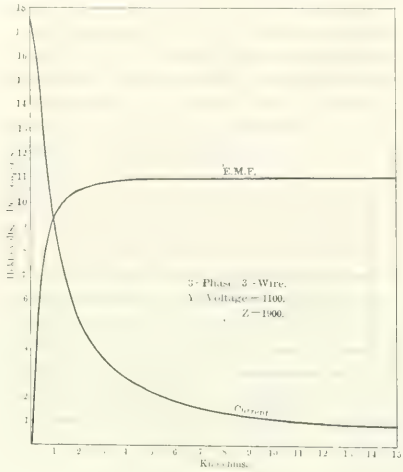


FIG 7.—CURVES, THREE-PHASE, THREE-WIRE SYSTEM.

when there is no connection to ground, and is, therefore, determined by putting $r = \infty$ in the above equations.

As in the preceding case, if there is a fair amount of capacity present in the system, the potential GC will undergo a very slow decrease as r decreases, until r becomes relatively very small. As an example, curves are platted in Fig. 6 for the case where $x = y = z = w = 1900$ ohms, and the Y — voltage is 1100. As there shown, a human body, assuming its resistance to be 5000 ohms, would be subjected upon making connection between phase-wire and ground to a potential of



FIG. 8.—DIAGRAM OF TWO-PHASE, FOUR-WIRE SYSTEM.

1095 volts, which is only 5 volts less than the corresponding value in the same system grounded at the neutral. This difference in favor of the ungrounded system is insignificant. To reduce the potential GC below a dangerous value, would require that the resistance of the grounding body be not more than 500 ohms; the current through this

resistance would be about 1.5 amperes. It is evident that, in this system, grounding the neutral point would not appreciably increase danger.

Let us next take the three-phase three-wire system. This is a special case of the preceding, in which there is no neutral wire; by substituting $w = \infty$ in (12), an expression for the potential upon a grounding body is obtained. (The notation is the same as in the preceding case.)

$$\left(\quad \right) \tag{6}$$

The locus of G is a circle, as before. If $x = y = z$

$$\left(\quad \right) \tag{6}$$

Curves are given in Fig. 7 for the case where $x = y = z = 1900$ ohms, and the Y — voltage is 1100. The remarks made on the preceding case apply here also.

Let us next take the two-phase four-wire system. The diagram for this system is given in Fig. 8, the construction of which is for $r = 1000$



FIG 9.—CURVES FOR THE FOUR CASES.

ohms; $a = 1000$ volts; $z = 2700$ ohms; $y = 2000$ ohms; $x = 1800$ ohms; $w = 2300$ ohms.

Employing the same methods as that used in the preceding cases, we get an expression for the potential upon a grounding body.

$$\left(\quad \right) \tag{7}$$

$$G C = \left(\quad \right)$$

where a is one-half the potential between opposite conductors. The locus of G is a circle, as in the preceding cases. These equations are similar to those obtained for the three-phase system, and the curves in Fig. 6 may be taken as typical for this case.

In the numerical cases considered above, the voltages assumed were all comparatively low, while the values of capacity assumed were such as are known to occur in existing installations. If higher voltages were assumed, and the cases worked out, the conclusion would be still more obvious that static capacity between line-wires and ground must usually be regarded as a source of danger. In the cases considered, the danger caused by capacity is seen to be fully as great as that caused by grounding. Under a slight modification of the conditions it will be greater. This occurs when the capacities of the line conductors are not equal, resulting in an unsymmetrical distribution of potential about the zero-point. This may be seen in Figs. 2, 5 and 8. In this case the potential impressed upon a grounding body might be higher than the Y — voltage, to which value it would be limited in a grounded system. Therefore, in certain cases the practice of grounding not only does not increase danger, but may actually reduce it.

The equations deduced above for the potential impressed upon a grounding body are all of the form

$$G C = f(a, z, r)$$

where a is the line voltage, z the capacity-reactance between conductors and ground, and r the resistance of the body through which the ground is made. This is the general equation; but if we wish to limit the discussion to the particular case where the resistance r is that of the human body, and can assign to $G C$ some value as the lowest limit of potentials dangerous to human life, we can get equations between z and a of the form

$$a = f(z).$$

These equations will give, for any system of voltage a, the (approximate) highest value of capacity-reactance (the lowest value of capacity) which will bring about in that system the condition of danger to human life. Curves for the four cases considered are platted in Fig. 9, from equations derived from (1), (4), (6) and (8), by assuming the resistance of the human body to be 5000 ohms, and the lowest dangerous potential to be 750 volts. In these curves the abscissæ are reactances; the ordinates are Y — voltages for the three-phase systems, and voltages between opposite conductors for the single-phase and two-phase systems. These curves show that static capacity between lines and ground, even though present in very slight amount, is to be regarded as a source of danger, especially in high-voltage systems.

Viewing the matter from another standpoint, that of securing maximum reliability in operation, we find that, in most cases, there are decided advantages in grounding the zero-point. In the first place, the practice secures the immediate detection of faults, and necessitates their immediate removal. Also, when the zero-point is grounded, the potentials between conductors and ground are thereby limited to a definite amount, namely, the Y — voltage; but no such limit is imposed in an ungrounded system. The potentials between phase-wires and ground may vary between wide limits, and may rise to such values as would seriously increase the liability of breakdown of the line insulation. For instance, referring to the numerical case diagrammed in Fig. 5, it is seen that the maximum potential produced between the wire B and the ground, by the presence of a ground on the wire C, would be 1830 volts. In a grounded system this potential would have been limited to 1000, the Y — voltage; here it is higher than the delta-voltage of the system. The increase is 83 per cent. Such a rise of pressure, taking place in a high-voltage system, would very greatly increase the danger of breakdown, as well as danger to human life. This, of course, is an extreme case; but the effect is always present to a certain extent, and may at any time occur in the extreme degree.

As a conclusion it may be stated, that the practice of grounding high-potential system conduces, in most cases, to reliability in operation, and that, with rare and unimportant exceptions, it cannot be objected to on the score of causing increased danger to life and property.

Another Wireless Telegraph Station.

It is announced that the American Wireless Telegraph & Telephone Company has begun the construction of a tower at the Highlands of Navesink for the reception of messages from incoming steamers. It is the company's intention to report incoming vessels in opposition to the Marconi company. The tower will be 130 feet high and will have a base 40 feet square. Its location is the highest point on the coast south of Maine, being 210 feet above the sea level. The American Company intends to erect towers at Fire Island and Montauk Point. Another important feature of the work will be the sending of wireless telephone messages along the Jersey and Long Island coasts, and ultimately from Maine to the Carolinas. The original intention was to build a 150-foot tower at the Highlands of Navesink, but builders said this height was too great to withstand successfully high winds. It is said a half dozen old pilot boats or other craft will be hired to stand out to sea and report by wireless telegraph the names of ships approaching the American coast.

The Storage Battery in the Commercial Operation of Electric Automobiles.

By W. H. Palmer, Jr.,

In discussing the merits of the various systems of automobile propulsion, the electrically-driven vehicle is too frequently dismissed with the arbitrary statement that, although ideal in so far as motor, controlling mechanism, etc., are concerned, it is rendered impracticable for commercial use by reason of the great weight of the necessary storage battery, its unreliability, and the great amount of attention which it demands. On the other hand, there are not lacking those who maintain that, thanks to the unremitting efforts of the past few years, the storage battery is, in the special types furnished for automobile work, freed to a great extent from those objections.

Attempts have been made, from time to time, to collect and publish results obtained by isolated users of electric vehicles, but, as is also true of similar data collected concerning other systems of automobile propulsion, the reports have been so contradictory, and improper conditions so large a factor, that the information so obtained has been of little value.

The greater the scale on which operation is conducted, and the more perfect the knowledge of the conditions surrounding it, the more accurate and interesting should be the conclusions drawn therefrom.

Electric cab service in New York City was inaugurated in the spring of 1897 by the Electric Carriage & Wagon Company, with an equipment of twelve hansoms and one surrey. To-day that service, conducted by the New York Transportation Company, has grown to such proportions that upwards of three hundred vehicles are in daily operation, running an average of nearly five thousand cab miles per day. That the service performed by these vehicles is successful, from the point of view of the patrons, is shown by the fact that, at rates equal to, or in excess of the rates charged for the highest class of horse livery service, far more applications for service are received daily than the company, even with its increased equipment, is able to accept.

This growth would seem to indicate that, by this company at least, solutions have been found for the various problems encountered—that of the storage battery among the rest. It is the object of this article to describe briefly the progress that has been made along this line, and the means that have been employed to obtain economy and reliability of operation. While vehicles of nearly every description are included in the equipment, the operation of hansoms and broughams constitutes the greater portion of the company's business, and the portion upon which accurate figures are most easily obtainable, and the statements which follow have been based upon the vehicles and batteries used in that service.

About one and a half batteries are kept in commission for each vehicle operated. This number is sufficient to meet the requirements of service calling for the use of vehicles at all hours, both day and night. Of these, about two-thirds are, at present, of the "Chloride-Manchester" type, and one-third of the "Exide" type—both the product of the Electric Storage Battery Company—one or the other being used according to the nature of the work to be done by the vehicle. No batteries of any other type are used by this company. Tests have been made of the other types of automobile cells which have from time to time made their appearance, but none have promised or performed so well as those now in use.

It is of great importance that the batteries used should be the product of manufacturers who can be depended upon to supply promptly and certainly such parts as may be necessary for increases, renewals and replacements. An unvarying standard of quality is also a prime consideration. The characteristics inherent in the batteries in use, which particularly adapt them to the service required, will be spoken of later.

The Chloride-Manchester elements are so well known that a detailed description of them should be unnecessary. The standard brougham or hansom battery of this type consists of 44 cells having three Manchester positive and four Chloride negative plates. The weight of the battery complete in the tray, with all connecting straps, etc., is 1790 lbs., and the capacity 108 ampere hours at the three-hour rate of 36 amperes.

These batteries, as originally furnished, were assembled with corrugated perforated hard rubber separators between the plates. These separators were unsatisfactory for various reasons. One of the principal sources of trouble was in the tendency of these separators to flatten out if, during the hot weather of the summer months the batteries, for any reason, became slightly overheated. The flattened portions would then form pockets in which the active material, which is always slowly being thrown off from the surfaces of the plates, would collect, quickly causing partial short-ciruits, leading to "dead" or "weak" cells, and, if neglected, to more serious trouble, if not the total loss of the plates. This was partly overcome by employing a "heat-proof separator," which, being corrugated before being vulcanized, was much less apt to flatten. These were, however, still unsatisfactory. To economize space, the distance between adjacent plates in the cells is necessarily small, and particles of active material frequently lodged in the perforations, forming the nucleus of bridges which gradually built themselves across from plate to plate; or, in assembling or repairing the cells, a careless workman might allow a quantity of lead, melted under the hydrogen flame, to run down between the plates, which, rivetting in the separator perforations, would eventually cause a partial short circuit, at once difficult to detect and remove. Moreover, the first cost of the separators was great, and, being brittle, many were broken in the operation of cleaning and repairing the cells, constituting a constant source of annoyance and expense.

The Electric Storage Battery Company, therefore, set itself the task of providing a substitute for this expensive and unsatisfactory separator, and about a year ago brought out a grooved wood separator, without perforations, which is now used in all batteries of this type.



Fig. 1.—Battery Charging Room, New York City.

and which is free from all of the above objections. These separators are ⅛-inch thick, with vertical grooves, 3/64-inch deep, on both sides. The distance between centres of grooves is ¼-inch. The width of the separators is equal to, and the height ½-inch greater than the corresponding dimensions of the plates. Being without perforations, they form practically a continuous diaphragm between the plates.

Partial short-circuits are almost entirely prevented, and, in the rare cases where they do occur, can be readily removed. Cleaning is necessary at less frequent intervals, and the life and capacity of the elements are therefore conserved and the efficiency increased. The first cost of these separators is small, and with a life of from 3000 to 5000 miles the maintenance cost is very low. These separators do not increase the internal resistance of the cells.

Connection between the battery and vehicle wiring is made by means of copper terminal plates mounted upon the sides of the tray On the sides of the battery compartment in the vehicle are spring-mounted contact-blocks, which have pressure contact with the plates on the tray when the battery is in position in the vehicle.

The 44 cells comprising a battery are connected in one series. This is a decided improvement upon former practice, when two, and even four series were the rule. The advantage is that only two contacts are required for the single series as compared with four or eight with the two and four series arrangements. These contacts, consisting of flat plates having upwardly extending lugs, are securely fastened to the sides of the tray. The lugs extend to within a few inches of the terminal cells of the series, to which they are attached



FIG. 2.—STANDARD EXIDE BATTERY FOR HANSOM OR BROUGHAM.

by short solid copper wires. With the two and four series arrangements, the contacts and wires were a source of much trouble. With the two contacts and short stout wires, such troubles are rare.

The weight of a standard brougham, with battery, driver and two passengers, is about 5300 lbs. Such a vehicle, when in good condition, will consume, at the normal running speed, on level asphalt, about 50 watt hours per 1000 lbs. per mile, or 265 watt hours per vehicle mile. This will be increased if the vehicle is not in good order, if the retardations, because of traffic, are very numerous, or if the streets traveled over are rough or covered with mud or snow. A fair average for reasonably clear streets has been found to be 60 watt hours per 1000 lbs. per mile, or 318 watt hours per vehicle mile.

The capacity of the battery at the three-hour rate is, as stated, 108 ampere hours. As the average voltage of discharge of 44 cells at this rate is about 84 volts, the watt hour capacity is about 9072 watt hours.

The mileage capacity under average conditions will, therefore, be 28.5 miles. The weight, and consequently the power consumption, of the hansom are slightly below these figures, but the difference is not great. The radius of action indicated by these figures is ample for the bulk of the service which vehicles are called upon to perform in and about New York. It is necessary, however, to allow a relatively high margin of safety to insure reliability, since imperfections in the vehicle, a battery not fully charged, or snow-covered streets, may materially reduce the mileage capacity. In order, therefore, to care for service requiring greater mileage on a single charge than could be secured from the Chloride-Manchester cells, and also to increase the margin of safety, the Electric Storage Battery Company was asked to submit for trial a battery of higher capacity.

Having anticipated this demand, the manufacturers had for some time been engaged in exhaustive tests of various types and forms of plates, and, as the result of this work, the first battery of the Exide type was furnished in the fall of 1900. This battery constitutes a signal advance in the art of storage battery construction. Presenting to the casual view no distinctly new features, it nevertheless embodies principles never before brought together and which combine to secure, in a greater degree than has hitherto been obtained, the three necessary features of a commercially successful automobile battery—high capacity, long life, and, if the phrase be pardonable, a strong constitution; that is to say, freedom from structural weakness and the ability to withstand, without serious injury, a great deal of neglect and abuse. The advent of this battery has given to the electric automobile industry a renewed impetus. As it is a comparatively recent development, a somewhat particular description of its construction and capabilities should be of interest.

The plates are of what is generally known as the pasted, or Faure type, consisting of antimonious lead grids or supports pasted with oxides of lead. Both theory and the results of many years of experience have shown that, just as the chemical changes undergone by the active material of the positive plate in the operations of charging and discharging differ from those undergone by that of the negative plate, so, in order to secure the best results, the distribution and mode of supporting the active material of the one should differ from those of the other. This principle has been recognized in the design of the Exide battery as it has not been in any previous form of the pasted type of cell. In previous forms both positives and negatives have been of the same general construction; in the Exide battery they are radically different, that construction having been adopted for each, which experience has proved to be the best.

The negative plate consists of a grid made of an antimonious lead sheet, around which a frame of sufficient weight to secure the necessary stiffness and strength has been cast. The body of the sheet is filled with perforations, evenly spaced at small intervals. These are made by a tool which does not remove any material, but instead tears its way through, leaving numerous small clawlike projections around each hole, which are curved back toward the sheet, forming a series of hooks. Half of the perforations are made from one side and half from the other, so that after the operation is completed both sides are thickly studded with these little hooks.

Both sides of this grid are then pasted with litharge. The paste is held to the grid by the little hooks and is also rivetted through the perforations, giving all portions of the mass a tenacious hold upon the support, and upon each other. There are no isolated pellets to shrink and drop out, no large masses pasted against a flat surface to scale off, and but little of the support exposed, leaving the whole of the faces of the plates active and giving a maximum rate of discharge per unit of area. The distribution of the mass of active material is nearly ideal. Being applied in a thin layer, all parts of it are close to the current carrying support and in a position to give maximum capacity per unit of mass. The thickness of the finished plate is 3/16-inch.

The grid of the positive plate is of the "cage" type, consisting of thin vertical ribs, the edges of which are flush with the faces of the plate, and which are connected by small bars having a triangular cross-section, the base of the triangle being at the face of the plate. These connecting bars on one face are staggered with those on the other. This grid is pasted with red lead and formed in the usual way, the thickness of the finished plate being 7/32-inch. The active material is in the form of continuous pencils, of rectangular cross-section, extending from the top to the bottom of the plate. The thin flat ribs are on two sides of the pencils and the triangular cross-bars are embedded in the other two sides, which constitute the faces of the plate. The design of the grid gives a maximum of strength and stiffness with a minimum of weight. The continuity of the material combined with the cross-bars holds it firmly in place, while at the same time provision is made for its expansion and contraction. In service the active material is gradually eroded from the surfaces. The bars, being embedded in the material, contact is maintained until the amount of active material is so reduced as to no longer be sufficient to give the proper capacity. The separation of the faces of the plate into relatively small sections by the ribs and bars prevents the rapid removal of the active material by the "wash" of the electrolyte.

The separators used in these cells are of wood and similar to those used in the Chloride-Manchester batteries. A plain perforated hard rubber sheet is also placed against each face of the positive plates.

The standard brougham or hansom battery of the Exide type consists of 44 cells of the T V-9 size, having four positive and five negative plates. The rubber jar is the same as that used for the T V-7 Chloride-Manchester cell, and the batteries are assembled in trays of the same size, making the two types of battery interchangeable in the vehicle. The weight of this battery complete with tray, etc., is 1650 lbs., or 140 lbs. less than that of the Chloride-Manchester type.

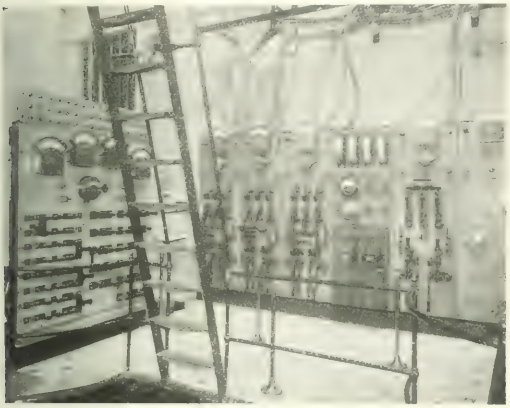


Fig. 3.—Rotary converter switchboard.

The capacity is 156 ampere hours at the 4-hour rate of 39 amperes. The average voltage during discharge is 87 volts; the watt hour capacity, therefore, is 13,572 watt hours, an increase of 50 per cent over that of the Chloride-Manchester batteries and of 62.5 per cent per pound. Using the figures for average vehicle consumption already given, the mileage capacity will be, under average conditions, 42.7 miles.

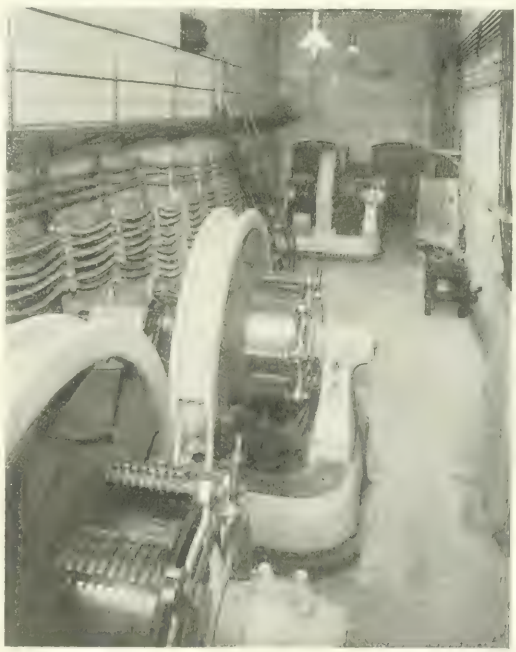
In connection with the general subject of mileage capacity, it should be noted that the mere statement that a certain vehicle equipped with a certain battery has run a certain number of miles on a single charge, is valueless unless accompanied by additional data concerning the relative weights of vehicle and battery, the load carried, the power consumption per mile, the speed, etc. Nor does the attainment of a high mileage capacity necessarily imply commercially successful operation. Increase in radius of action on a single charge may be obtained in three ways, by increasing the proportionate weight of the battery; by decreasing the power consumption per unit of weight per mile; or by increasing the effective capacity per pound of battery. Ill-considered steps in any of these directions may easily result in an increased maintenance cost which will far outweigh the advantages of increased mileage capacity. No reliance should be placed on any statements in which full details of the attendant conditions are not included.

The battery policy of the New York Transportation Company necessarily depends very largely upon the question of cost of operation per vehicle mile. It has, therefore, been most gratifying to find, after a year of operation, that the Exide battery not only provides a sufficient mileage capacity for all classes of metropolitan service, but at the same time can be operated at a cost, including maintenance, but little in excess of that of the Chloride-Manchester and within the limits of reasonable expense. This conclusion is based upon the results obtained from 75 batteries, which have been in continuous service for about one year.

In calculating the battery expense per vehicle mile the cost is divided under two general heads, "Operation" and "Maintenance." The latter is sub-divided into "Renewals," "Cleaning" and "Repairs." In the cost of "Operation" are included the expense for current and labor used in charging and handling the batteries, and also of the acid and labor used in regulating and replenishing the electrolyte. All batteries are removed from the vehicles for charging. This is done both to facilitate inspection and to avoid the loss of time and the other complications that would result from having the vehicle lie idle during the charging period. The batteries are handled entirely by machinery. The equipment provided for this purpose has been very fully described in previous articles. Labor is thus reduced to a very low figure. Current for charging purposes is taken direct from the high tension alternating mains of the New York Edison Company, at 6600 volts, 25 cycles. This is transformed and converted to direct current at pressures from 98 to 110 volts. The equipment of static transformers, rotary converters, etc., necessary to accomplish this is owned and operated by the Transportation Company. The capacity of this installation is 800 kilowatts. Four sets of large, stationary storage battery cells are also included in the equipment, being used as booster and crusher batteries to secure a number of bus pressures from a single rotary converter.

Four bus pressures are provided at the charging switchboard, being 98, 102, 106 and 110 volts respectively. The batteries are put in charge on the lowest and moved up as the current falls until the highest bus is reached. When the current taken on this bus falls to a value depending somewhat upon local conditions, but which averages 10 amperes for Chloride-Manchester and 7 amperes for Exide batteries, the charge is complete and they are cut out. The batteries, being kept in good condition, can stand fully charged for 24 hours without appreciable loss of charge, the loss in the course of a week being only about 10 per cent. By careful attention to this portion of the work, and by keeping the batteries in an efficient condition, a very fair degree of efficiency between the charging switchboard and the vehicle motors has been attained, the figure being about 50 per cent watt efficiency, which, considering the high rates of charge and discharge, and the loss of efficiency by operation on partial discharges, as will be explained later, is very creditable. The charging of all of the batteries is controlled from a single central switchboard. Under the system adopted, this portion of the work is so simplified that even during the hours when the greatest number of batteries are being charged, one boy is able to handle the entire board.

The specific gravity of the electrolyte of the Chloride-Manchester



batteries is 1.250 when the cells are fully charged, and that of the Exide batteries is 1.300. The maintaining of the density of the solution at the proper point and the replacing, with water distilled on the premises, of the loss by evaporation is very important. This work is in the hands of specially trained men.

Maintenance includes, under the sub-head of "Renewals," the cost of plates, separators and incidental supplies used in maintaining the

integrity of the equipment. The most accurate figures on the cost of renewals are based on the life of the plates, etc., in vehicle miles. This will, of course, depend greatly upon the conditions of service. The greater the mileage made on each charge, the longer will be the life, other things being equal; an Exide battery which had made 1480 miles on 40 charges, or an average of 37 miles per charge, showed no more deterioration than one which had made but 1040 miles on the same number of charges, or an average of only 26 miles per charge.

The average mileage per charge made by the Exide batteries in regular service is only 20 miles. The necessity of sending out every vehicle each morning, with ample power to meet the extreme possible requirement of every customer, makes it difficult to increase this average, although the cost of renewal would be decreased could it be done. The operation of batteries on partial discharges also means a reduced efficiency, as mentioned above. The reason for this will become evident from a consideration of the following, taking, for instance, an Exide battery having a capacity of 13,572 watt hours. If the watt efficiency on full discharges be taken as 75 per cent, the charge after a full discharge will amount to 18,096 watt hours, or an excess of 4524 watt hours. If, however, only one-third of the capacity be taken out, or 4524 watt hours, it will still be necessary, in order to fully charge the battery, to give an excess charge very nearly as great as in the former case, or, say, 4200 watt hours, making a total of 8724 watt hours, or an efficiency of only 52 per cent.

The private owner of an electric vehicle has, for these reasons, a decided advantage over a company renting them, as, knowing in advance the service required, he can operate his battery up to a much higher average mileage per charge, increasing its life and efficiency.

The 75 Exide batteries placed in service by the New York Transportation Company nearly a year ago, had made, up to Feb. 1, 1902, an average of 3742 miles each. Seven of them had made over 4500 each, the maximum being 4958 miles. Thirteen of these 75 batteries had been retired from service up to Feb. 1. Two of these were withdrawn from service because of their having been involved in accidents, in which a number of the plates were damaged beyond repair. The others have been withdrawn from time to time, not because they were unfit for further service, but to provide plates for necessary renewals and replacements in the remaining batteries. The idea has been to treat these 75 sets as a unit, gradually weeding out the plates which, through accident or use, fall below the rated capacity, and in this way to secure figures on the average life of the plates.

A very rigorous standard has been adopted in determining the end of the life. No battery is allowed to remain in service after it falls below its rated capacity, as given above. This is made possible by reason of a most valuable characteristic of cells of the Exide type, i. e., the maintenance of a very constant capacity during most of the life of the plates. In other words, the capacity upon which the above figures are based is not the maximum reached by the cells in the course of their life, nor the average capacity during that life, but is the minimum capacity. The initial capacity is about 6 per cent above this capacity, or 4¼ hours at 39 amperes. This increases during the first 20 to 25 discharges to a maximum of 25 per cent above the rated capacity, or 5 hours at 39 amperes. From this point it gradually falls until the rated capacity is reached. The end of the life is then at hand, the fall in capacity from this time on being very rapid. Rating the cells on this basis results in great satisfaction to the user, as the average capacity during the whole life is upward of 12 per cent in excess of the rating. The average maximum capacity has been given as 25 per cent higher than the rated capacity, or 5 hours at 39 amperes. This is a conservative figure, many batteries rising as high as 5¼ to 5½ hours at that rate, and few failing to go as high as 5 hours.

The high capacity attained by these batteries has made possible continuous runs on a single charge far in excess of the 42.7 miles given as the mileage capacity under average conditions. The New York Transportation Company appreciates that an abnormal performance under special conditions has little practical value, and no special effort has been made to establish a record. Runs of over 60 miles have, however, been made on several occasions, both in regular operation and under test conditions. The average capacity, as ascertained by recent test discharges, of the 7 batteries which had made, up to Feb. 1, over 4500 miles, is 4¼ hours at 39 amperes. All of these batteries are still in operation and doing as good work as at the beginning of their life. The average capacity of all the other batteries still in service (62 out of the original 75) was, on Feb. 1, about 4½ hours at 39 amperes. A conservative estimate of the average life which will be obtained would seem, therefore, to be not less than 4500 miles. This refers only to the positive plates. The negative plates in all of these batteries show much less deterioration than do the positives, many being apparently as good as when first placed in service. There is no doubt but that a majority of them will be able to outlast a second set of positives.

Assuming that only one-half will have a life double that of a set of positives (and this estimate is a safe one), the total life of one-half will then be 4500 miles, and of the other half 9000 miles, or an average life for all negative plates of 6750 miles. If, then, the life of the positives be 4500 miles, the average life of all plates will be 5625 miles. At the end of this life the plates are still worth from $30 to $40 as scrap lead.

These figures have been most carefully checked and are believed to under, rather than overstate the life of elements of this type. The life of the Chloride-Manchester elements is much greater than that of those of the Exide type, and has not been so accurately determined. As operated by the New York Transportation Company, these batteries suffer, in common with the Exide batteries, in being necessarily operated on a mileage per charge much below their capacity, the average being only 10 miles. As an average of but one charge per day is given, the yearly mileage of these batteries is in the neighborhood of 3600 miles. The oldest batteries of the Chloride-Manchester size now in use have been in service only two years and show but little deterioration except where there have been adverse conditions.

Prior to the introduction of the wood separator, and during the



FIG. 5. BATTERY CHARGING SWITCHBOARDS.

months just previous to the removal of the company to its present station at Forty-ninth Street and Eighth Avenue, operation was conducted under great difficulties. The old station, located at 1684 Broadway, had been outgrown, the business having assumed such proportions that the equipment and floor space were no longer adequate. During this time the batteries did not receive the attention necessary to satisfactory results, and for a time deterioration was rapid. Another reason why better data as to the life of batteries of the Chloride-Manchester type is not available is the fact that the earlier years were, to a great extent, years of experiment. The vehicles used during 1897, 1898 and 1899 were equipped with various sizes of battery, and it was not until 1900 that an equipment was secured using a uniform size in all vehicles of the brougham and hansom types. Many of the older vehicles were sold and others were reconstructed to adapt them to use the new size of battery. The older batteries, therefore, became obsolete before the end of their life had been reached. The company still has in its possession many of these old sets, and they are gradually being made use of by reconstruction and adaptation to the present equipment.

Another use which is being made of these obsolete batteries is in connection with the express cars operated by the Metropolitan Express Company, one of the sub-companies owned by the Transportation Company. These cars are at present equipped with both ploughs and overhead trolley poles, adapting them for operation on either the underground or overhead systems at will. To still further increase the scope of operation, a number are to be equipped with storage battery auxiliaries, making it possible to run them on the tracks of the various horse-car lines as well. Cars thus equipped with bat-

teries formerly used on the vehicles have been successfully experimented with, and the work of preparing a number for this service is now under way.

But while data regarding the Chloride-Manchester type, of accuracy equal to that of the Exide type is not at hand, much is known about the life of individual batteries, and fair conclusions may be drawn from an examination of the older of those batteries now in service, which have already made from 5000 to 8000 miles. A calculation based on all available information gives as the life of Manchester positive plates 12,000 miles, and as that of the Chloride negatives 20,000 miles, or an average for both of 16,000 miles, or 140 per cent more than that of the Exide plates. This would appear to constitute a very material difference in the cost of operation of the two types, and, taken alone, it would do so. But—and this point is too frequently overlooked—there are other factors in the total operating cost. The labor in handling and charging, for instance, will be, per vehicle mile, twice as great in the case of the Chloride-Manchester battery, averaging ten miles per charge as for the Exide running 20 miles per charge; the labor to charge each being approximately the same. The Exide operated 20 miles per charge is also somewhat more efficient than the Chloride-Manchester running 10 miles per charge, as explained above. These considerations reduce the apparent difference in cost of operation and the greater mileage capacity of the Exide makes it, for some classes of service, far preferable.

While on the subject of the life of the Chloride-Manchester batteries, it may be stated that the capacity during the life is even more constant than that of the Exide elements. The initial capacity is about 8 per cent in excess of the rated capacity, rises very slowly to a maximum of 15 per cent to 17 per cent in excess, and, after falling gradually to the rated capacity, remains constant at that point for a long time. The introduction of wood separators has greatly improved the performance of these batteries by preventing "weak" or "dead" cells due to partial short-circuits, as explained, and the present average capacity of all the sets of this type now in use is about 6 per cent to 8 per cent above the rating.

Under "Renewals" come also the separators. The life of these has already been mentioned, and this expense is small. Cleaning, the next item in the cost of "Maintenance," is made necessary by the gradual accumulation of sediment in the bottom of the jars. The plates rest on ribs which are two inches high. The active material is thrown down more rapidly from the Exide than from the Manchester plates. Cells of the former type require cleaning after each 1500 to 1800 miles, and of the latter after each 2400 to 2800 miles. With the corrugated perforated hard rubber separators Chloride batteries had to be cleaned after only 600 to 1200 miles, due to the sediment lodging between the plates instead of falling to the bottom. If cleaning be delayed after the sediment accumulates in sufficient quantity to touch the bottom edges of the plates, deterioration is very rapid. A watch is therefore kept on the mileage, and examination made from time to time, and the cells cleaned out promptly when it becomes necessary. The work of cleaning is systematized and is not a serious matter. A set of clean jars in a tray is provided, the connecting straps are cut and the elements lifted out, rinsed off and placed in the clean jars. Fresh acid is then put in, the straps reburned, and the battery is again ready for service.

The third principal cost of "Maintenance" is that of repairs. While the mechanical battery handling equipment is admirably adapted to its work, occasional mishaps are unavoidable, and a portion of the repairs are of damage resulting from such accidents. The bulk of the repairs at present is of broken connecting straps. Many of the older batteries were equipped with straps which experience has shown are too weak. These are rapidly being replaced by heavier ones, and this source of trouble will soon be largely removed. Jar breakages average one per 1000 miles, most of this occurring in the battery room. As the majority can be repaired, this does not constitute a large item of expense.

Expenses of all kinds are kept down by requiring and maintaining a high standard of condition of the batteries. The regular routine includes frequent examination for all of the troubles which may develop, and these are at once corrected when found. Thanks to the careful design of the elements, there is absolute freedom from many of the ills to which a storage battery is popularly supposed to be, by nature, heir. Neither the Exide nor Manchester plates, as operated by the New York Transportation Company, buckle or grow even under severe ill-treatment, and they are sufficiently stiff and strong to withstand without injury the handling incidental to cleaning, repairing and reconstructing. Storage batteries do not demand the attention of skilled mechanics, but they do need reasonably intelligent care, and the cost of maintaining them will be a minimum if this be given regularly, and a maximum if given spasmodically. The New York Transportation Company has not found it necessary to provide a large force of skilled workmen to operate and maintain its batteries, a relatively small number of careful men, of ordinary ability, working under competent supervision, being able to handle all of the work.

The practical results of the system of caring for batteries is shown by an examination of what is known as the "Daily Trouble Report." This comprises a carefully kept record of every trouble necessitating the repair of vehicles in the streets or their being towed to the station through inability to run on their own power. The vehicles and batteries participating in these failures are carefully inspected and the results of the inspections incorporated in this report.

During the months of operation prior to and just following removal to the new station, and when, as stated, the batteries were, through stress of circumstances, improperly cared for, the cases of "power exhaustion" averaged from 5 to 7 per 1000 vehicle miles. In the new station, with the better care made possible by increased facilities, the number of cases of power exhaustion has been reduced to an average, during the last nine months of operation, of only 1.31 per 1000 vehicle miles. These figures include power exhaustion from all causes, and the great majority are due to improperly oiled bearings, defective motors, snow or mud covered streets, carelessness on the part of drivers in wasting power, attempts to make abnormally long runs, etc., etc. These figures are being improved upon, but already the showing speaks well for the batteries and for the system of charging and caring for them.

The good results secured are also undoubtedly due in a great measure to the improvements made in the vehicles and to the efficient administration which prevails in the department responsible for their condition. The power consumption has been reduced to the figures given by the change from pneumatic to solid tires, changes in the bearings, and a careful treatment of many other details, of which it is not possible, within the limits of this article, to speak at length. The storage battery is the least variable of the many factors involved in electric vehicle operation; yet it is, by the thoughtless, the one most frequently blamed in the event of failure.

The business of the New York Transportation Company has increased greatly within the year, and is limited only by the capacity of the equipment. Disregarding pleasure vehicles, suitable only for summer use, over 90 per cent of the vehicles owned are in constant operation, less than 10 per cent being the proportion out of commission from day to day for repairs of all kinds. To sum up this presentation of the situation, the New York Transportation Company is demonstrating, in its daily business, that the electric automobile has been developed to the point where, in reliability, radius of action and operating costs, it meets all the requirements necessary to commercial success, and that the development of a storage battery especially adapted to work under the rigorous conditions imposed, has contributed greatly to this result.

So far from being an insuperable obstacle to the success of electrically propelled vehicles, the battery is to-day better adapted to its work than some other portions of the equipment, and, in point of maintenance cost, a smaller factor in the total expense of operation than are, for instance, the rubber tires on the vehicle it runs.

A Big Cable Ship.

The submarine-telegraph cable ship *Colonia*, built to the order of the Telegraph Construction & Maintenance Company, Limited, was launched last month, and will when finished proceed to the Pacific to lay the cable that will connect the mid-Pacific possessions, Fanning Island, with Vancouver. This done, the cable will be continued to New Zealand, and thence to other British possessions. The dimensions of the *Colonia* are: Length, 500 feet; breadth, 56 feet; depth, 30 feet. The vessel will be capable of carrying 10,000 tons dead weight, and is expected to develop a speed of about 11½ knots. She has an overhanging bow, and an elliptical stern, both of which are fitted with the necessary cable gear. Built up in her holds are four tanks, in which can be carried no less than 3000 nautical miles of cable. As the *Colonia* is destined to work in all climates especial attention has been paid to ventilation. The machinery for propelling the ship and for laying submarine cables is of the latest improved type, while the arrangement of the quarters, both private and official, of officers and crew, the electricians, engineers, etc., are on a fine scale.

The American Electrochemical Society.

THE first meeting of the American Electrochemical Society, which was held at Philadelphia April 3, 4 and 5, was successful from every point of view. Eighty-seven members were registered as in attendance, and at some of the meetings the audience numbered 100 or more. Twenty papers were read and the discussions which followed were excellent, both in form and matter. Indeed, in conciseness and in keeping to the point, some of the older technical organizations might well take a lesson from the inaugural proceedings of the new society, and it is to be hoped that the latter in future meetings will not depart from the standard thus set.

The society was officially inaugurated at a business meeting held Thursday evening in the Manufacturers' Club. The meeting was



PROF. J. W. RICHARDS,
PRESIDENT AM'N ELECTROCHEMICAL SOCIETY.

preceded by a dinner at the club, and though not on the programme, in response to calls from the diners, Messrs. Hering, Reed, Richards, Keith and several others, enlivened the occasion with postprandial remarks. After the dinner a meeting was organized with Prof. J. W. Richards as chairman. Mr. Hering read the minutes of the temporary organization from which the Philadelphia meeting proceeded. For several years several engineers in Philadelphia had met twice a month to discuss electro-chemical subjects, and with these gentlemen the movement for the organization of the Electrochemical Society originated. Though the names of these gentlemen were not mentioned at the meeting, we may say that they were Messrs. Hering, Reed and Roeber. When a circular was sent out to those likely to be interested, suggesting the formation of the Society, the plan was to proceed with the organization of the Society if 75 favorable replies were received. The first mail brought in 40 favorable responses, and not many days later almost 300 accessions were received, which had reached 327 up to the date of the meeting, and rose to 363 at adjournment.

After the reading of the minutes the necessary formal motions for the organization of the Society were made and carried. There was some discussion as to the manner of writing the name of the Society—whether "electrochemical" should or should not be hyphenated; upon vote being taken, a majority favored writing the word unhyphenated. Mr. Hering, as chairman of the Committee on Constitution and By-laws, submitted a draft of a constitution, which was discussed article by article and finally adopted with a number of changes.

The article dealing with the officers of the Society was first disposed of and a committee then appointed to recommend nominations for the various offices as follows: President, secretary, treasurer, six vice-presidents and nine managers; the vice-presidents to hold office for two years and the managers for three years. Later the discussion on the constitution was interrupted to receive the report of the committee, which recommended the following names: President, Prof. J. W. Richards, of Bethlehem; secretary, C. J. Reed, of Philadelphia; treasurer, Dr. P. G. Salom, of Philadelphia; vice-presidents, Prof. H. S. Carhart, of Ann Arbor; Prof. W. D. Bancroft, of Ithaca, N. Y.; Prof. C. A. Doremus, of New York; Prof. L. Kahlenberg, of Madison, Wis.; Prof. W. R. Whitney, of Boston, Mass., and Mr. C. M. Hall, of Niagara Falls. Managers, Prof. S. P. Sadtler, of Philadelphia; Dr. E. F. Roeber, of Philadelphia; C. O. Mailloux, of New York; W. D. Weaver, of New York; Dr. Samuel Sheldon, of Brooklyn, N. Y.; Carl Hering, of Philadelphia; Edward Weston, of Waverly Park, N. J.; E. G. Acheson, of Niagara Falls, and Col. Samuel Reber, U. S. A., of Washington, D. C. The ticket as presented was unanimously adopted by the meeting. Owing to the length of the discussion of the constitution, the meeting did not adjourn until a late hour.

On Thursday afternoon, preceding the formal organization of the Society, a visit was made to the chemical works of Harrison Brothers & Company in order to see in operation the Darling process for the electrolytic production of sodium and nitric acid from nitrate of soda. The electrolytic cells consist of an iron pot within which and extending close to the bottom, is a pair of concentric cylinders of perforated iron, the annular space between the two being packed with powdered magnesia. The outer vessel forms the anode, and the carbon electrode is submerged in the fused electrolyte contained within the inner concentric cylinder. In order to prevent these cylinders from being attacked, they are in shunt connection with the anode. The drop of voltage in each cell is 15 volts. A pipe leading from a space between the cylinders and the outer vessel carries off the gases liberated, which elsewhere are condensed and form nitric acid. The sodium floats on top of the space enclosed by the inner cylinder and at intervals is ladled out and deposited in tin cans; paraffin is first placed in the bottom of these cans, and as the sodium is added this material floats on top and protects the surface from the atmosphere. No difficulty has been found in handling the sodium, though, of course, every precaution is taken to obviate the presence of moisture.

In the same works there is apparatus for the electrolytic production of cyanide, but the details of the process were not divulged to the visitors. The same company is completing a new type of primary battery, which is soon to be placed upon the market. The negative element consists of a lead plate which has been pasted with red lead and "formed" to peroxide. An alkali electrolyte is used. The positive element is a hollow zinc rod open at one end; the wire connection passes through a lateral hole near the bottom of the rod, and the interior is filled with mercury, the creeping of which over the top keeps the rod amalgamated. It is claimed that this battery is superior commercially to other constant-current types now in use.

At a meeting of the Council during the sessions, it was decided to hold the next meeting of the Society at Niagara Falls next September.



C. J. REED, SECRETARY
AM'N ELECTROCHEMICAL SOCIETY.

While no regular programme of meetings has yet been fixed upon, it is probable that the regular annual meeting will in the future be held in connection with the annual convention of the American Institute of Electrical Engineers.

As stated above, twenty papers were presented, abstracts of which and the following discussions are given below. The papers were not printed in advance, but hereafter printed copies of papers to be read will be distributed prior to reading. The proceedings of the meeting will soon be issued and sent to the membership, and will probably form a volume equivalent to about 200 pages of the A. I. E. E. *Transactions*.

A UNIVERSITY COURSE IN APPLIED CHEMISTRY.

The first paper on the programme was read by Prof. J. W. Richards, the title being as above. In opening, Prof. Richards said that there have scarcely been special courses in electrochemistry in American universities in the past. That branch in some of its various aspects formed part of a course in chemistry or in metallurgy, or in electrical engineering. According to Prof. Richards, the course in electrical engineering is not to be recommended, because it gives no adequate training in chemistry. To take first a course in chemistry or metallurgy, and to take up electrical engineering afterwards, was a very good policy, but required at least six years. The author then gave an outline of what he considers to be the best course for a four years' study of a student who has graduated from a good high school. In its general lines, it is a course in metallurgy, but modified by leaving out some branches, like geology, hydraulics, etc., and replacing them by suitable sections of electrical engineering, such as electrical instruments, generators, laws of electrolysis and electric furnace work. He urges that the student should become familiar with the methods of calculus, and should receive an insight into the principles of theoretical chemistry. He recommends reading of technical literature in foreign languages. At the end of his paper he gave an outline of the subjects to be taken up in the different years.

The discussion brought out what is being done in electrochemistry in some American universities, the courses resembling more or less that outlined by Prof. Richards. The discussion was participated in by Prof. Bancroft, of Cornell; Prof. Carhart, of the University of Michigan; Prof. Burgess, of the University of Wisconsin, and Prof. Doremus, of the College of the City of New York. Prof. Burgess made a distinction between an electrochemical engineer and an electro-chemist, the former being primarily an engineer, the latter primarily a chemist. Prof. Bancroft agreed with him in this distinction. Prof. Doremus urged that organic chemistry should not be neglected, as there are very promising possibilities in the application of electrical methods in organic chemistry.

ELECTRODES.

The next paper, read by Mr. Clarence L. Collins, engineer of the Acheson Company, of Niagara Falls, was on the subject of electrodes. The paper was limited to the discussion of the use of artificial graphite electrodes in furnace work. Different forms of carbon have different temperatures of oxidation, and that of graphite is higher than of amorphous carbon by several hundred degrees. When reduction of an oxide takes place in the presence of two forms of carbon of different temperatures of oxidation, the one with the lower temperature of oxidation is consumed in preference to the other. One can, therefore, make the electrodes of graphite, while in the mixture to be reduced, an easily consumed form of carbon may be used, like charcoal. Another characteristic feature which distinguishes graphite from other forms of carbon is that graphite can easily be cut by machines. This makes it possible to cut easily artificial graphite electrodes of any form wanted for the practice. The author showed diagrams of different forms of electrodes for furnace work, some involving considerable machine work, and discussed the best and cheapest construction of the electrodes for large furnaces and for large currents. He gave some very interesting results of comparative tests with amorphous carbon electrodes and of graphite electrodes in practical furnace work in industrial processes on a large scale. These results, as stated, show the much greater resistivity to oxidation of the graphite electrodes; their efficiency was found four to eight times as great as that of amorphous carbon, while their price is only three times that of the latter.

In the discussion which followed, several speakers spoke of the use of graphite electrodes in the electrolysis of solutions. Graphite anodes were very highly recommended for the electrolysis of chlorides, for which purpose they are practically indestructible. Graphite anodes, used in the electrolysis of sulphates, are destroyed by oxidation; they are therefore not recommended for this purpose. Mr. Collins also described how the creeping of solutions upwards in the porous electrodes, with resulting corrosion of the joints, can easily be avoided by destroying the porosity by means of paraffin, the graphite electrodes being partly suspendid in a kettle of melted paraffin, so that the pores may be filled with paraffin.

A NOTE ON THE GLADSTONE-TRIBE COUPLE.

The following paper with the above title was read by Dr. Wilder D. Bancroft, of Cornell University. The Gladstone-Tribe couple is prepared in the most effective way by dipping zinc foil into a copper sulphate solution, rinsing, drying, and then heating the mixed zinc and copper to a temperature nearly that at which brass would be formed. This couple can be used for certain reductions, for instance, of chlorates to chlorides. It is certain that the action is electrolytic in principle, but a detailed investigation of this action was before impossible, because one could not reproduce the phenomena by the use of a voltaic cell. The author has now succeeded in doing so, having reproduced some of the phenomena with a pair of zinc plates or a pair of copper plates, and an external e. m. f. For instance, with copper electrodes he has reduced potassium chlorate to chloride and has varied the conditions of the experiment, in order to determine the influence of current density, temperature, concentration, etc. When determining the ampere-hour efficiency under assumptions as they would be ordinarily made, he found an efficiency of 180 per cent. Therefore the assumptions cannot be correct, and the author explained the cause of the error. He points out that while his investigation is not yet complete, his preliminary results show the possibility of performing electrolytic reductions with a much better efficiency than has in general been obtained by purely chemical methods.

THE NASCENT STATE.

In a paper with the above title, Mr. C. J. Reed attacked the nascent state theory. This hypothesis of the nascent state has, he said, been made to hide the ignorance of phenomena incorrectly understood, and has fulfilled this purpose for nearly a century. It is now time, however, to lay it aside, as it is no longer required for assistance in the explanation of experimental facts. The substance most frequently called upon to exercise the functions of a nascent body is hydrogen. The assumption of a peculiar reducing power, supposed to appertain to nascent hydrogen, has been made through mistaking coincidence for cause. The fact that hydrogen and other bodies are frequently reduced in juxtaposition by the same reducing agent, is the only ground for supposing that the reducing agent first causes the liberation of hydrogen and that the hydrogen in turn reduces the other substance. All hydrogen in being liberated from whatever source necessarily passes through the nascent state, and therefore we have as many ways for producing nascent hydrogen, as there are of liberating hydrogen. This enables us by the selection of a proper method to examine the effect of nascent hydrogen alone on a body and so determine whether it possesses reducing power different from hydrogen in its ordinary state.

As an illustration, a lead salt may be reduced to metallic lead in contact with nascent hydrogen, or it may not be reduced in contact with nascent hydrogen, depending on the nature of the reducing agent which evolves the hydrogen. It must be admitted, however, that if nascent hydrogen from one source reduces a metal, nascent hydrogen ought always to reduce the same metal. If metallic zinc in contact with metallic copper be immersed in hydrochloric acid, nascent hydrogen will be formed abundantly at the surface of the copper plate. If a lead salt be introduced in contact with the copper, metallic lead will be precipitated on the copper along with the hydrogen. If, instead of metallic zinc, metallic tin is used in contact with the copper, nascent hydrogen is formed in a similar manner, but this combination is unable to reduce lead. Hence it must be concluded that the reduction of the lead must be caused not by the nascent hydrogen, but by the reducing agent which simultaneously forms the nascent hydrogen.

Among the substances having greater chemical energy than hydrogen, which have been supposed at divers times by various philosophers to have been reduced by nascent hydrogen, are the alkaline and the alkaline earth metals, and also magnesium, aluminum, manganese, iron, zinc, cadmium, lead, and tin; but it may be shown in a manner similar to that described before that the nascent hydrogen may be formed in contact with any compound of any of these metals without the slightest reduction.

Another general class of reductions which have been assigned to the activity of nascent hydrogen is that of substances which have less chemical energy than hydrogen. Among these substances are gold, silver, copper, mercury, arsenic, antimony, and also various acids and powerful oxidizing reagents, such as iodic and nitric acids. That the nascent hydrogen, with its peculiar reducing power, is not necessary to the reduction of these substances, is proved by the fact that they may all be easily reduced by electrochemical action with a source of current having a lower e. m. f. than that required to form nascent hydrogen. Iodic acid has been frequently cited by chemists as an illustration of the great reducing power of nascent hydrogen, simply because in the electrolysis of iodic acid iodine appears at the cathode,

notwithstanding the fact that the e. m. f. required in this case is less than that which under these circumstances can possibly form nascent hydrogen. If it be assumed that the energy required for the liberation of nascent hydrogen is simultaneously restored to the circuit by the recombination of the hydrogen, such an assumption would amount to the admission that nascent hydrogen has no power of reduction, but merely transmits the energy or electric charge to another body, which it has received from the electric current. This is equivalent to the admission that the hydrogen merely acts as an electric conductor and that its action is in no wise different at a cathode from its action in any other part of the electrolyte, or from the action of any other positive ion in any part of the electrolyte.

The paper led to a long discussion, in which, among others, Profs. Doremus, Bancroft and Richards participated. It was pointed out that for the explanation of certain chemical actions it is difficult to give up the assumption of a nascent state. The subject of catalysis was also touched upon. Mr. Reed, in his reply, contended that the arguments brought forward against him did not refute his views.

THE ELECTROLYTIC REDUCTION OF LEAD.

Mr. Pedro G. Salom, of Philadelphia, read a paper describing a process of his invention for electrolytic lead reduction which is in operation at Niagara Falls. The principle lies in the use of lead sulphide as cathode in an acid solution, the hydrogen cation forming with the sulphur gaseous hydrogen sulphide, and thus reducing the lead sulphide to lead in spongy form. The form and construction of the cells used were described and the difficulties discussed which had been encountered. The principal difficulty was that the reduction was not complete, and the degree to which the ores are reduced varies without apparent reasons. It was stated that at present 92 to 95 per cent of the sulphide is reduced. Another difficulty is that the workmen's eyes are affected in the operation of the process. Two pounds of lead are produced per horse power-hour, 48 cells in series being electrolyzed at 130 volts. Specimens were shown of spongy lead, compressed sponge, litharge and other materials made by Mr. Salom's company. Owing to the spongy form, the material is very readily transformed into litharge. The company intends to take up later the manufacture of storage battery plates.

THE ELECTROLYTIC REFINING OF COMPOSITE METALS.

The final paper of the morning session was read on the above subject by Mr. Titus Ulke, superintendent of the copper refining department of the Lake Superior Power Company, Sault Ste. Marie, Ontario. The author first gave a review of the different methods patented by various metallurgists for the electrolytic treatment of composite ores, and then described in detail his new process, which is claimed to be especially suitable for extracting copper and nickel of commercial purity from nickeliferous copper material. It is best to use a material that contains not more than 20 per cent of nickel and not less than 80 per cent of copper. He casts this material into plates and uses them as anodes in a solution of sulphate of copper and nickel, sheets of copper being used as cathodes. The anodes are gradually dissolved by the current and commercially pure copper is deposited on the cathodes, while the electrolyte tends to become poorer in copper and richer in nickel. A certain amount of the electrolyte is regularly withdrawn containing just as much nickel as has been dissolved from the anode subsequent to the last withdrawal. The amount of electrolyte thus withdrawn is replaced by enough acid solution of copper sulphate to reproduce the original condition of the electrolyte.

The next step in the process is to separate the two metallic constituents of the withdrawn acid electrolyte, which may be done by any suitable method, and two such methods were described by the author. From the nickel salt obtained an ammoniacal solution is made, from which the nickel is deposited by electrolysis, an insoluble anode being used. Good results have been obtained with a lead anode which remained practically intact, barely a trace of lead being deposited with the nickel. As during this last step of electrolysis the electrolyte tends to become impoverished in nickel, portions are periodically withdrawn and the contained nickel salt and the ammonium sulphate or ammonia are recovered, the latter being used to make the nickel-depositing electrolyte ammoniacal. Nickel sulphate obtained from both the solutions withdrawn from the copper-depositing system and the nickel-depositing system is added to the nickel electrolyte to keep up its normal strength. From tests made, Mr. Ulke believes that his process, when worked on a commercial scale, will give nickel of great purity and at a comparatively small cost.

After the conclusion of Mr. Ulke's paper, lunch was taken at Houston Hall, the University of Pennsylvania having extended a cordial invitation to the Society. The afternoon session was held at the Randal Morgan Laboratory of Physics, and began at 2 o'clock.

A NOVEL CONCENTRATION CELL.

The first paper of the afternoon meeting was read by Prof. H. S. Carhart, of the University of Michigan, and described an extremely interesting cell having several very remarkable properties. The author opened with a brief discussion of the well-known relation between the e. m. f. of a cell, the heat tonings of the chemical processes in the cell, and the temperature coefficient of the e. m. f. (generally called Helmholtz's modification of Thomson's rule). He then briefly discussed Nernst's theory of concentration cells and pointed out that all concentration cells previously investigated, have an e. m. f. of such a direction that the current in the cell flows from the dilute solution to the concentrated solution. This is, for instance, the case in a concentration cell, consisting of two zinc electrodes in two solutions of sulphate of zinc of different concentrations. This rule regarding the direction of the e. m. f. of a concentration cell has been regarded to hold good for all concentration cells, but the author has found a combination to which it does not apply.

The cell consists of two nickel electrodes in two solutions of nickel sulphate of different concentrations. The e. m. f. has here such a direction that the current in the cell flows from the concentrated solution to the dilute solution. Not only is this direction of the e. m. f. of the cell extraordinary, but the magnitude of the e. m. f. has a much higher value than concentration cells otherwise have under corresponding conditions. The author accounted for the peculiar behavior of this cell, which he had anticipated from theoretical reasons. It is due to thermo-electric effects, the temperature coefficient being enormously large. He said that he is not an opponent of the ionic theory, but the facts ascertained experimentally concerning the behavior of this cell seem to be in disagreement with Nernst's theory of concentration cells; and although this theory has proven to agree with the facts in all cases heretofore investigated, one single exception would prove fatal. The author believes that the ionic theory of concentration cells has been built up on assumptions which are not yet fully worked out; but he would not deny that possibly the ionic theory might find a way to account for the thermo-electric effects, which are of importance in this case.

The paper was discussed at length. Mr. Reed remarked that in building up a large number of various concentration cells, he found that a nickel cell behaved in a way different from other cells; but he did not push his experiments on this point further. Dr. Roeber pointed out that when in the nickel concentration cell the electric current flows from the concentrated to the dilute solution in the cell, the concentrated solution must become still more concentrated and the dilute solution still more dilute, which is remarkable. Mr. Hering showed that the behavior of the cell is peculiar when considered from the point of view of the conservation of energy. Dr. Bancroft referred to experiments which he has made with amalgam cells, and pointed out that frequently the erroneous supposition is made that the heat of dilution is zero. Sometimes the Helmholtz formula is applied with this term lacking, thus giving rise to erroneous results. With all terms included, some so-called contradictions will be found not to exist.

Mr. Reed then showed a number of gravity concentration cells, all made up in the following way: In a test tube two solutions are placed one above another, that of lower specific gravity being at the top—for instance, silver nitrate and lead nitrate. If a silver rod is placed in the test tube, this arrangement acts as a short-circuited cell, silver being dissolved where it is in contact with the lead nitrate and deposited where it is in contact with the silver nitrate. This is a special case of concentration cell, the lead nitrate behaving like a silver nitrate solution of zero concentration of the silver ions. Mr. Reed showed a number of other concentration cells of the same type, the silver being replaced in them by other metals.

[illegible] OF BISULPHIDE OF CARBON IN THE ELECTRIC FURNACE.

In a paper with the above title, Mr. Edward R. Taylor described his process of manufacture of bisulphide of carbon. The first electric furnace built was surrounded with an external sheet of iron in which the sulphur was melted by heat radiated from the inner metal shell of the furnace, and admitted to the furnace proper by means of valves. This practice was found to be inconvenient, and has been superseded

by a new arrangement in which brick walls are substituted for those of metal, and the sulphur fed directly to the furnace in the cold state, surrounding the interior so completely as to make a blanket of sulphur which in melting carries the heat absorbed back to the furnace. There is practically no limit to the size of such furnaces. A furnace, of which diagrams and photographs were shown, is 16 feet in diameter and 41 feet in height. The operation of the furnace was stated to be extremely satisfactory. Profs. Richards and Doremus spoke in high terms of the merits of Mr. Taylor's invention.

CURRENT ELECTROCHEMICAL THEORIES.

In the absence of the author, Dr. Louis Kahlenberg, of the University of Wisconsin, his paper with the above title was read by Prof. Burgess. The author gave a review of the development of electrochemical theories in the last century. He discussed at length the dissociation theory and said that true credit is due to this theory for having elicited a large amount of experimental research, but he thinks that had the facts, as known at present, been known in 1888, it is safe to say that the theory of electrolytic dissociation would not have been born. It has been unfortunate that so much researches have been made with dilute solutions, as they represent only a special case, and he thinks, a very complicated one. Compared with Helmholtz's monumental work on the thermodynamics of galvanic cells, Nernst's osmotic theory appears like an artificial reproduction.

In the discussion which followed, Prof. Carhart called attention to the fact that the modification of Thomson's rule, taking into account the temperature coefficient of the e. m. f., is due to Willard Gibbs. Prof. Bancroft remarked that while this is true in a general way, the exact quantitative formula was first given by Helmholtz.

A ZINC BROMIDE STORAGE BATTERY

Mr. Herbert H. Dow, of Midland, Mich., described a cell made of Zn and C as electrodes and $Zn\,Br_2$ as electrolyte. When a current is passed, flowing in the cell from the carbon to zinc, zinc is deposited and $Br_2\,C$ is formed. The e. m. f. is 1.7 volt. It is quite remarkable that when short-circuited and opened again, the e. m. f. of the cell comes instantly back to 1.7 volt. The cell may therefore be used as a standard cell for commercial purposes.

CONTINUOUS ELECTROLYSIS OF SOLUTIONS OF METALS.

The next paper was read by Dr. N. S. Keith, of New York, and dealt mainly with the electrolytic treatment of sulphides of copper and iron. The first part of the paper dealt with the reactions which take place during the process discussed by him, while in the second part he discussed the methods by which continuous operation is carried on without waste. The mechanical arrangement of the electrolytic vats, the numbers of the electrodes in the different vats, the regulation of the current density, etc., were described.

A METHOD OF ELECTROLYTIC PRODUCTION OF ZINC FROM ITS ORES.

Mr. Samuel S. Sadtler, of Philadelphia, presented a paper treating of a means of dissolving certain metals, notably zinc, tin, silver and gold, in alkaline solution by means of alkaline hypochlorites. The process is said to be cyclic, involving the treatment of the metals, scraps or ores with the solutions, electrolyzing them so as to obtain the metals and at the same time regenerate the solutions used for acting upon fresh quantities of metals. The author claims, by means of suitable solutions for the several purposes, to make a number of separations, such as zinc from lead, iron and manganese; copper from iron, and gold and silver from lead.

THE ELECTROLYTIC RECTIFIER.

The next paper was a joint paper by Prof. C. F. Burgess, of the University of Wisconsin, and Carl Hambuechen, on the electrolytic rectifier. The peculiar behavior of the aluminum electrode, which makes it suitable for an electrolytic rectifier, is assumed to be due to the formation of an insulating coating of oxide. This coating is, however, not entirely insulating, but has a certain large resistance. A small leakage current is thus enabled to flow, which passes through small points and parts of the electrode irregularly distributed over the plate. Pictures were shown of the condition of the aluminum plate at different stages. The losses in the cell were then discussed in detail, and curves were shown for the e. m. f., current, and losses, from tests made with an aluminum and a lead electrode, potassium phosphate being used as electrolyte. The efficiency obtained in this case was only 30 to 40 per cent.; much higher efficiency claims have been made by others for the same arrangement. Curves were given, showing that the amount of leakage with continuous pressure applied is very small; that it is much larger with alternating pressure applied; and further, that the plate broke down (due to excessive sparking) at a much lower voltage with alternating pressure than with direct pressure. It is therefore wrong to make experiments with continuous pressure and draw therefrom conclusions concerning the behavior at alternating pressure.

The authors have found that a fused electrolyte is much more promising for commercial application than an aqueous solution. They used fued sodium nitrate and obtained finally an efficiency of over 80 per cent. They made continuous runs for a long while, in order to determine the cost for commercial purposes. The cost of rectifying was found to be ¼ cent per kilowatt-hour. The rectified current is pulsating. Such pulsating current has been formerly claimed to have advantages over steady direct-current for the purpose of charging storage batteries, but tests made on this point did not show anything of that kind, the efficiency and capacity being found the same with both kinds of current. The latter result was contradicted in the discussion by Mr. Sperry, who had found that pulsating current is better for charging storage batteries than direct current, the increase of efficiency being 9 per cent.

CAUSTIC ALKALIES AND CHLORINE BY THE DRY ELECTROLYTIC PROCESS.

The next paper was by Mr. Charles E. Acker, of Niagara Falls, and described his electrolytic process for the production of chlorine and caustic alkali. The principle of the Acker process is well known from numerous patent specifications, and was the subject of an article by C. T. Townsend, printed in our issue of last week. The inventor spoke about the numerous difficulties which had been regarded as insurmountable by some critics, but which were successfully overcome. He described the original experimental plant in Jersey City, and referred to experiments made with a view to manufacturing storage battery plates. He then described the present plant in Niagara Falls where his process is in operation at an industrial scale. 8000-ampere furnaces are used. There are four anodes, hence 2000 amperes for each, the current density being 2750 amperes per square foot. There is no wear and tear of the anodes. The only weak point relates to the connections between the anodes and the copper, the joints being gradually eaten off, but these connections have lately been considerably improved. The efficiency of the process is given as 100 per cent, this being the nearest integer number. Since 1900 the works have been in continuous operation. There have only been a few interruptions, one due to a fire in the Niagara generating plant, and another to stones falling upon the roof of the generating house. In his new form of furnace there is nothing liable to corrosion. The low current density formerly used was the main trouble, causing low efficiency. This has now been successfully overcome.

THE RELATIVE SPEED OF THE IONS IN SOLUTIONS OF SILVER NITRATE IN PYRIDINE AND ACETO-NITRITE.

The last paper of this session was by Dr. Herman Schlundt, of Madison, Wis., on the above subject, and in the absence of the author was read by Dr. Bancroft. The author points out that in these solvents the changes of the relative velocities of the ions with the concentration are quite different from those in aqueous solutions. This might be explained as being possibly due to complex ions. There would then be complex positive ions in aqueous solutions and complex negative ions in pyridine solutions. The enormous influence of the solvent is evident.

The afternoon session was closed at 6 o'clock. There were, therefore, on this day two sessions, each of four hours. That the audience of over 100 members and friends remained through these eight hours until the close of the session and followed the reading of the papers and the very animated discussions speaks well for the quality of the papers, and not less for the quality of the audience.

The Saturday session was held again in the John Harrison Laboratory of Chemistry and called to order at 9 o'clock by President Richards.

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The first paper of the day was a description by Dr. Konrad Norden, of New York, of a new type of electrolytic meter. In the absence of the author, the paper was read by Mr. Carl Hering. The meter measures not only ampere-hours, but is also a maximum meter, registering the ampere-hours during which the current rate is above a certain limit, and also those during which it is between given limits. The meter consists in principle of a cell with polarizable electrodes, requiring a well defined minimum e. m. f. for decomposition. When the electrolyte is decomposed, this indicates a voltage beyond the

cell if it is shunted by a resistance calculated, so that at the maximum current rate the drop of voltage between its ends becomes equal to the decomposition voltage of the cell. The ampere-hours above a fixed ampere rate are determined by measuring the amounts of products of decomposition, for instance, the volumes of the developed gases. The meter may consist of two electrodes of spongy platinum in acidulated water, the e. m. f. of decomposition being given by the author as 1 volt. If the resistance in shunt with this cell is 1-300 ohm, any current above 300 amperes produces decomposition. In parellel with this cell, another cell may be used with another decomposition e. m. f., say, 1.33 volt; this second meter registers a current above 400 amperes. The difference between the indications of the two meters gives the ampere hours at current rates between 300 and 400 amperes. In the discussion Mr. Reed expressed his doubts concerning the practicability of the apparatus.

THE REVERSIBLE COPPER OXIDE PLATE.

The next paper was read by Mr. Woolsey McA. Johnson, of Hartford, Conn., on a reversible copper oxide plate. The author described the method of making copper oxide plates and gave interesting curves of the e. m. f. of a copper oxide plate with a hydrogen electrode, which is a platinized platinum electrode saturated with hydrogen. When in these discharge curves the abscissas represent the time and the ordinates the e. m. f., such a curve may be described in a general way as follows: At first it is nearly a straight line parallel to the axis of abscissas; at a certain point it drops suddenly (represented nearly by a straight line parallel to the axis of ordinates); then follows another straight line parallel to the axis of abscissas, and so on. The several straight lines parallel to the axis of abscissas represent the e. m. f. of different oxides of copper with a hydrogen electrode. In the same manner charge curves were represented. Of practical importance was the conclusion of the author that, for several reasons, the copper oxide plate is not suitable as an accumulator plate.

[illegible] THE THEORY OF THE EDISON ACCUMULATOR.

The next paper was read by Dr. E. F. Roeber, of Philadelphia, with the Edison storage battery, as a subject. The author discussed mainly the question as to the influences to which the voltage drop of a storage battery of the oxygen-lift type is due. It may be due to increase of internal resistance (which influences only the voltage at the terminals, not the e. m. f. proper), or also to a change of e. m. f. proper. The latter can be due either to a change of the battery plates from one state of oxidation to another, or to local concentration changes in the pores of the two plates. The effect of the latter can be exactly calculated by a thermo-dynamical method analogous to that used by Helmholtz for calomel cells and by Dolezalek for the lead accumulator. The result for a cell of the oxygen-lift type is that when the concentration of $K\ O\ H$ in the pores of one plate increases to about 40 per cent, and that in the pores of the other plate decreases to about 10 per cent, the drop of the e. m. f. due to these concentration changes is several hundredths of a volt. This is not sufficient to account for the whole voltage drop, so that the other influences mentioned before must be of more importance.

In the discussion Mr. Reed doubted whether the operations, used in the thermo-dynamical cycles, could be performed in practice. Mr. Hering asked whether thermo-electric effects could not change the results of the calculation. Mr. Johnson considered that the voltage drop in the Edison battery is mainly due to increase of resistance; he also stated that he had found that the e. m. f. of a cell of the oxygen-lift type is practically independent of the concentration of the electrolyte used. Dr. Roeber replied that the latter case is different from that considered by him, and that the formulas and numerical results in both cases are different. Concerning the influence of thermo-electric effects, he said that in his method of calculation the temperature coefficient does not enter, because he calculates the change of what Helmholtz calls the "free energy" of a system, by an isothermic process.

[illegible]

The next paper was read by Prof. J. W. Richards, of Lehigh University; on alternating-current electrolysis. While it is generally thought that electrolysis is only possible with direct current, the author showed that it may also be accomplished with alternating current, namely, in all cases in which the ions set free at the electrodes combine either with the electrode or with the electrolyte to form a precipitate. He gave the formulas for several special cases in which this takes place. He doubted, however, whether the method can be made useful in practice, as the output which he obtained in his experiments, too small. The output depends much upon the frequency of the alternating current used.

THE ATOM OF ELECTROCHEMISTRY.

The last paper of the meeting was read by Mr. Arvid Reuterdahl, of Providence, R. I., on the atom of electro-chemistry. This paper was an elaborate one, of a highly theoretical nature, and it is difficult in a brief abstract to do justice to the many fine points brought out. The author gave a critical review of the historical development of the various atomic theories of matter. He then discussed the implications of the kinetic theory of gases, and analyzed the fnndamental hypotheses of this theory and proved that they cannot withstand critical examination. He considered how the highest authorities have spent much work and ingenuity to get around weak points, but that such attempts are often at the best scarcely more than interesting exercises in pure mathematics. Regarding the four-dimensional space he made the sarcastic suggestion that within that space some eminent mathematician ought to be able to detect not only an ideal perfect atom, but also a storehouse for unlimited amounts of energy. He then took up at considerable length the problem of action at a distance. At the conclusion of his paper he pointed out that ionic conditions must exist in the realm of electrostatics and electrodynamics as well as of electro-chemistry, and that the manifold phenomenon of electricity will be found to be ultimately the result of the activities of the atom of electrochemistry.

With a strong recommendation in favor of the adoption of the metric system, the first general meeting of the American Electro-chemical Society then closed.

An Interesting Sensitive-Flame Experiment.

By L. De Forest.

WHILE conducting experiments with Hertzian waves at the Armour Institute, Chicago, some time since, a rather new and striking sensitive-flame effect was accidentally brought to my notice. At the time I was carrying on the work at night, by the light of a Wellsbach gas-burner. An ordinary induction coil was used, giving at the time a 1-16-inch spark, and located twenty feet from the gas-burner.

The operation of this coil was frequently accompanied by a decided increase in the light in the room; and by altering the adjustment of the air-intake of the Welsbach burner, this increase of light produced by the spark could amount to several candle-power.

For this condition of maximum sensitiveness the mantel was put at considerably less than its maximum brilliancy, portions of it being at but red heat. The flame within, as in the case of the ordinary sensitive-flame, appeared to fan outwardly, at the sound of the spark, extend downward, and play upon the red portions of the mantel, causing these to incandesce. Hence the increase of light. There was a slight lag in the return to normal brilliancy after cessation of the sound.

When the coil was closeted, or placed behind a projecting wall, the effect on the light was naturally diminished; and when the door of the closet was almost but not quite closed, the effect was completely cut off, although the source was in plain view from the lamp.

At first sight this decided light effect from a coil spark might be readily mistaken for a new response to electric oscillations; but as a simple acoustic phenomenon the Welsbach mantel properly illuminated seems to afford an unusually sensitive sound-responsive device. The relative effect of different qualities of sound is very marked; it being, as is the case with the ordinary sensitive-flame for such weak sounds, practically unresponsive to ordinary sound or musical notes, but influenced chiefmost by the sharp crack peculiar to the electric spark. That from a small electric bell held not too far away also showed its effect.

As with the ordinary flame this is a pressure phenomenon. The relative proportions of gas and air have all to do with it. An excess of gas is necessary for the effect described, but by increasing the amount of air the reverse effect may be obtained, a diminution of the light by the sound. Between these two effects is a point of neutral regulation, near that of maximum illumination, at which the flame appears entirely deaf to any such sound. I have been able to obtain a falling off in the light of the mantel to one-half or one-third its normal brilliancy (which latter required to be made very low for this extreme sensitiveness, with a small pressure). In this condition

the light responded even to the exceedingly weak sound of the *primary* spark of coil, at the distance named.

When the gas is led to the lamp through a long rubber tube, offering considerable friction to its passage, the response is accompanied by a distinct jingling sound in the burner; and sometimes, as a secondary effect of the flame's motion, the whole mantel is seen to rock to one side when the spark is operated.

Methods of Engineering Instruction at Lewis Institute, Chicago.

The work in electrical engineering now done at Lewis Institute, Chicago, is rapidly assuming an important place among that done by the leading technical schools of the country. At the same time the institution seems to be meeting a demand in the educational line that has not heretofore been sufficiently appreciated and provided for. A brief review of the methods and work can hardly fail to be of value at the present time. These methods are due primarily to the efforts of Professor Philip B. Woodworth, to whom too much credit cannot be given for his skill in handling the class of men who apply to Lewis Institute for instruction. The classes at Lewis Institute are large, and especially is this true of the night school classes. All of the instruction is by laboratory work supplemented by lectures, and in this laboratory work, the great distinction between Lewis Institute and other institutions is that the apparatus given the students to experiment with is always something in practical every-day use rather than costly laboratory toys. Furthermore, the experiments, from the simplest elementary ones to the most elaborate tests, are all commercial tests. For example, the first thing a man is given to do is to test the efficiency of a common block and tackle and make a full report-sheet thereon. In this way the student gets his instruction in abstract science fully as well as if the experiments were made with purely laboratory apparatus, the cost is less and the instruction has the added charm to the beginner that he is doing something useful, not simply performing an experiment for the sake of abstract science. While abstract science may appeal to the trained scientific man more strongly than anything else, the same cannot be said of the average boy or young man in the beginning classes of an engineering school and even to those who love the work on account of their love for science, the fact that it is of a useful nature does not usually in any way detract from this charm.

In all departments the student's laboratory work consists of making a report to the instructor in charge on some piece of apparatus tested. The student is simply given the apparatus and the report blank and told to go ahead with the test, the instructor, of course, giving whatever personal supervision the student may need. In order to facilitate the handling of large classes and at the same time avoid cumbersome apparatus, Professor Woodworth has adopted 5-kw as the standard capacity of all dynamos, transformers, instruments or other apparatus purchased for laboratory use. There is then no trouble from "misfits" or with the instruments available not being adapted in size to the machinery to be tested, and the maximum usefulness can be got out of the apparatus at hand. Probably in no other technical school in the country does the ordinary student have so good an opportunity to handle and test apparatus. Indeed, it is a remarkable fact that a number of students who have graduated from electrical engineering schools and are at present in practical work are attending the night school classes at this institution in order to get practice in the handling of testing apparatus. As one of these students put it, "Here is where they let us handle the real apparatus; we were only allowed to look at it and told about it where I came from." Of course, in a laboratory of this kind the apparatus must all be of the portable commercial kind which will not be materially injured by inexperienced students' use. The laboratory, therefore, is not equipped with as remarkable apparatus in the way of fine scientific instruments as are the laboratories of many other institutions, but for the work it is laid out to perform it is unequalled.

It is in the night school classes of electrical and mechanical engineering that the most striking work is being done. During the past year there were 1128 night school students in electrical and mechanical engineering, and 600 in the day courses. The night school classes put in four hours a week in laboratory and lecture work, for thirty weeks in a year. Since changing from the old orthodox method of teaching physics to the present method (it is now called "engineering principles" instead of physics), the classes have practically doubled, and, as Prof. Woodworth puts it, "We have to drive the students out of the laboratory when their time is up, it is so hard to get them to stop." Day courses, giving the degree of M. E., after eight years' of work are offered. Encouragement is offered to advanced students who have pursued the full course, to do original investigation. Prof. Woodworth finds that graduates or members of correspondence schools make some of the best and most appreciative students in the night courses. The night school seems to fill a place between the university and the correspondence school, offering as it does the benefit of instruction and handling the actual apparatus to those who have no opportunity to take regular day studies and who feel the need of practical demonstration along with theoretical instruction. It further has in its advanced courses evident attractions, as is shown by its list of enrollments for students graduated from the regular technical schools who feel that they want more chance to handle and test apparatus than they were offered in college, or who may want instruction in advanced alternating-current work which has come up since graduation.

Self Revelations.

With the title "Industry's Magic Story; Labor Romance as Told by the Captains of America's Greatest Achievements," the *New York Herald* of Sunday, April 6, printed autobiographical sketches of a number of the guests at the recent "Captains of Industry" luncheon given at Sherry's, at which Prince Henry of Germany was the guest of honor. We reprint below the autobiographical portions of the sketches included of several gentlemen well known in the electrical field.

The introduction to a sketch of Prof. Elihu Thomson states that the subject claims he is not a business man, so-called, but a professional engineer and scientist. His inborn tastes shaped his course from early childhood. Unless such compelling tastes existed, coupled with good judgment and energy in overcoming obstacles, success would not have been possible.

"Publicity," he has said, "interferes with study, with work, with usefulness in a large measure when it concerns careers" such as his. He does not seek and never has sought it, and says the same of "honors" and "awards." He repeats the saying that "when a man does anything of value, attracting public notice, all the world seems to conspire to prevent his doing more of it. Some credit me with being what I certainly am not—a typical American millionaire, etc.—under a mistaken notion that a man only becomes known by his financial or business success."

Mr. Charles F. Brush says: "I was educated as a mining engineer, taking my first university degree in 1869. Believing there was a bright future for the professional chemist and metallurgist in the industrial arts, I followed this line of effort for several years. Time has long since proved my belief well founded, but its realization was too slow to warrant waiting. In 1877, after some years of study, thought and experiment, I gave up all other business and thereafter for many years devoted my time entirely to the invention and development of electric arc lighting on a commercial scale. This was an entirely new industry, and the attendant difficulties were great in consequence. The necessary inventions had to be made, patented and defended against piracy; the machinery had to be designed, experimented with and modified until it was reduced to the simplest and most efficient form, and the public had to be educated to the new light in the face of strong opposition from the gas companies everywhere. It was in the practical development of electric arc lighting that I achieved business success, and I attribute that success to the selection of a congenial and promising field of effort, followed by years of study and hard work, intelligently directed to a definite end."

FRANCIS B. CROCKER, NEW YORK.

Prof. Francis B. Crocker says: "In the first place, I believe a man should take up the profession or business he is most interested in and for which he possesses some talent. I believe this plan should be followed, even though it conflicts with family or social prejudices. A man should also prepare himself very thoroughly for his life's work, particularly if it is professional. Perhaps the most important quality is the ability and willingness to work hard. This does not necessarily mean an incessant grind from one year's end to another, but it

does signify that one must be keen after his duties and not in the slightest degree inclined to shirk them. It is only by doing the work of the man ahead of you as well as your own that one can be promoted. It is almost always foolish to avoid responsibility. This is bound to come to one and it is impossible to dodge it."

Reception at Columbia University to Lord Kelvin.

On April 21, the Monday following the installation of President Nicholas Murray Butler, the American Institute of Electrical Engineers and Columbia University will give a reception at the University in honor of Lord Kelvin and Lady Kelvin, in conjunction with the National Academy of Sciences, the American Association for the Advancement of Science, the American Mathematical Society, the American Physical Society, the Astro-Physical Society of America and the New York Academy of Sciences. To use the words of President Eliakim H. Moore, this event will be a "delightful expression of international scientific unity." The reception will be from 8:30 to 11 o'clock in the evening, with speeches by four eminent scientists, with a response by Lord Kelvin. Owing to the limited space in the reception hall, tickets to this reception at first will be issued only to members and one lady each. After the returns from the members for themselves, if the capacity of the hall will admit, guests may be invited by members. Persons desiring to attend the reception, who are not members of any of the above societies, will be given invitations by applying through members, if the capacity of the hall will admit. Entrance will be via the gate on 119th Street and Amsterdam Avenue. The executive committee for the reception are: Dr. Francis B. Crocker, chairman, Past President A. I. E. E., Member American Physical Society; Mr. Calvin W. Rice, secretary, chairman Committee on Meetings, A. I. E. E.; Dr. Robert S. Woodward, Past President A. A. A. S., Member American Mathematical Society: Mr. F. P. Keppel, secretary Columbia University; Dr. Arthur G. Webster, vice-president American Physical Society; Prof. J. McKeen Cattell, President New York Academy of Science, and Mr. T. Commerford Martin, Past President A. I. E. E.

Telephone Subway at St. Paul and Minneapolis.

The Northwestern Telephone Company has commenced, in St. Paul, Minn., the construction of a tunnel to connect the St. Paul and Minneapolis systems, and through which all of the interurban wires of the company will be run. The improvement will cost approximately $100,000 and will be completed before Fall. The object of the tunnel is to avoid interruption to the interurban service by storms, etc., and to give the company increased capacity between the two cities. There is no more pole room at present and the company is unable to supply the full service demanded by its patrons. Altogether the company will expend $500,000 in the Northwest this year in betterments of its plant. Of this amount $200,000 will be spent in extensions of the present underground system in Minneapolis and St. Paul, including the new interurban tunnel. Additions to the pole system, now under way, will cost $100,000 more; and the remaining $200,000 will be expended in the construction of additional toll lines, and in improvements of various systems owned by the company in northern Minnesota and the two Dakotas.

CURRENT NEWS AND NOTES.

NEW YORK CENTRAL TUNNEL.—Mayor Low has approved the bill providing for a change of motive power from steam to electricity in the Park Avenue tunnel by May 1, 1905, and giving to the New York State Railroad Commission the power to extend the time if it is made clear by the company that the change cannot be made in the period fixed in the bill.

WIRELESS TELEGRAPHY ON THE PACIFIC COAST.—A company represented by General A. W. Barrett is stated to be making active preparations for the installation of wireless telegraph stations on Catalina Island and in Los Angeles, Calif. The Marconi system will be used for communicating between these two points. The only wireless communication on the Pacific Coast at present is carried on between [illegible]

STATUE OF LIBERTY LIGHT.—At Washington, on April 3, Secretary Root said that he had decided to maintain a light in the Statue of Liberty on Bedlow's Island, New York Harbor, if he had the legal power to do so. Gen. Brooke, commanding the Department of the East at New York, will have a consultation on the subject with Secretary Root. There is an impression at the War Department that there is the same authority for lighting the statue, which is on a military reservation, that there is for lighting any other army p[illegible]

SUPPLIES IN MALTA.—Mr. John H. Grout, United States Consul at Valletta, Malta, in a report to the State Department says: The local government frequently advertises for bids for supplies, such as electric light carbons, tools, iron girders for structural purposes, printing paper, etc. The time for closing the bids is usually so short that I have never had an opportunity to report them for the benefit of our manufacturers. I would, however, advise such of our firms as have London representatives to instruct them to frequently pay a visit to the office of the Crown agent in that city, where bids for supplies for Malta are received.

A STORY OF RHODES.—One of the widest spread stories of the late leader of men, Cecil Rhodes, is that which credits him with having declared that he had never met a man whom he could not buy. This story is denied, and is said to be based on an expression of his which showed his confidence in his own powers of persuasion. When asked how he proposed to carry his Cape to Cairo telegraph across the Soudan, which was then under the domination of the Khalifa, he replied: "Oh, leave that to me. I never met the man yet that I could not come to an agreement with, and I shall be able to fix things up with the Khalifa right enough when the time comes."

TO SWITZERLAND BY WATER.—U. S. Consul Gifford, of Basel, sends, Feb. 27, 1902, the following description of a proposed all-water route from that city to the sea—the plan of a young Swiss engineer by the name of Gelpke: Basel is over 300 miles from Amsterdam, the nearest port on the North Sea. Mr. Gelpke proposes to render the Rhine navigable for freight steamers at all seasons of the year by regulating its water level. Beginning at the German frontier near Basel, he suggests the construction of fourteen dams, provided with suitable locks for the passage of vessels, and with sluices for driving turbines for the production of electrical power. It is estimated that the project would require $20,000,000 to carry it to completion, and that the turbines would yield from 100,000 to 150,000 horse power, which could be utilized by industrial establishments in Alsace and in the Grand Duchy of Baden.

THE TELEPHONE IN FIRE SERVICE.—In the course of an interesting article on Detroit in the *New York Sun*, it is said: Its fireboats are the most important part of Detroit's fire service. One guards the east water front of the city, one the west. Each carries 5000 feet of hose and helps at fires far back from the water front. A feature in connection with the pipe line part of the fire boat system is the telephone service, by means of which communication can be had from any plug on the line with the fire boats at the river. A small telephone apparatus is carried on each tug. This can be readily adjusted to any plug in the system, and the arrangement is of incalculable value. Through its operation the crews of the fire boats can be advised as to the progress of a fire at any point within their districts, so that the water pressure can be increased or diminished without the loss of time incidental to sending a message.

GERMAN-DUTCH CABLE.—A cable despatch from London of April 3 says: Details in regard to the formation of the new German-Dutch Cable Company are given by *The Times*. The company's headquarters will be at Cologne, and it will have exclusive rights to lay cables from Menado, the chief place in Northeren Celebes, to the Island of Guam, and thence to Shanghai, there connecting with the American Pacific cable. The company is to receive annual subsidies of $250,000 from Germany and $70,000 from Holland. The directorate is in part German and in part Dutch. It is believed, says *The Times*, that the treaty includes a secret protocol of a political nature. *The Times* says that the manner in which the Americans acted in regard to the cable to the Philippines is well remembered, and the Continent believes that if Great Britain became involved in a European war she would no more respect the neutrality of submarine cables than did the United States.

TROLLEYS AND POPULATION.—The new census of Berlin, Germany, gives the population at 1,901,567. The increase in population in the past year is only 12,857, as against 42,493 in the preceding year. This falling off in the yearly increase is attributed to the movement of the inhabitants to the suburbs as a result of electric traction.

INTERSTATE TELEPHONE CONVENTION.—According to the plans previously made, a convention of the Interstate Telephone Association is being held at Chicago as we go to press, viz., on April 9, 10 and 11. The headquarters are the Sherman House. The association is composed of independent telephone exchanges in the States of Illinois, Wisconsin, Michigan, Indiana, Kentucky, Missouri and Iowa.

WHY BOYCOTT MARCONI?—A special cable despatch from Berlin of April 3 says: "The *Lokalanzeiger* says that, under the existing statute, the Government can prevent the use of the Marconi wireless telegraph system on board German merchantmen, the erection of stations on the coasts of Germany, or the use of that wireless system in German waters. The paper suggests that the Government apply the law immediately." It would be very interesting to know how such a plan of obstruction can be justified. It would be worse than foolish.

POLITICAL CONVENTION BY TELEPHONE.—Farmers to the number of 200 in Kankakee County, Ill., listened to the speeches at the Kankakee County Republican Convention the other day without being present at the convention. These gentlemen were connected by the lines of the Central Union Telephone Company to the convention hall, and were able to sit in their homes from 15 to 36 miles distant, scattered over the county, and listen to the addresses. There are 1860 telephones in Kankakee County outside the city of Kankakee, or one to every 190 persons. This is said to be the largest percentage in the State.

THE BUCKET-SHOP TAX.—A special telegram from Washington of April 3 says: Another long conference on the War Revenue Reduction bill to-day resulted no more definitely than the last. It is certain that some very powerful influence is being brought to bear on both sides of the Capitol concerning the taxation of the so-called bucket-shops. Some powerful Wall Street interests are at work here in favor of the retention of the tax, and probably nearly as strong influences on the opposite side. No trustworthy predictions can be obtained regarding the outcome. It is believed here that the tax, if retained, can be made a very powerful weapon against certain classes of brokers who have not hitherto been supposed to fall within the scope of the law, and that if all of the other stock taxes were removed, thus relieving those affected by them of any misgivings in securing an absolutely rigid enforcement of the provisions of the law, there would be an effort to obtain such enforcement with the probable result of driving many individuals out of the business in which they are now engaged, or at all events of greatly hampering them. Hence a vigorous effort on the part of some to remove the taxes in order to give no advantage to the larger interests involved.

THOMPSON AND LODGE.—A cable despatch dated April 4 gives an extract from an article by Prof. S. P. Thompson, printed in the *Saturday Review*, and upholding the claims of Prof. Lodge as the original inventor of wireless telegraphy. Prof. Thompson expresses appreciation of Marconi's achievement in sending signals across the Atlantic, but ascribes the result to skilfully exploiting Lodge's invention. According to Prof. Thompson, neither Marconi nor Slaby is entitled to a patent on anything but the details of their systems, since neither of them can put himself in the position where Lodge stands as the original inventor. He adds: "The Slaby-Arco system is as much a lineal descendant of Lodge's earlier work as is Marconi's. Both of them employ Lodge's methods, inasmuch as both use a coherer to relay the Hertzian waves upon a telegraphic receiver, and both employ automatic tapper. Eliminate these features, which are due to Lodge, and both Marconi and Slaby collapse. So Marconi, who uses without acknowledgment these devices of Lodge, mouths out a denunciation of Slaby, who dares to use the same devices for the same purpose. It is a pretty quarrel. If Marconi imagines that his thin patent claims entitle him to a monopoly of the ether for the purpose of transmitting signals he is much mistaken. His dog-in-the-manger policy toward Slaby is simply silly, and the more so because neither of them can either transmit or receive a single wireless message in the United States without infringing on the patents of Lodge. It seems like the irony of fate that Lodge, the well-known principal of the University of Birmingham, after expounding the principles of wireless telegraphy in London and Oxford in 1894, should find himself pushed aside, first by the Italian, who by dint of advertising gains the public ear, and then by the German professor, and yet should actually stand master of the transatlantic situation because he holds the master patents in the United States. It is said that Lloyds has made an agreement with Marconi for fourteen years. Perhaps Lloyds is not aware where the patent rights lie. Marconi may whine as he pleases about other men snatching rewards from the scientific investigator. That is precisely what he himself has been trying to do in the last four or five years, his victim being the Englishman who was first in the field, and who, if he but knew it, is to-day master of the situation."

INDICATORS AND METERS.—Among the patents issued April 1 is one on means for preventing the creeping of meters, and another on an indicating instrument for use on alternating constant-current arc circuits. The first-mentioned patent, granted to A. D. Lunt, provides a dampening disk locally thickened at one or more places. The currents induced in such thickened portions react upon the magnetic field to which they are due and produce a repulsion, which opposes the passage through the field. By suitable adjustment or proportioning of the parts, this repulsion effect may be made just sufficient to overcome any creeping tendency which may exist. The second patent referred to was granted to Richard Fleming, and describes means to regulate alternating constant-current series arc circuits. In such circuits it has been found that the wave shape of the current supplied to the lamp varies with changes in the load, thereby affecting the working of lamps in circuit, and it is the aim of the invention to produce an indicating instrument which shall be responsive to changes in the wave form and also to changes in the frequency of the current, the latter also affecting the lamps. If the system be regulated to maintain a given deflection on the instrument, the current flowing will then at all times be such as to maintain proper voltage at the arcs. In a change of frequency of the source, the deflection of the indicating device is increased, and if brought back to normal will compensate at the lamps for such change of frequency, and the effect of change of wave form is similarly indicated and may be similarly compensated for by adjustment at the transformer. The current-indicating mechanism consists of a small transformer having its primary winding in series with the arc circuit, and the secondary winding connected through the winding of an inductance coil to a voltmeter. The core of the transformer and its primary are so proportioned that the iron is worked at a high magnetic density. Under these conditions, when the wave shape is changed the result will be less magnetization for a peaked wave than for a flat wave, even though the equivalent sine wave of current should remain unchanged. To overcome over-compensating effects for frequency, the inductance coil mentioned is used, which reduces to a proper amount the effect due to changes of frequency. A patent granted March 25 to Frank Conrad describes an instrument for indicating the phase and frequency relations of alternating currents and which has no moving coils. The instrument consists, first, of a laminated ring; second, a shell concentrically arranged within the ring, comprising a hollow cylinder of insulating material on which are wound two coils at right angles; and, third, a hollow coil within the cylinder. Also within the ring and on each side of the inner coil are semi-circular magnetic plates, the plate on one side of the coil projecting in a direction opposite to the plate of the other side. These plates are connected by a magnetic tube mounted on a shaft to which the indicating pointer of a dial is attached. The four leads from the two outside coils are combined to form a three-wire connection, and the three terminals are connected to three of the four conductors of the two-phase circuit to be indicated, thus securing a quarter-phase relation of e. m. f.'s. The stationary coil is connected to one circuit of the two-phase machine to be synchronized. The two coils at right angles produce a rotating field, and the inner coil produces a magnetic flux, the major portion of which is deflected by the two magnetic disks and the magnetic connection between the two disks. As a result of this condition the disk will take up a position corresponding to the difference of phase. The instrument may also be arranged to indicate the frequency relation as well as the phase relation, of any two circuits to which it is properly connected.

MORE FROM PROF. SLABY.—A cable despatch from Berlin of April 2 says: Prof. A. Slaby, the electrician, has issued a written reply to William Marconi's statement that he (Slaby) learned from Marconi what he knows about wireless telegraphy. The Professor says: "I have never omitted to mention, and at every opportunity have acknowledged, that I participated in the experiments carried on in May, 1897, by the English Telegraph Department, under the direction of Sir William Preece, with the Marconi apparatus of that day. But the present system of tuned telegraphy, as Marconi admits, has hardly anything in common with those primitive beginnings of 1897. The Slaby-Arco system is not based on those early experiments. On the contrary, as Marconi well knows, it is founded on discoveries that I published in December, 1900, to which Marconi referred in his address before the Society of Arts in these words: "I trust that it will not be thought that I desire to minimize in any way the importance of Professor Slaby's work." The very conspicuous change in Marconi's views, as contained in his letter published in New York, is something I very greatly regret."

LIGHTNING RODS are now under consideration of the Special Lighting Research Committee, which was organized last year by the Royal Institute of British Architects and the Surveyors' Institution. More than 200 competent observers have been appointed in the United Kingdom, the colonies, India, and elsewhere. The British War Office, the Home Office, the Post Office, the Trinity House Corporation, and the United States Department of Agriculture have agreed to furnish the committee with particulars of damage resulting from lightning stroke to buildings under their control. The net result, so far, is a series of seventy or more trustworthy records, which furnish promising material for the committee to work upon, with the view of formulating conclusions. The committee have arranged for getting photographs immediately after the occurrence of a disaster in cases of importance. Out of sixty cases tabulated up to the end of December, no fewer than twelve relate to buildings fitted with some form of lightning conductor. As regards the system recommended by the Lightning-Rod Conference of 1882, the facts at hand are not sufficient to determine the extent of its efficacy. The recently issued report, however, of the British Inspectors of Explosives goes to show that it has been found wanting, and that there is ample justification for the present inquiry.

LETTER TO THE EDITORS.

Mr. Marconi and His Critics.

To the Editors of Electrical World and Engineer:

Sirs.—So long as human nature remains pretty much what it is at present and apparently has been always, I suppose that one of the penalties of success, in whatever field of activity it may have been attained, will continue to be found in the subsequent forced endurance by the successful of whatever ill the rancor and disappointed spleen of outdistanced competitors may be powerful enough to inflict. Happily, however, this is not usually of very much account, and if ever a successful man was able to afford to consider the attacks of his unsuccessful rivals without anger and with some pity, I should imagine Mr. Marconi to be that man. After all, as one can easily conceive, it must be very, very annoying to Messieurs Slaby, d'Arco, Preece, Lodge, Thompson and the rest for whose arrows Mr. Marconi has lately in an especial measure found himself the target, really very annoying indeed, to feel themselves so utterly beaten in the race for success in wireless telegraphy, as they must do, I should suppose, in the privacy of their laboratories, however brave a face they may still strive to put upon it in the columns of the daily press. This consideration, however, though an explanation, can hardly be accepted as an excuse for the muddy torrent of press misrepresentation, to use no stronger term, which, since the *Deutschland* incident, has been let loose, principally from German sources, in the attempt—a very puny attempt, it must be agreed—to discredit Mr. Marconi and his system in this country. To that particular incident of the *Deutschland* and the wild vituperation and angry threats to which it moved Messrs. Slaby and d'Arco and their friends of the Allgemeine Electricitäts Gesellschaft, I think more prominence than they deserved has already been given by the press, but many of the statements current with regard to the affair have been so ridiculously beside the mark that, in the interests of accuracy, it may not be out of place that I should re-

To mention first the bare facts of the incident itself: The *Deutschland*, as everybody knows, is the German passenger steamer which a few weeks ago was selected to have the honor of conveying Prince Henry on his voyage home from the United States. This steamer carries an installation of the so-called Slaby-d'Arco system of wireless telegraphy. I say "so-called" because Mr. Marconi has publicly expressed his opinion that the fundamental principles of that system are identical with those which he himself communicated to Professor Slaby some four or five years ago, when, at the request of the German Government, transmitted to him through the authorities of the British Post Office, he (Mr. Marconi), showed to Professor Slaby, who was his guest at the time for several weeks, the whole working of his system, so far as he had then developed it. If, therefore, as would appear from Mr. Marconi's statement to be the case, its details alone constitute the part of it for which the invention of Messrs. Slaby and d'Arco is truly responsible, it would seem to be doubtful how far it is appropriate to bestow a special designation of such nature upon what, on the above hypothesis, ought to be reckoned as a mere modification of the Marconi system, and, to judge by its results, a modification only for ill, at that. The point, of course, is one which cannot be finally decided in the columns of this or any other journal, but until the question of infringement is definitely settled by the proper tribunals, impartial persons will, I think, see that it behooves them to suspend their judgment as to whether anything to be fairly called a "Slaby-d'Arco system" is, in fact, in existence. The reason why the matter has not yet been raised is doubtless to be found in the slight importance attached by the Marconi Companies to the whole of the Slaby-d'Arco pretensions. Should these ever attain a more practical realization than any they have as yet reached; I mean to say, should the working of the system ever be extended by the efforts of the Allgemeine Electricitäts Gesellschaft or otherwise, to such a point as to cause the Marconi companies to consider an attack upon the validity of their patents to be worth their powder and shot, then undoubtedly the question will immediately be made the subject of rigorous test.

At present, however, no such degree of extension has been attained by the German system. The *Deutschland* is the solitary first-class passenger steamer which enters the port of New York—indeed, I might say, the only first-class passenger steamer in the world—carrying the Slaby-d'Arco installation. Nor is this a new installation, as one might well have supposed it to be, judging from the recent ebullition of wrath with respect to the steamer's disability to communicate with Marconi stations. On the contrary, I remember to have myself noticed her aerial wire as being arranged in a manner similar to that adopted by Mr. Marconi, when passing the *Deutschland* at her pier in New York harbor now nearly twelve months ago. I do not know how long before that the installation had been made and, I confess, it seems to me really a rather pitiable exhibition of Teutonic snobbery that until a German Prince happened to take passage on the ship, no particular public attention seems to have been paid to the disability in respect of wireless communication under which, of course, all along, her ordinary passengers have suffered. Be that as it may, the *Deutschland*, with Prince Henry on board, passed out into the ocean as usual without communication with Nantucket; made her voyage without any exchange with other transatlantic steamers, of messages such as frequently come to vary a little the monotony of the long sea days for passengers on vessels carrying the Marconi system; passed up the English Channel without speaking any Marconi station, and, as she approached Cuxhaven, the favored site of the lonely Slaby-d'Arco pole, was "jammed," it was alleged, by wicked persons sending Vs with wild persistence from a (purely imaginary) collection of sixteen transmitters stated to have been installed by the Marconi companies in Cornwall! Whereupon there arose in Germany a chorus of effervescent indignation, which quickly sped along the cables to the *Herald* office in New York, so that the American hardly less soon than the European public was treated to the unedifying spectacle of a learned professor, a noble Count and various other potent and distinguished personages alike, foaming at the mouth with a species of almost Berserk fury which, for brevity's sake, I will indicate as malignant Marconiphobia. And a very bad attack of it they had. To believe these gentlemen, nothing so uncivilized, nothing so "impolite," nothing, positively, so "inhuman"—dear Herr Professor!—had ever before been presented to the observation of a German Prince and of the German people, as the alleged refusal of those odious Marconi people (who, by the way, however, were never officially asked), to take in even the mes-

sage of a Hohenzollern when [illegible] Slaby-d'Arco apparatus. I hardly know what dreadful things in consequence were not going to happen to poor Mr. Marconi. One almost got the impression, indeed, that if the Kaiser did not forthwith order the German fleet to steam out, on the first really fine day, and shell Mr. Marconi's station at the Lizard, he would be doing something less than loyal Teutons had a right to expect from him! The whole thing was, in fact, as overdone as a German steak! Since, however, a doubt may have been left in some minds as to the exact relation of the Marconi companies to it all, I should like, so far as my information goes, to say a word or two on that point here. And, in the first place, let me mention that it is by no means clear that the *Deutschland's* failure to communicate with their stations on the occasion in question was exclusively to be set down to the hostile attitude of those companies. The contrary is, in truth, more than suggested by what occurred, according to the report which appeared in the *New York Herald*, sent direct to the paper from its own operators, at Nantucket. These operators, it seems, employed there by the *Herald*, and although their proceeding was in direct contravention of the *Herald's* contract with the Marconi companies, did in fact do their best to get into communication with the *Deutschland* on this famous voyage, and entirely failed, although, according to the testimony of that vessel's engineer, she passed so near that those on board her actually picked up the Nantucket light. This would seem to be a distinct evidence that the *Deutschland's* equipment of Slaby-d'Arco apparatus was not technically suitable for communication with a Marconi station, and that at least in one case, therefore, if Slaby-d'Arco could not work with Marconi apparatus the fault lay in the inherent unfitness of the former for the purpose. And, if this was proved in the case of one station, as it was in that of Nantucket, we may fairly conclude that the same experience would have been repeated had communication been attempted with the Marconi stations on the other side of the ocean, since these use for ordinary sea telegraphy installations in all respects similar to that employed at Nantucket.

But, however this be, as I understand the case, the Marconi companies would not at all wish to ride off on a side issue of such kind, and to the question whether the *Deutschland* would have been allowed to communicate through their stations, granting, for the sake of the argument, though the fact would seem to be the contrary, that she could, their answer has been a very unhesitating "No." I have not the honor of knowing Professor Slaby, except, of course, by repute, so I cannot judge how far a conjecture based upon his impassioned protest against the commercial spirit as applied to wireless telegraphy may be accurate. He has, however, I gather, ceased to have any commercial interest in what, if the *Herald* interviewer is to be trusted, he has himself described, rather suggestively, as the "exploitation" of the Slaby-d'Arco system, and there is, indeed, as we all must admit much to be said for the taking of short profits, since the practice has been known frequently to avoid the necessity of "cutting" a considerable loss. Professor Slaby's action in this respect has been marked, if I may say so without presumption, by a worldly wisdom and circumspection which I find it difficult to coordinate satisfactorily with this subsequent protest of his, which reminds one less of a man of affairs than of what one might expect from some mild, scholarly recluse among, it might be, those gentle dons of Oriel, who found themselves the other day referred to with such charming tenderness in Mr. Rhodes' will as being "like children in commercial matters."

Personally I happen myself to dislike in general that commercial spirit which so largely pervades contemporary life not less cordially than can, I think, even the most conservative of German professors. I recognize, however, as I think it might be recognized even by the latter, and as it must be recognized by everybody who looks the facts of existence in the face, that the class of enterprises which for their passage from the brain of the inventor to the service of the public require the expenditure of large sums of money and, naturally, in their earlier stages, at any rate, the taking of large risks by the parties who supply that requisite capital, is the very last class which could reasonably be expected to be conducted on other than strictly commercial principles. Professor Slaby apparently would reverse what, rightly or wrongly, has become in this connection the natural order of things. There is an English saying that trade follows the flag. It is even more certain that civilization, the modern brand of it, at any rate, such as it is, the civilization which, whatever it omits, as it omits much, does at any rate include a measure of the humanitarian element desiderated by Professor Slaby—it is even more certain, I say, that this sort of civilization follows trade. It would, no doubt, be all very well—for Professor Slaby, or rather, I beg pardon, for the assignees of Professor Slaby's commercial interests—that the Marconi stations should be thrown open to Slaby-d'Arco messages, and that free trade in wireless telegraphy, which is proposed so ingenuously by the chairman of the Allgemeine Electricitäts Gesellschaft, represents really a very charming and idyllic state of things which, were I financially interested in the success of the Slaby-d'Arco system, doubtless I should feel it my duty to do my utmost to promote. But at the same time I am sure I should expect a holder of Marconi stock to take a very different view and to insist with some pertinacity upon having from his directors a satisfactory answer to the vulgar question: "Yes, but where do I come in?" Seriously, the suggestion is absurd, for consider what the situation really is. Here, on the one hand, you have this so-called Slaby-d'Arco system with its one pole at Cuxhaven and its one—apparently not very workable—installation on the *Deutschland*, and, so far as I am aware, those two equipments indicate the limit of the system's present pretensions to free commercial development. And on the other hand, you have the Marconi system, which, apart altogether from its employ in the British and Italian navies and from its forthcoming undertaking of trans-oceanic work, is already, thanks to the genius of its inventor and the enterprise of his friends, in full commercial working upon some fifteen first-class passenger steamers plying to the port of New York alone, and at nearly forty land stations, established all, of course, at very considerable expense; a system which also, upon its merits, after a large expenditure of time and money upon the trials of other systems, has been selected exclusively for use by the Corporation of Lloyds at their telegraph stations—I think there are over 150 of them—throughout the world, through all of which stations as soon as equipped with the apparatus it must be remembered that the Marconi companies have right of way for their own messages. So that, in view of the fact that there is not anywhere in existence any corporation connected with the work of sea telegraphy and marine insurance to compare in importance with Lloyds, there would seem to be ample justification for the claim made by the Marconi directors in their last report that, for the present and during, at any rate, the fourteen years which their agreement with Lloyds has to run, their apparatus must be considered the standard apparatus for the ships of all nations.

It appears that the Kaiser's decree has gone forth in its favor and the Slaby-d'Arco system rejected by the British is to be used exclusively in the German Navy, which will thus, let us hope, find itself in good company, since from Professor Slaby's confidences to a *Herald* reporter the world learns that the said system is already in use in the navies—save the mark!—of Sweden and Norway, Denmark, and I know not what other world powers. I trust soon to hear that the Allgemeine Electricitäts Gesellschaft has placed an armed barge fully equipped with the Slaby-d'Arco system on a Swiss canal, in order that the list may be satisfactorily rounded off.

Truly, this German demand for wireless telegraphic free trade is explicable enough! But, so far from being "inhuman," it is, I fancy, very human indeed that the Marconi companies should see no reason at all why the Slaby-d'Arco people, who, as I notice that Mr. Marconi is reported to have remarked, very justly, have borne no part in the burden and heat of the day, the trouble and expense which it has cost them to get their own arrangements for sea telegraphy to their present advanced stage of development—should now come in as a matter of right, for that is the nature of their claim, and without the least recognition of the necessity of a preliminary coming to terms, or even so much as the suggestion of a thank you, merely to reap where Mr. Marconi and his companies have sown. It is really difficult to take such a proposition seriously. It is precisely as reasonable as would be the demand of a stranger who should have succeeded in tapping the circuit of a telephone company and ringing up the Central, to be connected with regular subscribers free gratis and for nothing. The suggestion has of course been made that Mr. Marconi's aim is to secure a monopoly of the ether, and that some international congress should be held for the purpose chiefly, it would appear, of restraining him therefrom. In the sense in which it is intended, the first of these suggestions is totally untrue, and on both points I certainly cannot do better than quote Mr. Marconi himself: "With any parties working a system," he has said, "which could prove itself to be workable without infringement of my patents—and that, I may say, I do not believe to be provable in the case of the Slaby-d'Arco system—we should at any time be willing to discuss the question of co-operation with a view to a mutual understanding upon

terms that should be deemed fair, in consideration of the advantages, enormous compared with any we could receive, which our long start of other competitors would enable us to offer under any such arrangement, and in view also of the common-law rights of the first comer." And with regard to the suggestion of an international conference, Mr. Marconi remarked further: "Nobody would welcome it more than I should myself, for the reason that I am quite certain that in no hands would the legal rights of the inventor—which are all that I claim—be safer or better protected."

I take it that these two passages convey a statement which is not [illegible] Mr. Marconi's [illegible] meets also, fairly and squarely, precisely that which I think most unprejudiced persons will concede to be the justice of the case.

That for the present Mr. Marconi does possess a practical, as distinguished from that theoretical, monopoly, which apparently he has no desire whatever to claim, is due simply and solely to the sheer merit of his system, which to-day holds a position from which absolutely no serious rival is in sight. For that state of things Mr. Marconi's competitors have no one to blame but themselves. It is unfortunate for the dignity of controversy that some of them seem not to see that to abuse Mr. Marconi instead is a proceeding as vulgar as it is ridiculous.

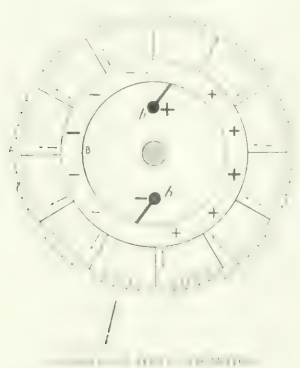
[illegible] Wilfrid Blandy

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

[illegible] Heyland.

An illustrated article, beginning with some historical notes. The first note on non-synchronous motor in which no phase-difference between current and e. m. f. existed under certain conditions, is due to Goerges in 1891; but his motor, although non-synchronous, did not belong to the induction motor type, but to the commutator motor type, "moteur de conduction" (as distinguished from "induction"); independently Latour has recently worked in the same direction; Latour's motor cannot be compared with the Heyland motor, except that there are superficial similarities. A motor which is more similar to Heyland's motor has been described by Blondel in 1896; this is an induction motor with short-circuited armature; it also has a direct-current winding with collector and is excited by a direct current supplied through two revolving brushes, the speed of which is equal to that of the field. The motor operates in a perfect manner; it has perhaps been too complicated to be introduced into practice. Heyland's present motor is distinguished by the feature that it has an armature short-circuited in itself—which is not the case with Goerges and Latour—and that it is excited by alternating current, which is not the case with Blondel. It is characterized by the typical arrangement of a conducting ring which closes the circuits of the winding, and serves at the same time for receiving the alternating current which is transformed into direct current. The adjoining diagram explains



the action of the Heyland motor. *A* is a uniform winding, closed in itself at different points, although not directly but through the ring *B*. There are two brushes *b* to which are supplied single-phase currents or more brushes when polyphase currents are used, the frequency being that of the network. The figure shows two brushes which are sliding on the short-circuiting ring *B* and which are connected with the stator winding. *N* is the instantaneous position of the revolving field at a given moment. Under these conditions the revolving field produces currents in the rotor, the direction of which is indicated by the arrows in the figure. These currents do not produce magnetization or demagnetization, and are exactly compensated by the energy currents of the stator. The potential is distributed symmetrically on both sides of the brushes and is positiv on one side and negative on the other, as indicated in the figure. If the resistance of the ring *B* is negligible, but has a certain value the drop of potential corresponds approximately to the e. m. f. of th armature currents. The simplest arrangement which is sufficient for the demonstration of the theory, and which has been used in the first trial motors, is that represented in the adjoining figure, where two brushes are supplied from the stator with single phase alternating currents which changes the direction exactly with the number of the periods of the field so that the dissymmetry is always produced in the direction of the field. The brushes must then be fixed so that they have their maximum of e. m. f. in the position of the figure, where they are in the direction of the field. The resulting dissymmetry is oscillatory, but the pulsations of the e. m. f. do not prevent the magnetizing currents in the armature remaining practically constant. If the two brushes which are fed with single-phase current are replaced by several brushes, fed with polyphase currents, the principle of the arrangement is not changed. His method gives a constant excitation of the field in the armature, which excitation is practically absolutely equivalent to that which one would obtain by supplying direct current to the armature through two brushes; he concludes the article as follows: "The practical importance of the modification which is the subject of my invention, is best illustrated by the fact that at present, i. e., six months after the first publication, the construction has been adopted by the majority of the leading European firms."—*L'Eclairage Elec.*, March 22.

[illegible] Heyland

tion of his illustrated article. While it has been demonstrated that the reactance voltage may be made so low as to permit of departing altogether from the principle of using an impressed magnetic field to reverse the current in the short-circuited coil, he suggests now to go a step further, and, by using very low reactance voltage per segment, give the brushes a suitable negative (backward) lead, thus enabling the armature m. m. f. to supply, wholly, or in part, the desired compounding or over-compounding in proportion to the current output. With armatures of sufficient strength, estimated in terms of the armature ampere turns per pole piece, it is possible to dispense altogether with the series winding on the magnet poles and derive the compounding from the armature current. Such a machine would be characterized by an armature short in the direction of the shaft, and of large diameter, with very many rather narrow segments and generally but one turn per segment. The magnetic and current densities would be extremely high, chiefly for the purpose of obtaining the lowest possible reactance voltage; this would result in a machine of very moderate first cost, although of rather low full load efficiency; but the efficiencies at light loads would tend to be higher than in customary types. The reactance voltage may be still further decreased by having the armature conductors of stranded copper located at or near the armature surface. This could be arranged mechanically as strongly as if the conductors were embedded by having non-magnetic manganese steel, low conductivity disks pro-

jecting above the surface of the effective laminations at several points of the length of the armature. These disks would be constructed of such shapes as to, at the same time, serve to provide ventilating ducts at their sides. The non-magnetic disks would have suitable numbers numbers of equi-spaced slots, just like ordinary armature disks for slotted armatures.—Lond. *Elec. Rev.*, March 14.

Lights and Lighting.

Bremer Arc Lamp.—A description of the Bremer arc lamp placed upon the market by the British Westinghouse Company. Its light is of a much yellower and softer color than that of the ordinary arc. The arc proper is not controlled by varying the distance between the carbon tips, but the length of the arc is dependent upon the strength of certain electromagnets in its neighborhood. The carbons are made of a certain mixture of carbon and other materials. The carbons are almost parallel and vertical converging towards each other at the lower ends at an angle of about 20 degrees; they feed by gravity. The carbons are placed in the lamp by dropping them into brass tubes from the top of the lamp; there are no screws or clamps to manipulate. The carbon ends project through the lamp into the globe space for about 0.5 inch. A conical hood or reflector surrounds the carbon ends. The arc burns between the lower ends of the carbons inside of this reflector. It is prevented from traveling up between the sides of the carbons by a small electromagnet, the pole of which enters the hood between the carbons, and just above the arc, so that the arc is driven down to the carbon tips. The coil of this magnet is in series with the arc. Below the level of the carbon tips are the two poles of another electromagnet; these poles are placed outside the reflecting hood, and tend to drive the arc flame upwards. The lower magnet is compound wound, having a shunt circuit across the lamp and also a few opposing turns in series with the arc. The combined effect of a magnet blowing the arc downwards at the centre and a magnet blowing it upwards at the sides is to spread the flame into a broad fan shape. The reflector is of brass, but is soon coated with a white deposit from the vapor of the burning carbons, which makes an excellent reflecting surface. The carbons are not expensive and they are all consumed to within the last 0.5 inch or less. Moreover, the mechanical arrangement of the lamp permits the use of odd lengths or broken carbons. The arc is struck by a metallic contact piece which moves forward, and electrically connects the two carbon tips when current is switched on to the lamp. As soon as current passes through the carbons the striking piece is automatically withdrawn, leaving the arc across the carbons. Efficiency tests are said to have shown that a 12-amp. 44-volt lamp requires 0.126 watt per hemispherical c. p. when working without a globe. The same lamp with its globe on, all other conditions remaining the same, required 0.196 watt per c. p.—Lond. *Elec.*, March 21.

Nernst Lamp.—A short note on another Patent-Office decision against some broad claims of the German patents for the Nernst lamp. *Elek. Anz.*, Feb. 27.

Power.

REFERENCE.

A reprint of an older illustrated paper, by Farmer, on impulse water wheels, with some remarks by Henry, on this paper.—*Jour. of Elec.*, February.

Traction.

The Electric Problem of Railways.—Swinburne.—A long abstract of a paper read at the Manchester section of the (Brit.) Inst. Elec. Eng. He considers the question of the different systems, not only in actual use, but of possible application. He discusses two cases of typical imaginary railways, one being a long main line, the other a line such as may be run in a "tube," having nothing but passenger trains and stations every half mile or so. He first discusses the latter case, in which acceleration and braking is the important consideration. He compares the use of direct-current series-wound, shunt-wound, and polyphase motors, at constant pressure and constant current. He mentions as a possible constant potential arrangement that the motor may be run at constant speed, and some sort of magnetic or fluid friction clutch applied. To get the advantage corresponding to that of putting two motors in series, the clutch must be arranged so as to couple through two different speed gears. There seems to be no advantage in applying such a system as this to direct current motors; but it gives the opportunity of using ordinary alternating current motors running at constant speed. The real demand is for a variable speed gear. The problem can be solved electrically; for instance, as proposed by Leonard, a constant speed motor may drive a variable pressure generator which feeds a variable speed motor; this arrangement is somewhat expensive, and involves three machines instead of one, or rather an extra double machine on each locomotive. It may be possible to arrange one motor-generator for each train, the train motors being on the multiple unit system; but this has nearly, if not all, the disadvantages of the locomotive system. He then discusses the current distribution on short lines. The first point is to settle the pressure; the present practice of using 500 volts is really due to the street tramway; there is no particular reason why it should be adopted for railways. In the second part of the paper he deals with the problem of long railways. The problem is entirely different from the former; acceleration is comparatively unimportant, and the energy is chiefly used for overcoming the train resistances. The capital cost in mains and sub-stations is greater in proportion to the traffic, as large proportions are frequently idle. It is therefore important to run light trains frequently. The constant pressure system with direct currents has the drawback of waste of energy during acceleration; but if the trains go long journeys, it is no longer important. The chief difficulty is the limit of pressure possible, but there should be no difficulty in making large railway direct-current motors for 1000 or 2000 volts. The direct-current constant pressure system has the great disadvantage of only suiting fixed speeds. This trouble can be largely overcome by making the motors large, so as to give a better acceleration, and running two motors either in series or in parallel. The series, constant, direct-current system has not the same advantages as in the case of a tube railway; the acceleration is no longer of vital consequence. With a given maximum pressure, and a given distance between sub-stations, the loss in the leads is greater, for the leads always carry the maximum current. The series system has compensations, however. It does not follow that because the motors are taken as limited to 2000 volts, that the line may not work at, say, 10,000. The difficulty here is that the motor must be insulated from the bogie, so as to stand high pressures; 10,000 volts with a maximum loss of 25 per cent, or 2500 volts, would allow a distance of 92 kilometers between sub-stations. This would generally mean that there would be no sub-stations, only generating stations, and they could be placed as a rule near large towns, so that they could supply their customers. The series system has the advantage of allowing any speed at high efficiency. It is preferable to brake by mechanical means instead of wasting time to slow down in order to get back a little energy. The three-phase constant potential system has some of the advantages of the constant pressure direct current. It falls behind in some points. There are three wires instead of two, and the motors cannot exceed their normal speed, however late a train may be. On the other hand, the system has the advantage that it can be worked for long distances, as frequent sub-stations can be put down, as they contain only machinery at rest. The distances between the generating stations are thus limited only by the economy of transmission at high pressure. The series three-phase system gives the same advantages as regards distance between central stations, but it is at a disadvantage compared with the constant pressure, three-phase system, as its advantage in acceleration is more than compensated by the need of having sub-stations with moving machinery for each block, with a motor-generator for each train that may be fed by the sub-station. He then gives some rough estimates of cost. He concludes that "it is advisable to pause a little before we convert our railways into electric street railways. We may, by doing so, not only work under drawbacks, which, though unavoidable in tramways, need not exist on railways; but we may stereotype a system which is found to be more and more unsuitable as the electrification of railways develops." It is most important that systems should not be adopted which prevent coupling up with other systems. What is most necessary is standard pressures and currents.—Lond. *Elec.*, March 14. A reprint of the paper in full is begun in Lond. *Eng'ing*, March 14.

Automobiles.—Mueller.—The conclusion of his long mathematical article on the problem of utilizing the energy, generally wasted in braking, for recharging the batteries in an automobile. He shows that while this problem appears at first sight very promising, it is much less so when carefully considered. Only in a few special cases would the advantages of such an arrangement balance the disadvantages due to the compound motors required for this purpose. In general it is better to prefer series wound motors and to abandon the

idea of the utilization of the energy of braking.—*Centralblatt f. Accum.*, March 1.

REFERENCE.

Interurban Electric Road.—DAMON AND RAY.—An illustrated paper in full of their Chicago Elec. Ass'n paper on the Grand Rapids, Holland & Lake Michigan Rapid R'y.—*St. R'y Rev.*, March 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Los Angeles.—An illustrated description of the electric system of Los Angeles, Southern California. There are seven single-phase, 10,000-volt generators of together 1460-kw; two 200-kw, 500-volt, direct-current generators, and five 60-light, 9.6 amp. arc machines. The alternating current, supplying the suburban districts, is transformed up to 2000 volts. The distributing system is composed of alternating current lines for lighting service, 500-volt lines for power, constant current lines for commercial arc lights, and the municipal street lighting lines for series alternating constant current enclosed arc lamps. Los Angeles claims to be the first city in the world which adopted and used, exclusively, the electric arc lamp for municipal lighting; this was done in 1882.—*Jour. of Elec.*, February.

German Single-Phase Plant.—An illustrated description of the plant of Frankfort-on-the-Main which contains at present four single-phase alternators, each of 750-hp, and four, each of 1500. The load is approximately equally divided into a lighting system and a motor and traction service, the single-phase induction motors ranging from 0.1-hp to 50-hp, with 500-kw motor generators for the tramway supply. Connections are being made to supply over 5000-kw for power and about 7000-kw for lighting, and to meet this demand, two 4000-hp steam turbines are to be installed.—Lond. *Elec. Rev.*, March 14.

REFERENCE.

San Francisco.—An illustrated description of the Independent Electric plant in San Francisco. Two-phase currents are generated, three-phase currents transmitted to sub-stations, the distribution being by means of two-phase alternating and three-wire direct current.—*West. Elec.*, March 29.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Submarine Cables.—BAYOL.—A very long illustrated article on the covering of submarine cables. He gives the general mathematical formulas and applies them to special numerical examples.—*L'Eclairage Elec.*, Feb. 22, March 8.

ELECTRO-PHYSICS AND MAGNETISM

Magnetic and Electric Deflection of Becquerel Rays and the Apparent Mass of the Electrons.—KAUFMANN.—An account of an investigation in which he determines the ratio of charge to mass and the velocity of the Becquerel rays produced by a small grain of radium bromide. Since the Becquerel rays are not homogeneous, a fine pencil of rays is broadened into a band when it is deflected. He uses the method of crossed spectra, allowing the electric and magnetic lines of force to act at the same time and parallel to each other, so that the two deflections are normal to each other. The fine pencil of rays thus traces a curve on a photographic plate placed normally to the direction of the rays, and in this curve every point corresponds to a definite value of the velocity and the ratio of charge to mass. The magnetic field was 299 absolute units and the electric field 44.3×10^{11}. The whole apparatus was enclosed in a completely exhausted glass tube in order to permit a measurable electric field to be used. The exposure amounted to 48 hours. The following set of figures gives some of the results, two figures always belonging together, the first figure when divided by 10,000,000,000 gives the velocity, the second when divided by 10,000,000 gives the ratio of charge to mass: 2.83, [illegible] electron is assumed to be a constant quantity) the mass of the electron increases with the velocity, "and this is in accordance with the theory, if the electron consists altogether or partly of apparent mass in the electromagnetic sense." He finally endeavors to calculate the ratio of the real to the apparent mass, and finds, for velocities which are small in comparison with the velocity of light, this ratio to be three.—*Goettinger Nachr.* 1, 1901; abstracted in *Ann. d. Phys. Beibl.*, February, and Lond. *Elec.*, March 14.

[illegible] rate of recombination of ions in gases under different pressures. The rate at which the ions recombine in ionized air is determined by the same law, no matter what the pressure of the gas may be, at least between the limits of .125 of an atmosphere and 3 atmospheres. The coefficient of recombination for the ions in air is independent of the pressure of the air for the same range of pressures. Hydrogen and carbon dioxide also behave like air.—*Phil. Mag.*, March.

Radio-Active Lead.—GIESEL.—An account of an investigation in which, from a large quantity of the mother liquor of barium-radium bromide, resulting from the industrial working of about 2000 kgr. of uranium ore, he separated about 3 milligrams of an intensely radio-active substance which behaved like lead and resembled preparations of radium in its action. After a year had elapsed, it still exhibited stray radiation. A spectroscopic examination showed that the spectrum was principally that of lead. Iron, magnesium, and a few other metals were also present, but lines of radium were absolutely wanting. He inclines to the belief that the lead owed its radio-activity to the quantities of radium with which it was associated in the original ore.—*Chem. News*, Feb. 21; abstracted in Lond. *Elec.*, March 7.

Effect of Magnetic Field on Resistance.—J. J. THOMPSON.—A note on the effect of a transverse magnetic field on metallic resistance. Everdingen has come to the conclusion that the theory that the electric current is carried by charged particles which move freely through the metal, requires the resistance to be diminished by a transverse magnetic force. J. J. Thomson had previously come to the opposite conclusion, namely, that the resistance on this theory ought to be increased. He now gives the reason for adhering to his original result. He thinks that some of Everdingen's assumptions are extremely unlikely.—*Phil. Mag.*, March.

Magnetic Expansion of Iron and Steel.—SHAW AND LAWS.—The conclusion of their paper, giving the results in diagrams and tables. Even if the chemical composition of specimens be identical, and they be annealed repeatedly from a temperature of bright redness, there is found to be an irregularity of behavior which indicates that the ultimate molecular structure is very heterogeneous; this is found under all possible variations of the experimental conditions. Regularity of expansion is obtained when a reading, under like conditions, has been repeated many times; this shows that the cause of irregularity is not in the measuring instrument, but in the particles which gradually take up a definite position under definite treatment. The irregularity is more noticeable in Swedish iron and mild steel than in hard steel. They observed a new and striking fact in the mode of expansion when current is switched on or off. Let H be the field required to give maximum elongation; if a field greater than H is applied, the rod first expands and then contracts; when the field is cut off, the rod expands again to its maximum, and then contracts to its stable state. Thus the rod undergoes every stage in expansion up to the point in question, and does not take a short cut, as might be expected.—Lond. *Elec.*, March 7.

Ionization of Liquids by Radiation.—CURIE.—An account of experiments in which he found radium rays and Röntgen rays are capable of imparting a conductivity to a liquid dielectric. All liquid dielectrics show an increase of conductivity by the action of both kinds of rays, but to prove this increase it is necessary that the original conductivity of the liquid should be small.—*Comptes Rendus*, Feb. 17; abstracted in Lond. *Elec.*, March 7.

REFERENCES.

Induction Coils for X-Light Tubes.—ROLLINS.—A long and well illustrated detailed description of the method of making a type of induction coil which he has found particularly satisfactory for X-light tubes and wireless telegraphy; and an explanation of the principles underlying the successful building of such coils.—*Elec. Rev.*, March 29.

Electric Oscillations of Higher Order.—LAMOTTE.—A mathematical note on electric oscillations of higher order, occurring in electric wave propagation over wires. He discusses the Drude-Blondlot, the Blondlot, and the Lecher exciters.—*L'Eclairage Elec.*, March 8.

Circular Filaments or Magnetic Shells.—LYLE.—A highly mathematical paper on circular filaments or circular magnetic shells equivalent to circular coils, and on the equivalent radius of a coil.—*Phil. Mag.*, March.

ELECTRO-CHEMISTRY AND BATTERIES.

Resistance Furnaces.—VOGEL.—A long abstract of an article giving some notes on resistance furnaces. He remarks that in many smelting operations the use of the arc causes a waste of energy; sometimes arc furnaces were at first adopted, but practice showed later that resistance furnaces were amply powerful. In resistance heating, it is

desirable that for a given cross-sectional area the electrode shall have the largest surface possible, short of making it mechanically weak. He gives the results of tests concerning the rate of oxidation in air of a carbon resistance. He says that if a resistance furnace for carbide is to work smoothly, it requires to be fitted with a set of electrodes arranged gridiron fashion; by this improvement a formation of crust still occurs, on the left and right of the grid, but not above it; and since the finished carbide constantly drops, by its own weight, to the bottom of the furnace in the shape of stalactites, the raw material on top is always free to descend to take its place.—Lond *Elec. Rev.*, March 14.

REFERENCES.

Furnaces.—Blount.—A long abstract of a paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. He gives a summary of the various substances which are or may be prepared in the electric furnace. The main considerations in the design of furnaces are the avoidance of waste of energy, the attainment of a sufficiently refractory chamber, and the arrangements for tapping off, or otherwise removing the products of the process. Electric furnaces are most suitable in districts rich in water power and poor in fuel. The paper does not seem to give anything new.—Lond. *Elec. Times*, March 13.

Ions and Electrons.—Nernst.—A French translation in part of his recent German lecture which has been noticed in the Digest.—*Gen. Gen. des Sc.*, Feb. 28.

Units, Measurements and Instruments.

Test Coils for Alternating-Current Wattmeters.—Beattie.—An illustrated article. While it is generally recognized that most ordinary wattmeters are liable to read wrong when the power factor is low, he shows that by a very simple addition to a wattmeter which is inaccurate at low power factors, it may be made in a certain sense self-testing, so that the actual amount of the error can be easily determined at any moment by taking the difference between two readings of the instrument itself. This is based upon the principle that when the lag in the fine wire circuit is small—i. e., the reactance of the fine wire circuits small compared with its resistance—the formula representing the relation between the actual reading and the true reading becomes very simple; the actual reading being then a linear function of the inductance; hence the curves representing the wattmeter reading as function of the self-inductance in the fine wire circuit, become straight lines. If a few points of this straight line are found experimentally and plotted in a diagram, then the intersection of this line with the axis of zero inductance represents the true reading of the wattmeter. He gives a diagram with three such lines representing the results of an experiment made by introducing self-inductance into the fine wire circuit of a wattmeter, the total resistance of the circuit being adjusted so as to have the same value throughout. Instead of this graphical method he recommends providing a wattmeter with what may be called a test coil. This test coil would have its inductance carefully adjusted to equality with that of the wattmeter pressure coil, and may form part and parcel of the instrument itself, being so arranged that it will not directly affect the suspended coil when traversed by a current. By means of a two-way key either this test-coil or a non-inductive coil of equal ohmic resistance can be switched into the pressure circuit. With the test coil inserted the inductance of the circuit is just doubled, and the reading therefore altered by an amount exactly equal to the error. Thus, if on inserting the test coil, the reading should be increased by, say, 3 degrees, the true reading would be gotten by subtracting 3 degrees from the original reading. The method, of course, depends wholly upon the assumption that the reactance of the fine wire circuit be small compared with its resistance; but this should be the case in any wattmeter which makes any pretence to accuracy.—Lond. *Elec.*, March 14.

Measuring Inductance by the Speaking Arc.—Janet.—An application of the result obtained by Duddell, that if a direct-current arc is provided with a derived circuit comprising a condenser of capacity C and an inductance L, the arc under certain conditions gives a very pure note, having a period which depends in a very simple way on L and C. For capacities of 7 microfarads and feeble inductances, due to the coils of the circuit, the sound obtained is very shrill, and the alternating current intensity may be 20 or 25 effective amps. in the condenser circuit. Under these conditions, the present author measures with a thermal ammeter the current I in the derived circuit and with a thermal voltmeter the difference of potential E at the ends of the coil. Then, neglecting the resistance of the coil and the inductance of the rest of the circuit, he gets a formula which states that the inductance L is equal to C multiplied by the square of the ratio of E to the current I, so that L may be found by purely electrical methods and without any acoustic measurements.—*Comptes Rendus*, Feb. 28; abstracted in Lond. *Elec.*, March 14.

A New Electric Thermometer.—Meslin.—An account of a method of measuring temperatures when it is not required to follow all the changes of temperature very rapidly. He uses the Clark cell; the temperature coefficient of its e. m. f. is pretty high, being about 0.5 per cent per degree, and the circuit may be so arranged that the observations are made by a zero method, and that the temperatures are measured in terms of resistance. In his arrangement the principal circuit contains two resistance boxes of about 30,000 ohms, an accumulator, and a double key, which enables the observer to close first the principal circuit and then the derived circuit, containing the galvanometer and the Clark cell. The resistances may be so arranged that 1 ohm corresponds to one-tenth of a degree, and fractions of degrees may be accurately measured.—*Comptes Rendus*, Feb. 17; abstracted in Lond. *Elec.*, March 7.

REFERENCES.

Wattmeters.—Armagnat.—The conclusion of his illustrated article on wattmeters. He gives the principles of induction wattmeters and of electrostatic wattmeters. He discusses the correction required for exact measurements and gives a review of the different formulas. He finally discusses the effects of higher harmonics and describes the method of calibrating wattmeters.—*L'Ind. Elec.*, Jan. 25.

Testing Materials.—Holitscher.—A long article in which he describes the methods applied by Lahmeyer & Company for testing the materials used for making electric machines and apparatus, and a general account of the results obtained with these methods. The article deals with the following subjects: sheet iron, wrought iron, cast steel, etc.; bare conductors, copper; insulated conductors; fuses; material for resistances; insulating materials; ammeters and voltmeters; meters; switches.—*Elek. Zeit.*, Feb. 20, 27.

Localizing Earth Faults.—McDonall.—An article on the final localization of earths on low-tension networks. The faulty section having been found by throwing off and testing section by section, the positions of the fault is determined fairly accurately by a loop test. As an example, he describes the procedure of localizing a fault on the negative of a three-wire system, with the middle wire permanently earthed. He also describes an extension of the test, for cases in which the disconnecting arrangements are difficult of access, or where all joints are permanent.—Lond. *Elec. Rev.*, March 14.

Measuring Insulation Resistance.—Charpentier.—A very critical discussion of methods for measuring insulation resistance, and especially of the inherent disadvantages of the method in which the loss of charge of a condenser through the insulation resistance is measured.—*L'Eclairage Elec.*, Feb. 15.

Telegraphy, Telephony and Signals.

Synchronizing Device for Telegraphy.—Duane.—An illustrated, detailed description of a device for synchronizing the two motors which are used at the transmitting and at the receiving stations in certain kinds of multiplex and printing telegraphs, and in the picture telegraph. To keep each motor running at a practically constant speed, a device provides that when with increasing speed a certain speed is reached, the armature is short-circuited by means of the centrifugal force; when the speed decreases the short circuit is broken. When both motors are running at nearly the same rate, the speed of one or both is automatically varied so as to always keep them synchronized with each other. This is done by sending a small current over the wire, enough to work a sensitive relay; this happens for a small part of the time only, so that the wires may be used for telegraphing nearly all the time.—*Elec. Rev.*, March 15.

REFERENCES.

Private Branch Exchanges.—Zopke.—A well illustrated article on the Janus system. In Germany the Post Office, which has a monopoly of public telephony, allows five branch telephones to be used with each main telephone, the latter being connected to the line. Private telephones are not allowed to be connected with these public telephones; for a private telephone system separate apparatus and wires are required. The purpose of the Janus system is to use the same instruments for public and private telephony under guarantee of satisfactory control by the Post Office Department.—*Elek. Zeit.*, Feb. 20.

Telephone Exchange.—Wormull.—An illustrated paper, read before the Newcastle section of the Brit. Inst. Elec. Eng., on "The Equipment of a Modern Telephone Exchange." An outline is given of three different systems, the last being the Western Electric common battery relay switchboard, in which both the signaling and speaking currents are supplied from the central energy station.—Lond. *Elec. Eng.*, March 7.

Printing Telegraph.—A well illustrated description of the Gilmore automatic printing telegraph.—*West. Elec.*, March 22.

Wireless Telegraphy.—Reyval.—A continuation of his illustrated article on wireless telegraphy experiments in Germany. This part deals with Brann's system.—*L'Eclairage Elec.*, Feb. 1.

London.—The first part of a detailed and will illustrated description of the city exchange of the Post Office Telephone Department This part deals with the underground cables, the street work, and the power plant.—Lond. *Elec.*, March 7.

Telegraphy and Telephony.—The first part of the quarterly review of progress and improvements made in telegraphy and telephony from October to December, 1901.—*Elek. Anz.*, Feb. 27.

Statistical.—Statistical articles on telegraphy and telephony in Germany in 1900, and in New Zealand in 1900.—*Jour. Teleg.*, Feb. 25.

Miscellaneous.

[illegible] Bigelow and Clinton Article on the medical use of the arc between iron poles. Its crater is only slightly luminous and the chief luminosity proceeds from the gaseous arc itself. Another peculiarity which renders it specially fit for photo-therapeutics is the great intensity of the actinic rays when compared with the heat rays. This makes it possible to bring the diseased part within 8 c. m. of an arc of 20 amps. and 35 volts without interposing any cooling device. The absence of water further enhances the actinic effect. They have treated nine cases of Willan's lupus with the aid of the iron arc. An exposure of 15 minutes sufficed to produce a marked effect. Some 24 hours after exposure the healthy skin was found not to have been attacked, but the lupus nodules were profoundly altered, and replaced in most instances by excavations about 1 mm. in depth.—*Comptes Rendus*, March 3; abstracted in Lond. *Elec.*, March 3.

New Books.

Hydraulic Power Engineering. A Practical Manuel on the Concentration and Transmission of Power by Hydraulic Machinery. By G. Croydon Marks. New York: D. Van Nostrand Company. 360 pages, 201 illustrations. Price, $3.50.

This book is a short treatise covering the field of the generation and transmission of hydraulic power, and the change of hydraulic power into the required mechanical power. The author systematically gives, first, a short introduction to the general principles of hydraulics, flow of water, loss of head, etc., and then takes up the questions of hydraulic pressures, materials for machines, packings and valves. Having thus "laid down his raw technical material," he turns out the refined product—the various practical applications—in the same systematic way.

To those who consider the only use of hydraulic motors is to run coffee mills and old-fashioned elevators—pardon us, we should say "lifts"—a short perusal of the last chapter on "Recent Achievements" is recommended to remedy the error of their ways. As the actual concreteness of the flow of water as opposed to the intangible flow of electricity—not so intangible if you receive a full 550 volts through your arms—has certain charms for the British mind by reason of the massive size of the fixtures and the ponderousness of the machinery, it is hardly to be wondered that this sort of power has obtained a strong foothold in England. Not only in shipbuilding plants, but in engineering works of all kinds, development of hydraulic power is in a far more advanced state than in this country. However, the American engineer is making great use of hydraulics to-day, as witness the hydraulic dock of the Union Works at San Francisco, etc.

In view of the inefficiency of hydraulic power transmission, it is to be expected that in the future that for a certain class of work in[illegible] and small [illegible] hy[illegible] draulic machinery with motor-driven pumps will attract the attention of electrical engineers more and more to this subject. We can hardly doubt that all the large plants of the future will have one electrical generating station and be equipped in the various departments with motors supplying power to the machines by direct connection, gears, belts, ropes, or indirectly to the tools by the means of pneumatic or hydraulic power generated by motor-driven pumps. This consideration makes the book valuable as a text book to the student and as a manual to the electrical engineer, as well as to those, very few in number to-day, who are purely mechanical engineers

Manual of Electrical Undertakings and Directory of Officials. 1901-1902. London: Garcke. 976 pages. Price, 12½ shillings.

The sixth annual volume of this valuable British manual contains information relating to upwards of 1500 electrical undertakings owned in Great Britain and colonies by companies and municipalities. The aggregate capital represented is over $775,000,000, in which central stations and electric railways enter as follows: Central stations, companies, $92,000,000; municipalities, $95,000,000. Electric railways, companies, $200,000,000; municipalities, $12,000,000. The aggregate capital was increased by $160,000,000 during the year covered by the annual.

The following information is given concerning working capital and average rates of dividends: Telegraph, $150,000,000, dividends, 4.78 per cent; telephone, $45,000,000, dividends, 4.59 per cent; central stations, $72,000,000, dividends, 4.79 per cent; electric railways, $140,000,000, dividends, 4.29 per cent; manufacturing companies, $83,000,000, dividends, 6.81 per cent.

A section is given in the book to each of the central station, electric railway, manufacturing and other companies, which, in the case of the two former, includes a description of the system, a list of the officers and a financial statement for the year, covering capital expenditures, revenue account and balance sheet. In the case of central stations there are given the kw-hours of energy generated during the year, the respective amount used in public and domestic lighting, and the percentage of electricity sold to electricity generated. Also the rates at which current is sold, the number of public lamps, the total number of customers, the number of domestic lamps and the maximum load.

The book contains a large number of maps, showing the districts served and the location of generating and sub-stations, and the lines of electric railway. The map of the London District shows that there are 217 miles of electric railway constructed, authorized or projected in the metropolis.

A section on the progress of the year gives an account of the legislation relating to the electrical industry during the year 1900-1901, and various tables of statistics. A directory of officials contains over 4000 names of directors and officers of electrical companies. A large supplement shows by means of colors the results of the operation of central stations during the year covered. The black portion of a horizontal line indicates expense of generation, and is followed by a blue portion indicating expense of distribution; a yellow portion indicating rent, rates and taxes; a green portion representing management expenses; a white portion representing special charges, and a red portion representing profit.

To those interested in British electrical undertakings, this manual should prove simply invaluable, and it contains much of interest to the American reader, particularly with respect to central station and electric railway finances and statistics. While the American electric railway industry is represented by a similar book, it is very much to be regretted that there is no work of the kind devoted to American central stations. There would, however, be great difficulty in compiling a satisfactory book giving statistics of American central stations, since these are considered purely matters of private business, as in the case of other commercial enterprises. Massachusetts is, we believe, the only State which requires publication of central station business, and its requirements are far less exacting than those of the British Board of Trade, the records of which render possible the compilation of such an extremely satisfactory manual as the present one.

A Correction.—In the title entry of the review notice of Wiener's "Practical Calculation of Dynamo-Electric Machines," which appeared in the issue of March 29, the price of the book should have been $3.00 instead of $2.50, as printed.

BOOKS RECEIVED.

ELEKTROMECHANISCHE KONSTRUKTIONEN. By Gisbert Kapp. Berlin: Julius Springer. 202 pages, illustrations. Price, 20 marks.

CONTRIBUTION A L'ETUDE DES PERTES D'ENERGIE DANS LES DIELECTRIQUES. By Paul L. Mercanton. Lausanne: Imprimerie Corbaz & Company. 63 pages, 8 plates.

AN ELEMENTARY TREATISE ON ALTERNATING CURRENTS. By W. G. Rhodes, M. Sc. 211 pages, 83 illustrations. London: Longmans, Green & Company. Price, $2.60.

HIGH SCHOOL PHYSICS. By Henry S. Carhart, LL.D., and Horatio N. Chute, M. S. Boston: Allyn & Bacon. 433 pages, 322 illustrations.

A MANUAL OF PHYSICAL MEASUREMENTS. By John O. Reed, Ph. D., and Karl E. Guthe, Ph. D. Ann Arbor, Mich.: George Wahr. 185 pages, 86 illustrations. Price, $1.50.

THE ELEMENTS OF PHYSICAL CHEMISTRY. By J. Livingston R. Morgan, Ph. D. New York: John Wiley & Sons. Second Edition, revised and enlarged. 352 pages, 23 illustrations. Price, $2.00.

DIE ELEKTRISCHEN EINRICHTUNGEN DER EISENBAHNEN. By R. Bauer, A. Prasch and O. Wehr. Vienna: A. Hartleben. 431 pages, 318 illustrations. Price, 6 marks.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 18-21, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

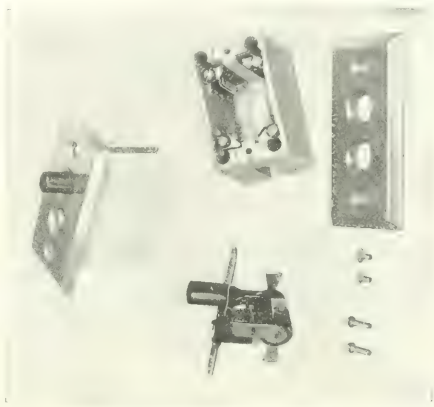
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

Push Button Flush Pocket Switch.

A complete line of single-pole, double-pole and three-way push-button flush pocket switches, is being manufactured by the General Electric Company. These are designed to meet all requirements for places where the maximum current is 10 amperes, and they are suitable for use on 250-volt circuits. They can, of course, be installed in the standard outlet boxes regularly manufactured for the reception of switches of this character. The mechanism, which consists of an unusually small number of working parts, is entirely enclosed in a substantial porcelain box. A quick make and break is one of the characteristics of these switches, and a liberal contact surface prevents heating.

The quick positive action of the switch is accomplished by means of but one spiral spring which, with the other distinctive features of the switch, precludes any possibility of sluggish action or loosening of parts. One of the switch buttons is finished to correspond with the cover of the switch, while the other is black, so that a glance determines the position of the switch. The switch may be conveniently wired from the front after being placed in position. The standard finish adopted is nickel, but other finishes can be furnished. There is manufactured a cast iron wall pocket for use with these switches in connection with cleat or knob concealed wiring. Separate nickel covers are also furnished for the installation of two switches or three switches.



PUSH BUTTON FLUSH POCKET SWITCH.

Search Lights in the New York State Signal Service.

At a recent inspection of the Second Signal Corps, N. G. N. Y., by Major General Roe, an interesting exhibit was made, showing the usefulness of an electric searchlight for army signals. The apparatus as devised by Capt. Baldwin and other members of the Corps consisted of an ordinary automobile operated by steam, and provided with a trailer carrying the searchlight and dynamo. When the searchlight is required to be put in service, the automobile is jacked up, and a belt from one of the wheels is connected with the generator, the engine on the carriage supplying the necessary steam power.



SEARCHLIGHT IN SIGNAL SERVICE.

The searchlight used is of the marine projector type, having a Mangin mirror. The lamp is automatic, with horizontal feed carbons, passing 10 amperes, and was built by Charles J. Bogue, 213 Centre Street, New York. This exhibit was successful in every way, and clearly demonstrated the fact that the automobile searchlight will greatly add to the efficiency of the signal corps in field and other operations.

Roller Bearings.



ROLLER BEARING.

Boston is putting on the market a bearing having for its leading features rollers of very generous proportions; a system of separating rollers for preventing friction between the main or bearing rollers and for keeping them in perfect alignment; rolling supports for these separators, and an efficient system of bevels for taking the end thrust of the bearings. One of the greatest difficulties with roller bearings seems to be the inability to keep the rollers in alignment. The system used in this bearing depends upon the tensile strength of the separator to maintain this alignment. Another point of the bearing is the fact that a comparatively short roller is used. This reduces the possibility of breakage from twisting to a minimum.

The system is so planned that every part rolls in perfect harmony with every other part, thus avoiding rubbing friction. All rolling parts are carefully hardened and ground with extreme accuracy. These facts, combined with the liberal proportions of the rollers, give a bearing of great durability. The care required to keep the bearings in good condition is reduced to a minimum, as they do not require lubrication, but merely the use of a good rust preventive.

The company is devoting much of its attention to special applications of the bearing to heavy machinery and shafting, where the saving in power is sufficient to make the cost of the bearing insignificant in comparison.

The Adams' Secondary Generator.

Feeling that for heavy duty and continuous operatiin a demand existed for something more trustworthy and certain in its action than primary batteries, the Western Electrical Supply Company, of St. Louis, Mo., has recently perfected and is putting on the market a device which is claimed to be eminently convenient as a substitute, not only in regard to the matter of cleanliness, but particularly from its capacity for handling heavy work continuously without running



down and subjecting the service to occasional interruption. The principle is essentially that of a step-down transformer, but with numerous modifications in construction to render it particularly available for the purpose intended, and entirely suitable for the displacement of primary batteries in all localities where a continuous, 24-hour, alternating electric light service is maintained.

One type of machine will be found sufficient to handle the entire electric bell and annunciator system of the modern office or flat building, and consuming as it does about one watt of electrical energy in the 7200 alternations type, and about ¾ of one watt in the 133 cycle machine for continual operation, the running expense becomes a negligible quantity.

Another size of the machine, of twice the capacity, is designed for use on heavy electric door opener, annunciator, burglar alarm, gas lighter systems, and for small power purposes, such as supplying the necessary current for operating small, direct-current, toy motors, etc.

They consume from 1¼ to 1½ watts, and for heavy duty are claimed to be superior to any form of primary battery, either in regard to general convenience or low cost of maintenance.

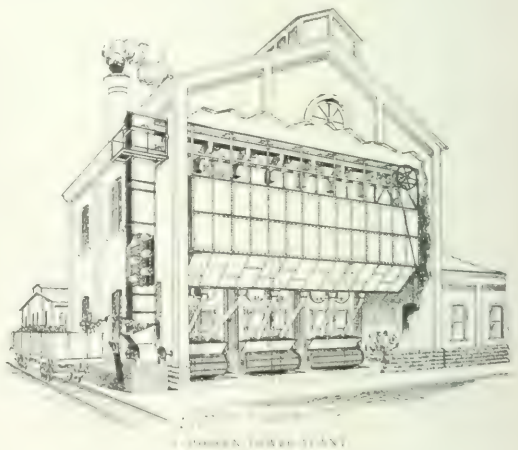
The magnetic circuit is so proportioned as to provide for a predetermined limit, being automatically set for the maximum secondary load, the $C^2 R$ loss at this point being kept well within the allowable limit, making overheating, under even the most severe short-circuit conditions, impossible, and at the same time preventing any chance of dangerous heating in the wiring and liability of fire from the same, as a result of any short-circuit conditions in the secondary circuits.

Annunciators, door openers, and in general all devices having a large number of turns, and consequently considerable impedance in the windings, usually require, on alternating current, somewhat higher pressures for their operation than is preferable for use with bells, and to meet this requirement the machines are each built to supply three secondary pressures, the load being taken in any proportions, from the various terminals. The machines are fireproof, and comply in every way with the requirements of the underwriters.

The Jeffrey Power Plant at Columbus, Ohio.

The Jeffrey Manufacturing Company's power plant at Columbus, Ohio, is a modern steel and brick fireproof building, provided with good light and ventilation. The boiler room is equipped with three 250-hp Babcock & Wilcox boilers, fitted up with chain grate stokers. The induced draft system is used in connection with the boilers and is put in in duplicate, thus making provision for any accident that might occur, allowing one to be shut down and the other started without any hindrance to the working of the boilers. Modern purifiers and feed water heaters are also features of the plant.

Another feature of the boiler room is the absence of the customary coal pile in front of the boilers. This is due to the storage tank of 280 tons capacity. The coal is unloaded directly from the cars into an elevator boat, or in case of lump or run of mine coal, into a crusher which is directly over the boat. The coal is taken to the tank by the



continuous Jeffrey bucket system. The tank is in direct communication with the stoker by means of chutes, provided with a gate valve, operated by a hand chain and wheel from the floor. The engine room is equipped with three 250-hp high-speed engines, belt-connected to three 150-kw, 250-volt Jeffrey generators. The switchboard is of black polished slate, especially designed and built by the electrical department to suit requirements. The power is furnished from this board to the different departments, which are electrically driven, the light and power lines being independent for each one.

An air compressor is also installed in the engine room which furnishes power for a number of pneumatic hoists and tools throughout the works. While this power plant is not very large, it is arranged to operate in the most economical manner.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money gradually became easier in tone and was freely offered, there being a light demand, however. The closing rates were 4¼ per cent for 60 days to four months; 4 per cent for six months. In the stock market there was increased activity, with advances led by the high-priced dividend-paying stocks. Amalgamated Copper was irregular, although there was a disposition on the part of inside interests to support it. The traction stocks were rather neglected, although there was talk of bullish manipulation in Brooklyn Rapid Transit. This stock closed at 65¾, being a net gain of 1 point, the sales aggregating 26,705 shares. Metropolitan Street Railway closed at 165, ex-dividend, which quotation represents a net loss of ¾ point, the total sales being 14,460 shares. General Electric was a strong feature. The recent buying of this stock, it is stated, is partly explained by the advance figures of the annual report, already published in these pages, showing earnings for 1901 which are equivalent to 32 per cent on the stock. The closing price was 325⅞, being a net gain of 3⅜ points, and only ⅛ lower than the highest figure of the week. Western Union made a net gain of ¼ point, closing at 90½; trading was light, however, only 1931 shares having been sold. Westinghouse Electric, both common and 1st preferred, made net gains of 4 points each, the former closing at 197½, and the latter at 201. Other closing prices are: American District Telegraph, 33; American Telegraph & Cable, 85¼, a net decline of 1½ points, and American Telegraph & Telephone, 185, ex-dividend, being a net gain of 14½ points. In Boston American Telegraph & Telephone closed the week with a net gain of over 9 points. Following are the closing quotations of April 8:

NEW YORK.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
American Tel. & Cable..	84	87½	General Electric...	[illegible]	[illegible]
American Tel & Tel.....	—	183	General Carriage..	[illegible]	[illegible]
American Dist. Tel.....	30	33	Hudson River Tel.....	—	—
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan Street R.	[illegible]	[illegible]
Commercial Cable.....	148	150	N. E. Elec. Veh. Trans..	—	1
Electric Boat...	[illegible]	[illegible]	N. Y. Dock...	[illegible]	[illegible]
Electric Boat pfd	[illegible]	[illegible]	N. Y. Transit	[illegible]	[illegible]
Electric Lead Reduc'n...	1½	1⅜	Tel. & Tel. Co. America..	—	4½
Electric Vehicle.....	2¾	3	Western Union Tel.....	90¼	90
Electric Vehicle pfd	[illegible]	[illegible]	Westinghouse E. & M. Co.	[illegible]	[illegible]
			West. E. & M. Co. pfd...	197	215

BOSTON.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
American Tel. & Tel	[illegible]	[illegible]	Mexican Central	[illegible]	[illegible]
Cumberland Telephone...	—	—	New England Teleph....	146¾	147
Edison Elec. Illum	[illegible]	[illegible]	Westinghouse Elec.	[illegible]	[illegible]
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	—	—
General Electric pfd	[illegible]	[illegible]			

PHILADELPHIA.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
American Railways	[illegible]	[illegible]	Phila. Traction	[illegible]	[illegible]
Electric Storage Battery	[illegible]	[illegible]	Philadelphia Electric	[illegible]	[illegible]
Elec. Storage Batt'y pfd..	77	74½	Pa. Electric Vehicle.....	—	—
Elec. Co. of America	[illegible]	[illegible]	Pa. Elec. Vehicle pfd	[illegible]	[illegible]

CHICAGO.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
Central Union Telephone.	—	—	National Carbon pfd....	90	90
Chicago Edison	[illegible]	[illegible]	Northwestern Elevated	[illegible]	[illegible]
Chicago City Ry	[illegible]	[illegible]	Union Loop	[illegible]	[illegible]
Chicago Telep. Co.....	—	*180	Union Traction pfd.....	—	—
Commonwealth Electric	[illegible]	[illegible]			

*Asked.

A NEW WAY TO FINANCE TELEPHONE COMPANIES.—The Co-operative Telephone Company, of Detroit, which is seeking a franchise in that city, has proposed a rather remarkable scheme for the floating of its bonds. The company proposes to raise $200,000 by subscriptions to its capital stock. It is estimated that at least $600,000, and probably more, will be needed to build the plant. The problem is to make $200,000 to do the work of $600,000. This is easy. After the $200,000 in cash has been raised from the sale of stock, this money is to be placed in the hands of some trust company acting as trustee for a bond guarantee company. The trust company is to invest the money in some reliable securities yielding 5 per cent. Bonds will be issued to the amount of $600,000, and the payment of these bonds will be insured by the bond guarantee company. The Bond Guarantee Company will have as security the $200,000 invested by the trust company acting as its trustee. This $200,000 at 5 per cent compound interest in thirty years is to yield the premium to the bond guarantee company, and the $600,000 which will secure the payment of the $600,000 in bonds, and it will make no difference to the bond guarantee company whether the telephone plant is in existence at the end of the thirty years or whether it is built at all. While this scheme secures the ultimate payment of the bonds, there is less to insure that the interest on the bonds will be paid than there would be in the ordinary method of issuing bonds. The amount paid in by the stockholders would represent nothing whatever in the way of tangible assets, as it would all go to insure the payment of the bond issue at maturity instead of going into the actual construction of the exchange. The amount invested in revenue-producing plant would, therefore, be less in proportion to the stock and bonds issued than by the ordinary method of procedure, and the chances for returns to both stock and bondholders proportionately less. At least, that is the way it strikes us.

ALBANY & HUDSON RAILWAY.—The plan for the reorganization rendered necessary by the unfortunate collision last summer, due to the gross carelessness of a motorman, calls for the deposit with the Colonial Trust Company of the existing securities ($2,500,000 each of stock and 5 per cent bonds, and 5 per cent notes given for coupons due Sept. 1, 1901) and the creation of the following new securities: (a) New series of bonds aggregating a total authorized amount of $1,800,000 of 4½ per cent, 40-year gold bonds, of which $1,500,000 par value are to be issued for the purposes of this plan and the remaining $300,000 are to be reserved to provide for future extensions, improvements and betterments. (b) The capital stock, now $2,500,000 par value, all of which is common stock, shall be divided into approximately $1,800,000 of 5 per cent non-cumulative preferred stock, preferred as to dividends, and also as to assets in case of dissolution, and $700,000 common stock. (c) The $700,000 new common stock shall be divided pro rata among the holders of the present $2,500,000 of capital stock. In case the new bonds are not marketed by the committee, the present bondholders will receive in new bonds 51.92 per cent of their present holdings—payment for the remaining 48.08 per cent being in preferred stock, amounting to $1,202,000 face value. In case the bonds are marketed by the committee, the present bondholders will receive for each $1,000 principal of old bonds $478 cash and $522 preferred stock. This agreement will only become operative when in the judgment of the committee, enough bonds and shares of stock shall have been deposited.

MINNEAPOLIS GENERAL ELECTRIC.—The earnings of the Minneapolis General Electric Company for the twelve months ended Feb. 28 compare with previous year's earnings as follows:

	1902.	1901.		Changes.
Gross	$354,958	$333,643	Inc.	$21,315
Expenses	199,252	164,135	Inc.	35,117
Net	$155,706	$169,508	Dec.	$13,803
Fixed charges	107,833	103,145	Inc.	4,688
Net profit	$124,867	$65,362	Inc.	$59,505
Improvement fund	30,000	30,000		
Surplus	$94,867	$35,362	Inc.	$59,505

Under a supplemental indenture, the company has agreed to expend out of earnings $30,000 per annum in improving the property or in purchasing bonds. The dividends on $750,000 of 6 per cent preferred stock call for $45,000 per annum, leaving $49,867 earned for the common stock during the 12 months ending Feb. 28.

DULUTH GENERAL ELECTRIC.—A trust deed of $1,000,000 was filed at Duluth by the Duluth General Electric Company and the Old Colony Trust Company of Boston, trustee. The mortgage is filed on account of the indebtedness of the company at present, and the additional obligation it will incur by the acquisition of an electric light plant in buying stock in the Prindle Gas Company, the Northern Electric Subway Company, and the West Duluth Electric Company, and by the purchase of materials for extension of the plant. The board of directors has been authorized to issue first mortgage bonds of $1,000 each for a sum not to exceed $1,000,000, to run for twenty-five years, the interest being 6 per cent.

BIG RISE IN WESTINGHOUSE.—On Tuesday, April 8, on the New York market a remarkable feature was the phenomenal advance scored by the shares of Westinghouse Electric & Manufacturing Company, the common jumping up 14½ points to 217½, and closing at a net advance of 12 points on dealings in 9700 shares, while the first preferred rose 15 points to 220 on transactions involving 1000 shares. There was no news to explain the rise, but the talk was that the company is earning something like 30 per cent on its capitalization. At the offices of the company the report of a consolidation with General Electric was again denied.

WESTERN TELEPHONE.—The advance in American Telephone has turned attention to Western Telephone & Telegraph Company securities and a number of the leading Boston houses are advising the purchase of these securities, especially the preferred stock. Theo. P. Harding in a special letter regarding this company points out that only about 40,000 shares of the preferred stock are in the hands of the public, 25,000 of which were distributed to old Erie stockholders upon payment of $100 per share and 10,000 shares were issued for the 5 per cent bonds of 1928 and 1929 in part consideration of their assent to the readjustment plan. Mr. Harding says: "In justice to the bondholders a dividend of 5 per cent per annum no doubt will be paid on this stock provided the earnings of the company will warrant. The net earnings of the company for 1901 may be placed at $1,400,000, from which should be deducted 5 per cent interest on the outstanding bond issue amounting to $500,000, leaving $900,000 applicable to dividends on the preferred stock, which at 5 per cent would amount to $800,000. It is believed that the net earnings of the Western Company for the year 1902 will be at least $1,080,000."

GENERAL ELECTRIC.—The General Electric Company has filed with the Massachusetts Commissioner of Corporations a report of its condition as of Dec. 31, 1901, as follows:

Assets:	Dec. 31, '01.	Dec. 31, '00.
Real estate	$533,959	$550,848
Cash and accounts receivable	16,014,553	13,339,127
Inventions and work in progress	8,449,664	7,330,832
Patents, etc.	2,000,000	2,000,000
Plants, investments, etc.	12,621,658	10,736,926
Total	$39,619,836	$33,957,733
Liabilities:		
Capital stock	$24,936,300	$23,750,000
[illegible]	[illegible]	[illegible]
Profit and loss	12,868,928	6,962,054
[illegible]	$39,619,836	$33,957,733

SAFETY INSULATED WIRE COMPANY.—The Safety Insulated Wire & Cable Company, of which Leonard F. Requa is president, has been acquired by a syndicate formed by Messrs. Zimmerman & Forshay, bankers. The Safety Insulated Wire & Cable Company is one of the most prosperous insulated wire and cable manufacturing concerns of the United States. It has done a large business in furnishing cables to the Government at Manila. It has recently acquired large factory and water front properties at Bayonne, and installed the newest machinery to produce submarine cables of any desired length. Mr. Requa will continue in the board of directors. It is reported that the deal involves about $1,000,000. Mr. Max Osterberg has been active in the affairs as expert and representative of capitalists.

STROWGER TELEPHONES.—The following is a special despatch from Chicago of April 8: "A financial transaction of big proportions was announced to-day in telephone circles. The Government of Germany appears as the purchaser of patent rights covering all Europe except Great Britain, Ireland and France for an automatic switchboard manufactured in Chicago. The deal is the result of seven months' investigation in this city by a representative of the German Government. The electrical appliances will displace a telephone system of 40,000 instruments. Many operators will be forced to seek other employment, as one person can keep an entire system in order." This seems rather twisted, but it is said to be a fact that the German Government has taken up the Strowger system for Germany.

AN AMERICAN MARCONI COMPANY.—American capitalists, including Mr. J. P. Morgan, it is said, and represented by E. Rollins Morse, have secured the American rights of the Marconi Wireless Telegraph Company of London. The parent company retains a majority of the outstanding stock, and so has a controlling vote in the corporation's affairs. The new company, to be known as the Wireless Telegraph Company of America, will be capitalized at $6,150,000. It is stated that Mr. Marconi, on behalf of himself and English associates receives $250,000 and 55 per cent of the stock. The new company will operate in the United States, Cuba, Porto Rico, Danish West Indies, Alaska, Hawaii, Philippines, etc.

DIVIDENDS.—The Twin City Rapid Transit Company has declared a quarterly dividend of 1¼ per cent on its common stock. This is an increase of ¼ per cent quarterly. The first dividend on the stock was paid in August, 1899. In 1900, 3 per cent in all was paid. Since August, 1901, it has paid 2 per cent semi-annually. The Bell Telephone Company of Missouri has declared a quarterly dividend of 2 per cent. The Imperial Electric Light Company, of St. Louis, has declared a dividend of 2½ per cent. The trustees of the Street Railways & Illuminating properties will distribute $2 per share [illegible]

GENERAL ELECTRIC STOCK.—A special meeting of the stockholders of the General Electric Company is called for Monday, May 5, at Schenectady, N. Y., for the purpose of voting upon a proposition to increase the capital stock by the amount of $19,757,800, to consist of 197,578 shares of common stock, so that the capital stock shall be increased from the present amount, $25,242,200, consisting of 252,422 shares of the par value of $100 each, to $45,000,000, to consist of 450,000 shares of the par value of $100 each.

EVERETT-MOORE PROPERTIES.—The Eastern syndicate that had an option on the Everett-Moore interests in the Toledo Railway has obtained a renewal of the option for fifteen days. The purchase of the Everett-Moore independent telephone lines in Stark County, Ohio, by public subscription has been assured. The price is $250,000.

TELEPHONE BONDS.—This week a deed of trust was filed by the Inter-State Independent Telephone & Telegraph Company of Illinois to cover $50,000,000 7 per cent 25-year bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade to the mercantile agencies continue favorable, as heretofore. In the East and West retail trade was quieter, due to cool weather and the natural reaction from the ante-Easter activity, while heavy rains and floods have interfered with demand and movement in the South. *Bradstreet's* points out that there is the usual spring unrest in the leading industries, but the only important strike is that of the soft coal miners in Pennsylvania. Special promise of activity is held out this year in the building trades, and in the hardware trade country-wide activity is reported, the only difficulty being the obtaining of supplies fast enough. In iron and steel, strength continues. A contract for 100,000 tons of Bessemer pig for delivery in the fourth quarter is reported as about being placed at $17 a ton, valley furnaces. What sales were made during the week were at $17.50@$17.75, valley furnaces. Steel is scarce and billets are quoted at $32, which is $10 more than a year ago. The demand for finished material seems to be still in excess of the supply. Reports from Cleveland are to the effect that lake navigation having opened, iron foundries are crowded with orders and building is active. In coal, the usual spring reduction in anthracite (small sizes) is noted, but large sizes have been advanced. The business failures for the week, as reported by *Bradstreet's*, numbered 176 as against 183 the week previous and 188 the same week last year.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., advise that the demand for electric cranes continues satisfactory. They have recently booked orders for 45 cranes and hoists, among which are representative firms, as follows: Henry Vogt Machine Company, Louisville, Ky.: One 5-ton, two 10-ton and one 15-ton. Oil Well Supply Company, Oil City, Pa.: One 2-ton. Wheeling Steel & Iron Company, Wheeling, W. Va.: One 7-ton. Allis-Chalmers Company (Fraser & Chalmers plant), Chicago: One 20-ton with 5-ton auxiliary. Allis-Chalmers Co. (Gates plant), Chicago: One 50-ton with 5-ton auxiliary. Bradley Manufacturing Co., Allegheny, Pa.: One 6-ton. Fairbanks, Morse & Co., Beloit, Wis.: One 15-ton. Colorado Fuel & Iron Company, Bessemer, Colo.: One 10-ton and one 20-ton. Newport News Shipbuilding & Dry Dock Company, Newport News, Va.: Two 20-ton. Whitney Iron Works Company, New Orleans, La.: One 10-ton and one 20-ton. American Bridge Company, Philadelphia: One 20-ton, double trolley. Pittsburg Plate Glass Company, Pittsburg: Two 3-ton. American Sheet Steel Company, W. Dewees Wood Company Department, McKeesport, Pa.: Two 5-ton. Structural Steel Car Company, Canton, Ohio: One 12-ton. The American Well Works, Aurora, Ill.: One 10-ton. Norton Emery Wheel Company, Worcester, Mass.: One 10-ton. Lackawanna Iron & Steel Company, West Seneca, N. Y.: One 3-ton. Follansbee Bros. Company, Pittsburg: One 5-ton, one 10-ton with 3-ton auxiliary, and one 25-ton. The Vulcan Works, Chester, Pa.: One 15-ton with 5-ton auxiliary. Northern Central Railway, York, Pa.: One 25-ton. The Midvale Steel Company, Philadelphia: One 10-ton jib. The Standard Steel Works, Burnham, Pa.: Five 5-ton and one 15-ton. American Sheet Steel Company, Wellsville Works, Wellsville, Ohio: One 30-ton, with 5-ton auxiliary. The Trenton Iron Company, Trenton, N. J.: One 3-ton. The William B. Pollock Company, Youngstown, Ohio: One 20-ton riveter, with 5-ton auxiliary.

THE HARTWELL ELECTRICAL COMPANY has been incorporated in New Orleans and has purchased the New Orleans Electric Company, the oldest electrical construction and supply house in New Orleans, and will carry a stock of supplies and engage in general construction, superintendence and electrical engineering. The personnel is Mr. C. A. Hartwell, president, and Mr. T. S. McLoughlin, vice-president and general manager.

VARIOUS BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, with New York offices, under the management of Mr. Paul Bigelow, 30-41 Cortlandt Street, has lately secured a number of substantial orders from various domestic sources for engines to be used for electrical purposes. The Southern Pacific Terminal Company, of Galveston, Tex., has ordered three 16½x30½x30 in. cross compound engines, each of which are to be direct-connected to 300-kw generators. The Allan Wood Iron & Steel Company's plant at Conshohocken, Pa., is to be installed with two 17½x30½x30-inch cross compound engines for direct connection to generators of 300-kw capacity each. Two 14½x25x24 Buckeye tandem compound engines have been requisitioned for installation in the St. Louis Glass Works at Pittsburg, Pa. These engines will be direct-connected to 150-kw generators. A 7½x12x12 simple engine direct-connected to a 50-kw generator is also to serve as equipment for the same Pittsburg plant. The General Electric Company works at Latrobe, Ohio, are to be installed with a simple 17½x21-inch engine for direct connection to a 175-kw generator. Wickwire Bros., of Cortlandt, N. Y., have sent in an order for a 15¼x26½x24-inch tandem engine to be direct connected to a 200-kw generator. A 16½x30½x30 cross compound engine to be direct-connected to a 300-kw generator will be furnished the Cleveland Woolen Mills Company, of Cleveland, Ohio. The American Steel Hoop Company has ordered for its Etna, Pa., plant a 17x30-30 cross compound engine to be direct-connected to a 300-kw generator. C. C. Mengel, Jr., Bros. & Company, of Louisville, Ky., have called for a 15¼x24 simple engine for direct connection to a 150-kw generator. Four 10x12-inch simple engines to be direct-connected to generators of 50-kw capacity each will be shipped the Standard Steel Car Company, of Pittsburg, Pa.

THE SPRAGUE ELECTRIC COMPANY reports among very recent sales the following orders for split-pole generators: E. L. Epperson Construction Company, St. Louis, 200-kw, engine type, 200 r. p. m., 550 volts; Chillicothe Street Railway Company, Chillicothe, Ohio, 300-kw, belted type, 450 r. p. m., 550 volts; Cosmopolitan Power Company, Chicago, 75-kw, belted type, 600 r. p. m., 250 volts; Ohio Powder Company, Youngstown, Ohio, 100-kw, belted type, 585 r. p. m., 500 volts; Keystone Leather Works, Camden, N. J., 200-kw, engine type, 200 r. p. m., 230 volts; Providence & Danielson Railway Company, Providence, 400-kw, belted type, 400 r. p. m., 575 volts; Board of Education, Chicago, two 150-kw, engine type, 225 r. p. m., 115 volts; E. W. Bliss Building, New York, four 150-kw, engine type, 225 r. p. m., 250 volts; Lackawanna Iron & Steel Company, Buffalo, 500-kw, engine type, 100 r. p. m., 250 volts; St. Joseph Railway, Light, Heat & Power Company, St. Joseph, 150-kw, engine type, 150 r. p. m., 200 volts; Otis Elevator Company, Yonkers, 50-kw, engine type, 290 r. p. m., 250 volts; The Wm. Tod Company, Youngstown, Ohio, 175-kw, engine type, 200 r. p. m., 230 volts; Railroad Construction Company, Princeton Junction, two 400-kw, belted type, 400 r. p. m., 575 volts; Sturges, Cornish & Burns, Chicago, 200-kw, belted type, 425 r. p. m., 250 volts; American Electrolytic Company, Rock Glen, N. Y., 200-kw, belted type, 550 r. p. m., 250 volts; Alfred F. Moore, Philadelphia, 75-kw, belted type, 600 r. p. m., 125 volts; Arlington Company, Arlington, N. J., two 75-kw, belted type, 460 r. p. m., 230 volts; one 62½-kw, belted type, 470 r. p. m., 230 volts; one 37½-kw, belted type, 500 r. p. m., 230 volts; Adams & Westlake, Chicago, 125-kw, engine type, 250 r. p. m., 250 volts.

NEW CUTLER-HAMMER SHOPS.—The Cutler-Hammer Manufacturing Company, of which F. R. Bacon is president; H. H. Cutler, vice-president; A. W. Berresford, secretary; and F. L. Pierce, treasurer, has consummated a transfer of real estate at Milwaukee with F. A. W. Kieckhefer, of the National Enamel & Stamping Company, which gives the former possession of the entire block bounded by Twelfth Street, Thirteenth Street, St. Paul Avenue and the Chicago, Milwaukee & St. Paul Railroad tracks. The Cutler-Hammer Manufacturing Company has its plant on a portion of this property and the additional space will enable it to construct buildings which will more than double its present capacity. The company now employes about 250 hands, but the business that could be handled were it in a position to do so, would mean the employment of upward of 500 men and steps will immediately be taken to enlarge the plant, which will eventually cover the entire block. The Cutler-Hammer Manufacturing Company is one of the very largest manufacturers of electric motor controlling devices in the world, shipping products to all quarters of the globe.

HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry & Machine Works, New York offices, 203 Broadway, under the management of Mr. W. P. Mackenzie, reports receipt of an order for a 220-hp Harrisburg standard engine for direct connection to a 150-kw Westinghouse generator. This equipment will be installed for general power purposes in the Carteret, N. J., plant of the Chrome Steel Company. The George A. Fuller Company, 135 Broadway, has requisitioned for a 150-hp Harrisburg standard engine for direct connection to a 100-kw General Electric generator to be used for lighting the Union Club, New York City. Mr. James McKane, of Coney Island, has ordered a 90-hp standard engine for direct connection to a 60-kw generator—make not yet decided on—for installation in the Seaside Athletic Club, Coney Island. An order has also been secured by the Harrisburg people for a 60-hp standard engine to be direct-connected to a 35-kw generator—not yet ordered—which will serve for lighting the new Rahway, N. J., chemical works of Merck & Company.

A LARGE ORDER FOR ARCS.—Probably by far the largest order ever given for arc lamps—certainly the largest for enclosed arcs—is that recently secured by the General Incandescent Arc Light Company, of New York City, from the Cincinnati Gas & Electric Company. The installation will consist of about 4500 "G. I." series alternating current lamps of the enclosed type. These will be divided into circuits of 60 lamps each, connected to 75 automatic transformers and controlled from a switchboard consisting of 75 panels, with ammeters, switches, lightning arresters, kicking coils, etc. The contract was entered into early in January and the first instalment of over 500 lamps has already been shipped. The contract calls for complete delivery of all the apparatus by June. The tests have been very satisfactory, and although such an order, on top of a great volume of regular business, has taxed the productive resources of the G. I. factory, it will be delivered on time.

LAWRENCE PUMPING OUTFITS.—The Lawrence Machine Company, of Lawrence, Mass., reports receipt through its New York representative, Mr. H. E. Maxfield, of 39 Cortlandt Street, of an order for a double suction centrifugal pumping outfit of 15,000,000 gallons' capacity for installation in the new Mount Washington Hotel, Mount Pleasant, N. H. The pump is to be direct-connected to an alternating current motor which is to be utilized also for various other purposes. The motor will be furnished by the Westinghouse Electric & Manufacturing Company. The Georgia Railway & Electric Company, of Atlanta, Ga., has just requisitioned for a 30,000,000-gallon pumping equipment. This pump will be direct-connected to a direct-current 50-hp motor of Westinghouse build. The outfit will be installed in the Southern Company's central power station.

TELEPHONE ENGINEERING WORK.—It is understood that important changes are being made in the engineering department of the American Telephone & Telegraph Company. It is proposed to have the Bell engineering work of the parent organization consolidated in Boston, having thus in one organization the control of all engineering matters in which the company is interested directly. The aim is to establish a condition of things which will result in standardizing and simplifying telephone engineering questions throughout the country, so far as these may belong to the company's jurisdiction or be submitted to it for advice and suggestion. The details are now being worked out. It would appear from this that for some time to come Boston will remain the actual Bell headquarters.

WESTINGHOUSE EQUIPMENT FOR MERSEY TUNNEL.—The Westinghouse Machine Company from its East Pittsburg shops will next week make shipment of an important lot of equipment to be installed in the power station of the Mersey River Tunnel Railway, between Liverpool and Birkenhead, England, the contract for the electric conversion of which system was recently awarded to the British Westinghouse Electric & Manufacturing Company, Limited. The shipment will consist of two 2000-hp Westinghouse vertical cross-compound engines and the same number of Westinghouse generators of 1200-kw capacity each, for direct connection with same.

THE BUFFALO FORGE COMPANY, Taylor Building, Cortlandt Street, under the management of Mr. J. J. Lyle, M. E., has been allotted an order by the Bowery Bay Improvement Company, of North Beach, L. I., calling for a 280-hp engine, which it to be direct connected to two Stanley alternating-current generators of 90-kw capacity each. The Northern Engineering Company has requisitioned for a 10x10 Buffalo engine, to be direct-connected to a 35-kw Elwell-Parker generator. This outfit is intended for lighting purposes by Conrad Eurich & Company, Brooklyn.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, will, within a few days, ship to Seattle, Wash., four batteries of chloride accumulators. One of these will be installed in the power station of the Seattle Electric Company for use with the railway machinery as a regulator of the fluctuating load and as a reserve. The three remaining batteries are for use on the Seattle & Tacoma Interurban Railway, and are to be used for regulating the great variations in load on this system.

BALL ENGINE ORDERS.—The Tennessee Copper Company has recently installed a tandem compound engine, direct-connected to a generator, in its plant at Isabella, Tenn. The Ball Engine Company, Erie, Pa., furnished the engine. The School for Deaf at Devil's Lake, N. D., is about to install an electric plant, consisting of a Northern Electric generator direct-connected to an engine built by the Ball Engine Company.

General News.

THE TELEPHONE.

distance lines into thickly populated points in Carroll, Haralson and Paulding counties, Ga., which are under control of the home office at Carrollton, Ga. It has begun a line to Roopville, and arrangements have been completed for an exchange in connection with the long-distance service at Dallas, Ga.

OSMAN, ILL.—The Rantoul telephone line is to be extended to this place.

CHAMPAIGN, ILL.—The Home Telephone Company, in Champaign, will improve its plant.

OQUAWKA, ILL.—At a meeting of the County Board of Commissioners three telephone franchises were asked for and granted: The American Telephone & Telegraph Company; The Carman Farmers' Telephone Company, and another company, of which George Chandler is president.

INDIANAPOLIS, IND.—R. J. Williamson, Ed. Taylor and D. N. Reed are the directors of the Montmorenci Telephone Company, incorporated with $3,000 capital, to operate in Tippecanoe and White counties.

INDIANAPOLIS, IND.—The Dolan Telephone Company, with headquarters at Bloomington, which will operate in Monroe, Morgan, Brown, Owen and Greene counties, has been incorporated with $5,000 capital stock.

INDIANAPOLIS, IND.—The Ohio River Telephone Company, of Rising Sun, has been incorporated, capital stock, $45,000; directors, William M. Calvin, R. and W. M. Green, Jr. The company will operate in Dearborn, Ohio, Switzerland, Jefferson and Ripley counties.

MARION, IND.—The Merchants' Association, at a recent meeting, appointed a committee to see that every member of the association takes out the Bell telephone and use only that of the United Telephone Company. The merchants have come to the conclusion that one telephone is enough, and as the franchise of the United Telephone prevents an increase in rates the merchants have decided to use this system exclusively.

ELWOOD, IND. Work has begun on the plant for the new telephone company in this city, which is to form a part of the independent combination which was recently granted a franchise by the City Council. A large force of men is employed and the plant is expected to be in operation within six months. Simultaneously the construction of ten miles of telephone lines, to reach farmers north of town, was begun. The company includes some of the wealthiest farmers of that section, and one hundred rural telephones will be put in at once. This line will be connected with the Elwood exchange.

EVANSVILLE, IND.—The sentiment in favor of municipal ownership is sufficiently strong here to culminate in a scheme to install a municipal telephone plant to cost $250,000. The scheme originated with the Mayor, City Attorney and members of the Board of Works, who propose to organize a company to operate a new plant to be installed by issuing $200,000 of preferred stock to draw 3½ per cent payable semi-annually. The city is to receive $250,000 of common stock in consideration of a franchise, the interest on said stock and other profits to be used in retiring the preferred stock and thus in time the city will own the plant. Subscriptions are now being taken for the preferred stock and a wave of sentiment for municipal ownership is sweeping over the city. Evansville owns its water plant, from which it derives $50,000 profits each year and, it is claimed, that a telephone plant will do better.

NEVINVILLE, IA.—A telephone company has been formed at Nevinville.

OELWEIN, IA.—The Cedar Valley Telephone Company will rebuild the Oelwein system this year, at an expenditure of $5,000.

OTTOSEN, IA.—The Farmers' & Merchants' Mutual Telephone Company, capital, $10,000, has been incorporated by L. J. Clave and others.

CENTER JUNCTION, IA.—The farmers residing between Center Junction and Onslow have organized a telephone company and will build a line between both towns.

FORT MADISON, IA.—The Lee County Telephone Company has been incorporated here, with a capital of $1,200. The incorporators are H. D. Everingham, H. F. Benbow and Albert Benbow.

TURKEY VALLEY, IA.—The Turkey Valley Telephone Company, of Wiota, has been incorporated with a capital stock of $10,000. The incorporators are O. Coomes, R. E. Daughenbaugh, L. A. Engle and C. V. Beaver.

ELTZEN, IA.—The farmers southwest of Eltzen have organized a mutual telephone company. They will run a line between Dorchester and Eltzen.

MONROE, IA.—The Monroe Telephone Company held a meeting to consider an offer to sell out to the Cumberland Company. A board of liquidation was appointed. Mayor A. A. Forsythe also undertook to organize a company to purchase the plant of the home company.

PORT HURON, MICH.—Articles of association of the Capac Telephone Company have been filed; capital stock, $3,000. Incorporators, Robert Morrison, John P. Willoughby, W. H. Sturgis and E. J. Buck.

MINNEAPOLIS, MINN.—Mr. D. N. Tallman, of Willmar, Minn., president of the Minnesota Central Telephone Company, has completed arrangements for the expenditure of $250,000 in betterments for his company. The Minnesota Central Company is a consolidation of the Southern Electric Telephone Company, the Northern Electric Telephone Company, the Western Minnesota Telephone Company and the Minnesota Electric Telephone Company, and its lines cover an extensive territory in Minnesota, from Bemidji on the North to New Ulm and Sleepy Eye on the South, and from Minneapolis to the Dakotas. During the past few months, Mr. Tallman says, the company has experienced a very satisfactory growth, and there is a constantly increasing will be spent this year. It is the intention of the company to install copper metallic circuits throughout the various lines and to make many improvements in its local exchanges, of which there are about thirty in various parts of the State. The company is now operating about 2000 miles of toll lines in Minnesota.

MADISON, MO.—Emmet Weston has bought the Lasbury telephone line and will soon make some improvements on it.

DAVENPORT, MONT.—John Hausen has obtained a telephone franchise for Davenport, and is putting in an exchange. Lines will be run to Mosow, Mondovi and Reardon, where exchanges will be installed.

BOULDER, MONT.—The Rocky Mountain Bell Telephone Company has contracts for 35 telephones to be connected with the long-distance system at Boulder. The line will be greatly extended in the spring.

BOZEMAN, MONT.—The West Gallatin Telephone Company, with headquarters at Bozeman, has been incorporated with a capital of $10,000. Directors, E. B. Martin, E. C. Kennedy and W. L. McDonnell, all of Bozeman.

OMAHA, NEB.—The Iowa & Hilton Township Telephone Company, of Conroy, Ia., has been incorporated, with a capital of $10,000, by John Ahrens and others.

NORWOOD, N. Y.—A franchise has been granted by the village to a local company to put in and operate a telephone system during the coming summer.

ALBANY, N. Y.—The Frontier Telephone Company, of Buffalo, has filed with the Secretary of State a certificate of increase of capital stock from $500,000 to $3,000,000. The certificate is signed by Elgood C. Lufkin, John B. Weber, F. R. Green, C. B. Hill and W. P. Cooke.

PLAINDEALER, N. D.—The Allen-Tompkins Telephone Company, of Devil's Lake, has been granted the privilege to construct and maintain a local telephone system here.

MADISON, OHIO.—The Madison Telephone Company has commenced extensive improvements to its exchange at Geneva.

TOLEDO, OHIO.—Marshall & Fraser, of this city, have incorporated the Local Telephone Company at Norwalk, Ohio; capital, $250,000.

WARREN, OHIO.—The Warren & Niles Telephone Company is erecting a line to Champion from this city. Other extensions are also planned for this year.

BELLAIRE, OHIO.—The Enterprise Telephone Company, capital stock $25,000, has been incorporated by Robert McKelvey, Theo Neff, J. D. McKelvey, Frank Neff, Alex Neff, John W. Neff and W. T. Unterzuter.

TOLEDO, OHIO.—Sections of the switchboards of the Toledo Home Telephone Company's exchange have arrived and are being installed. Cables are being put up to afford long-distance service over the lines of the United States Telephone Company.

BATAVIA, OHIO.—The Bell Telephone Company is extending its lines throughout Clermont County and is establishing exchanges in Williamsburg, Bethel and Batavia. All the towns in the county are to be connected and free service is to be given throughout the county.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has filed an answer to the injunction suit brought by the Bell Company. It denies that it intends to interfere with the operation of the Bell lines and claims that the Bell Company is stringing wires so as to interfere with the lines of the new company.

COOLVILLE, OHIO.—The Coolville Home Telephone Company has organized as follows: F. P. Ames, president; H. A. Cook and J. P. Parris, vice-presidents; Otto Barth, secretary; C. E. White, treasurer; W. E. Matlack, C. E. Burrows and James Drain, directors. The company is building lines in Belpre, Pomeroy and Olive townships. Connection will be made with West Virginia systems at Parkersburg.

CLEVELAND, OHIO.—Despite rumors to the contrary, the bankers' committee in charge of the affairs of the Everett-Moore Syndicate have not decided definitely to sell the assets of the Federal Telephone Company, nor is it believed that there is much likelihood of the assets being sold as an entirety. As the investigations into the affairs of this company become more thorough there is a growing desire that the property shall be maintained practically intact, since ɹǝʇɐɹodoɔ ɥʇuoɯ ʇsɐ ɥʇ ɟo ʇsɐd ɥʇuoɯ ɥʇ puɐ sʇuǝɯdɐʎ ɹnoʎ ɟo ʇsɐd ɥʇuoɯ ɥʇ ǝɥʇ ɟo ɹnoʎ

OTTAWA, ONT.—[illegible] Ontario municipalities to Ottawa, recently, resulted in a notable victory for the municipalities in regard to the proposed telephone legislation of the Dominion Government. The Minister of Justice withdrew the bills that were before the Canadian Parliament, and announced that another bill, in which the interests of municipalities as well as vested interests would be carefully guarded, will be introduced at the next session of Parliament. Beyond desiring to assume control of telegraph and telephone development, the Government is willing to let municipalities have a large say in the drafting of whatever legislation may come before Parliament on the subject.

OTTAWA, ONT.—An initial move has been made towards securing for the people of Ottawa relief from the present system of telephone monopoly, whereby the Bell Telephone Company is enabled to charge what are regarded as exorbitant figures for telephone service. Recently the company advanced its rates, and now the citizens are paying $45 for office and $30 for residence service. One year hence the agreement between the city and the company expires, and the corporation will then be at liberty either to establish a system of its own, or enter into a more advantageous agreement with some other concern. At the civic elections, last January, the ratepayers of Ottawa voted in an overwhelming majority in favor of municipal ownership and operation of the telephone system of the city. A resolution is now before the City Council for the purpose of inviting proposals from individuals or companies: First, for installing a telephone system equal at least to that of the Bell Telephone Company, ready for operation April, 1903, and capable of serving 4000 subscribers; the proposals to state whether the system will be overhead or underground wires; and, second, what amount of money an individual or company will pay the city of Ottawa annually for the privilege of operating a telephone system for a period of ten years, equal to the Bell Telephone Company, the rate to subscribers not to exceed $20 per annum.

OTTAWA, ONT.—Mr. Oscar W. Rogers, of New York, recently addressed the City Council of the city of Hamilton, Ont., and afforded such an insight into the prospects of telephone competition, that the Council, which was about to close a five-year contract granting the Bell Telephone Company an extension of its exclusive franchise, decided to postpone action. Mr. Rogers submitted a scheme for installing 3,000 telephones in Hamilton, the rates to be $15 for business and $10 for house telephones. The installation is to be on the automatic principle, and will involve working expenses to the amount of only $12,000 a year, and depreciation of plant, $8,400. He also stated that he was negotiating with the city of Toronto for the installation of a similar, but very much larger plant. In the itemized statement as to the cost of an automatic exchange for the leading cities of Canada, the capital of the Dominion is included, on the following scale: Population, 60,000; business telephones, 1500; residence telephones, 1500; business rates, $15; residence rates, $10; average length of lines, ¼ mile; percentage in conduits, 50; cost of central equipment, $15,000; subscribers' equipment, $30,000; lines in conduits, $90,000; lines on poles, $45,000; buildings, $5,000; total cost, $185,000. Depreciation—conduits, 3 per cent; others, 6 per cent; working expenses, $12,000. This would afford a revenue of $37,000 with working expenses of $12,000, leaving over $25,000 annually for depreciation, sinking fund on capital investment and profit.

PITTSBURG, PA.—About 500 linemen, employed by the local telephone and electric lighting companies, have gone on a strike for an advance in their wages. This was decided upon by a meeting of Local Union No. 14, of the International Brotherhood of Electrical Workers. The men are now getting $2.50 per day, but they want $3.00. All the companies to whom the scale has been presented have refused to accede to the new demands.

SHERBROOKE, QUE.—The shareholders of the People's Telephone Company, of Sherbrooke, have approved of an issue of $25,000 preference stock.

NASHVILLE, TENN.—The Tennessee Telephone & Telegraph Company and the Memphis Company have been seeking franchises in Nashville.

UVALDE, TEX.—This place is to have two new long-distance telephone lines, one of which will go to San Antonio and the other to Carrizo Springs and intermediate points.

COLUMBIA, VA.—The James River Valley & Fluvanna Telephone Company has recently declared a dividend of 6 per cent and has a good reserve fund. This company is in excellent condition and hopes soon to extend its line to Richmond.

SPOKANE, WASH.—Doerr, Mitchell & Company, of Spokane, have just closed a contract with the United States Selector Telephone Company for the sole agency of this company for Washington and Northern Idaho. Mr. Mitchell has secured a franchise, and will install a telephone system taking in the farming district around Spokane.

CLARKSBURG, W. VA.—The Sardis Telephone Company has been granted franchise to install a system along the county roads.

MADISON, WIS.—The Farmers' Union Telephone Company, of Dane County, has increased its capital stock from $1,000 to $4,000.

DELAVAN, WIS.—The Badger State Telephone Company is planning to extend its line from Delavan to Racine by way of Rochester.

FOND DU LAC, WIS.—The Theresa Union Telephone Company has secured a franchise from the town of Fond du Lac to erect lines in town.

CHIPPEWA FALLS, WIS.—During the coming summer the Wisconsin Telephone Company will rebuild its exchange in this city at a cost of $20,000.

MADISON, WIS.—The Wind Lake Farmers' Telephone Company has been incorporated and will build a line from Watertown to Wind Lake and North Cape.

MARINETTE, WIS.—A new [illegible] county from this city to Crivitz and Wausaukee, 30 miles. It is designed to be a farmer telephone line. The estimated cost is $8,000.

BARABOO, WIS.—The Baraboo Telephone Company has made arrangements for the construction of a telephone line connecting Madison and La Crosse and all intermediate points, with headquarters at Baraboo.

MADISON, WIS.—The Althens Telephone Company, of Althens, has been incorporated with a capital stock of $750. The incorporators are J. Brann, G. A. Kreutzer, W. G. Cotanche, F. Reitbrock and W. C. Klamm.

KENOSHA, WIS.—The Kenosha County Farmers' Telephone Company, recently orgnized, is making another effort to get into the city. The Wisconsin Telephone Company is trying to arrange with the company to use its long distance lines.

MILWAUKEE, WIS.—The annual meeting of the Wisconsin Telephone Company just held resulted in the election of the following directors: F. G. Bigelow, Charles Ray, H. F. Whitcomb, Jesse Stone, F. P. Fish, Alonzo Burt, John Balch, Thomas Sherry, P. Dexter, W. S. Hutchinson and H. J. Pettingill. The engineering department is now engaged in making estimates on the cost of proposed improvements.

ELECTRIC LIGHT AND POWER.

EUFAULA, ALA.—At a special meeting of the City Council recently the matter of lighting the city, which has been quite a perplexing one, was definitely settled. A contract was made with the present electric company for a period of ten years. The conditions are that the company is to build a new and modern plant and also install an incandescent system.

SAN FRANCISCO, CALIF.—The Walker Electric Power & Irrigation Company has been incorporated in Los Angeles, Calif., by J. A. Walker, J. P. Reed, B. Darlington. The capital stock is $100,000.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company recently consummated the purchase of a large additional supply of power water in Butte County, Calif. It will be possible to erect an electric power plant, on Butte Creek above the Butte Creek Power Company's dam, that will give a combined capacity of 20,000 hp. The water can be used twice, on account of the high head available. An additional pipe line and water wheel will be installed at the Centerville power station, whence current is now being transmitted to the main electric power lines of the Bay Counties system. A special high tension line will be constructed to connect with the gold dredging plants near Oroville.

COLORADO SPRINGS, COL.—The Guanajuato Power & Electric Company has been incorporated at Colorado Springs, with a capital of $3,000,000. Incorporators, L. E. Curtis, Henry Hine and I. W. Bondbright. The company will have headquarters at Colorado Springs, and will operate in the Republic of Mexico.

SALIDA, COL.—A franchise has been granted J. C. Vanriper and W. M. Mathews, of St. Louis, by the City Council of Salida, Colo., for the operation of a large electric power plant. Power and light will be furnished Salida, Monarch, Garfield, Turrett and Whitehorn districts. A car system will also be operated connecting Salida with Poncha Springs and the new smelters.

MOORE'S HILL, IND.—The Town Council has made provision for an electric light plant. A company will be organized at once and the plant installed this summer.

PETERSBURG, IND.—An electric light plant will probably be established in this town during the summer. Further particulars may be obtained by addressing Mr. Frank C. Thomas, the town clerk.

NEW CASTLE, IND.—The annual report of the local municipal electric light plant shows that each arc light cost $20.70. Other cities, the report says, are paying from $55 to $85. This city has also a natural gas plant and derives a good revenue from both the electric light and the gas plants.

LOUISVILLE, KY.—The Peerless Manufacturing Company has taken possession of its new plant, which is said to be the largest and best equipped in the country devoted exclusively to the manufacture of iron and brass fireplace goods. Electric power is used in this plant, each department being operated independently.

HILLSDALE, MICH.—At the next election the voters will decide on the proposition of enlarging the municipal lighting plant. The measure will probably pass.

ALBANY, N. Y.—The Addison Electric Light & Power Company, Addison, Steuben County, has been incorporated; capital, $40,000. Directors: F. H. Wheaton, Fannie A. Wheaton, Addison; G. M. Kellogg, Hornellsville.

WARREN, OHIO.—A special election will be held soon to decide on the proposition of a municipal lighting plant. The lighting service is now furnished by a New York corporation.

OTTAWA, ONT.—The Montreal Heat, Light & Power Company proposes to double the capacity of the Chambly power house by the addition of four more generators. The street lamps of Montreal will be changed over to the alternating current type. The company now has four power houses, three in the city operated by steam, and the Chambly plant run by water power, which when completed will alone give the company 20,000 horse-power. This will enable the company to dispense almost entirely with the steam power plants.

OTTAWA, ONT.—An agreement has been reached whereby leading capitalists of Toronto, who are connected with the street railway, the electric light and the General Electric companies, will build a pole line for the transmission of electric energy from Niagara Falls to Toronto, as soon as such energy is available. Mr. William Mackenzie, of the Toronto Electric Railway, and President Pellatt, of the General Electric Company, are the chief promoters. These companies consume over 12,000 horse-power daily. It is probable that the extension of the electric railway from Mimico along the lake shore will be the first result of the new agreement.

ATHENA, ORE.—A. M. Gillis, of this place, has obtained an electric light franchise.

PHILADELPHIA, PA.—Plans for a new power house in this city, to cost $300,000, have been filed by the Southern Electric Light & Power Company. The building, which will be erected at Twenty-sixth and Christian streets, will be five stories high and 163 by 166 feet in area.

SALT LAKE CITY, UTAH.—The Seaton Electric Company has completed the installation of its auxiliary plant, two miles below Idaho Springs, Colo., and started the plant. It will be used for supplying the mines and mills that are now taking power from the main plant.

THE ELECTRIC RAILWAY.

[illegible] the Tampa Municipal West Coast Development Company, with a capital of $1,000,000. The company will build a street and electric light plant in Tampa and construct 200 miles of trolley lines over South Florida with Tampa as the center.

MACKAY, IDAHO.—The owners of the electric railway which is building from Mackay to the mines in Thunder Mountain, a distance of 10 miles, have decided to enlarge the power plant from the first plans and will light their smelter and mines, as well as others in the district, using about 2000 lights in all.

GALESBURG, ILL.—The People's Traction Company is building a power plant and constructing 12 miles of road. The electrical equipment is being supplied by the General Electric Company.

DES MOINES, IA.—The Iowa Construction Company, of Creston, has been incorporated with $10,000 capital, with Lyman Waterman, of Omaha, at the head, to build the proposed electric line from Creston to Winterset, and probably on to Des Moines.

OSKALOOSA, IA.—By an overwhelming majority the voters of this city decided to give the Interurban Construction Company a franchise for twenty-five years to construct and operate a street railway system in this city and to light the city streets for the same period.

FT. WAYNE, IND.—The contract for constructing an electric road between Angola and Goshen has been let to Flint, Jones & Co., of New York City, and the firm is advertising for a large force of men. The townships have voted $80,000 in subsidies for this road.

MUNCIE, IND.—C. L. Briggs, of Cleveland, O., has been awarded the contract to construct the power house at Eaton, and sub-stations in Muncie, Hartford City, Bluffton and Ft. Wayne, for the Muncie-Hartford City Electric Railway. Work is to begin at once. The estimated cost of the road is $1,000,000.

NOBLESVILLE, IND.—The Central Traction Company of Indiana has sold out to the Union Traction Company, and its franchises in this and other towns have been surrendered and similar grants given to the Union Traction Company. This sale ends the long fight between these two companies and settles the fact that there will be but one line between Kokomo and Indianapolis.

MINNEAPOLIS, MINN.—The new storage battery plant of the Twin City Rapid Transit Company is now in service. It is utilized during the rush hours from 6 to 8 p. m., and will be drawn on in case of emergencies. It is charged from the water power plant, utilizing the water which has hitherto run to waste during the night. The plant has storage capacity sufficient to operate the St. Paul and Minneapolis systems for one hour. There is a similar battery plant at St. Paul. The Minneapolis plant consists of 315 cells of battery, each cell containing 43 plates.

MANKATO, MINN.—The Mankato & St. Peter Railway & Lighting Company has been organized to build an electric street railway in this city, with a suburban line to St. Peter by the way of Kasota, and also to construct an electric lighting and gas plant. The capital stock was placed at $300,000. The incorporators are: Mayor Nic Peterson, W. D. Willard, George M. Palmer, Col. Gus Widell, W. L. Nixon, A. E. Clark, A. G. Meyer, Leo S. Lamm, S. Willharts and W. G. Moerr, of Mankato; Mayor W. H. Mueller and C. D. Davis, of St. Peter, and C. W. Babcock, of Kasota. The directors elected W. L. Nixon, president; W. D. Willard, vice-president; A. E. Clark, secretary, and W. G. Moerr, treasurer.

BUFFALO, N. Y.—The Buffalo, Springfield & Cattaraugus Railway Company will build a power house of 2000-hp capacity for the operation of its road, which is now being constructed.

NEW YORK, N. Y.—The Health Board has ordered the Metropolitan Street Railway Company to remove "flat" wheels from its cars or take the cars off the streets. It is claimed that the noise of the "flat" wheels on the West Thirty-fourth street line keeps the residents along that thoroughfare awake at night, hence the complaint to the Board of Health.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company has increased its capital stock from $1,000 to $2,500,000.

ALLIANCE, OHIO.—The Stark Electric Railway Company has been granted a franchise for its line through Alliance; also a franchise for a lighting and power system. The latter may be revoked if the city decides to build its own lighting plant.

CLEVELAND, OHIO.—Stockholders of the Cleveland, Painesville & Eastern Railway will meet April 10 to pass on a proposition of increasing the capital stock from $1,500,000 to $2,000,000. The object is to provide funds for the Ashtabula extension and to liquidate unfunded and floating debt and other liabilities.

ELYRIA, OHIO.—The Cleveland, Elyria & Western Railway Company is preparing to increase the capacity of its Elyria power house and has given a contract to the Westinghouse Machine Company for two Parsons turbines to be direct-connected to generators. The contract will soon be awarded for the boilers, mechanical stokers, economizers, etc. This, it is said, will be the first electric railway plant in the country to use steam turbines.

PROVIDENCE, R. I.—The Senate has passed the so-called Merger Act, which incorporates under the title of the Rhode Island Company, the United Traction, the Narragansett Electric Lighting and the Providence Gas companies, with a combined capital of $16,000,000. The amount of capital stock mentioned in the act is $2,000,000, and power is given to increase this at any time it becomes desirable.

NEW INDUSTRIAL COMPANIES.

[illegible] COMPANY has been incorporated at [illegible] with $[illegible] capital, by [illegible] Incorporators, [illegible] N. E. [illegible] Incorporators, [illegible]

THE HERZOG SYSTEMS COMPANY has been incorporated at Trenton, N. J., to manufacture and deal in telephones, etc.; capital, $1,500,000. Incorporators, Theodore F. Hicks and Norton F. Paton, of Jersey City.

THE McKIBBEN GAS ENGINE & ELECTRIC MANUFACTURING COMPANY, of Lima, Ohio, has been incorporated, with $10,000 capital, by C. W. McKibben, L. L. Thomas, John Carnes, Irvin Munch and W. S. Walter.

THE NATIONAL TELEGRAPHONE COMPANY, capital, $2,000,000, has been incorporated in New York to manufacture telegraph and telephone instruments. Incorporators, Edmund L. Grannel, George E. Milligan and Allen E. Kirby.

THE NORTHERN ELECTRICAL CONSTRUCTION COMPANY, capital, $100,000, was organized at La Crosse, Wis., to build telephone and light plants and city and interurban electric lines in Wisconsin, Minnesota, Iowa and the Dakotas. Several large contracts have already been secured in the northern part of Wisconsin.

THE BUFFALO AUTOMOBILE STATION COMPANY has been organized at Buffalo, N. Y., with a capital of $10,000. The directors are Wm. Hamlin, Frank A. Babcock, Charles Wesley, Jacob Amos and F. A. Baldwin, jr. The company will build automobiles and automobile parts and operate charging stations for electric automobiles.

LEGAL.

METROPOLITAN LEASE VALID.—Justice Gildersleeve, in the New York Supreme Court, Special Term, has denied the application of Messrs. Content and Wormser to continue the temporary injunction restraining the Metropolitan Street Railway from leasing its properties to the Interurban Company. This is a great victory for Metropolitan. The suit, however, still remains on the calendar awaiting trial on the original complaint. In his decision Justice Gildersleeve said there was not the slightest indication of fraud or anything improper. The lease was a fair one and well within the power of the Metropolitan Company to make. He said that it had been ratified by its stockholders and board of directors and that the charges made by the plaintiffs had not been established.

OBITUARY.

MR. J. LAMBERT.—Many of our readers will regret to learn of the death of Joshua Lambert, vice-president of the Clayton & Lambert Manufacturing Company, Detroit, Mich., which occurred March 1, 1902. He had been ill for over a year, steadily failing, still his interest in the company's business, which he had helped to build up from a small beginning to the largest in its line in the world, daily brought him to the factory, and, though unable to perform his customary duties, up to the last day of his life he gave the company the benefit of his counsel and was deeply interested in all that would advance its interests. "Uncle Jay," as he was familiarly called by his many friends and the company's employes, was born in Livonia, Mich., Feb. 14, 1834. He was a kind and loving father and a sympathetic friend whose heart was large enough for all his wide circle of friends, all of whom will mourn his loss. His sunshiny disposition and his anxiety to make life pleasant for others made friends and confidants of all who knew him, particularly the employes of the Clayton & Lambert Manufacturing Company, and it was touching to see the sympathetic glances which followed him during the last year as, according to his usual custom, he visited the various departments. It will therefore be readily understood that his sudden death was a sad blow to his family and to his many friends. He leaves a widow and four children, three sons and one daughter, all of whom reside in Detroit. The three sons are part owners of the company, which was organized in 1889 with the following officers: Nelson J. Clayton, president; Joshua Lambert, vice-president; J. E. Lambert, secretary and treasurer, who together with Charles R. Lambert and Bert Lambert were directors, all having served the company continuously since it was organized.

PERSONAL.



BARCLAY.

MR. JOHN C. BARCLAY, who has just been appointed to the position of electrical engineer of the Western Union Telegraph Company, was born [illegible], April [illegible], 1856, and, like many others who have attained prominence in the electrical profession, began his career as a telegraph messenger. As a carrier of [illegible] he was in the employ of the Pennsylvania Railroad, and in 1870 he obtained his first position as [illegible] at Connellsville, Pa. He afterwards held positions in various [illegible] was at one time an inspector for the Automatic Fire Alarm System in New York. Since [illegible] has been connected with the Western Union Telegraph Company, first in Chicago, rising from the rank [illegible] electrician, which latter [illegible] he held at the time he received the appointment as electrical engineer, with headquarters in New York. Personally, Mr. Barclay is highly esteemed by all who know him, and professionally he is, by long experience, eminently qualified to fill the im[illegible] which he has been called. He is progressive and energetic,

and no doubt, under his management, the electrical interests of the great corporation he represents will be lifted to the highest plane attainable. Mr. Barclay assumed his new duties on April 1.

MR. LUTHER STIERINGER has returned to New York City from a long vacation down South.

MR. THOS. A. EDISON came home last week from his plantation in Florida, much the better for the change.

MR. WILLIAM BOEHM, chemist, of Berlin, Germany, is now visiting this country and inspecting electrical installations, etc.

MR. A. S. BROWN, for many years electrical engineer of the Western Union Telegraph Company at New York, has resigned owing to ill-health.

MR. JOHN A. MATHEWS will read a paper on April 11 before the American Chemical Society on the electrical conductivity of alloys. He is the secretary of the society.

MR. CHARLES S. COLTON, assistant manager of the Westinghouse Electric & Manufacturing Company's plant at Cleveland, has resigned to become works-director of the Ludwig-Loewe Company, Berlin, Germany.

MR. WM. MARCONI was a guest at the "Irish dinner," given last Saturday night by the members of the British Schools and Universities Club, at the New York Athletic Club. He spoke on the topic, "The Irish and Electricity." The dinner was private. He sailed on Wednesday for England.

MR. ARTHUR J. WOOD, who has been engaged for some time past in technical journalism and was associated with the *Railroad Gazette*, has been appointed professor of mechanical and electrical engineering at Delaware College, Newark, Del., and has taken up his duties there.

SWAN-CLARK.—Mr. J. J. Swan, at one time on the editorial staff of *Engineering News* and now with the engineering department of the Ingersoll-Sergeant Drill Company, was married on April 2 at Plainfield, N. J., to Miss Helen R. Clark, daughter of Mr. and Mrs. Edward B. Clark, of that place.

MR. ARTHUR BERGTHEIL, of the British electrical engineering and contracting firm of Bergtheil & Young, Camomile Street, London, E. C., England, which concern represents the interests of the Bullock Electric Manufacturing Company, of Cincinnati, in the United Kingdom, is now on a visit to America. He is at present at the Waldorf-Astoria.

MR. R. FRANK HARTFORD, consulting engineer, has moved his office from Atlanta, Ga., to Memphis, Tenn., in the Randolph Building. He has recently designed and installed several isolated lighting and power plants in Arkansas and Louisiana, and is now at work on a long-distance power transmission project in Northern Alabama.

MR. O. A. STRANNAHAN, formerly of the Chicago office of Westinghouse, Church, Kerr & Company, now head of one of the departments at the new Trafford Park, Manchester, works of the British Westinghouse Electric & Manufacturing Company, Limited, has arrived from Europe on a three weeks' visit. He is at present in Pittsburg.

PROF. LOUIS A. HERDT, who is associated with Prof. R. B. Owens in the electrical engineering department of McGill University, has been taking a vacation in the United States for some weeks, seeking restoration from ill-health. He was in New York this week, greatly improved by the change, and has returned to McGill to resume his work.

MR. F. A. PICKERNELL, in charge of the engineering department of the long-distance branch in New York City of the American Telephone & Telegraph Company, has been transferred to Boston, owing to the consolidation of the company's engineering work there. Mr. Pickernell is greatly missed in many circles in New York and his early return is hoped for.

MR. T. S. McLOUGHLIN, well known throughout the South in the electric construction business, with an office at 824 Union Street, New Orleans, is now also vice-president and general manager of the Hartwell Electric Company, Perdido and Carondelet Streets, New Orleans, in which capacity his experience will undoubtedly prove invaluable to the new concern.

MR CHAS. F. SCOTT, president of the Engineers' Society of Western Pennsylvania, delivered a very interesting address at the annual banquet last February, and this has now been issued in pamphlet form. Mr. Scott notes incidentally in his speech that within five years the Society has elected two secretaries and two presidents from electrical engineering ranks.

COL. JOHN T. DICKINSON, who has heretofore represented the Consolidated Railway Electric Lighting & Equipment Company in Chicago, has been transferred to New York as general agent, with headquarters at the general offices of the company, 100 Broadway; and Mr. Geo. W. Carhart has succeeded Col. Dickinson as general agent of the company in Chicago and the West.

MR. OSCAR T. CROSBY, the well known electrical engineer and manager of traction and power properties at Washington, D. C., writes for the *Century*, for April, a very interesting article embodying his reminiscences of King Menelik, of Abyssinia. Mr. Crosby went through the country in 1900 and explored the Blue Nile regions that had not been previously visited, but since investigated also by Mr. Hugue Le Roux.

MR. HENRY A. REED, the veteran manager of the Bishop Gutta Percha Company, in the course of an interview in the *New York Times*, on an alleged increase in the supply of gutta percha, expressed the hope that it might be true, and said as to its present uses: "Gutta percha furnishes material for vessels, bottles, pitchers, and panels for acids and alkalies. Also for machinery belting in places where there are acid or chemical fumes. Again in electrotyping to get impressions from steel plates for duplicating, and by the United States Government for gun impressions in gun testing. And just now it is in great demand for golf balls. We are not yet making ping-pong balls of it."

NEW YORK ELECTRICAL SOCIETY.—At the last meeting of the society the following members were elected: C. J. Sweek, 507 East Fifty-fifth Street, New York; Albert Granish, 54 East Seventh Street, New York; F. B. Sage, 123 Liberty Street, New York; Edward Cromwell Cockey, Room 141, 195 Broadway, New York; Walter D. Francis, 253 Broadway, New York; Frederick Pearce, 18 and 20 Rose Street, New York; C. August Harsch, 916 Forest Avenue, New York; W. H. McCormick, 575 East 153d Street, New York; Byron W. Smith, care of Western Electric Company, 57 Bethune Street, New York; Alfonse Kaufman, 256 West 129th Street, New York; W. D. Sargent, 81 Willoughby Street, Brooklyn, N. Y.; Frank C. Mason, 16 Smith Street, Brooklyn, N. Y.; Walter E. Brown, 763 Nostrand Avenue, Brooklyn, N. Y.; Edwin W. Babcock, Edison Building, Brooklyn, N. Y.; Richard E. R. Lubben, 77 Murray Street, Elizabeth, N. J.; Chas. S. Dunn, 315 Market Street, Newark, N. J.; Edward Kassel, 142 Smith Street, Evergreen, L. I.; Fred W. Lawson Fullerton, 46 North Twenty-second Street, East Orange, N. J.; Geo. W. Williams, 56 Montgomery Street, Jersey City, N. J.; S. Marshall Williams, 56 Montgomery Street, Jersey City, N. J.; Wm. G. Chamberlain, 215 North Avenue, Cranford, N. J.

Trade Notes.

MESSRS. BLOOD & HALE, Boston, Mass., have removed their offices from the Equitable Building to the Delta Building, 10 Postoffice Square.

TO MANUFACTURE ELECTRICAL NOVELTIES.—Mr. W. P. Freeman will open a factory in Cridersville, Ohio, for the manufacture of electrical novelties.

SOCKETS AND RECEPTACLES.—Pass & Seymour, Inc., Solvay, N. Y., have issued a neat little pamphlet giving illustrations of their weatherproof sockets and receptacles.

THE MASURITE EXPLOSIVE COMPANY announces that on April 10 it will succeed to the business of the Safety Explosive Company, of New York. Its office is at 43 West Eighty-seventh Street, New York. Mr. Fred. L. M. Masury is president.

EYANSON & ARMPRIESTER.—Notice appears under date of April 4 that the partnership existing under the firm name of Eyanson & Armpriester has been dissolved by mutual consent and that the business will be continued by George T. Eyanson at the same address, Seventh and Commerce streets, Philadelphia. Mr. Eyanson assumes all liabilities and collects all accounts.

THE STANDARD POLE & TIE COMPANY, of 44 Broad Street, New York, has been awarded the contract for the poles to be used on the line of the Columbus, Delaware & Marion Electric Railway, running from Columbus to Marion, Ohio. The pole which it will supply is the Southern white cedar or Juniper, which has of late become so popular for interurban lines owing to its symmetry and freedom from sap and butt rot.

LIGHTNING ARRESTERS.—Catalogue No. 35, dated March 15, 1902, issued by Garton-Daniels Company, Keokuk, Iowa, describes the latest models of its well known lightning arresters. It contains also a practical statement of the methods in use to-day for the protection from lightning, of electric railway, light and power circuits. It is the most complete publication of this character that has been issued in the history of the electrical business, and should be in the hands of every one interested in the subject. It will be mailed without charge on request to the Garton-Daniels Company, Keokuk, Ia.

S. K. C. BULLETINS.—Circulars No. 125 and 126 of the Stanley Electric Manufacturing Company are devoted to the subjects of condensers, and to a voltmeter compensator and voltaphone, respectively. The condenser circular describes and illustrates the S. K. C. condenser, and contains a diagram showing its method of connection to two-phase motors. The voltmeter compensator is designed for use in connection with a station voltmeter so that the latter will indicate the voltage at the center of distribution, instead of the voltage at the station, and is set to operate correctly at a given power factor. The voltaphone accomplishes practically the same result as the voltmeter compensator, but its function is to inform the power house through the medium of a telephone the exact voltage at the center of distribution or at any point on the line. An electrical impulse from the station releases a detent, and a spring sets the voltaphone mechanism in operation. There is a finger in contact with the pointer of a voltmeter and the arrangement is such that dot and dash signals are conveyed over the telephone line. By reference to a code the signal will indicate if the voltage is correct, or from 1, 2, 3 or 4 per cent above or below normal.

"THE LIGHT THAT NEVER FAILS."—There are a great many methods of lighting a church or other large auditorium now in vogue, some of them very good attempts at successful lighting, but the system that never seems to fail, and has scored over 20,000 successful installations in churches alone in all parts of the world, is that of the famous Frink reflector, familiarly known to thousands as "The Great Church Light," a title gained by nearly half a century of work in this line. Among more recent installations made by I. P. Frink might be mentioned Grace Evangelical Church, Scranton, Pa.; Zion Ev. Luth. and English Luth., Loudonville, Ohio; St. Luke's Luth., York, Pa.; Baptist, Picture Rocks, Pa.; Belmont Avenue Baptist, Springfield, Mass.; Bruns Avenue M. E., Detroit, Mich.; First Christian and German Presby., Shelbyville, Ind.; Dayspring Presby., Yonkers, N. Y.; Plymouth Congl., Des Moines, Ia.; Grove Avenue M. E., Johnstown, Pa. The lighting of a church auditorium successfully is not as simple a problem as it appears on the face of it, and mistakes occur where least expected. A consultation with this firm beforehand insures a successfully lighted church at a minimum expense, and it will be glad to forward literature, catalogues and all necessary information on receipt of required data as to size, etc.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 1, 1902.

695,913. INSTRUMENT FOR INDICATING THE PHASE AND FREQUENCY RELATIONS OF ALTERNATING CURRENTS; F. Conrad. [illegible] See Current News and Notes.

696,398. ARAMATURE COIL; A. F. Bachelder, Schenectady, N. Y. App. filed Nov. 3, 1900. In order to wind fine wires into rectangular coils and prevent them from slipping out of place, each turn is composed of a number of wires bound together side by side.

696,427. ELECTRIC INDICATING INSTRUMENT; R. Fleming, Lynn, Mass. App. filed Nov. 21, 1901. (See Current News and Notes.)

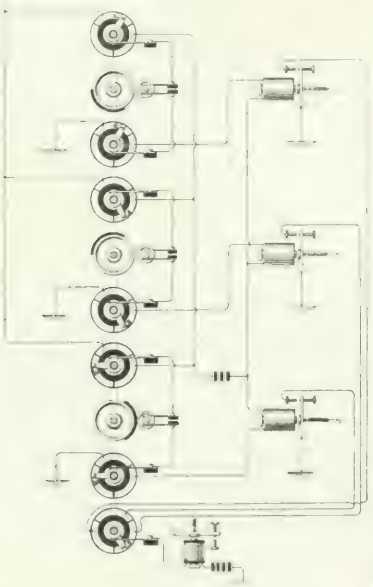
696,429. SOLDERING IRON; H. Geisenhoner and T. Van Aller, Schenectady, N. Y. App. filed Nov. 21, 1900. The resistance coil is wound on the shank of the iron and its layers are separated by a cord of heat-resisting insulating material.

696,447. ELECTRICAL SWITCH; E. G. Kastenhuber, Bloomfield, N. J. App. filed June 6, 1901. Details of a push-button switch.

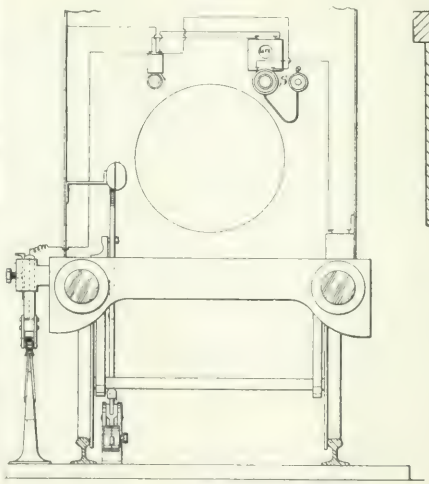
696,459. MEANS FOR PREVENTING CREEPING OF METERS; A. D. Lunt, Schenectady, N. Y. App. filed Oct. 23, 1901. (See Current News and Notes.)

696,473. ARMATURE REGULATOR FOR ELECTRIC CIRCUITS; F. C. Newell, Wilkinsburg, Pa. App. filed April 28, 1900. The invention consists in a shunt-circuit with its ends connected to opposite sides of the field of the generator and a solenoid in the generator-circuit adapted to open or close the shunt-circuit, according to the strength of the current in the generator-circuit.

696,488. COMMUTATOR; E. D. Priest and G. L. Schermerhorn, Schenectady, N. Y. App. filed Nov. 30, 1900. A commutator for dynamo-electric machines, consisting of conducting segments separated by soft insulating



696,715.—Wireless Telegraphy.



696,737.—Conduit for Underground Conductors.

[illegible] as fast as the segments

696,489. SEPARATOR FOR BATTERY PLATES; James K. Pumpelly, Chicago, Ill. App. filed April 8, 1901. A fibrous glass is applied to the active surface of the positive pole electrode and retained in place by sheets of insulating material, each sheet having a series of parallel slots, the slots in adjoining sheets being placed at right angles with reference to each other.

696,496. ACCUMULATOR; Georges de Roussy de Sales and Francois Gueugnon, Lyons, France. App. filed March 13, 1901. The cathode consists of a supporting frame of aluminum enveloped with a very thin sheet of lead, which forms both a covering for the frame and a plate surrounding the frame. The sheet is perforated and provided on its external faces with projecting wires. After coating the sheet with oxide of lead, the cathode is rolled, which bends over the free ends of the wires, thereby holding the layer of oxide to the plate. The anode is composed of an aluminum tank having a flange for its suspension in a battery receptacle. The tank is divided into compartments by means of partitions of the same metal, and the interior coated with a layer of porous or other lead in such manner that each trough or compartment forms an anode. The tanks are perforated and are separated from each other by an absorbent material.

696,497. FUSE BOX; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 29, [illegible]

[illegible]

Medford, Mass. App. filed Dec. 5, 1900. A wire running the length of the hose is so connected with the coupling as not to be strained when the coupling is rotated to disconnect the hose.

696,597. COMBINED SWITCH AND PLUG RECEPTACLE BOX; F. J. Russel, New York, N. Y. App. filed May 1, 1901. Details.

696,599. ELECTRIC WATER HEATER; M. H. Shoenberg and H. Levt, San Francisco, Calif. App. filed April 10, 1901. A U-shaped pipe through which the water circulates and around one leg of which an electrical resistance is wound.

696,619. WATCHMAN'S TIME RECORDER AND SIGNAL; J. B. Yeakle, Baltimore, Md. App. filed Dec. 10, 1900. Unknown to the watchman switches can be arranged at a central office to record at the office the fact that the watchman has or has not visited a certain station.

696,647. DEVICE FOR PURIFYING WATER; J. M. A. Lacomme, Brooklyn, N. Y. App. filed Oct. 24, 1901. A pair of electrodes are adjustably located in a pipe through which water flows. The passage of sparks between the electrodes is said to purify the water. The invention resides more particularly in the means for adjusting the electrodes.

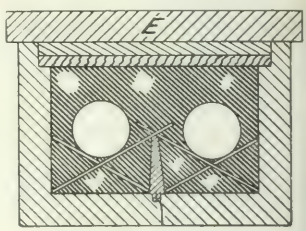
696,662. SYSTEM OF ELECTRIC LIGHTING AND APPARATUS THEREFOR; P. Lapertot, G. Villard and L. Pignaud, Lyons, France. App. filed Oct. 6, 1900. Means for supplying a current to several series of lamps successively during the half-period of the current and means for adding to the current thus supplied the self-inducted currents of the coils of the generator; whereby a momentary increase in the potential of the currents reaching the series of lamps in succession will be produced.

696,665. WIRE INSULATOR; W. C. Benbow, Columbus, Ohio. App. filed Jan. [illegible] Details.

696,702. ELECTRIC HOSE COUPLING; G. G. Weitz, Medford, Mass. App. filed Jan. 24, 1902. Details.

696,710. INTERIOR CONDUIT OUTLET BOX; W. F. Bossert, Utica, N. Y. App. filed Sept. 16, 1901. A sheet metal box whose bottom, sides and cover are formed with interlocking parts, the construction intended to cheapen the cost of manufacture.

696,715. WIRELESS TELEGRAPHY; J. Burry, Fort Lee, N. J. App. filed Dec. 6, 1899. In order that the receiver shall record dots and dashes distinctly, a number of coherers are employed. Means are provided for



696,811. Railway Signaling and Communicating Apparatus.

throwing each coherer first into a collector circuit; second, into the local circuit containing a battery and a relay, and third wholly out of circuit, and for repeating this cycle of operation indefinitely.

696,737. CONDUIT FOR UNDERGROUND CONDUCTORS; F. Jones, Liverpool, England. App. filed Sept. 4, 1901. Bare conductors are temporarily held in the conduit by non-conducting supports and plastic insulating material is then filled into the spaces around the conductor.

696,752. MEANS FOR AUTOMATICALLY CONTROLLING CAR MOTORS AND BRAKES; J. H. Robert[illegible], New York, N. Y. App. filed July 25, 1899. The motorman stands upon an auxiliary platform and when he leaves it, the current is automatically shut off and the brakes applied.

696,757. SHUNT FOR ELECTRICAL INSTRUMENTS; M. C. Rypinski, Schenectady, N. Y. App. filed Sept. 5, 1901. A shunt for an electrical measuring instrument containing a plurality of transverse corrugations to serve as retainers for a more readily fusible metal, such as solder.

696,775. ELECTRIC LIGHT SIGN; H. Tripp and G. E. Stephenson, Chicago, Ill. App. filed Dec. 17, 1901. Fastening clips are attached to the back of each letter and are adapted to be secured to two rods in the sign which carry the current as well as support the letters.

696,781. TROLLEY CATCHER AND RETRIEVER; C. F. Wilson, Brooklyn, N. Y. App. filed Aug. 12, 1901. Details.

696,807. ELECTRIC ARC LAMP; R. Froment, Paris. App. filed Sept. 7, [illegible] Details.

696,811. RAILWAY SIGNALING AND COMMUNICATING APPARATUS; H. Gulliver, South Yarra, Victoria, Australia. App. filed July 9, 1901. A telephone and signal bell are arranged in the cab of the locomotive and in circuit with a contact brush and rail whereby a signal operator in a tower can, when necessary, communicate with the engineer.

696,880. TRACTION SYSTEM; F. J. Sprague, New York, N. Y. App. filed

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NEW YORK, SATURDAY, APRIL 19, 1902.

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THE INTERSTATE TELEPHONE CONVENTION.

The convention of independent telephone men from the seven central states surrounding Chicago, held at that city last week, was an unusual success as to the number of interested exchange owners in attendance. The convention brought into existence a new organization, the Interstate Independent Telephone Association, composed of companies of the nine central states in which the independent telephone movement has been most active. This association is not intended to take the place of any present association, but to occupy a middle position between the state and national associations.

Earlier conventions have been largely devoted to the fight with the Bell companies, and in view of the bitterness of the struggle, participants in past conventions can be pardoned if it often happened that considerable time was devoted to relating the history of various encounters with the common enemy, and the application of choice epithets to Bell men and methods rather than to the more profitable questions of how to maintain a service and rates which would continue the popularity of the independent telephone exchanges. How to take care of the future development is the great question before the independent telephone companies to-day, and the discussions at Chicago show that this is being realized more than ever. Mr. L. A. Frazee expressed this well in his review of the telephone situation in Indiana, and what is true in Indiana is almost equally true in other states near-by. Mr. Frazee alleged in effect that the past problem was how to cope with Bell efforts to put the independent companies out of business, both by patent suits and by all conceivable business tactics. The present problem is how to conduct a largely increased business at a fair profit, for unlike other business the cost of telephone service increases with the number of subscribers. Then, too, there are the financial and engineering questions arising from the connection of numerous farmers' lines with town exchanges, and the connection of one exchange with another, the establishment of rates fair to all and the standardization of apparatus—the last by no means the least difficulty.

Speaking of farmers' lines, one thing that the convention papers served to emphasize was the important part independent telephony has played in giving rural districts the benefits of telephone service, and the entire lack of such service before the independent movement started. The figures given in Mr. Frazee's paper are even startling on this point; and the $100 offered for every farmers' telephone in use previous to 1894, cited by Mr. Conklin, still further emphasized the fact. At the same time, as pointed out by Mr. Rainey, the construction of cheap farmers' lines with poor material and poor instruments has tended to spread an impression that telephone service costs almost nothing, and this constitutes one of the greatest dangers that small independent telephone companies have to face.

Although the object of the convention was not, as some of the Chicago daily papers had previously announced, to form a consolidation of independent telephone companies, such gatherings may be regarded as stepping stones toward that end. While the accomplishment of such a consolidation is far too large a task to be accomplished by a hurriedly called convention, and for manifest reasons could not in any event be accomplished by such a gathering, it is nevertheless true that prominent members expressed themselves in no uncertain tone on the convention floor as to the desirability and probability of better traffic agreements and greater uniformity of

aims and methods, and even of absolute consolidation. If such consolidations do not come, it will be contrary to the present sentiment of the men interested, as well as contrary to the general tendency of the times. There will certainly be large groups of exchanges, under the "independent" flag. Such, indeed, exist already in many sections of the country.

The Ratio of Transformation in Three-Phase Circuits.

Mr. Del Mar calls attention in an article this week to the changes in ratio of transformation that can attend the various methods of connecting sectional transformers with three-phase circuits. There does not seem to be much novelty in the algebra or numerics of the method of computation outlined. The resolution of deltas into their corresponding stars, or vice-versa, has been effected from time to time in our columns according to rigid rule; and it is only necessary to resolve all complex forms either according to an imaginary complete star, or according to an imaginary complete delta, and then apply the sectional ratio to find the total or net transformation ratio. The article, however, is instructive as showing the great variety of transformation ratios that such methods of connection render possible. It would be interesting, as a matter of curiosity, to compute the total number of possible ratios of which a given number of section transformers—say thirty—is susceptible. No doubt, the calculation would resolve itself into some branch of pure mathematics, such as "groups" or "quantics." It would give ample occupation to any computer who is yearning for work that has no immediate industrial utility.

The Age of Reckless Waste.

In a recent paper Prof. John Perry has sounded a note of warning against the ruthless waste of the world's fuel, for which future generations may have to pay a fearful price. Starting with the proposition that the normal value of energy is based on the value of human labor, he shows that when mankind, to save human labor, has spent its capital of stored energy, values must revert to the original basis, which in terms of our electrical units is not far from a dollar and a half per kilowatt hour. Whatever of economy has resulted from the use of steam is like the economy of one who keeps within his income by spending his principal. Sooner or later a day of reckoning must come—a time when the living will have to pay for the avarice of the dead. And unless some far reaching change in our methods comes to the rescue, this evil day will, in Prof. Perry's opinion, be upon the world not in some distant age, as unreal a phantom of the future as the epoch of the pyramid-builders is of the past, but even before the children of this century are come to see the dawn of the next. Great as is the store of fuel hidden under the surface of Old Earth, it is not infinite, and even the inroads of the last fifty years have brought the end within sight so far as the coal fields now known are concerned. Six or seven hundred million tons is the present yearly output of the world, and the demand grows with appalling rapidity. Deeper and deeper burrow the mines, and the labor of production steadily increases. Even now only our enormously developed systems of transportation keep the cost of fuel within bounds, and at the least touch of demoralization in these a fuel famine is upon us.

It is a serious situation even from the most optimistic standpoint. It is possible that modern civilization has been bought at so huge a price of terrestrial resources that it will fall a victim to its own immensity—die as the vast and terrible prehistoric monsters died, because the failing vegetation of the cooling globe could no longer furnish them food? Such a fate is not pleasant to contemplate, but it is upon the world's fuel that the world's industry now depends, and they must stand and fall together. In the century just ended, much was accomplished in economizing the fuel supply, but for every ton of coal saved ten more were demanded. The engines of a century ago required for each horse-power four or five times the coal now necessary for the same work, but in spite of this the output of coal has increased with prodigious rapidity. Something vastly more radical must be devised to bring the yearly consumption within bounds that may give a better outlook for the future. Prof. Perry looks to the direct transformation of the energy of coal into electric energy as a possible means of escape. If the world's latent power could be utilized at 90 per cent. efficiency instead of 10 per cent., there would result at least some centuries of respite. The task does not seem impossible, and yet the sum total of recent research is not encouraging, and the day of success seems afar off. The world's water powers form a reserve of which use cannot rob us, and which is as yet utilized only here and there in trivial amounts. But on the other hand, it is strictly limited in amount, and all the devices of modern power transmission cannot prevent dependence on water power shifting the world's centres of industry far from their present sites. Not all the syndicated powers of the world could save London or Paris or New York if water power held the key to industry. And the same insensate lust of gold that wastes our coal supply has denuded two continents of forest to an extent that seriously impairs the available water powers.

Perhaps a more promising remedy than either of those just noted lies in the direct utilization of solar heat, a problem of which the solution presents no formidable difficulties, and which has already been studied to some purpose. So prodigious is the world's annual income in solar energy that it could not be spent by any population that the earth could support. Even with our present wasteful heat engine, a hundred square feet of properly arranged mirror surface can be made to yield approximately a horse-power. The apparatus does not in any form yet devised lend itself readily to great concentration of energy in a small area, but it is singularly well suited to the development of those widely scattered industries which are a sure index of general prosperity. But the most striking characteristic of solar engines is the fact that they belong essentially to a climate of unbroken sunshine. If such is to be the world's refuge from the failure of fuel, it may be that the shades of centuries past will see again the streets of Thebes and Palmyra peopled with hurrying throngs and ringing with awakened industries. Even if the march of invention should greatly lessen the present waste of coal, even if the unexplored tropics should disclose unimagined wealth of coal fields, the steadily increasing cost of transportation will inexorably force industry near to its base of supplies. The population of the globe has been shifting its center of gravity since the beginning of time and will shift until the end. When the time comes in which the conditions of existence become hard in any given region, its population, slowly perhaps, but infallibly, drifts elsewhere. In the enormous waste of fuel going on from day to day, we see then not so much a vision of desperate struggle with hunger and cold as a sign of the enforced wandering that drove Norseman and Saxon southward and westward to conquer new continents, to develop their resources to the fullest, and then if need be to turn again over the seas and once land to work out with strong hands their restless destiny.

Prof. Perry makes an interesting suggestion apropos of a proposition, originally offered by Kelvin, that any great improvement in the thermo-dynamic engine—for example, a steam-engine—might enable local heating to be obtained more cheaply by engine than by direct fuel consumption. That is to say, just as in existing refrigerating plants, their apparent efficiency, with existing steam engines, may be 400 per cent., reckoned on the basis of heat transferred per heat-unit of energy consumed in coal; so it might be

possible to have one potential-heat-unit in coal transfer 50 or 100 heat-units from out-of-door temperatures to living-room temperatures. Prof. Perry suggests that a few millions of dollars should be entrusted to such scientific leaders as Kelvin or Rayleigh, to expend upon the problem of improving the heat-engine, in order to realize a solution that would be an enormous benefit to mankind, and which would pay handsomely upon the expense as an investment.

The Genesis of Hertzian Telegraphy.

In these strenuous days when the wanton slaughter of man is glorified, and when dynasties and political parties strive to fan the embers of racial hatred to the heat of ruder ages, we cannot be surprised that even science becomes a field for controversy based, not upon facts, but upon prejudice. For some time the newspaper press has almost daily reported incidents in a warfare over priority in the invention of wireless telegraphy which, from the part nationality has been made to play, is strikingly illustrative of the uncivilized spirit to which we refer. One claimant is reported to have secured the support of his Emperor in his contentions; and a friend of another sneers at the "Italian" and the "German Professor" for their temerity in advancing claims in conflict with the "Englishman who was first in the field." The bitterness of the controversy has reached a point where, for the sake of decency, a halt should be called, particularly as the warfare appears, from the manner in which patents are flourished, to be a mercenary one instead of in the interests of scientific chronology. The matter has, in fact, ripened for the courts, and the sooner it is brought up for legal adjudication, the better, that the public may be spared an indefinite continuation of the present clamor. In the meantime we venture to present a few observations on the genesis of signalling by etheric waves as distinguished from signalling by means of electrostatic and electromagnetic disturbances.

If any name is to be associated with the designation of wireless telegraphy it is that of Hertz; for he was the first to demonstrate experimentally the existence of electric waves, and the first to devise means for their detection. By far, however, the greatest step in actual wireless telegraphy was taken when the filings electric wave detector was discovered. This discovery was independently made, first by Prof. Onesti in 1884, and, second, by Prof. Branly in 1890. Prof. Onesti's detector consisted of a small glass tube filled with copper filings, enclosed by two rings of brass and so mounted that it could be revolved. He showed that certain electrical disturbances had the effect of decreasing the resistance of the filings circuit, and that the original resistance could be restored by moving the tube so as to cause a rearrangement of the filings. The Italian Professor does not appear to have gone beyond a mere observation of the above facts, nor does he appear to have clearly understood the nature of the acting electrical disturbance. In November, 1890, Prof. Branly read a paper before the French Academy of Sciences, and printed in the *Comptes Rendus*, in which he described the coherer as it exists to-day, and it was from this description that the art of wireless telegraphy dates. As in the case of Onesti, an insulating tube was used containing filings between two electrodes. Prof. Branly found that the effect of a spark from an induction coil 20 meters distant reduces the resistance of the filings from several million ohms to as low as 100 ohms. He also stated that the original resistance could be restored by light blows on the base supporting the tube.

Crookes in 1892 put forth a speculation in which he anticipated in a remarkable manner the later development of wireless telegraphy. Hertzian rays, he said, could be received "on a properly constituted instrument, and by concerted signals messages in the Morse code can thus pass from one operator to another." He also very clearly enunciated the principles of syntonic wireless telegraphy. Had Crookes known of the Branly tube, the art of wireless telegraphy might have had its beginning at that date. In 1894, Lodge constructed an arrangement consisting of an electric bell connected with a relay, the relay being in circuit with a Branly tube, which latter Lodge called a coherer. With this he signalled over 40 yards, but suggested that "something more like half a mile was nearer the limit of sensitiveness." It was presumably on this experiment, which appears to have had no influence on the development of wireless telegraphy, that claims are based, assigning to Lodge not only the invention of the art, but also of the Branly tube. In connection with this latter claim, Branly, in a communication to the French Academy of Sciences on Jan. 6 of the present year, quotes from a letter written by Lodge, dated Jan. 8, 1899, in which the latter disclaims "any part in the discovery made by Branly in 1890 on the action exercised at a distance of electric sparks on metallic filings." The first practical application of the Branly tube appears to have been suggested by Popoff in 1895, in connection with meteorological observations. His arrangement of apparatus is in some respects very similar to that employed later by Marconi. The tube at one end was connected with a long antenna, and at the other to the earth. To the tube was connected a Richards recorder for the registration of atmospheric discharges, and a relay in the tube circuit controlled a tapping hammer.

We come now to the work of Marconi, which had its origin in Italy in 1895, but soon after was transferred to England. The vast and rapid strides that Marconi made from his first public English exhibition in 1896, when signals were transmitted 100 yards through intervening walls, to his recent Trans-Atlantic feat, are so familiar that no account need here be given. The first Marconi patent was applied for, June 2, 1896, and a consideration of this will show the advance over his predecessors—an advance which was, in fact, the creation of the art of non-syntonic wireless telegraphy as it exists to-day. This patent described the use of antennae at both stations, the construction in detail of a transmitter particularly adapted to its purpose, the construction in detail of a Branly tube of extreme sensitiveness, the proper arrangement of the coherer, tapping and relay circuits, and of the transmitting and telegraphic circuits. In other words, his work was comparable to that of Edison in producing, in 1880, a complete practical system of incandescent lighting from elements, some new, but mostly old, their commercial co-ordination involving practical inventive ability of the highest order. Since then Marconi has added numerous other improvements to the system, the most important of which is the "jigger," or inductive relation between the tube and antenna.

The controversy over the invention of wireless telegraphy has been conducted in such vague terms that the public could not otherwise than conclude that credit for every part of the invention was denied to Marconi and claimed by others. In point of fact, though apparently the claimants would deprive Marconi in the eyes of the public, of all credit, yet the contentions of the two principal claimants relate specifically to the invention of syntonic telegraphy; and the patents which have been flourished and the experiments adduced relate specifically to the syntonic feature, and in date are subsequent to the date of issue of the fundamental Marconi patent. As Marconi has not disclosed the details of his system of syntonic telegraphy, we leave this branch of the subject for such a time when all the facts will be at hand upon which to base an opinion as to the priority and relative credit of the several claimants. Whatever may be the issue with respect to syntonism, the credit will remain to Marconi of having created the art, unless better evidence can be produced to deprive him of it.

Three-Phase Four-Wire Systems.

Mr. Peter Junkersfeld, assistant to the mechanical enngineer of the Chicago Edison Company, read a paper before the Chicago Electrical Association, April 4th, on the "Application of four-wire three-phase systems in reconstructing and modernizing central stations." The Chicago Edison Company was one of the first to adopt this method of primary high-tension distribution for its outlying districts. The voltage used on this system is 4,000 between any two outside legs of the three-phase circuit. A fourth or neutral wire is run, which gives 2,300 volts between any of the outside wires and the neutral. When large motors are to be run, the transformers for the motors are connected delta-fashion to the outside legs of the circuit; the distribution, as far as the motors are concerned, is, therefore, 4,000 volts. For lighting circuits the three 2,300-volt single-phase circuits offered by the Y-connected three-phase system are utilized. The various single-phase lighting feeders are balanced between the three legs of the circuit. The distribution of these single-phase light circuits among the three-phase is done at substations, at which each lighting-feeder is provided by switches, whereby it can be thrown onto different phases. The system has the advantage of giving the standard voltage for alternating-current single-phase lighting, while at the same time supplying larger motors at a higher voltage. Motors of less than five horse-power, when not starting under load, are of the single-phase type. It has not been found difficult to maintain a balance between the three legs of the circuit.

The Annual Convention of the Iowa Electrical Association.

The Iowa Electrical Association held its annual convention April 9 and 10, 1902, at the Grand Hotel, Cedar Rapids, Iowa. This association has never had the publicity given to some similar organizations of equal size, but it is doubtful if any state electric light organization equals it in the amount of solid and beneficial work done. At this last convention 57 central station men were present. The entire time during the two days, evenings excepted, was given over to business.

The first morning was taken up largely with the report of the secretary, W. B. Keffer, of Des Moines. This report went very fully into the various items which go to make up the expense and income accounts of plants in different parts of the state. These items, including costs of coal, meter rates and other contract prices received for light, formed a document which will be published for the use of the members of the association.

Mr. Higley, of Burlington, read a paper on the "Relative Merits of Open and Enclosed Arc Lamps and the Relative Merits of Direct Current and Alternating Current Enclosed Series Lamps." This paper was discussed at length by Mr. J. G. Pomeroy, of Chicago, who took a stand in favor of the direct current series enclosed arc as against the alternating current series enclosed arc, on account of the greater amount of light below the horizontal plane, the longer life of carbons and the simple mechanism.

Mr. I. B. Smith, superintendent of the Cedar Rapids Electric Light and Power Company, presented a paper on the "Analysis of the Cost of Supplying of Electric Current." This paper was in the shape of a recommended form of classifying accounts, and was printed for the use of the members.

Mr. D. F. McGee, of Red Oak, gave a paper on "Free Lamp Renewals." All of these papers will be printed for the benefit of the members.

Mr. Murray C. Beebe, chemist of Nernst Lamp Company, lectured Thursday evening on the Nernst lamp, and Mr. W. J. Greene, manager of the Cedar Rapids Electric Light and Power Company, gave a smoker at the Grand Hotel on Wednesday evening.

Among other business transacted by the association was the appointment of Royal H. Holbrook, superintendent of the Ottumwa Traction and Light Company, a committee of one to determine the relative evaporation value of different kinds of Iowa coal. The selection is an excellent one, as Mr. Holbrook is an engineer, fully competent to carry out unprejudiced and thorough tests, and to make a report which will be of much practical value.

Supply men were not numerous at the convention, but among those present were J. G. Pomeroy, of the Adams-Bagnall Electric Company; Mr. Monroe, of the General Electric Company; Mr. Pinkard, of the Westinghouse Electric and Manufacturing Company, Mr. H. H. Coughlan, of the Manhattan Electric Company; Messrs. Millard and Towner, of the Electric Appliance Company; Messrs; Switzer and Mason, of the Central Electric Company; Mr. McNeal, of the Illinois Electric Company, and C. L. Ethridge, of the Evans-Almirall Company. Mr. Pomeroy, who took a prominent part in the arc lamp discussion, feels especially at home at this association, as he was able to find only three central station men at the convention who had not become converted to his views on the arc lamp question sufficiently so that they were not using "A. B." arc lamps.

The following officers were elected for the coming year; W. J. Greene, Cedar Rapids, president; D. F. McGee, Red Oak, vice-president; W. S. Porter, Eldora, secretary; C. S. Carson, Iowa city, treasurer. The next meeting will be at Davenport.

Electrical Engineers of the Day—XLII.

AUGUSTUS TREADWELL, JR.

Augustus Treadwell, Jr., was born July 15, 1869, in Brooklyn, N. Y. He received his education at the Polytechnic Institute, Brooklyn, graduating therefrom in 1892 with the degree of B. L., upon presentation of a thesis, having for a subject the specific inductive capacity of dielectrics, in which a digest of the literature of the subject up to date was included as well as a critical comparison of the methods of measurement of the dielectric constant. In 1893



he received the degree of E. E. from the same institute, again presenting a thesis, the subject of which was hot wire ammeters and voltmeters and the emissivity for heat of wire of various substances.

After his graduation Mr. Treadwell spent one year at the Polytechnic as assistant to Dr. Samuel Sheldon, the professor in charge of the electrical engineering department, and during the latter's illness that year took his place at the Polytechnic and had charge of the various classes. He then spent considerable time in experimenting, particularly on storage batteries, of which latter branch he early made a specialty. In 1898 he published a book, "The Storage Battery," which is to-day recognized as the standard on the subject of storage batteries. He has also written several articles on the subject of the use of storage batteries, which have appeared in the various technical publications.

For about a year Mr. Treadwell occupied the position of assistant to Mr. Charles Blizard, manager of the New York office of the Electric Storage Battery Company, which position he left in 1899 to become the private secretary of the then president of the company, Mr. Isaac L. Rice, and which position he still occupies.

As a worker, Mr. Treadwell is conscientious and persevering. This is evidenced by the wealth of detail material to be found in his book upon the storage battery. Personally he is possessed of great executive ability and discretion, both of which qualities are essential in his position as private secretary to one who is engaged upon the development of problems of considerable commercial magnitude.

The Evolution of the Message Rate Telephone Service—II

By Herbert Laws Webb.

THE description in the issue of April 5 of the development of the New York message rate service mainly touched on what has been done for the moderate and average users of the telephone, but side by side with this evolution of the general rates and service has been developed a special class of service for the large user which has been successful from every point of view, improving the service for all concerned and vastly increasing its value to the user. I refer to the private branch exchange, which most telephone companies are now taking up, but which has nowhere been developed in such a remarkable manner as in New York. The private branch exchange was originally introduced to provide subscribers who made great demands on the service with a flexible and efficient method of handling any desired amount of traffic. Under flat rates a busy office would keep its line or lines always busy with outward calls, blocking inward traffic and making bad service for many subscribers. With a private branch exchange, consisting of a switchboard on the subscriber's premises to which are connected trunk lines running to the nearest central office, and extension stations placed in the various offices or departments requiring the service, it is obvious that a flexible system is provided, capable of handling efficiently any amount of telephone traffic. Originally designed for business needs only, the private branch exchange naturally affords an economical method of supplying service to large aggregations of small users, as in apartment houses and hotels. It is rare now for a large hotel or apartment house to be built in New York without including in its equipment a private branch exchange, giving service to every tenant. The new Ansonia Hotel contracted the other day for a branch exchange to serve 360 stations.



FIG. 1.—EIGHTEENTH STREET TELEPHONE BUILDING, NEW YORK CITY.

An excellent feature of the private branch exchange, most useful in a business establishment, but an important money saver in a large hotel or apartment house, is that it gives a complete interior service as well as the exchange and long distance service. The main object of the system, of course, is to make the exchange service available at as many points as may be required in the same building, and the interior service is a by-product, as it were. To the hotel manager the interior service is an important gain, as it saves labor and vastly improves the service he supplies to his guests. Telephoning an order direct from the room to the office is so obvious a gain all round over the method of ringing for a boy to take the order that the point needs no elaboration.

The private branch exchange was introduced in 1896 and took some little time really to catch on, for the reason that the large users were naturally the most reluctant to abandon the flat rate and unlimited service. Gradually they were convinced that their excessive use of their lines was in reality working against their own interests in that it blocked incoming calls, which were probably of just as much value and importance to them as the outgoing calls that naturally got the right of way. The branch exchange, once established, is capable of expansion or contraction both in number of trunk lines and of extension stations; properly designed to suit the needs of the traffic to be handled it can cope efficiently with any amount of traffic. At the time the private branch exchange system was introduced, one of the greatest obstacles to a generally efficient service was the excessive use of single lines by very busy subscribers, which resulted in such numerous answers of "busy" to callers requiring connection with the overloaded lines that "busy" was in danger of becoming a by-word. A good deal of missionary work had to be done in getting the private branch exchange service established. Many subscribers would not believe they used the service so much or that they lost so many inward calls through constant outward use. Others did not think the improved facilities worth the cost, and very few had realized the important work the telephone service was doing for them or saw how its effectiveness could be improved by new methods. A few discerning ones did at once realize the great gain in flexibility of the branch exchange service and adopted it without hesitation, but the majority had to be canvassed and argued with, to be supplied with records of tests showing the numerous ineffective calls made for their telephones every day, and to be gradually converted to the use of a system that to-day they would not part with at any price. Without hesitation it may be said that the private branch exchange system has been the most potent factor in improving the efficiency of the telephone service, both for the individual subscriber using it and for the general user. It has largely reduced the "busy" trouble, which a few years ago threatened to become a serious evil on account of the high pressure at which things are run in New York. It has given every subscriber who adopted it a rapid, smooth-working and effective means of handling his telephone traffic, by which every user has the service immediately available and every incoming call goes direct to the person for whom it is intended. It has made the large subscriber realize as he never realized before the important part of his business machinery the telephone service is, and it has provided a means of making the service directly available at a most reasonable cost to the army of dwellers in apartment houses and sojourners in hotels that forms a large proportion of New York's active population.



FIG. 2.—EIGHTEENTH STREET EXCHANGE.

The private branch exchange rates and facilities have undergone various changes and modifications since the service was introduced. The service in a way has been an evolution from the extension sta-

tion and auxiliary line. The earliest attempt at adding flexibility to the service was the connection of an extension station to the line. Then an auxiliary line, at a lower rate than the original line, was offered, and if the service was needed at several points two extension stations could be connected to each line, giving an arrangement of two lines with three stations on each. The two lines had separate numbers and the extension stations were, of course, not common to the two lines, but each permanently connected to one or the other. To connect the two lines and the four, five or six extension stations to a small switchboard so that any station can be connected to either line, and to give the two lines consecutive numbers in the main switchboard, so that an operator on getting a call for the first, and finding it busy, could try the second, makes a very much more flexible arrangement, giving far better and more convenient service than the two individual lines, each with its two or three stations.

This is the simplest form of private branch exchange, and from this modest equipment of two trunk lines with four or five extension stations, the branch exchanges now in use run up to imposing equipments, having switchboards of several positions serving systems of several hundred lines and stations. As noted above, a recent branch exchange contract calls for a system of 360 stations, and several of the large hotels now considering the adoption of branch exchange service will require systems of nearly 1000 stations. At the end of February, 1902, there were in service in Manhattan 2160 branch exchanges with an aggregate of 5952 lines and 22,072 stations. During the last twelve months 1036 branch exchanges with 2584 lines and 9227 stations were added to the system.

The rates for private branch exchange service at present in force are the result of a process of evolution similar to that which has produced the main tariff for direct and party line service. Practically every item in the branch exchange tariff has been reduced at various times, and certain charges, as for a supply line to furnish ringing current, have been abolished altogether. With the common battery system, it is necessary to provide feeders for supplying current for talking and for operating the relays and signals, and no charge is made for these lines, either. The branch exchange tariff as it stands to-day is as follows:

Item.	*Annual Rate.*
Local switchboard with telephone station	$36.00
Each trunk to the central office	36.00
Each extension station on the premises	12.00
The right to send 3600 local messages in one year	108.00

Additional local messages 4c. each, or $3.00 per hundred if contracted for in advance.

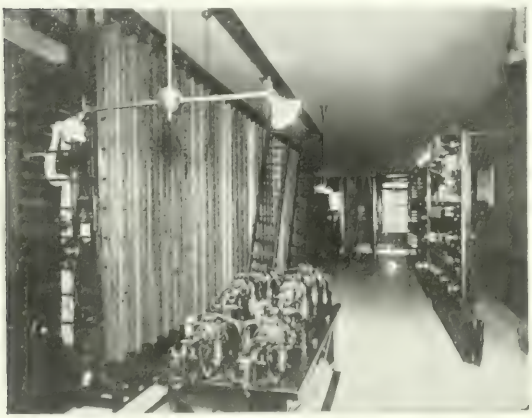


FIG. 3.—TERMINAL ROOM, EIGHTEENTH STREET EXCHANGE.

for both branch exchanges and for direct lines. To hotels and apartment houses, for which a special wall set, very compact and of neat and attractive appearance, has been designed, a discount is made on the extension station rate which eventually brings the rate down to an average of $8 a station when 120 or more stations are used. As with the other rates the extension station rate has been reduced by successive steps from the old flat rate of $60 a year to the present modest figure of $1 a month.

The extensive use of private branch exchanges leads to some curious results, and has certainly led to a much keener appreciation among business people of the usefulness of the telephone service than ever existed before. For example, among concerns that have several branch establishments in different parts of the city, the demand



FIG. 4.—EIGHTEENTH STREET EXCHANGE.

naturally arose for private trunk lines connecting the branch exchanges in those different establishments. These lines are supplied and maintained by the telephone company, and there are now several large businesses, express and railway companies, having private branch exchange systems consisting of exchanges in different parts of the city, each connected to the nearest central office, but also connected together by direct trunk lines—practically a miniature reproduction of the main telephone system itself. The branch exchange system is capable of almost infinite ramification in this way. The Pennsylvania Railroad Company has a private branch exchange system which is a combined local and long distance system of no mean proportions, with branch exchanges in New York, in Philadelphia, in Pittsburg, Altoona, and various other towns along the line, all joined by direct trunk lines into one system, each branch exchange also having connection with the central offices of the town in which it is located.

Another curious feature of the popularity of the private branch exchange service is that there are now more telephone operators in private employ than there are in the employ of the telephone company itself. Not all of the 2200 private branch exchanges in service need an expert operator, as the smaller switchboards serving a limited number of lines and stations are generally put in charge of a stenographer or office boy. For these small exchanges cordless switchboards, in which the connections are made by means of cam-lever keys or dummy plugs, are generally supplied, as these are easy to operate and not likely to develop trouble from damaged cords, since they have none to get damaged. But in an exchange of any size, where the traffic is heavy, an expert operator is a necessity if good service is insisted on. Some subscribers make the mistake that the telephone companies did in the early days, and try boy operators. But the average boy is not intended by nature for a telephone operator, and his work is damaging both to the apparatus and to the temper of the telephone user. One of the bitterest diatribes against the shortcomings of the telephone service published of recent years in the editorial columns of a daily paper was indirectly inspired by the boy operator in charge of the private branch exchange of that paper. When a competent young woman operator was put in charge there was no more trouble with the service. In general, private branch exchange subscribers employ expert operators who have been graduated from the telephone company's ranks, and in this way, with expert operating at both ends of the line, good service is assured. In the Broad, Cortlandt, and John Street exchange districts, the private branch exchange operators outnumber the central office operators by about two to one. Uptown there is naturally not such a large proportion of branch exchanges, but taking Manhattan as a whole there

are considerably more private branch exchanges in service than there are employes in the whole traffic department of the company.

The development of the system described above has necessitated an enormous and very rapid increase in the plant. In 1894, when message rates were first adopted, the Manhattan system consisted of nine exchanges, Broad, Cortlandt, Franklin, Spring, Eighteenth, Thirty-eighth, Columbus, Seventy-ninth and Harlem. Of these, Broad, and Franklin were new, both having been put in service in that year, and Eighteenth Street had lately been rebuilt on the bridging system in a new building. Columbus and Seventy-ninth Street were comparatively insignificant exchanges, and Harlem was in process of reconstruction in a new building. At the present time there are thirteen exchanges, the four new ones being John Street, Madison Square, (East Twenty-ninth Street), Riverside (West Eighty-ninth Street) and Highbridge. In 1898 the change from magneto to common battery working was begun with the equipment of the Harlem exchange on the new system, which was put in operation in October of that year. The Riverside exchange was built from the beginning as a common battery exchange in a building erected specially for telephone purposes, and a similar building and equipment took the place of the old Seventy-ninth Street exchange, which was in leased quarters. The Madison Square exchange is in the same type of building as the two just mentioned. Columbus central office, on Fifty-eighth Street, just west of Ninth Avenue, is also in a modern telephone building, replacing the old small exchange in leased quarters in the same neighborhood. A new building has also been built for the Eighteenth Street exchange at Irving Place and Eighteenth Street. This exchange has rather an interesting record among telephone exchanges. It was originally at Twenty-first Street, and in 1889 the lines were transferred to a new central office in the building at the southwest corner of Broadway and Eighteenth Street. This office was equipped with a metallic circuit multiple board, the second of its type to be placed in New York, Cortlandt Street being the first.



FIG. 5.—COLUMBUS TELEPHONE BUILDING, WEST FIFTY-EIGHTH STREET.

The building seemed to have a fire hoodoo on it, as the exchange was twice in danger of burning down. In 1893 the exchange was transferred to a new bridging equipment in the fire-proof McIntyre building, on the opposite (northeast) corner, and in 1901, finally, "Eighteenth Street" brought up in the common battery exchange in the new building at Irving Place and Eighteenth Street. So that in a little over eleven years this exchange was rebuilt three times with a different style of equipment; probably a unique case, but strikingly illustrative of the rapid development of the telephonic art. The conversion to common battery working was completed with the opening of the new Cortlandt Street exchange in November, 1901; this office was fully described in recent articles in ELECTRICAL WORLD AND ENGINEER.

The construction of all these new exchanges, involving extensive alterations to the older telephone buildings and the establishment of several new ones, by no means represents all the work demanded by the rapid enlargement of the plant and the change in method of working during the past three years. The equipment of every subscriber's



FIG. 6.—COLUMBUS EXCHANGE.

station and of every private branch exchange has also had to be changed from magneto apparatus to common battery, and the installation of the new exchanges and of the many new stations has also involved a vast amount of new work on the cable plant. The distribution of telephone wires has now reached a fine art in New York City by the systematic development of the direct or block distribution method, another of the many improvements in telephone practice for which the industry at large is indebted to the New York Telephone Company. What the message rate system is to the business as a business, what the common battery is to the service proper, so the direct underground distribution system is to that very delicate portion of the plant—the subscribers' lines—a vast and far-reaching improvement. Briefly described, the method consists in carrying the main cables, now generally called feeders, into blocks of buildings and by means of distributing boxes or pot-head joints splitting up the wires into smaller cables, which in turn split up into yet smaller and so finally taper down to the pair of wires wanted at a given point. This results to all intents and purposes in carrying the subscriber's line in an underground cable, or at any rate in a lead-covered cable, the whole way from the terminal room in the central office to the subscriber's premises. The work was begun in a tentative way several years ago on a few down-town blocks, and it has progressed steadily so that now the method is in use in all parts of the city and more than 43,000 stations are at present connected by direct underground distribution. The gain in permanency of service is of course obvious, as the cables are free from almost any risk of damage except from fire, whereas the numerous risks that overhead distributing wires run are well known. There is also a gain in the time of connecting up a new subscriber or effecting a removal, as when a block is wired it is wired with a view to the probable future demand for telephones, and all the work then required to establish a new station is to run the inside wiring.

The thirteen exchanges at present in service have a total capacity of about 125,000 stations. Five more exchanges in Manhattan are at present planned for or in course of construction, "Orchard," on the lower East Side, which will serve a new district, relieving Franklin Street; "Chelsea," on West Seventeenth Street, which will relieve Eighteenth Street; "Plaza," on East Fifty-eighth Street, which will relieve Thirty-eighth and Seventy-ninth Streets, and two new exchanges in Harlem, one near the present exchange, and one on the west side of that thriving city within a city, to be named "Morningside." When these exchanges are completed the Manhattan plant will have a total ultimate capacity of about 225,000 stations, though this

figure is capable of considerable expansion without exceeding the limits of the switchboard capacity by reason of the growing use of private branch exchanges.

Across the Harlem River, northward, while the development has naturally not been so rapid as in Manhattan, on account of the difference in the population and business interests, still there has been a steady growth which has been nurtured and encouraged according to the same methods as those employed in Manhattan—the making of popular rates, the improvement of the plant and service and the systematic canvassing of the territory by direct work of agents and by advertising. The borough of the Bronx has its own contract office,



FIG. 7.—THIRTY-FOURTH STREET EXCHANGE.

In a short time, with the completion of the new Melrose exchange building, the Bronx will have its own telephone headquarters building, which will contain the new common battery exchange, a toll switchboard for working all the Westchester toll lines, and accommodation for the contract office and other working departments. The new Melrose exchange will have an ultimate capacity of 7200 lines. The other five exchanges in the Bronx have a total capacity of about 2700 stations, all except Tremont being quite small exchanges in districts at present sparsely settled.

Kingsbridge, Williamsbridge and City Island exchanges were established in such districts with a view to cheapening the service by cutting down the mileage rates formerly necessary in supplying service over the large area served by Tremont and Westchester central offices, both, like Melrose, situated near Third Avenue, the "backbone" of the Bronx. The Bronx has at present about 2000 telephones in use, and is making a steady gain of between 400 and 500 a year.

In the Westchester division, which consists of twenty-three exchanges in Westchester and Rockland counties, and one—Greenwich—in Connecticut, a similar campaign of development has been conducted, the plant having been almost entirely rebuilt and greatly enlarged, and various modifications in rates introduced. The public has made good response to these efforts, as the Westchester system has trebled in size in three years, increasing from 2400 stations at the beginning of 1899 to 7400 at the beginning of 1902. Underground wires have been used extensively in Westchester towns as well as in the Bronx, and towns like Mount Vernon, New Rochelle, Greenwich, White Plains, Yonkers, Tarrytown, Ossining and Nyack all have their underground systems of distribution. The principal centers, such as Mount Vernon, Yonkers and Tarrytown, are being provided with special telephone buildings; those at Mount Vernon and Tarrytown are completed and the new exchanges working, while the building at Yonkers, which will be equipped with a 3500 line common battery exchange, is nearing completion.

Since this article deals mainly with the development of the telephone service *per se*, and not with the technical details of the complex engineering and administrative problems that have had to be solved to keep pace with the very remarkable development record, it may be in order to say a few words on the purely business methods adopted to encourage the use of the telephone by the public. In New York direct canvassing and direct advertising were first applied to the telephone business. In 1893, when the contract department was first organized as a force to go out among the people and get new business, a radical departure was made from previous telephone business policy. The value of the work of an organized contract department, manned by agents specially chosen and trained to meet the public and discuss telephone service and rates in an intelligent manner was quickly apparent, and the department has grown year by year to its present large force.

Direct advertising was a little slower in being adopted, but it came naturally and in due course as a necessary part of the policy that regarded telephone service as something to be sold to the public in the same way as any other service or commodity. In advertising, as in other directions of telephone effort, the New York company has set the pace for telephone managers, and its advertising phrases are copied from Maine to California. The famous "Don't Travel, Telephone!" first saw the light on a column at the telephone exhibit in the electrical exhibition held at the Grand Central Palace in 1896. It has since gone wherever telephone service is used and English is spoken. The general principle of the advertising done for the telephone in New York has been to draw attention to the advantages of the telephone service by some such pointed phrase as the above, to proclaim the scope of the service by announcing the steadily growing number of stations in the system, and conspicuously to advertise the rates at which service is supplied. If you tell a man not to travel, but to telephone, that "telephoning typifies time saving," that the telephone service puts the whole organization of a city at his command, and so on, you make him think; when you tell him that there are 75,000 telephones in service in New York you show him that there is a great and far-reaching system of communication at his disposal, and when you tell him that he can have this service for $4 or for $5 a month, as the case may be, you make your case complete by showing him that that which is highly useful is also cheap. The newspaper advertising has been supplemented by a steady stream of circulars and booklets, attractively printed and illustrated, drawing attention to rate reductions and to special features and facilities of the service. These make a more direct appeal to the recipient, perhaps, than the newspaper advertisement, which does its work by reiteration; the two together have certainly been of great service in spreading among the people a knowledge of the usefulness, of the scope and of the cheapness of the telephone service. Any telephone company that gives a good service at reasonable rates is hiding its light under a bushel if it neglects systematic advertising.

Ratio of Transformation in Three-Phase Circuits.

BY WM. A. DEL MAR, A. C. G. I.

A SIMPLE formula for ascertaining the ratios of transformation attainable by the use of various combinations of transformers is here proved, and may be found useful by those engaged in work on three-phase currents.

The coils of transformers are usually built in several sections, as shown in Fig. 1, in order to facilitate a change of ratio, but a number of one-section transformers gives the same result. As the terms

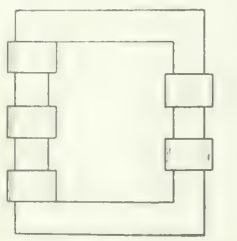


FIG. 1.—DELTA CONNECTIONS.

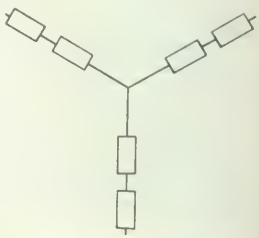


FIG. 2.—STAR CONNECTIONS.

"primary" and "secondary" might introduce confusion on account of their interchangeability, the expressions high and low tension will be used and abbreviated to *H. T.* and *L. T.*, respectively. The difference of potentials (*P. D.*) at the *H. T.* and *L. T.* terminal of a combination of transformers will be designated as the *H. T.* and *L. T.* line *P. D.*, respectively.

The three arms carrying currents in different phases may be connected in star, as shown in Figs. 2 and 4, in delta as shown in Fig. 3, or

in a combination of star and delta, such as shown in Figs. 5 and 6. This last case being a general one, it will be considered in detail. As the number of sections in multiple does not affect the potential of a balanced combination, only those in series need be considered, so that if they are quite similar, the drop of potential is the same in each. Let it be v volts in the *L. T.* and $n\,v$ volts in the *H. T.* sections. First consider the *L. T.* side. If there are d sections in each arm of the delta, the drop of potential in one of these arms will be $v\ d$; and if y be the number of sections in series in each arm of the star, the drop of potential in each of these arms will be $v\ y$. This is true of any of the three arms of the star, so that as the *P. D's.* between the ends of the arms differ

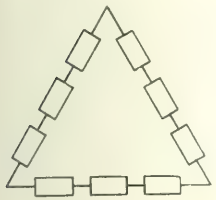


FIG. 3.—DELTA CONNECTIONS.

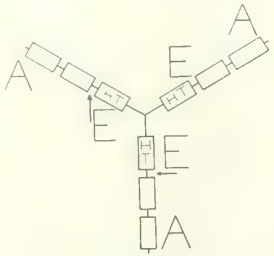


FIG. 4.—STAR CONNECTIONS.

in phase 120 degrees, the sum of the drops of potential in any two arms is $v\sqrt{3}$ times that in one arm; that is, $v\ y\sqrt{3}$. From this it follows that the *L. T.* line *P. D.* or the sum of the drops of potential along two arms of the star and one arm of the delta, is $v\ y\sqrt{3} + v\ d$ or $v\ (y\sqrt{3} + d)$.

If corresponding capital letters be used to denote the corresponding number of sections on the *H. T.* side, the *H. T.* line *P. D.* will be $n\,v\,(Y\sqrt{3} + D)$. Hence the ratio of transformation, or

$$\frac{\textit{H. T. line P. D.}}{\textit{L. T. line P. D.}} = \frac{Y\sqrt{3} + D}{y\sqrt{3} + d}$$

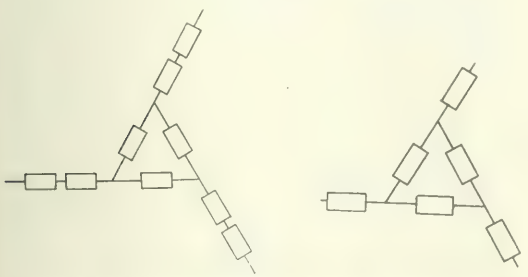
Consider the case of a transformer having two *L. T.* and three *H. T.* sections, the ratio from section to section being 5 to 1. If the *H. T.* coils be arranged as shown in Fig. 5 and the *L. T.* coils as shown in Fig. 6, $y = 1$, $d = 1$, $Y = 2$, $D = 1$, $n = 5$, so that

$$\text{ratio} = 5\,\frac{2\sqrt{3} + 1}{1\sqrt{3} + 1} = 22.3$$

If the *H. T.* sections be arranged as shown in Fig. 3 and the *L. T.* sections as shown in Fig. 2, $y = 2$, $d = 0$, $Y = 0$, $D = 3$ and $n = 5$ so that

$$\text{ratio} = 5\,\frac{3}{2\sqrt{3}} = \frac{15}{3.46}$$

When the high and low-tension sections are connected together,



FIGS. 5 AND 6.—[illegible]

arrangements such as that shown in Fig. 4, are obtained. In this case as in the last, line *P. D.* $= (y\sqrt{3} + d)\,v$, if only the *L. T.* sections are used. Now the *H. T.* sections each produces the same drop of potential as n *L. T.* sections. Hence, if both sets of sections are used, the line *P. D.* $= v\,[y\sqrt{3} + d + n\,(Y\sqrt{3} + D)]$

If such a combination be tapped at three symmetrical points nearer the center, the *P. D.* between these points may be obtained from the above formula if the quantities y, d, Y, D, are taken to designate the number of sections between the center of the combination and the points in question. An example of this is shown in Fig. 4. The *P. D.* between the points *A A A* is

$$v = 5\,(1\sqrt{3} + 3)\,v$$

because $y = 2$, $Y = 1$, and $n = 5$, while the *P. D.* between the points [illegible]

$$5\,(1\sqrt{3} + 3)\,v$$

as $y = 0$, $d = 1$, $Y = 0$, and $n = 5$. Hence the ratio of transformation is,

$$\frac{7\sqrt{3}}{5\sqrt{3}} = \frac{7}{5} = 1.4$$

A special case of this formula, namely that in which the *L. T.* and *H. T.* sections form simple stars and deltas, has long been used in the testing department of one of the great manufacturing concerns; but the ratios for compounds of stars and deltas are there calculated graphically. The simplicity and accuracy of this algebraic method recommends it as superior to the graphical method.

The Economic Design and Management of Telephone Exchanges—X.

By Arthur V. Abbott, C. E.

THE RELATION BETWEEN SUBSCRIBERS' DISTRIBUTION AND WIRE MILEAGE.

ATTENTION has already been directed to the effect of the distribution of the subscribers on the location of the central office, and it is now necessary to consider, in addition to the shape of the group of sub-stations tributary to the office in question, the density of the group, or the number of sub-stations, per unit of

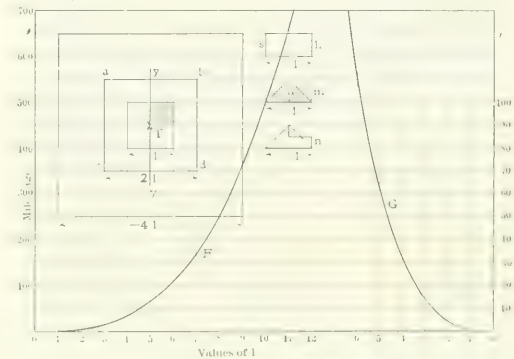


FIG. 21.—GROUPING OF SUB-STATIONS.

area; the way in which changes in density affect the cost of installation, and the complete relation between the shape of the group, its density and the necessary wire mileage to reach all stations. The simplest case is that of a group of regular geometrical section, such as a square, or circle, over which the sub-stations are distributed in uniform and regular order. Unfortunately, such a group never occurs in practice, but even the most heterogeneous arrangement may, by differentiation, be split up into sensibly uniform parts, and the results of reasoning applied to each differential will, when integrated, supply a solution for the whole area. Referring to Fig. 21, suppose the territory under consideration to be represented by the square *a b c d*, over which the stations are uniformly distributed. Let l be the length of one side of the square, then the area will be l^2, and if there are S stations per unit of area, the total stations will be Sl^2. The telephonic center will evidently be at the geometrical center of the figure, and as all stations are brought to the office by rectangular routes the best wire plant system will consist in building a main lead along a diameter of the area passing through the office, say, at *y y*, and bringing to this main lead all the sub-station lines, as shown by light black lines in the upper right-hand quadrant, and then carrying them to the office along the main lead. If l be the side of the square, it is evident by inspection that the average distance of all the stations from the main lead is $\frac{l}{4}$, and the average length of each line along the main lead is also $\frac{l}{4}$, hence the average distance of all sta-

tions from the office is $\frac{l}{2}$, and the total distance or circuit mileage of all stations is $S \frac{l}{2}$, [illegible] the wire mileage will be double the circuit mileage or $S l^2$, thus giving a very simple expression for the total wire mileage or *lineage*, as this quantity may for brevity be called in cases of the kind.

If a plane be imagined to be passed along $y\,y$, the distribution of sub-stations will be represented by the projection of this plane on the plane of the paper as shown at *II*, in which S represents to scale the sub-stations per unit of area and l the length of the section of the group. Suppose now the group to increase in size until l becomes $2\,l$, $4\,l$, etc., the area will be 4 times, 16 times, etc., as large as the orginal area, then the successive total circuit mileages will be found (by substituting $2\,l$, $4\,l$, etc., for l) to be $4\,S\,l^2$, $32\,S\,l^2$, etc., but in each of these expressions l is the length of the side of the original plot. As S or the number of stations per unit of area is a factor of the first power in the expression, any change in the station density will simply make a pro rata change in the wire mileage. The curve F given in Fig. 21 gives the relation between the total circuit mileage and the size of the territory covered. The vertical and horizontal scales must be read in the same units, thus if l is taken in miles, then the left-hand scale giving the circuit mileage must be read in miles, and the station density is to be taken in the same unit squared. For example, suppose a certain territory to be two miles square and to contain one subscriber per square mile, then from the curve four circuit miles or eight wire miles will be needed to reach these stations. Assume another group four 1000 ft. on a side, with one station per 1000 ft. square, then the circuit mileage will be 32×1000 ft., or about six miles, and the wire mileage about 12 miles. If S or the number of stations per unit of area be different from one, it is only necessary to multiply the mileage thus found by the value of S. Thus in the preceding example, suppose S to have a value of 5 per 1000 ft. square, then the needed circuit mileage will be $32 \times 1000 \times 5$, or about 30 miles. At the right hand of the sheet the curve G is a portion of the lower part of the curve F magnified five times for convenience in reading small value of circuit mileage.

Suppose now the shape of the group is that of a rectangle the sides of which are a units and b units, respectively, then the area will be $a\,b$ and the total number of stations $S\,a\,b$. If the main lead is built parallel to the side a, then the average circuit distance to the main lead will be $\frac{b}{4}$ and the average length of circuit along the lead $\frac{a}{4}$. The total circuit mileage will be $S\,a\,b\left(\frac{a+b}{4}\right)$ and the wire mileage $S\,a\,b\left(\frac{a+b}{2}\right)$. An expression of the same value is easily found if the main lead is built parallel to the side b, showing that either diameter may be used indifferently to give the same total wire mileage. An extension of the same reasoning may be applied to a group of any shape, though those which are, or those which approximate to the well-known geometrical forms, are easiest dealt with.

So far the reasoning has proceeded on the assumption that the density of the distribution of sub-stations was uniform over all the area under consideration. But this condition rarely if ever obtains, on the contrary, station density per unit of area is usually greatest near the telephonic center, and decreases with greater or less regularity towards the perimeter of the area. To consider the effect of a varying density return to Fig. 21, and again consider the square $a\,b\,c\,d$ to be the territory under consideration, but suppose the density to be a maximum of, say, h at the point T and to decrease regularly to the bounding lines in all directions. Imagine now, for the sake of obtaining a clear mental picture, that the stations are piled on top of each other all over $a\,b\,c\,d$ in proportion to the assumed density. This will give a solid of the shape of a regular four-sided pyramid, of which the base is the area $a\,b\,c\,d$ and the altitude is h, or the maximum station density. If a plane be passed along y, the section of the pyramid will be a triangle with a base l and an altitude h. The vertical lines or ordinates to the base l shown at m (Fig. 21), represent the varying station density, while the horizontal lines or abscissæ to the altitude of this triangle are proportional to the circuit mileage required to reach the several clumps of stations that make up the entire group and the product of all the ordinates and abscissæ will be proportional to the circuit mileage required to bring the stations to the office, or, in other words, to the area of the triangle. But this area is equal to that of a rectangle of the same base and half the altitude, hence it is proper to replace a non-uniform distribution by a uniform one of the same base and a proportional altitude and calculate lineage by the preceding method. So all forms or densities of sub-station groups may be reduced to equivalent simple areas and densities and considered accordingly.

The slightest inspection of the curves of Fig. 21 shows that the necessary lineage to reach sub-stations increases very rapidly as the size of the territory tributary to any office is augmented, the formula for mileage showing the ratio to be proportional to the cube of the side of the territory, and directly proportional to the station density. In formulating, therefore, the design of any telephone plant, the present and future, station density, and present and future area to be served must be carefully considered separately from each other. If further future growth is to take place by increments in density, the wire plant expense will increase pro rata with the density, while if growth in territory be anticipated, the wire plant cost will grow as the cube of the side of the original area. Ordinarily it is probable that there will be both an increase in station density and territorial expansion, though as telephone companies usually work within well defined boundaries, specified by franchise grants, such as town or city limits, the ultimate available territory is usually well defined and grows very slowly, only as fast as corporate limits are extended, yet it is rarely that a telephone company plans at its start to cover all territory included in its franchise.

THE AVERAGE LENGTH OF LINE.

If in any territory the total circuit mileage needed to reach all sub-stations be divided by the total number of stations a quantity is obtained that represents the *average circuit mileage* of each station from the office, or the average distance of all sub-stations. For a square group with uniform distribution the average mileage is by the previous discussion $\frac{l}{2}$, for a rectangle $\frac{a+b}{4}$. For all non-uniform station densities, the average mileage will be less than the preceding expressions, except in the extraordinary case of a density greater at the perimeter than at the center. Though average mileage is an implicit function of density and size of territory, its dimensions do not convey the slightest idea of either of these quantities, for a small exchange with low density may yield an average mileage either greater or less than a much larger one with greater density. While a theoretical investigation of total and average mileage is an interesting subject, the practical telephonist is usually more concerned in what *is* than as to *why* it is, and the actual determination of average mileage is an easy though somewhat laborious task. For an untelephoned town the most accurate possible estimate obtainable is made by plotting on a good map the location of probable sub-stations, and then making measurements, following streets, from the office site to all stations. As, however, a large number of cities possess telephone plants it is easy, by plotting from the telephone directory the location of all sub-stations, to calculate the average existing mileage with great accuracy. By thus tabulating from a large number of cities a valuable collection of data may be gained from which it is possible to prophesy with more or less accuracy the probable average mileage in a similar untelephoned town. There are, however, at present two perturbing influences, which should cause deductions from such source of information to be received and used with the greatest caution. The first of these disturbing causes lies in the rapid increase in the number of subscribers to all existing telephone plants. This increase arises partly from the natural growth of the business, partly from unprecedented prosperity and business activity in the whole country, but at present chiefly from a keen competition that stimulates all telephone companies to secure as many subscribers as possible, by all means in their power, thus incidentally lowering telephone rentals and bringing service within the reach of many who otherwise would not subscribe. From these causes it is safe to estimate that within ten years past the telephonic population of American cities has more than quintupled. The general effect of this increase in sub-stations is to decrease the average length of line, though this decrease is by no means proportional to the rate of increase in numbers. For with a diminishing telephone tariff, there is a tendency to build up the station density about the perimeter of the territory inhabited by the less wealthy classes, much more rapidly than in the center, where the converse holds true. Again, in many cities two competing telephone companies are established. There are some who subscribe to one company, some to the other, and some to both. While as a matter of fact it is easy to determine the actual average length of line by dividing the total wire mileage

by the total number of sub-station instruments, such a deduction is misleading, as telephonically two instruments at the premises of one subscriber are superfluous. With these reservations the curves shown in Fig. 22 may be considered as approximate indications of the probable average length of line to be expected. It is convenient to divide these curves into three groups: Those that apply to large cities having a population over 500,000, those for medium cities with, say, 200,000 to 300,000 inhabitants, and those for small cities, having 100,000 inhabitants or less. The curves *a b* and *c* apply to the first group. On the lower horizontal scale the number of sub-stations included in the office will be found, while on the right-hand vertical scale the corresponding circuit mileage in tenths of a mile is given. The curve *a* refers to the central portion of a large city, curve *b* to a part midway between the center and the outskirts, and curve *c* to the outer portion. The curves are used as follows: Suppose it be desired to find the probable length of line in the middle portion of a large city for an office of 2500 subscribers. On the lower horizontal scale find 2500, then follow a vertical until the curve *b* is intersected, then a horizontal to the right-hand scale reading .705 miles The curves *d, e* and *f* are similarly the data for the central, middle and outer portion of a medium-sized city, while the curve *g* applies to the center of a small city or a large town. To avoid confusion these curves are plotted to scales on the top and left hand of the sheet, which should be turned over to read the curves. It should not be forgotten, however, that these values apply only to *wire plant used*, and as a certain surplus must always be counted on, the curve

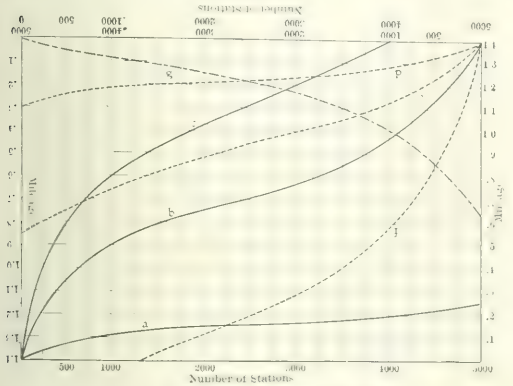


FIG. 22.—AVERAGE LENGTH OF LINE.

values must be multiplied by from 50 per cent to 100 per cent if they are used to indicate the probable plant necessary to install.

DECREASE IN LINEAGE BY SUB-DIVISION OF TERRITORY.

An inspection of the curves of Fig. 21 shows that if any given territory be sub-divided into several parts, and an office placed in each one, the sum of the wire mileage needed to serve all the stations in the sum of the parts, is much less than that required when the territory is treated as a whole tributary to one office. Thus, for example, a square territory divided into four parts will need one-half the mileage of the same area taken as a whole, and the question at once arises, why not sub-divide all territories into a large number of small offices? This at once introduces the great debatable ground in telephony, of one office versus many offices, over which the entire fraternity have from the beginning been divided into two opposing factions, and about which has been fought a long, wordy war, with here and there spits of bitterness, far more indicative of personal prejudice than of such a calm spirit of impartial evaluation of evidence as is demanded for the proper investigation of scientific or economic problems. Like many other controversies, however, this question resembles the old argument about the Druids Shield, for there are two entirely distinct, and totally different sides to it, and the controversants rarely take the pains to consider that the color of the other side may be entirely different from the one at which they are gazing.

There is on the one hand the economic or engineering aspect that considers only how to build and operate the best plant for the least money, while on the other is the standpoint of character of service rendered to the subscriber; a question belonging strictly to the general manager, being entirely foreign to the province of the engineer; unless, as is sometimes the case, a single individual attempts "Poo Bah" fashion to combine both offices. It is beyond cavil certainly that within reasonable limits the sub-division into several offices of a territory either containing a large number of stations or spread over a territory of considerable area, will decidedly cheapen both the cost of original construction and that of annual operation over the same territory designed on the one office plan. But it is equally *sure* that with this multiplicity of offices the *service* to the subscriber will be somewhat slower, and the percentage of errors increased. It is the province of the engineer to estimate as accurately as possible the probable cost of equipment and operation on both methods, and express an opinion as to the relative excellence of the service rendered by each. But here the engineering questions end, for it is purely a general manager's question to decide whether the difference in service is worth the cost thereof, and whether the finances of a particular company will permit the expenditure of the required difference in investment or annual expense. A precisely similar problem is presented in the determination of the kind of switchboard system to be employed. A well constructed magneto exchange is cheaper to install and maintain than a common battery system, but the service is not so pleasing nor effective. To telephonic engineering belongs the problem of estimating the relative cost of each, the determination of the kind of service each will give, and the successful installation of whichever system may be selected, in the cheapest possible manner consistent with good work. But the selection of the one to be used in a given instance is a general manager's problem, with which the engineer has nothing to do. In the succeeding paragraphs, therefore, it is proposed to detail the effect on cost of installation and operation of the sub-division of a given territory into several offices, and the effect of this sub-division on the service rendered, as compared with a single office, and leave the reader to form his own estimate of the relative value of these two incommensurable quantities—quality of service and cost of plant—for there is no common unit by which both can be measured, and this is the real root of all differences of opinion on this question. But first, however, it is necessary to exhibit the method of sub-dividing any territory into subordinate parts in such a manner as to demand the minimum wire mileage to reach all sub-stations in each division.

THE SUB-DIVISION OF A GIVEN TERRITORY IN ORDER TO MAKE SUB-STATION MILEAGE A MINIMUM.

In order that any territory may be divided into several subordinate parts such that the sum of the mileage in all the parts to their respective sub-stations shall be a minimum, two conditions must be fulfilled. These are:

Condition I.—The office in each division must be at the telephonic center of that particular division.

Condition II.—Each division line between each of the sub-divisions must bisect and be perpendicular to a line joining the telephonic centers of the two groups that it separates.

CONDITION I.

It has already been shown that for any arrangement of sub-stations a minimum mileage is secured by locating the office at the telephonic center. If any territory be sub-divided into a number of smaller parts, and the office of each part be located *away* from the telephonic center of that part, the mileage for this group will be greater than if the office be placed at the telephonic center. As the sum of all the parts can only be a minimum when each part is a minimum, it is only possible to secure this result by placing each office at the telephonic center of its own portion.

CONDITION II.

This condition requires that each division line between groups shall be perpendicular to, and bisect a line joining the telephonic centers of the adjacent groups. Let Fig. 23 represent any territory whatever with any distribution of sub-stations. Suppose this territory to be sub-divided into two parts, the telephonic centers of which are at A and B, and let $A\ B$ be any straight line joining these centers. Also let m_1 m_2 and m_3 be any sub-stations equidistant from $A\ B$. Let $a\ b$ be any division line drawn through the point midway between A and B. Then $A\ O + O\ m_1$ is equal to $B\ O + O\ m_1$ by construction and m_1 is equidistant from either A or B. Now, assume the line $a\ b$ to move in either direction to the points P or Q. Then $A\ O + O\ P + P\ m_3$ is greater than $B\ P + P\ m_3$ and $A\ Q + Q\ m_3$ is less than $B\ O + O\ Q + Q\ m_3$. Hence, any station to the right of $a\ b$ in its original position can be carried to B with less mileage than to A, and any one to the left can be carried to A with less mileage, also any station on

$a\ b$ can be carried indifferently to either office with the same mileage; therefore, the division line must bisect $A\ B$. Suppose now the line $a\ b$ to revolve about the point O till it intersects any station m_2, which is at the same distance from $A\ B$ as the station m_1. Since m_2 is on the dividing line it is immaterial to which office it is carried, for m_2 [illegible] A, $m_2\ O + O\ B$ is greater than $m_1\ O + O\ A$ or $m_1\ O + O\ B$, hence the only line which passes through O, all of whose points are at a minimum distance from A and B, is one which is perpendicular to $A\ B$.

This demonstration has not recognized the condition that all stations must proceed, rectangularly to the co-ordinate axes, to their respective offices. So *Condition II.* must be modified to read that all points on the lines of division between adjacent districts must be *rectangularly* equidistant from the adjacent offices. For, in Fig. 24, let A and B be the telephonic centers of two divisions of any district the lines of the paper standing for the street directions. Draw $A\ B$ according to *Condition II.*, the division line separating the two parts of the territory must bisect and be perpendicular to $A\ B$ at O. Stations, however, cannot reach A or B, save by routes that are parallel to $A\ D$ or $A\ C$. Therefore, the shortest available distance connecting the offices is $A\ C\ B$ or $A\ D\ B$. To determine the division line, therefore, it is necessary to bisect $A\ C\ B$, obtaining the point H, and



FIG. 23.—SUB-DIVISION OF TERRITORY.

$A\ D\ B$ obtaining the point I, and to erect the perpendicular $H\ G$ and $I\ K$. By inspection it is evident that all points on $G\ H\ O\ I\ K$ are equidistant rectangularly from either A or B. Hence this line will be the true division line separating the two parts of the district. All stations on the line may with the same mileage go to either office while all stations to the left must proceed to A and those on the right to B.

This condition of rectangular measurements leads to a special case when the telephonic centers are so located that the separating line joining them is at 45 degs. with the co-ordinate axes. Refer to Fig. 25, in which A and B are the respective telephonic centers and $A\ B$ the line joining them is 45 to the lines of the section paper representing the street directions. Then $f\ A\ e$ and $f\ B\ e$ are the shortest rectangular routes between the two office locations. These lines must be bisected to determine the direction of the division lines and the bisecting points will lie at the points e and f, the diagonal corners of the quadrilateral $f\ A\ e\ B$. At the points e and f draw the perpendicular $e\ x\ e\ x'\ f\ x''$ and f''', including the spaces $x\ e\ x'$ and $x''\ f\ x'''$. From inspection, all the stations within these areas can be taken indifferently, to either A or B, while the stations in the space $x''\ f\ A\ e\ x'$ must go to A and those in $x\ e\ B\ f\ x'''$ to B.

Ordinarily speaking, compliance with *Conditions I.* and *II.* is sufficient to sub-divide any territory as may be desired, but it is conceivable to imagine such a distribution of stations as would permit the fulfillment of these requirements when the position of the division lines is indeterminate, or could exist under the specifications given in more than one location. Therefore, for strict accuracy, some criterion is needed whereby it is possible to discover if desired,

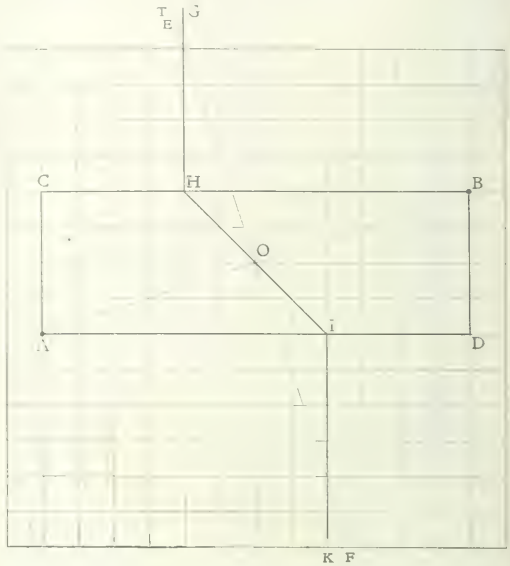


FIG. 24.—SUB-DIVISION OF TERRITORY.

which of several possible locations of telephonic centers and corresponding division lines that all fulfill the preceding conditions, will yield the desired minimum mileage.

In Fig. 26 let $A\ B\ C\ D$ represent any territory with any station distribution, the lines of the paper representing the street directions. For simplicity assume the district to be divided into two parts of which the telephonic centers are P_1 and P_2, and let $E\ F$ be the di-

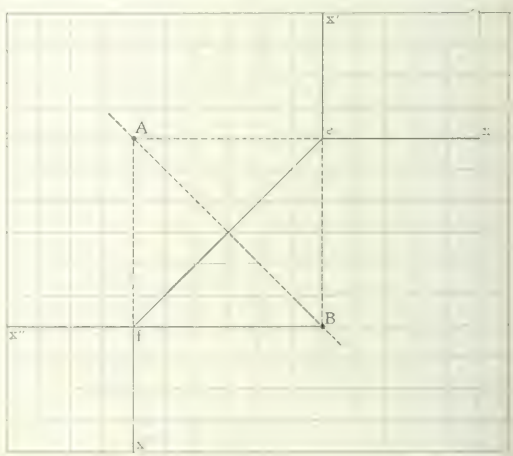


FIG. 25.—SUB-DIVISION OF TERRITORY.

vision line between them according to *Conditions I.* and *II.* Suppose some other location of this at, say $E'\ F'$ would also carry out the conditions. As the line $E\ F$ moves to its new location $E'\ F'$, it will cross a certain number of stations which may be denoted by R; so when it has arrived at $E'\ F'$ R stations will have been transferred from the office at P_2 to that at P_1. But the law of telephonic center location requires an equal number of stations to be on each side of a

line drawn through the center parallel to the co-ordinate axes, and P_1 and P_2 were so located.

If, now, R stations have been taken away from P_2 and added to P_1, this equality is destroyed and P_2 and P_1 must be moved in the same direction as $E\ F$ till each has crossed $\frac{R}{2}$ stations. To accomplish this, suppose P_1 to move C units into P_1' and P_2 to move b units to P_2'. Let $G'\ H'$ and $M'\ N'$ be the respective new axes of Y through the new telephonic center at P_1' and P_2'. Let X_1 and X_2 be, respectively, the average abscissæ of $\frac{R}{2}$ stations from $G\ H$ and $M\ N$, and m the average abscissæ of R stations from the line $E\ F$. Let l_1 and l_2 be the distances of $E\ F$ from P_1 and P_2, respectively. Let S_1 and S_2 be the number of stations in office P_1, and office P_2 and L_1 and L_2 the

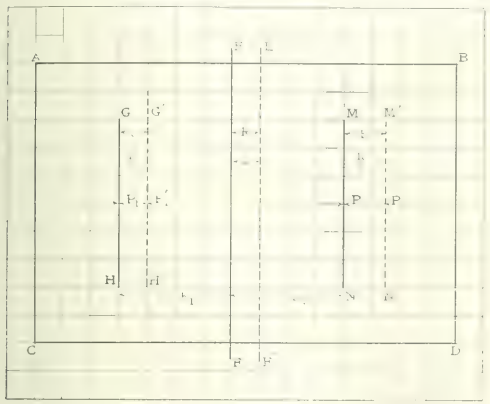


FIG. 26.—SUB-DIVISION OF TERRITORY.

average abscissæ in each division. Then $S_1\ L_1$ and $S_2\ L_2$ will, respectively, be the sum of all abscissæ in each division.

When $G\ H$ moves to $G'\ H'$ all stations on the left of $G\ H$ have their lines increased by an amount C. Those on the right of $G\ H$ have their lines decreased by C. While $\frac{R}{2}$ stations crossed by the moving line have their abscissæ changed by an amount $C - 2\ x_1$. Similarly it is easy to show the change in abscissæ in office P_2. As the line $E\ F$ moves to $E'\ F'$ R stations are changed from P_2 to P_1. Originally, these stations had abscissæ represented by $R\ (l_2 - m)$. When transferred to office P_1' their abscissæ will be $R\ (l + m - C)$. It is now easy to calculate the sum of the abscissæ in the two parts of the given territory both before and after the division line is shifted. The sum of the abscissæ *before* the line moves is $S_1\ L_1 + S_2\ L_2$. The sum afterwards is $S_1\ L_1 + S_2\ L_2 - R\ x_1 + 2\ R\ m - R\ x_2$. Subtracting the latter expression from the former there remains the quantity $2\ R\ m - [R\ x_1 + R\ x_2]$. This is the difference in mileage caused by the movement of $E\ F$ to $E'\ F'$.

Considering this expression, so long as $2\ R\ m$ is greater than $R\ x_1 + R\ x_2$, it has a real positive value indicating that there is an increase in mileage by the movement of $E\ F$, and that the original location of this line is the preferable one. When $2\ R\ m = R\ x_1 + R\ x_2$ the expression reduces to zero, showing that the new location has made no change in the value of the sub-station abscissæ, while if $2\ R\ m$ is less than $R\ x_1 + R\ x_2$, the expression has a negative value proving that in the new position the sub-station distances are decreased, and the arrangement of groups improved. $2\ R\ m$ represents twice the sum of the distances of the sub-stations crossed by the moving division line measured from its original position. $R\ x_1$ and $R\ x_2$ represent the sum of the distances of the sub-stations crossed by the axes of Y in each case as they move from P_1 to P_1', and from P_2 to P_2', also measured from the original location. The criterion is, therefore, deduced that when twice the distance from the original position of the division line to sub-stations crossed by it as it moves, is greater than the sum of the corresponding distances of the sub-stations crossed by the co-ordinates through the several offices as they move, a change in the location of the division line is detrimental.

If the most complete and exhaustive analysis be desired the expression $R\ [2\ m - (x_1 + x_2)]$ may be used to determine the effect of moving a division line over an entire territory, thus ascertaining the effect on sub-station lineage of every possible position of the line. If for successive points the value of this expression be plotted, a curve is obtained giving the relation between sub-station lineage and location of divisions between offices. It is conceivable that several minima could, under some circumstances, be found from which the best one could, by inspection of the curve, be discovered.

By applying the same process to the other co-ordinate axis, and combining the results of both analyses, the effect of every possible sub-division may be plotted. At first sight the process appears formidably laborious, and there is no gainsaying that to secure valuable results considerable time must be expended, yet with a good map, a square arranged to slide rectangularly over it, whose edges are graduated to read directly in wire mileage, and an adding machine, it is surprising how fast a skillful operator will sub-divide a district. Again, exchange sub-division is chiefly of value to large and telephonically very populous territories, where the saving of a very small wire mileage on each of the lines of many thousand stations may aggregate a very handsome return on a few weeks' labor in the drawing room.

Practically the process is much simpler than the theoretical description would indicate, for provided with a good map on which stations are plotted, and armed with a fair local knowledge of the various business interests of the territory the skillful telephonist will, by inspection of the map, pick out the approximate groups into which the whole territory should be divided in a general way. The telephonic center of the subordinate groups may then be quickly located and the boundary lines sketched in accordance with *Conditions I.* and *II.*, and the wire mileage to all stations calculated. For a large territory it is usually best, for reasons to be subsequently recited, to make several sub-division designs, and compare the several wire plant expenses with each other; therefore, for any city of, say, 500,000 inhabitants, it is well to make four or five trial sub-divisions splitting the territory into, for example, four, six, eight and ten groups, and plotting a resulting curve of the relation of sub-station mileage.

Every time that a subordinate group in any given territory is sub-

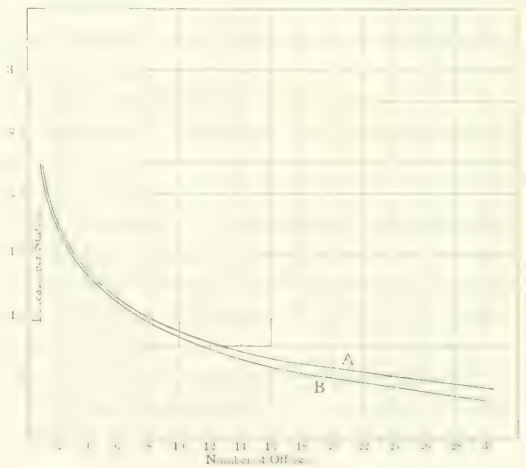


FIG. 27.—CURVES OF SUB-STATION MILEAGE AND NUMBER OF OFFICES.

divided the process of division slightly reacts on all other groups, so for strict accuracy, it is necessary after any group is split, to correct the boundary lines and telephonic centers of all others, but practically this error is too small to be entertained. To illustrate the process of finding the curve of sub-station mileage and number of offices, together with the effect of probable error when the mutual adjustment of boundary lines and telephonic centers referred to is neglected turn to Fig. 27.

The curve B gives the relation between the number of offices and average length of sub-station lines in a hypothetical territory resembling an average city of 500,000 inhabitants. The number of offices varies from one with an average sub-station mileage of 2.25 to 30

with an average mileage of .30. In this case all the corrections have been made. Curve *A* is plotted without adjusting adjacent boundary line and telephonic centers when a sub-division is made. The failure to make this adjustment returns results that are somewhat too high For four offices the unadjusted curve is one-twentieth of a mile, or about 3.75 per cent in error. But for 30 offices the error is about 27 per cent, but it is not possible to give a general error curve applicable to all territories, it is best to use the uncorrected mileages for the various trial sub-divisions, and when the actual number of offices is finally selected to carefully adjust all boundary lines and telephonic centers to each other.

The First Convention of the Interstate Independent Telephone Association.

INDEPENDENT telephone men from the states of Illinois, Indiana, Iowa, Wisconsin, Michigan, Kentucky and Missouri met at the Sherman House, Chicago, April 9, 10 and 11, 1902, for the purpose of organizing the Interstate Independent Telephone Association. At a preliminary meeting, held in Chicago in January, 1902, by a few independent telephone men from the states named above, a committee was appointed to take charge of getting together a convention of telephone men from the seven states surrounding Illinois. This committee consisted of Messrs. H. B. McMeal, J. J. Nate, I. A. Lumpkin, S. A. Dinsmore and W. E. Burke. This committee had practically the entire responsibility for the convention arrangements.

The first half day of the convention, Wednesday, April 9th, was devoted to registration and the issuing of credentials. In the afternoon, Dr. I. A. Lumpkin, of Mattoon, Illinois, who has always taken a prominent part in independent telephony in Illinois, called the meeting to order, and made a brief address, relating some of the things which led up to the calling of the present convention for the purpose of forming a permanent organization. In conclusion, he said: "What is the object of this meeting here in Chicago to-day is a question I have often been asked. It is simply a meeting in the mutual interest of the states here represented, and to bring them into closer alliance one with the other, to the end that these meetings may be the cause of forming some plan whereby long-distance toll lines may soon be built from Chicago to the several states represented here to-day, for it is a fact that these public gatherings attract the attention of the public, and, like the press of our country, have much to do with the forming of public sentiment, and in this way it is possible to reach the ear of the mayor and city council of this city and obtain a franchise, after which the money would soon be raised to build an exchange in this city."

The convention then adjourned until Thursday morning.

The Illinois Independent Telephone Association met Wednesday afternoon following the Interstate meeting, and elected the following officers: President, Milford Savage, Champaign; vice-president, E. M. Harwood, Shelbyville; secretary, L. C. Schwerdtfeger, Lincoln; treasurer, G. M. Hughs, Hume. A committe was appointed to draft amendments to the constitution. This committee consisted of E. D. Glandon, Pittsfield; B. F. Wasson, Clinton; P. M. Warner, Rossville. The time and place of the next meeting was left for the president and secretary to decide.

Wednesday evening the telephone exchange owners and operators, and as many manufacturers as could be accommodated by the 500 seats at the Sherman House banquet room, sat down to a banquet, tendered by the telephone manufacturers and supply houses and the electrical press. Besides the main banquet for the men, the ladies—wives and relatives of the telephone men attending—had a banquet in an adjoining room. Mr. J. J. Nate acted as toastmaster, and Mrs. Geo. A. Briggs as toastmistress.

Thursday morning Dr. Lumpkin again called the Interstate Convention to order, and resolutions were passed that each state name two members of a committee to select a president, secretary and treasurer. This committee reported at the afternoon session.

The "Future of the Business Part of Telephony" was taken up by C. F. Bennett, of Waterloo, Iowa. After touching on the methods of financing a modern telephone plant, Mr. Bennett said, in part: "The trend of methods of charging is not clearly seen yet. In one locality flat rates prevail, and in some foreign countries this seems to have stood years of competitive influence. In other localities the tendency is to measured service, which likewise, in Europe, has its supporting argument. I can see equity in neither. A minimum flat rate is necessary in order to warrant an extension of the service on the measured rate plan. By this, I would suggest a charge of a low flat rate for private telephones for a corresponding low measured per message-rate, and a percentage of the latter to go to the one who pays the former and co-operates to increase the latter. I fear this is the outcome, and I say 'fear,' for it will be a costly one which should be long anticipated. Telephone business in the future will have many subdivisions. I am wondering what features will be their outlines. Will they be municipal or commercial? Governmental influences may in the future reach as far as ownership. Certain it is, they will effect some of the following changes: Remuneration for use of public ways, supervision of franchise rights, investigation of standard methods of construction to require quality of service, restriction of tariffs and supervision of competition. These will harm little and help much to those who see farthest into the coming work. From the fact that the general questions rising between connecting companies will come prominently before this association, I omit the extended discussion and will only say that we should be guided by the experience of the railway companies, and quickly find that we must deal with each other, remembering that the most dangerous method of doing good is to give more than value received. Regular balances between companies are the greatest bond of friendship I have known."

"The Telephone Situation in Wisconsin" was reviewed by Richard Valentine of Janesville, Wisconsin, of which the following is an abstract: "From conversations I have had with telephone men from other western states, I conclude that the telephone situation is the same in Wisconsin as elsewhere; that is, the business is growing beyond all expectations. We have in our state 176 independent telephone companies. Statistical reports received from a majority of them and a fair estimate of the balance shows:

Copper metallic toll lines	200 miles.
Iron metallic toll lines	3,000 "
Iron-grounded toll lines	4,000 "
Toll stations	650 "
Telephones in use	23,000 "
Invested capital	$2,316,875

"Of this $366,975 is represented by 16 companies that have been incorporated since Jan. 1, 1902.

"Much of the growth has been within the last three years. One of the most encouraging signs of the times is the rapid growth of the farmers' lines. They are going up in all parts of the state, and the construction is mostly complete metallic circuit. We find the farmers to be our most enthusiastic customers, and it is a business we will do well to cultivate. What independent telephony in Wisconsin needs most is an exchange in the cities of Milwaukee and Chicago and a system of copper toll lines to connect up our system. The status of the independent franchise ordinance in Milwaukee was briefly discussed. Efforts of Bell interests to make working agreements with independent companies throughout the state were described, and the making of such agreements condemned." In concluding, he said: "In my opinion, the weak point in the independent telephone movement is in the great multiplicity of small companies, and I believe the time is not far distant when a movement for the consolidation of the small companies in each state will be adopted. Consolidation would bring us economy in management, economy in the purchase of supplies and economy in construction. Under the present condition many small companies can be said to have no management whatever beyond an operator and the lineman. They are, therefore, the prey of cheap instruments, the dealer in common fence wire, and the vendor of bean poles, who tells them 15 poles to the line is sufficient for any telephone line. With only one company in each state, we would have first-class instruments and the best of construction. We would have first-class copper toll lines and all the good things we long for. How this consolidation is to be brought about, I will leave that to your consideration, but that it is to come in time I have not the least doubt."

"The Future of the Independent Telephone Movement from the Operators' Standpoint" was the subject of a paper by H. C. Rainey, of Fairfield, Iowa, of which the following is an abstract: "The development in the independent telephone business has been one of the most remarkable movements in the business world in the last decade. Twenty years ago the independent telephone in a commercial way was wholly unknown, and it is only within the last ten years that the movement began to assume any importance. The business had its foundation in the necessities of the people. I wish to call your

attention to the telephone proposition from the standpoint of men who have invested in independent exchanges and toll lines with reference to future probabilities and possibilities. Whether we consider the amount of capital invested or the service rendered, the growth of the independent exchange and toll business is most wonderful. Almost every village and every neighborhood enjoys the blessings of the telephone. At the present rate, but a few years will elapse before the telephone becomes as much a part of the home as a table or a stove. The remarkable and growing demand for the telephone is at once the guarantee for a prosperous future for the business, and at the same time the most dangerous element in the business. It is a sure guarantee because it is the proof of a demand that must be supplied. Its danger lies in the fact that people are almost wholly ignorant of the laws that govern the business. They are ignorant because the business is only in its beginning and the laws governing it are not yet developed, and because the business itself is not governed by the rules that govern any ordinary business. This has led to a most serious difficulty. A great mass of the people have become possessed of the idea that telephone service can be obtained for almost nothing, and for that reason they are disposed to make demands for a low-priced service that cannot be complied with. The great reduction in price made by the independent companies from the old Bell rates may have something to do with the people getting such ideas, but I think the most potent factors in bringing about this condition of affairs have been the manufacturers of cheap telephones who have sought the farmers' trade, and led him to believe that any kind of a telephone and a fence wire would make a first-class telephone system, and a farmer finding that by this system he can carry on a conversation with his neighbor a quarter of a mile away has accepted the idea and is acting accordingly.

"This condition constitutes one of the greatest dangers that the operator has to face. He has invested his capital in his exchange and small toll-line system, and because he will not give some set of farmers the free and unlimited use of the same, they proceed to build parallel lines and ask for a franchise and start a competing exchange. I think that time and experience on the part of the farmer will evidently remove this trouble, but in the meantime it may have financially wrecked the small operator. If the independent companies engaged in the business will take a stand together and refuse connection to all companies except on strictly business principles, the evil will be greatly minimized. It, of course, follows that the larger and stronger the independent companies engaged in the legitimate business become, the better they will be in control of the situation. This brings us to what, in my judgment, is one of the urgent things of the future in our business; that is, a consolidation and a larger community of interests in our companies. I believe this must come along the lines of clearing house association and long-distance telephone companies made up of small independent companies.

"The long-distance toll line is one of the recognized things of the future. I do not mean the lines hundred of miles long, but lines covering a distance of 25 to 150 miles. It is a recognized fact that at least four-fifths of the so-called 'long-distance' business is done within a distance of 100 miles. One of the best means of solving the long-distance question is improved construction and equipment. Business men, especially, will soon learn that they cannot get good service except for fair compensation, and will also learn that poor service is dear at any price, and in view of these facts the future of the independent telephone business is largely what the independent telephone men see fit to make it. Their fate is in their own hands. We no longer have anything to fear from the old companies as to infringement of patents. One of the dangers that will require our attention is the matter of hostile legislation. If there is anything we should avoid it is asking for too much legislation supposed to be in our favor. What we need is to carefully guard what we have, rather than to ask for more. Telephone securities and income are less affected by hard times than any other form of public service company securities. The outlook for the coming year is brighter than at any time in the history of the telephone business. Reports from every section indicate an enormous growth. In the prosperity we enjoy as a country the telephone business will receive its full share."

"The Telephone Situation in Indiana" was the subject of an address by L. Frazee, of Connorsville. He said that to-day the paramount issue in the independent telephone situation differs widely from that of the past. The past was a fearful struggle against the great and powerful enemy. Some of the adversities of the earlier days of independent telephony were related in an interesting and amusing way, and the beginnings compared with the magnificent developments of to-day. The Indiana field, which the Central Union Telephone Company has been developing for more than twenty years, now supports, Mr. Frazee said, 19,000 Bell telephones, according to Central Union claims. In the same state he gave the number of independent telephones as 65,000. There are some 25 counties in the state with no Bell exchanges. There are not more than six county seats which the Bell telephone has exclusively. In most of the cities where there are two companies, the independents have three or more telephones to one of the Bell. In Mr. Frazee's own county and the immediate surrounding counties there are in operation approximately the following number of telephones:

	Central Union. (Bell.)	Independent.
Fayette County	160	660
Franklin County	...	195
Union County	...	128
Wayne County	325	2,050
Henry County	325	900
Rush County	125	500
Total for 6 counties	935	4,433

"While we are disposed to congratulate ourselves over these results," he said, "should we stop here? Are the Independents in any county of those mentioned keeping abreast with the demands? They certainly are not. The more telephones that are installed the greater the demands for the others. When will this stop? Who can tell? It seems it will continue until every person who can afford it will have a telephone. This brings us to the present paramount issue. How are we to conduct this business at a fair profit? We all know that the more on an exchange beyond 100 or 200 telephones, the more it costs to install a telephone and operate it. Small is the exchange with the minimum cost of installation and operation. Now, where is the exchange that has been built that will not grow to four or five times as large as is contemplated? The lines must average longer. Those originally built in turn must be made metallic. There must be more cable. In many instances overhead work must be changed to underground, the old switchboard discarded and the one costing more per drop installed; the larger exchanges must be changed to central energy. Labor and most materials are at least 25 per cent. higher than they were four years ago, which still further complicates matters. Here comes our good brother farmer of Indiana (and no doubt of other states) some distance from the city exchange; building his own lines like mushrooms springing into existence between two days; using home timber, any kind but the right kind; using wire, and it is of the quality called fence wire; installing his telephone complete for $25.00, not counting his work (and it is right that he should not count that) (laughter), and operating his system on 25 cents per month per telephone. Now he comes in the form of a committee with powers plenipotentiary, and meekly informs you that it will be to your interest to give him free connection with your exchange, or at least some proposition that is not feasible in view of operating an enlarged exchange.

"The most of us must face this proposition, and we who feel that we have successfully met the Central Union Telephone Company, have problems yet to solve. If you give it the same study and give it the same zeal, there is no doubt of a successful outcome. My personal view is that the city exchange should own all the lines for at least five miles from the exchange. If service is needed farther than that, and farmers or villagers, or both, build an exchange then run a circuit, or more than one circuit if necessary, and charge each of the subscribers 50 cents a month for your entire exchange. As a general proposition, I believe a farmer should have the privilege of talking to his county seat without paying toll. The telephone is a great blessing to the farmer, and its use to him should not be restricted by charging him toll for reaching his court house, his lawyer, his physician or his market. This line of the business, as well as other lines, should be conducted on a carefully studied basis, which will pay a fair profit, giving the farmer the unlimited use of the service. Our own plan of building farmers' lines is as follows: We furnish all material and do the work except that the farmers haul the poles, dig the holes and assist us in setting the poles. We use 20 and 25-foot poles, 32 to the mile. We build a metallic circuit of number 12 steel wire, and use long cross-arms, spreading the wires Western-Union style. The wires widely separated reduce crosses,

thereby having your 'phone get out of order less often and reducing maintenance. We put from five to eight 1,600-ohm 'phones on a line. We have one selective signal line, it having been in operation about eight months so far. However, we do not consider it a success, as we have more trouble with it than regular bridged 'phones, and find it much harder to locate trouble on this line. Our rates to farmers are $15.00 per year in advance, or $4.50 per quarter in advance, or $1.66 per month for any rental in arrears. We feel that we can maintain good service at these rates, and doubt if good metallic service can be furnished for a number of years, at a profit, at any less rate. After all we should keep in close touch with our patrons, and give careful attention to their wants. The crime of the Bell Company has been utter disregard of this. This caused the birth of independent telephony, and we should not be unmindful of this fact." Mr. Frazee expressed himself as against measured rates for conditions as found in Indiana.

The Thursday afternoon session was opened by the report of the committee to select officers, which resulted in the election of H. C. Rainey, of Fairfield, Iowa, as president; Dr. I. A. Lumpkin, of Mattoon, Ill., vice president; E. M. Coleman, Louisville, Ky., secretary, and W. H. Harper, of Madison, Wis., treasurer.

"Public Confidence in the Independent Movement," was next discussed by E. R. Conklin, of Aurora, Illinois. He outlined some of the necessary elements which should characterize independent operations. "We are not in the position of a mariner without a compass, but on the contrary, have a more or less thoroughly tested chart with the true, steady, unerring index of public sentiment to keep us in our course. The chart referred to is the history of the Bell Company. By reference to it we are able to avoid the hidden rocks which have proved so disastrous to its popularity. The answer to the question, 'Who needs telephones?' is, every business man, whether professional, merchant or farmer. The wants of none of these can be disregarded. One of the pioneers in the independent telephone field once made a standing offer that he would pay $100 per telephone for every telephone in one of our most thickly populated states that could have been proved to have been in a farmer's residence on his farm before 1894, or before independent telephone companies began giving service. He said the bold proposition had never cost him a cent, because no farmer had a telephone prior to that date. Now, thanks to the independent movement, this condition has changed, until at present thousands of farmers in every State have them in their homes, and, who needs a telephone more than the farmer who is so far off from the telegraph and telephone stations, post office and family doctor, say nothing of his social isolation? Who of all classes has any greater need of the telephone? As to the method of supplying customers, the former Bell custom was to establish just as few exchanges as possible, and to charge the subscribers so high a rate that only a small percentage of the people could afford a telephone. Let us not venture by these rocks, but rather let us establish ourselves on a more liberal basis and give every subscriber the highest telephone service known to the arc. It is true that where lines are extended in the rural districts for several miles, it becomes necessary, in order that the service may become popular and of real use to the community, that party lines should be resorted to in order to bring the service within reach of the average farmer. Somewhere between the extortionate price charged by the Bell Company and a price so cheap as to be unremunerative is a point where the volume of business at a fair profit will net the largest profit upon the investment, and this is the point to be sought. Right along this line I wish to say the mistake is just as liable to be made of naming a price that is too cheap as of making it too high. A business man is willing to pay a living, profitable price for our stock in trade—telephone service." Mr. Conklin then briefly touches upon the enormous present growth in the telephone business and the importance of more and better toll connections for all companies.

At Friday morning's session, W. H. Crumb, of Chicago, read a paper on "Telephone Construction," which took up, in detail, matters of outside construction. The constitution of the association was read and adopted, the states finally included in the association being Illinois, Iowa, Indiana, Michigan, Ohio, Kentucky, Missouri, Minnesota and Wisconsin.

In the afternoon of Friday, Mrs. Anney McElroy Brett, of El Paso, Tex., president and general manager of the Southern Independent Telephone Company and the Brett Telephone Construction Company, made a short address, advocating an education of the public as regards cost of telephone service with increase of number of subscribers.

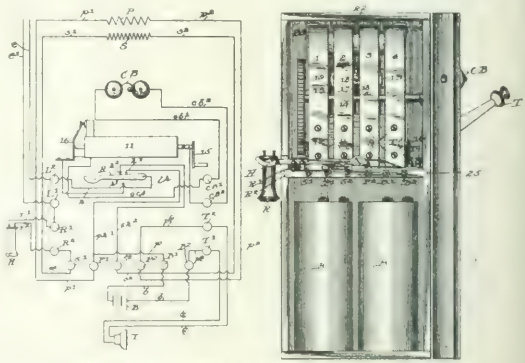
Dr. H. S. Herr, of Ottumwa, Iowa, read a paper on the "Cost of Construction and Maintenance of Telephone Plants," in which his estimate of depreciation as ten per cent. per year was criticized in the discussion which followed, as too high. Later a resolution was passed, that it was the sense of the association that the depreciation on a well-constructed and well-engineered telephone plant should not exceed five per cent. per year.

There were present about 250 independent telephone exchange owners and operators from outside of Chicago.

New Telephone Patents.

The issue of April 1st contained no patents relating to telephony. In the case of some telephone patents one has read, the appropriateness of omission on such a date would be in doubt. Telephone patents have been neither very numerous nor strikingly novel during the past few weeks, the issue of April 8th contains two only, and when people come to take out patents on telephone sets it would almost look as if the well of telephonic invention were suffering from a temporary drought.

Mr. James G. Nolen, of Chicago, patents a combination telephone instrument, in which "a call-bell generator, a bell-ringer, an induction-coil or transformer, and the switch-hook are all combined and constructed in one integral self-contained unit," which is hardly such an unusual arrangement of a telephone set as to warrant an application to the Patent Office for protection. "The object of the invention is *to improve the quality of each of the different instruments* combined in the single unit by virtue of this construction, and to so combine the associated instruments composing a telephone set in one construction



FIGS. 1 AND 2.—NOLEN'S COMBINATION TELEPHONE.

as to avoid the necessity of making complicated electrical connections at the time when the instrument is placed in service, all of the connecting binding-posts being placed in accessible positions upon the insulated base upon which the instrument is mounted." The italics are ours. To improve the quality of each of the different instruments by virtue of combining them in a certain mechanical manner sounds a little like modern magic. Fig. 2 gives a general idea of Mr. Nolen's improved telephone set. The binding-posts are mounted on the insulating base 25, each of the instruments in the set, even down to the switch-hook, being wired to its set of binding-posts, as shown in the diagram of connections, Fig. 1.

An addition to the army of three-wire party-line systems is contained in the patent granted to Mr. William E. Pembleton, of Wittenberg, Wisconsin. This system does not provide for selective signalling nor automatic switching nor any of the usual objects aimed at by three-wire party-line system, its object being to "eliminate resistance of the coils of the call-signal magnetos from the talking-circuit of an electric telephone system," to provide means for testing the line at any station to discover whether it is busy or not, and means for automatically signalling on the line the cutting in or out of any station. Mr. Pembleton has worked out a fairly complicated arrangement of apparatus and circuits for accomplishing these objects, referring to Fig. 3, lines *A* and *B* are the talking circuit, and *B* and *C* the signalling circuit, though the generators and ringing-keys

are so wired that calls can be sent over lines *BC* or *BA*. At the subscribers' stations, lines *BC* are short-circuited and *j' j'* when the hook is up, cutting out the signalling apparatus. The hook is prevented from rising when the receiver is taken off by the pivotted latch *M*, to be swung aside by hand when desired; the receiver is then in bridge across lines *AB*, the bridge containing also battery *M* and ratchet contact breaker *N*. On turning the ratchet a series of clicks will occur in the receiver if the line is closed at another station, but there will be no sound if the line is open, and therefore free. The hook *H* carries a bent arm *H'*, having two wedges or shoulders *q q'*, the lower of which, *q'*, has insulation on the lower surface; when the hook is allowed to move up *q* and *q'* make contact

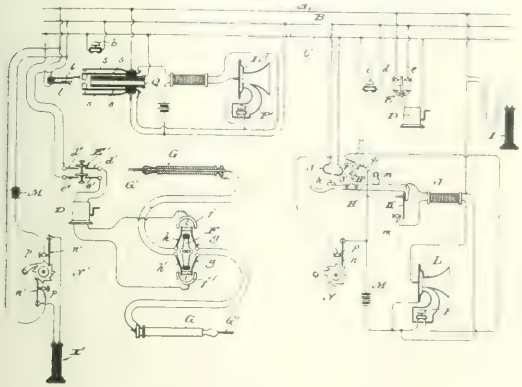


FIG. 3.—PEMBLETON TELEPHONE SYSTEM.

with spring *r*, thus closing twice in succession the circuit containing attery *M* and audible signal *P* attached to the transmitter, giving a double signal on the line indicating a station cutting in. When the hook moves down only *q* makes contact with *r*, the lower surface of *q'* being insulated, and a single signal is given, indicating a station cutting out. So that a station cannot cut in or out without giving a distinct signal of each operation, audible to those using the line.

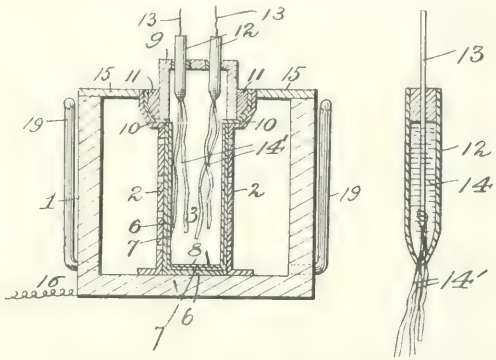
The arrangements at the central office shown on the left of the diagram give similar results. The generator *D* is wired to key *E'* for ringing on line *BC*, and to key *F*, by which either plug may ring on line *AB*. As the call-bells and signals *cb* are shown wired to *BC*, it is not clear why signalling current is wanted on circuit *AB*. The vibrating contact busy-test circuit is the same as at the sub-station. The automatic signal of cutting in is given by means of closing springs *s's'* on springs *SS* when the plug is inserted in the jack *Q*. The plug makes a similar contact on being withdrawn. Besides its normal tip, which is solid with the sleeve, the plug has an abnormal tip or pin which makes contact with the rear spring *t* of the jack, and so connects to the line *A*. On the whole, while considerable ingenuity is shown in the arrangement of circuits and apparatus, this system can hardly be considered the last word in party-line methods.

Electrolysis of Brine.

An electrolyte cell recently patented to Frank McDonald, of Rumford Falls, Maine, and designed for the production of chlorine and caustic soda from brine, belongs to the type rendered familiar by the early constructions of Le Sueur, and the later forms of Hargreaves and Moore, in which a perforated cathode is employed as a support for the diaphragms which enclose the anode compartment. In the later forms above mentioned, the cathode compartment has been empty, and the alkaline solution has been permitted to gravitate freely from the cathodes; in the Le Sueur cell the cathode compartment remains filled with the caustic solution, and the hypochlorites which result from the diffusion of this caustic into the anode cell, are decomposed by the graduated addition of hydrochloric acid. The device now patented operates upon the Le Sueur principle, and is therefore to be considered as a modified form of this cell. The anode is formed of a number of platinum wires or ribbons, fused into a glass tube and contacting therein with mercury, through which the electrical connection is made. Aside from the radial arrangement of the platinum ribbons to adapt them for use with a horizontal cathode, this is precisely the form heretofore described by Le Sueur and patented to Carmichael.

The cell is illustrated herewith, in cross sections through the three compartments, in Fig. 1, Fig. 2 showing the anode in detail. The iron tank 1, is divided by perforated iron cathode plates 2, suitably flanged, into three compartments, of which the central, indicated by 3, contains anodes 14'. The diaphragms comprising layers of asbestos cloth 6, faced with asbestos paper 7, are supported by the cathode. The cover 9 of the anode cell is sealed by cement 11, into the upper flanged portion of the cathode plates, and the anodes are supported by this cover. A bed of cement 8, covers the bottom and end walls of the anode compartments and protects the iron from the action of the electrolyte.

The lateral or cathode compartments are likewise tightly covered, as at 15, and are provided with suitable induction pipes for water and with eduction pipes 19, arranged to draw the caustic from the bottom of the cell. The anodes comprise a glass tube 12, into the



FIGS. 1 AND 2.—SECTIONS OF CELL FOR ELECTROLYSIS OF BRINE.

lower end of which platinum ribbons 14' are sealed; the anode conductor 13, contacts within the tube, as do the ribbons, with mercury 14. These ribbons constitute the working anodes and hang freely in the vicinity of the diaphragms.

The chief departure in this cell from the Le Sueur type is the substitution of vertical perforated plate cathodes for the inclined bed of wire sponge originally used; the changes involve both the structure and position of the cathode, and both are distinct advances in that they facilitate the free escape of the liberated hydrogen.

The Kelvin Reception.

Matters have advanced very favorably for the reception to Lord and Lady Kelvin by the American Institute of Electrical Engineers and other technical societies, at Columbia University, on April 21. The committee, of which Prof. Crocker is chairman, has been working very hard and successfully, and the present indications are that between 2,000 and 3,000 people will attend, including chiefly members of the societies and a large number of distinguished guests, as well as many leading educators present also for the inauguration exercises of President Butler. The reception will be held in the big gymnasium, and will last from 8.30 to 11 P. M. Owing to the size of the affair and other difficult conditions, it has been deemed wisest by the committee and university authorities not to provide any collation, but aside from the special preparations the university, which takes a great interest in the affair, will leave intact also the special decorations used this week at the Butler exercises. Addresses will be delivered by President Butler, Dr. Woodward, Prof. Elihu Thomson, Prof. Webster and others, and Lord Kelvin will make a reply. The proceedings will be interspersed with music. In addition to the regular admission tickets, the committee has had prepared a very handsome large invitation card, which will serve as a souvenir of the occasion, printed in gold and two tints of blue and embracing a beautiful little portrait of Lord Kelvin as well as his coat of arms, and vignettes of Columbia and Glasgow universities; as well as little panels with the initials or badges of the contributory bodies.

American Underground Electric Traction in England.

A situation that had become somewhat confused and complicated at this distance appears to be cleared up by the following cable dispatch from London, of April 10: The *Times* understands that an agreement has been reached between Charles T. Yerkes, Speyer Brothers, Speyer & Co., and the Old Colony Trust Company (of Boston) and a new company, with a registered capital of £5,000,000, for the purpose of installing electricity on the District Railway and four other lines. The four lines in question are the Brompton and Piccadilly Railway, the Great Northern and Strand Railway, the Charing Cross, Euston and Hampstead Railway, and the Baker Street and Waterloo Railway. Parliamentary powers have already been obtained for these lines. It may take five years to build the whole system comprised in the scheme.

With regard to this, Mr. Yerkes adds: "It was soon discovered that the original company, with a capital of a million, was too small. I went to America with the intention of forming another concern, which would absorb the original organization, and have an additional four million of capital. In the meantime, four railways were purchased, the Baker Street and Waterloo, Brompton and Piccadilly, Great Northern and Strand, and the Charing Cross, Euston and Hempstead. Thus, a system of intramural transportation, enabling persons to travel in most of the districts of London, was assured. The expenditure of the present capital of the new concern will extend over a period of three years. I intend to form a comprehensive system of intramural transportation for London, on the basis of cheap fares and rapid transit."

The Associated Press learns that the new Underground Electric Railways Company, as it is called, will eventually increase its capital to £15,000,000. Mr. Yerkes will be chairman; but the Speyers and the Old Colony Trust Company will have a controlling interest. They will nominate the directors, who will all be English, except Mr. Yerkes and Mr. Adams of the Old Colony Trust Company. The capital will be privately subscribed in London and New York. In addition to the district line, four partially completed and projected tubes come under the control of the new organization. Mr. Yerkes's methods will be adhered to, and he will carry out his previous policy.

The new company is incorporated as the Underground Electric Railway Company of London, Limited. Its main property will be the Metropolitan District Railway, now operated by steam locomotives in connection with the Metropolitan Railway, the so-called inner-circle underground railway. Plans for the electric operation of both these lines have been agreed upon, the British Westinghouse Electric Company having the electrical equipment in charge. The Metropolitan District Railway is not held outright, Mr. Yerkes and his associates having large stock ownership, and the contract for converting the road to an electric line. Other roads owned by the new syndicate founded by the Speyers are the Baker Street and Waterloo Railway Company, the Brompton and Piccadilly Circus Railway Company, the Great Northern and Strand Railway Company, and the Charing Cross, Euston and Hampstead Railway. The development of all these lines will be carried out in accordance with the most modern American methods, and American cars and other equipment and machinery will be used.

Electrical Works in Germany.

In a communication upon the outlook for export trade in Germany, Mr. Frank H. Mason, the excellent U. S. Consul-General at Berlin, remarks incidentally:

"In order to make clear the present condition of the German market for these products, a brief review of what Mr. Vanderlip calls 'the Americanization of certain German industries,' which has taken place since 1870, may be of pertinent interest.

"It was about that time, or soon after the organization of the Empire, that Mr. Ludwig Loewe, a young and enterprising hardware merchant of Berlin, became impressed with the fact that American sewing machines were finding a large and constantly increasing sale in this country. He compared them with the home-made sewing machines, recognized their superior construction and finish, and determined to see how this was accomplished. He went to America, visited sewing-machine factories and other machine [illegible] and unerring accuracy the shaping and fitting that had always been done by hand. He bought a complete outfit of American machines and tools, returned to Berlin and established a factory, which proved the germ and inspiration of a new era in German manufacture.

"That original factory has expanded until it includes, under management of the same daring and intelligent innovator, the Union Electrical Works, the vast private arsenal where the Mauser rifle is made by hundreds of thousands for the armies of many countries, and an immense machine shop and foundry of the most modern type, where hundreds of American machine tools—with an Allis engine driving one of the dynamos that generate electrical power for this vast equipment—have been employed during the past four years turning out lathes, milling machines, automatic screw cutters, planers, and stamping, punching, boring and reaming machinery, all modeled exactly after the best American types, and in some cases embodying improvements upon the originals. When, in the summer of 1900, the American mechanical engineers were brought here from Paris by Mr. Loewe in a special train and entertained for three days with princely hospitality, they said with entire frankness that nowhere in the United States had they seen a machine shop of more perfect plan and construction or containing so extensive and complete an outfit of the latest and most improved American machine tools. They found also everywhere about the place, as well as at the electrical works, American and German-American foremen and skilled machinists, who had taught here the methods which they had learned at Providence, Paterson, Philadelphia and Pittsburg. They saw the streets of Germany's capital traversed by electric street cars, built by the 'Union' and the General Electric Company, of Berlin, identical in every detail with those turned out by the great shops in the United States. Throughout all these establishments, which have in effect revolutionized certain industries in Germany, the American system of standard types with interchangeable parts, and to some extent the American method of treating workmen, have been introduced and permanently established. The Bergmann Electrical Works, of Berlin, is an example of a class of large industrial establishments founded in Germany during the past five years, in which not only the machinery and tools are of American make, but the technical directors, many of the foremen, and even some of the workmen are either native or naturalized American citizens who learned their handicraft in the United States. At the Bergmann works, the operatives are classified and paid by the American factory system, and have even given up the 11 and 4 o'clock stops for beer and lunch, which are customary in German workshops."

Wireless Telegraph Claimants.

Every day some new claimant for the honor of having originated wireless telegraphy springs up.—Daily paper.

Who invented wireless telegraphy?
"I," growled Professor Lodge;
"It is my own dodge.
I invented wireless telegraphy."

Who sent the first message?
"I," answered Shearer;
"With my coherer,
I sent the first message."

Who invented the receiver?
"I," whimpered Slaby,
Like a big baby;
"I invented the receiver."

Who spanned the ocean?
"I," said Marconi;
"I'll bet my money
I spanned the ocean."

Who talked with Mars?
"I," Tesla said;
"With my own head
I talked with Mars."

—The Rochester *Post Express*

A Pennsylvania Railroad Trolley Experiment.

The Pennsylvania Railroad has just abandoned an experiment which should never have been begun. It had failed to make its Burlington and Mt. Holly line, in New Jersey, succeed with steam, and therefore just changed the motive power to electricity. In practically all other respects the line remained a steam road and part of a steam system. These conditions are brought out very clearly in the accompanying dispatch from Trenton, N. J., of April 12:

The Pennsylvania Railroad has decided that its experiment in operating its small branch lines by electricity is a failure, and has ordered the demolition of the power-house of the Burlington and Mount Holly line, which was recently partly burned. The Pennsylvania owns a number of roads which it thought could be operated more successfully by using electricity instead of steam power. The company selected the Camden and Burlington County Railroad, which runs from Burlington to Mount Holly, a distance of seven miles. It cost $74,506 to equip the road for trolley purposes. The cars used were regular railroad passenger coaches with a double trolley bar. They were capable of a speed of over sixty miles an hour, but owing to numerous stops that speed was impossible. The advantage secured was a complete connection from Mount Holly and vicinity with all Trenton and New York trains, and those touching the Delaware front towns. These frequent trains did not increase traffic, but only gave the public a large variety of service. The first year the total cost of operating the road was $14,120. There has been an annual deficit ever since. The report of the company just filed with the State Board of Assessors shows that the operating expenses last year were $22,779.64, while the income from passengers during the year was only $12,658, and from other sources, $1,062, making the total earnings $13,720. The deficit, as recorded in the statement, does not represent the total loss, for the company made many experiments to improve the service and to cheapen it. For over a year the company has been considering the question of abandoning electricity because it could not serve the purpose of a railroad. The burning out of the power-house at Mount Holly brought the matter to an issue, and during the past week the order was given to tear it down, and the company does not hesitate to announce that the experiment is a failure, and that it willingly goes back to the steam locomotive.

Patents in Germany.

Referring to the doubt expressed by Signor Marconi as to the fair play he is likely to receive in the German courts when the issue between his system and that of Prof. Slaby is presented for adjudication, the New York *Times* says the apprehension is not without basis in the experience of most inventors who have attempted to sustain their patents in Germany against the piracies and obvious imitations of German citizens claiming rights as ex-post facto inventors. The average experience of the outlander, it says, is that it is extremely difficult to obtain in Germany a patent of any value, since if the subject matter is sufficiently important the hypertechnical objections raised by the Patent Office officials are usually found insuperable. If a patent is obtained, it is extremely difficult to sustain it in a suit for infringement against a German subject, and it is quite certain to be infringed if valuable. This is essentially unfair, but many affect to think that it is characteristically German.

"A nation probably has the right to enact any laws it pleases relative to patents for inventions. It may refuse foreigners protection if, as in the case of Holland, it deems this wise policy. On the other hand it may, as in the case of England, grant practically any patent application filed, leaving the question of novelty and of the inventor's right to be determined by the courts. Germany, however, subjects an inventor's application to a very strict examination, often rejecting claims which other countries grant after like examination. It will not give a patent unless it can find no reason for refusing it. It charges large fees for the rights it accords, and, having entered into a contractual relation with an inventor, it would seem morally bound to protect him, at least against infringement by German subjects. That it not only does not do this, but that in such conspicuous instances as Krupp and the Harvey armor-plate patents, Slaby and the Marconi patents, and many others, it favors rank injustice through the machinery of its civil courts, is not creditable to its standards of public morality."

Our contemporary might also have cited the cases of the incandescent lamp patents and the Tesla polyphase patents; possibly now also the Pupin patents.

CURRENT NEWS AND NOTES.

ELECTRIC POWER IN THE YUKON.—The Yukon Electrical Company proposes to furnish the copper mines in the vicinity of White Horse with electrical power. If the plan is carried out the present machinery will be replaced by polyphase machinery to supply current, also for the present lighting circuits.

DISTRIBUTED INDUCTANCE IN TRANSMISSION LINES.—As is well known, if inductance is placed in a transmission line carrying leading currents, the effect is to cause the e. m. f. at the receiving end of the line to have a value higher than the impressed e. m. f. In a patent issued April 8 to J. E. Woodbridge, the patentee states that he has discovered that if the inductance is distributed rather than localized at the receiving end in accordance with present custom, a uniform boosting effect may be produced over the whole length of the transmission line. The drawing represents a circuit having inductance coils distributed at intervals in the line. One of the claims of the patent appears to claim quite broadly this use of distributed inductance, the claim reading "The combination of a source of alternating-currents, transmitting lines, extending therefrom, inductance coils located at intervals in said lines, and a source of leading current connected to the receiving end of the transmission line."

SINGLE GENERATOR THREE-WIRE SYSTEM.—A patent issued April 8 to C. P. Steinmetz relates to the Dobrowolski system whereby from a single direct-current machine the ordinary three-wire system may be realized. In this system an inductance coil is connected across the two brushes of the direct-current machines, the middle point of the coil being an image of the neutral point of the winding. From this neutral point a wire is led, which corresponds to the neutral conductor of the three-wire or Edison system. The specification states that as this method is ordinarily applied, trouble frequently arises when unbalanced loads are either thrown on or off the system, as for example, when a motor is started on one side of the system. To obviate this objection two inductance coils are placed in parallel with the brushes, and a neutral for the lighting load led from the middle point of one coil and a neutral for the motor load, led from the middle point of the second coil. With this arrangement it is stated that lamps connected with one of the neutral conductors are comparatively unaffected by sudden changes in the load connected with the other neutral.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Secretary George F. Porter sends us the following data as to the May Convention: Advices from various sources lead us to believe that our coming convention, to be held at Cincinnati, May 20-22, will be more largely attended than any ever held by this association. Not only has there been a great increase in our actual membership, but more non-members are inquiring about the meeting than ever before, many of them expressing an intention to join the association at that time. Our programme will include fewer technical papers than usual, but fifteen or twenty topics of practical interest to central station managers have been selected, and competent men asked to prepare discussions upon them. These discussions will be printed before the meeting and brought up there for further consideration by all our members. A few of them are as follows: "Rates," "Hot-water *vs.* Steam Heating," "Free Lamp Renewals," "Loose-Leaf Ledgers," "Uniform Accounting," "Three-Phase *vs.* Two-Phase for City Distribution," "Improvement Desired in Meters," "Caring for Consumers' Complaints." Other topics will be announced as soon as arrangements are perfected for their discussion. This method of making up our programme is sure to render the meeting most attractive, and will result, we are convinced, in practical benefit to all our members. The meetings will be held in the Grand Hotel, the headquarters of the convention. The Central Passenger Association has granted a rate of a fare and one-third from all points in its territory to Cincinnati and return, and the other associations will, undoubtedly, grant the same rate, due notice of which will be given.

NEW YORK ELECTRICAL SOCIETY.—The 224th meeting of the New York Electrical Society will be held at the College of the City of New York, Lexington avenue and 23d street, Wednesday, April 23, at 8 P. M. Mr. Caryl D. Haskins, of the meter department, General Electric Company, Schenectady, N. Y., will lecture on Electric Meters. The lecture will be illustrated by lantern slides.

TWO HUNDRED MILES AN HOUR.—A special telegram from Trenton, N. J., of April 12, says: New life was given to the proposition to have quick passage between Philadelphia and New York on an elevated trolley road, which will ignore crossings and small communities. The original American Elevated Railroad Company has increased its capital stock from $5,000,000 to $10,000,000. The company proposes to construct an air line between New York and Philadelphia at an elevation which will give clear passage across the state. The speed is to be 150 to 200 miles per hour. It is currently reported that the line has control of the franchise recently granted to the Trenton and New Brunswick Traction Company, which completes the connection between Trenton and New York.

ALTERNATING CURRENT STORAGE BATTERY CHARGING.—A radical system for the charging of storage batteries is the subject of a patent granted April 8, to R. E. Ball, alternating currents being employed. The method consists in throwing in and out cells during an alternation, according to the variation of alternating e. m. f.; that is to say, when the alternating e. m. f. is, say, three volts, one cell is thrown in, and as the e. m. f. increases more cells are thrown in until at the peak the entire battery is in circuit; as the e. m. f. begins to fall, the cells are cut out in reverse order. The negative side of the wave is then commutated, and the same operation is repeated, the cells, however, being cut in and out in reverse sequence to what they were on the positive wave. The apparatus to accomplish this object consists of a complicated commutator driven by a synchronous motor.

ARC LAMP CONTROL.—A system for cutting constant-current arc lamps in and out at predetermined times, is the subject of two patents issued April 8 to Eustace Oxley. Arc lamps to be thus controlled on two or three-wire circuits are provided with an electromagnetic mechanism, which is operated when one of the line wires is grounded. A magnet of the mechanism has one side grounded, and when one of the line wires is grounded a current flows through this magnet, thereby bringing into play mechanism which cuts out the lamp. A second patent applies to arc circuits supplied by a Brush, Thomson-Houston or other open coil dynamo, which admits of being short-circuited. In this case each lamp to be controlled is supplied with an electromagnetic mechanism, which acts when the arc generator is short-circuited. The device is made selective by the addition of a ratchet wheel to the mechanism, whereby lamps may be cut out of circuit at different hours, depending upon the number of times the machine has been short-circuited.

CONVERSAZIONE AT INDIANA UNIVERSITY. — The Physics Department of Indiana University held a conversazione during the session of the Southern Indiana Teachers' Association, at Bloomington, Ind., April 3, 4 and 5, 1902. There were six demonstrations witnessed by more than 2,500 visitors. Each demonstration required ten minutes, and was repeated six times. The following exhibits were given: The Wehnelt interrupter and Roentgen rays. A new form of Wehnelt interrupter and circuit maker (described in these columns, March 1, 1902) was used to operate the Roentgen tubes of the highest power. The gyroscope principle, illustrated by means of the bicycle wheel. A complete series of lamps, illustrating the history and development of the subject, from the grease-pan to the Nernst-lamp. Two types of the latter were exhibited. The Hewitt vapor lamp. By consent of the inventor lamps of various forms and sizes were constructed and exhibited. One of the most successful and brilliant used but 20 watts. In a demonstration with a speaking arc, no capacity was used, but the inductance was made very large. The microphone shunt-circuit carried from one to four amperes, and the arc was run at about 12 amperes. The Marconi system of wireless telegraphy was used in sending signals, starting machinery, etc.

TEST OF RITCHIE TELAUTOGRAPH.—A Paris correspondent writes to us that the despatch which we noticed in our issue of March 15th, referring to experiments with a telautograph, related to tests made with the Ritchie telautograph. A description in full detail of this interesting apparatus appeared in our issue of Dec. 8, 1900, including illustrations of all its details. Our correspondent writes that the tests were made over two looped telephone lines, from Paris to Lyons, a distance of 320 miles. A loop was made between the lines at Lyons, and the transmitter and receiver were installed in Paris at the ends of the 640-mile circuit, in order that both pieces of apparatus could be accurately observed. This is the longest distance over which the instruments have been tested. At the beginning the tests were not satisfactory, and it was found that this was due to induction from telegraphic circuits. M. Claude had predicted the possibility of such disturbance a year ago. To test the cause of the unsatisfactory working, a telephone was connected to the line, and it was found that the telegraphic signals were plainly audible. A test then was made during a time when these disturbing influences were not present, using 15,000 ohms in circuit, and the transmission of writing became very satisfactory; the signatures transmitted duplicating exactly the originals.

SPRAGUE MULTIPLE UNIT SYSTEM.—The third of three principal patents on the Sprague multiple-unit system was issued April 1. The first of this series was granted in October, 1900, and related more particularly to the fundamental principles of the system. The second patent, granted on the same date, dealt with details, and particularly with the individual throttling of the various equipments in the train. The patent just issued is for alternative devices and connections of the general scheme of multiple-unit control, and covers the new features of the equipment used in the Brooklyn Elevated Railway, which are in many respects departures from those used when the system was first applied in Chicago. The patent carries 99 claims, these bringing the aggregate of claims of the three principal Sprague patents on multiple-unit control up to almost 400. Owing to the great detail of the recent patent, mention can be made in the space here allowed of only its principal features. The main features of invention in the present patent, which also constitute the differences between it and the system of the former patents are nine in number, as follows: First, a rheostat cylinder which operates in one direction only, with or without means for giving to this cylinder an interrupted or step-by-step movement, or both. Second, a rheostat combined with an independently mounted and independently moving series multiple switch, to which combination may also be added an independently mounted and independently movable reverser-switch. Third, a combination by means of which it is possible to effect by four wires substantially everything effected in the earlier system with five train wires, one speed-determining wire of the old combination being dropped. According to this present invention the rheostat may be operated by a pilot-motor, there being a limit switch for the motor and a circuit-changing switch for the series-parallel switch or the reverser switch, or both. Fourth, means for opening the reverser or series multiple switch, or both, independently of the position of the rheostat, with or without means such as a cut-out switch on the rheostat, for preventing the closure of the reverser switch or the series multiple switch, except in certain positions of the rheostat. Fifth, independent series-multiple and reverser switches having both like or opposed movements relative to each other, with or without automatic return to open position, and with or without a rheostat having a like automatic return to open position. Sixth, various other combinations of these devices into unitary devices. Seventh, a method of operating the reverser switch, series-multiple switch and the rheostat, whereby the circuit is opened in passing from series to multiple position. Eighth, a permanent shunt with the field of a series motor in combination with the circuit-changing devices, to hold the field and reduce the arc in breaking circuit. Ninth, a three-way cut-off between the train line, the operator switches and the governing system on each car, whereby any one of these elements can be cut off without disconnecting the other two, and whereby both the governing system and the operator switches can be cut off without impairing the train line. The application for the present patent was filed Dec. 16, 1898. The specifications are accompanied by 26 figures, and unlike the case of most patent specifications, a clear idea of the system as a whole may be obtained from their reading.

TRAIN LIGHTING.—The Pennsylvania Railroad has put in service out of Pittsburg a train lighted throughout with electricity, generated by storage batteries under each car. The present batteries will supply lights for twelve hours, and improvements are expected to be made whereby batteries can be installed that will furnish lights for twenty-four hours. It is said that all the through equipment of the Pennsylvania Railroad will be furnished with these electric storage batteries.

ROYAL TELEPHONES.— According to a recent cable despatch from London, Buckingham Palace is being fitted with a complete telephone service, communicating with the nearest police and fire stations, the King's apothecary and the residence of the Prince of Wales. When a confidential message is sent by telephone between royalties it is invariably transmitted in a cipher code known only to members of the royal family and a few privileged officials. The codes are kept in small books, metal mounted, and with patent locks.

Letters to the Editors.

An Electrical Board of Arbitration.

To the Editors of Electrical World and Engineer:

Sirs:—It is a well-known fact that in spite of the best drawn plans and specifications, and contracts, disputes have frequently occurred in the past between parties to such contracts; and that similar disputes are bound to arise in the future goes without saying. It has occurred to the writer, therefore, that it might interest American engineers and manufacturers to learn that the representative electro-technical society in Austria, the Elektrotechnischer Verein in Vienna, has recently established a permanent tribunal, or Board of Arbitration, with the object of making it possible to secure an entirely impartial and technically accurate settlement of disputes in electro-technical matters.

The Board consists of twenty members, elected for three years, and is made up of representative manufacturers, electrical engineers and scientists. From this body of twenty, the parties to the disputes may select their arbitrators. The Austrian society hopes that all cases of dispute relating to contracts on electro-technical work and deliveries will, in the future be submitted to the above-mentioned tribunal as their forum.

Boards of arbitration have already been established in a number of trades and industries in the United States, and it has therefore occurred to the writer that possibly a tribunal of similar nature might be of benefit to the electrical industries. If such a Board is to be constituted, there is no doubt that the American Institute of Electrical Engineers, as the representative electro-technical society of the United States, would be the organization from which such a project would best emanate, and which would carry the greatest weight among all parties interested in electrical work. That it is no difficult matter to get together the manufacturer, the consulting engineer, and the user, and to have them agree upon terms, is shown by the admirable set of rules governing the quality and performance of electrical apparatus, prepared by the Committee on Standardization of the American Institute of Electrical Engineers, and adopted by the Institute in 1899.

It goes without saying, of course, that a tribunal of this nature would have no possible jurisdiction in disputes arising over patent matters and cognate subjects, which can alone be settled by the regularly established courts of law.

The writer cannot help thinking that a tribunal such as outlined would have plenty to do, and that parties resorting to it would have their cases adjudicated in an expeditious manner, at a small cost, by a body of men thoroughly conversant with the technics and economics of each case.

New York City. [illegible]

Mr. Marconi and His Critics.

To the Editors of Electrical World and Engineer:

Sirs: In my letter, published in your issue of last week, I have, I find, omitted to mention one point to which I desired to call attention. I refer to the question of the possibility of interference with tuned wireless messages. So far, I have not heard of any complaint on this score being made on behalf of Mr. Marconi or his companies, though Professor Slaby and his collaborator, whose claim also is to have devised a syntonic system, seem to be unable to avoid interference with their messages, not only by the ordinary working of Marconi stations, but by the working of other wireless telegraphic apparatus, which is installed, it appears, in the vicinity of Cuxhaven and is controlled by countrymen of their own. I pass over the charges of malicious "jamming" which, upon the occasion of the *Deutschland* incident, it was not scrupled to bring forward. So far as these concerned the operations of the Marconi stations it was sufficiently answered by Mr. Marconi when he remarked that, to put it on no other ground, the time of his companies was far too valuable to be wasted over such childish nonsense. If, therefore, the Slaby-d'Arco method is not capable, as it is demonstrated that it is not, of eliminating such external interference, the fact merely proves its inadequacy as compared with that employed by Mr. Marconi, who since his introduction of his own method, has found himself perfectly able to protect his messages, from all such outside disturbance. An excellent illustration of the effectual nature of this protection, which, I think, can hardly have been sufficiently appreciated by the writer of a paragraph on the "Wireless Telegraph Situation" in the recent number of Electrical World and Engineer, was furnished in the course of Mr. Marconi's recent long-distance tests on board the *Philadelphia*. On that occasion he received messages from his Cornwall station over distances varying from 250 to 1557 miles. During the whole time covered by these tests several ships carrying the ordinary standard installation of his system were within the radius over which the messages were received by Mr. Marconi on board the *Philadelphia*. The *Umbria*, notably, throughout the voyage was steaming at a distance of several hundred miles behind the *Philadelphia*, and lay therefore all the time between that vessel and the transmitting station, to which it was accordingly nearer than was the *Philadelphia*. The operator on the *Umbria* tried every device which his experience could suggest to tap any messages which might be passing through the ether, but neither the *Umbria's* operator nor any of the operators on other ships within the radius was able to induce his apparatus to respond to so much as a single dot of the messages which, however, continued to fly nimbly over them and were recorded accurately by Mr. Marconi's tuned receiver. In view of this result, even though it stood alone, which it is, in fact, far from doing, I must consider somewhat unfair the statement of the writer of the paragraph to which I have before referred that "it (Mr. Marconi's syntonic method) has never yet accomplished anything on a material scale." If we are to understand by a "perfect syntonic method" a method by which "wireless telegraphic messages can be transmitted in such manner that by no possible combination of accident or malice shall they be liable to the least interference from any point outside the walls of the transmitting station," then it is clear that no such method is in existence, and certainly no claim to have discovered such has at any time been put forward by Mr. Marconi. But I submit that a scale of this degree of absoluteness is not quite the just scale to apply with a view to measuring the exact value of what Mr. Marconi's syntonic method does actually accomplish. It is surely a little early in the day to ask of the Marconi system that it should not only offer no more liability to interference than is possessed by the cable system, but that it should offer actually less.

So far as my apprehension of the situation goes, Mr. Marconi's claim for his syntonic method, a claim which many very severe tests have gone to substantiate, is that by means of it his system of wireless telegraphy is put in respect of all such outside disturbances, adjacent trolley car work, and the like, on an identical footing with the existing cable system. Criticism, then, based on the absence of a still further claim by Mr. Marconi to go beyond this point of security were surely a little ungracious.

Of interference, however, with the work of one by that of another of his own stations, even when they are quite close together, Mr. Marconi's experience has demonstrated that he has no reason whatever to be afraid. The German suggestion, in particular, that his transoceanic work will in the least interfere with, much less "paralyze," wireless communication between ships or between ship and shore within the radius over which the long-distance messages are sent is completely disproved by the *Philadelphia* tests and I may mention, in further illustration of the same point, that the ordinary standard apparatus at the Lizard station, only some six miles distant from the big power transatlantic station at Poldhu, is, at the will of the operator, completely cut off from all sensitiveness to the etheric waves generated at, and transmitted from, the latter.

There remains the question of malicious interference, and I scarcely

suppose that in this, either, Mr. Marconi need find very much to alarm him. I do not know how the law may stand in America, but in England, at any rate, I think the promoters of any such wilful disturbance would find in those same "common-law rights of the first comer" alluded to by Mr. Marconi, a somewhat formidable obstacle to get over. And pending the arrival of that international regulation of the matter which we are promised, I fancy that once the public, whether American or British, has had time to realize the advantages of the transoceanic wireless telegraphy at comparatively cheap rates, which it is hoped will now shortly be placed at its disposal, the popular feeling on both sides will be too strongly in its favor to allow anything of the kind to be practiced upon a serious scale.

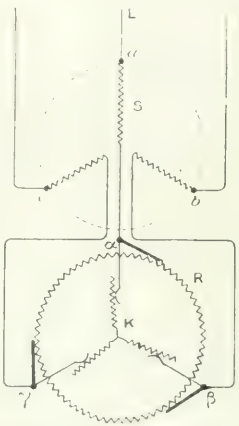
New York City. Wilfrid Blaydes.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

[illegible] Lincoln. A Franklin Institute paper. He gives a mechanical analogy of the operation of alternators in parallel. A bank of alternators taking mechanical power from their prime movers and supplying electrical power to a common bus bar, is analogous to a bank of spur gears also taking power from prime movers and supplying it through these gears to a common shaft. This line shaft is the mechanical analogue of the bus bars and the spur gears of the alternator. For successful operation in parallel the load should be properly divided; for this, the prime movers are to be provided with governors of such a type that the speed falls as the load increases. Proportional division of load, while desirable, is not an absolute essential to the successful operation of many plants. Freedom from hunting is an essential. Hunting in synchronous machines is the oscillation of the armature masses accelerated and retarded above and below normal average speed. Hunting can be prevented therefor either by removing the synchronous force tending to keep alive the oscillating motion, or by providing "electric friction," tending to destroy such motion if once started. Probably the most potent factor in keeping alive hunting is found in the steam engine governor as usually installed. Hunting induces or tends to induce in certain governors a synchronous force to keep itself alive. The remedy to this action is to make the time between a movement of the governor balls and its application of the corrective force, greater than the time of a half cycle in the period of oscillation. The remedy involves the prolongation of the time of response to motion of governor balls. This object may be accomplished by the aid of properly designed dash-pots. The uneven torque at different points in an engine cycle may give rise to hunting if the natural period of oscillation is synchronous with the engine impulses. One remedy for this difficulty is to synchronize engines as well as alternators, so that at any instant each engine is in a similar part of its cycle. Another remedy lies in the addition of fly-wheel capacity. The second prevention for hunting lies in so designing the alternating machines, that as soon as hunting occurs, a resisting force of a frictional nature is set up tending to destroy the oscillation. This electric friction is produced by surrounding the field poles, especially near the tips, with a band of copper. He has found cases in practice in which the hunting could be ascribed neither to the irregularity of torque in the prime mover, nor to the action of the governor, in all of these cases some part of the electric system—not necessarily that in which hunting was most noticeable—contained synchronous machines with laminated poles and no damping devices. He finally discusses the methods and apparatus used for throwing alternators in parallel. He describes the use of the synchronizing lamp, the use of synchronizing voltmeters, Woodbridge's method, and his own phase-indicator for synchronizing, which has already been described.—*Jour. Frank. Inst.*, April.

Self-Exciting Series Alternator.—Latour.—After describing his self-exciting shunt alternator, which was noticed recently in the Digest, he describes his self-exciting series alternator. This alternator consists of a secondary stator *S*, connected in star, and of a primary rotor *R* in series with it. A rheostat *K* for excitation is normally in parallel with the rotor. The synchronous running of such a machine is assured for a given inductive or non-inductive load by a very accurate adjustment of the brushes, this adjustment depending only on the power factor, but not otherwise on the load. When the rheostat *K* has a resistance of the same order of magnitude as the winding, the rotor can be considered to be short-circuited by means of the brushes through a small non-inductive resistance; this gives the best damping for the higher harmonics.



SELF-EXCITING ALTERNATOR.

Concerning commutation, the most favorable conditions are fulfilled when the field of the machine is approximately fixed with regard to the rotor, and when the harmonics of the field are annulled. The alternator operates on a constant current distribution network. Synchronism and a power factor, equal to unity, are maintained at varying load by adjusting both the rheostat *K* and the brushes. The advantages of a current system are well known for direct current from Thury's system. Leblanc has pointed out its advantages for the alternating current. But for polyphase current a constant system does not seem practical on account of certain difficulties. His series alternator is therefore more of theoretical interest, because it leads to his compound motor.—*L. Ind. Elec.*, March 10.

Sparking at the Brushes.—A. L. Rice.—An illustrated article on sparking, its causes and cure. The current should be zero when the bar leaves the brush. This is ordinarily accomplished by so placing the brush on the commutator that the self-induction effect tending to prolong the current in a coil is neutralized by a back e. m. f. set up in the coil as it enters the weak magnetic field under the following pole tip. If the poles are all of the same strength and all have similar distribution of magnetism, and if all coils of the armature have the same amount of self-induction, both of which conditions should obtain in a well-designed machine, the brushes being set symmetrically around the commutator, may all be shifted back and forth together until sparking disappears. He discusses the trouble due to a high or low bar, to wearing away of the bars, leaving the mica insulation in ridges, to getting out of round owing to poor construction of the commutator or unequal wear or to cutting from a rough brush or from previous sparking induced by other causes than roughness. When one set of brushes shows sparking, and a shifting of the rocker ring changes the sparking to another set, the probability is that there is a wrong setting of the brushes. He then discusses the troubles due to windings of field or armature. If one set of brushes is giving trouble, the difficulty is probably in an unequal distribution of magnetism in the field opposite that brush. The most probable trouble is the short-circuiting of part of the field-coil due to defective insulation This can be tested by measuring the voltage drop over each coil with a voltmeter. The uneven distribution may also be due to a poorly made joint or to a difference in the iron of the several pole pieces; this can be tested with an exploring coil and a galvanometer. Another point to be investigated in a compound-wound machine, is whether the series and shunt coils are acting together or not. A loose commutator connection or a broken armature coil

often produces a flash, as the bar to which it is connected passes each set of brushes, in much the same way as a very high bar. As a temporary remedy the bar affected may be short-circuited by a piece of copper bridged across the insulation to the one next it on either side, but a new coil should be inserted or the connection repaired as soon as possible. If a machine shows any tendency to spark, it should be carefully guarded from having to carry overload.—*The Eng.*, April. 1.

REFERENCE.

Operation of Two or More Dynamos in Parallel.—McCormick.—An article in which he discusses, by simple algebra, the arrangement of dynamos working together, formulas being given for three cases: dynamos in parallel, the three-wire system, and dynamos in series.—*Elec. Rev.*, April 5.

Lights and Lighting.

Enclosed Arc Lamp.—Donath.—An illustrated article on the theory of the Regina enclosed arc lamp. Wedding found that the lamp consumes on the average 1,075 watts per average spherical candle, while other types of enclosed arc lamps consume on the average 2.5 watts per candle. The Regina lamp is distinguished from other enclosed arc lamps by the method of leading the carbons through the globe and by the method of regulating the supply of oxygen, as has already been described in the Digest. He confirmed Wedding's result. The Regina arc lamp therefore consumes even less energy than an open arc lamp giving the same illumination, as the latter consumes on the average 1.65 watts per candle. He made experiments concerning the photographic actinity of the lamp, which was found to be excellent in comparison with other arc lamps. He believes that the higher efficiency of this lamp is due to the greater emission of light by the arc. When projected upon a white screen, the arc is intensely light, while with other lamps it is relatively dark compared with the carbons. "Evidently the discharge in the enclosed space approximates that in a slightly evacuated Geissler tube." The air inside the globe is poor of oxygen and very rarefied on account of the high temperature. When the lamp has produced this condition the emission of light increases on account of the increasing temperature of the carbon and of the part which the arc then takes in the emission of light. With the temperature the actinity also increases.—*Elek. Zeit.*, Mar. 13.

Power.

The Misuse of Coal.—John Perry.—A vehement plea against the misuse of coal. In the best steam engines less than 10 per cent. of the energy of coal is utilized; in many small engines only 1 per cent. The great waste of energy inevitable in all heat engines of the world is enormous. It is known that when fuel energy is converted into the electric form directly, as in a voltaic cell, more than 90 per cent. of the fuel energy is convertible into the mechanical form, but at present contrivances to do this even in the case of gaseous fuel are too bulky and expensive to compete with heat engines. He suggest that an organized attempt be made to convert the energy of coal into electrical energy in some form of engine which shall not cost more or have greater weight than a steam engine of the same power. "Many men have advanced the subject beyond its first principles; they know of directions in which to work with prospects of success. In the animal machine the thing is actually done; but of this machine the mere conversion of fuel energy into mechanical work is not the most important function, and the machine is very complex. Still, in it we have no heat engine, but the sort of thing we are looking for. . . . The writer feels sure that if one or two chiefs like Lord Kelvin or Lord Rayleigh were entrusted with the expenditure of a million a year for two or three years by the English nation for the benefit of the world, with power to impress the service of all scientific workers likely to be of use, to make their operations as extended as they pleased, they would bring the invention within reach of the ordinary engineer."—*Nature*, Mar. 20; Lond. *Elec.*, March 28.

An editorial note on Perry's suggestion, which is not looked upon favorably, while the invention of such an engine is highly desirable, it is said that the inefficiency of the heat engine is not to be blamed "for all the impending troubles." By far the largest proportion of coal is used, not for heat engines at all, but for metallurgical and other similar furnaces, and for heating buildings.—Lond. *Elec.*, March 28.

Electric Power Supply.—Brown.—A paper read before the Newcastle section of the (Brit.) Inst. of Elec. Eng. on "electric power supply on the Northeast coast." He thinks that at no distant date the steam turbine will be a strong competitor for first place in the equipment, especially in view of the very marked economy at full load and overload which was demonstrated in the recent experiments at Elberfeld. The combination of blast furnace gas and the boilers in a generating station of 30,000 hp should be able to allow an economy of production which is hard to exceed with coal-fired boilers. The use of gas engines of large power is strongly advocated by many, but beyond powers of 1,000 or 1,500 hp the gas engine maker has not yet shown that it would be possible to equip an electric power system with units of 4,000 to 5,000 kw. The system of distribution along the trunk mains should undoubtedly be by three-phase currents. He is inclined to the adoption of 40 periods as a standard unless the supply is entirely for power purposes, when probably 25 periods is better. Ten thousand volts should be the minimum pressure at which any generating station should generate and distribute along its trunk cables. The question whether it is less costly to generate from say, one large plant with 25,000 to 30,000 hp installed, than from say five plants each of 5,000 to 6,000 hp, is answered decidedly in the affirmative, provided the larger station is equipped with relatively larger units, but not if small units of 500 to 1,000 kw are installed. He advocates standardizing frequency and pressure.—Lond. *Elec. Eng.*, March 21.

REFERENCE.

High Tension Electric Power Transmission.—Gibson.—An illustrated review of the progress made in high tension transmission in recent years, with a description of various typical modern transmission plants.—*Eng. Mag.*, April.

Traction.

Electric Traction.—An editorial discussion of the paper of Swinburne, recently abstracted in the Digest. The writer agrees with Swinburne that the tramway system should not be extended to meet the case of a long main railway or of a crowded suburban line. In no case has tramway practice been adopted in operating metropolitan railways either in Europe or in America. Trains with larger motors and some sort of multiple-unit control, or hauled by locomotives, have been used, and no overhead wires have been employed. Doubt is expressed whether any experimental manufacturer would care to build a 3,000-volt 250-hp traction motor. While Swinburne seems rather favorably inclined towards the constant current system, it is said that this has been tried and abandoned and cannot be recommended. The problem in Great Britain at present is the electrification of the suburban lines in the large cities. This has nothing to do whatever with the electric equipment of long train lines. It would be very wrong to think that in the electrification of suburban lines the chief point to be considered is to make the system there adopted, fit in with that which might eventually be used on our main lines. This will not only lead to the retardation of the equipment of the suburban lines, but may also cause the wrong system to be employed.—Lond. *Elec. Rev.*, March 28.

REFERENCES.

Cleveland.—Woodward.—An illustrated article on the evolution of electric railway power plant apparatus, as illustrated by the Cedar Avenue Station of the Cleveland Electric Ry. Co.—*The Eng.*, April 1.

St. Louis.—An illustrated description of the power plants of the St. Louis Transit Co., which controls the entire street railway system of the city and its suburbs, aggregating about 360 miles.—*Eng. News*, April 3.

London.—Robinson.—A long abstract of a paper, read before the Society of Arts, on "electric traction: London's tubes, trams and trains, 1901." The paper is divided into three parts, the past, the present ,the future.—Lond. *Elec.*, March 28.

Installations, Systems and Appliances.

Influence of Tariff on Electricity Supply.—An article giving the results of statistical comparisons. The conclusion reached is as follows: The general moral is that the flat rate system is the only one at present in general use which may be considered satisfactory all round to both consumer and producer. "There remains the fact, however, that that valuable by-product, the day load, is still a glut in the market, and that if a sale is to be found for

cheap electricity out of peak-hours, a method of charging must be adopted which will enable the consumer not only to ascertain by estimation in advance or direct inspection the amount of his liability, but will, as in the little tried Kapp system, enable him to know when and at what rate the cheap supply obtains." Such methods, with a method of charging, which the consumer is able to understand, and by which he is able at any time to ascertain the amount of his bill to date, would build up a day-load.—Lond. *Elec. Rev.*, March 21, 28.

Nelson.—An illustrated article of the new municipal plant of this British town, which has been built on land adjoining the refuse destructor ,the system being changed over from the two-wire 110-volt system to the three-wire 2 x 230-volt system. The steam from the destructor is utilized for the traction day-load, and the generating plant is available for both traction and lighting. The generating plant consists of three 200 kw steam dynamos and a battery of 268 cells, giving 137 amps. for 10 hours and 263 for 3 hours.—Lond. *Elec. Rev.*, March 28.

REFERENCES.

Central Station Losses.—An article in which several rules and suggestions are given to show how by skilled supervision and by special means, the cost in central stations can be reduced. This refers to the mechanical part of the plant.—*Lond. Elec. Rev.*, March 28.

Electricity in Greece.—JACKSON.—An illustrated review of the development of light and power stations and electric tramways in Greece.—*Cassier's Mag.*, April.

British Central Station Statistics.—A very large table, giving in 21 columns a list of electricity supply works of the United Kingdom, with a large amount of special information concerning system and plant employed.—*Supplement to Lond. Elec. Rev.*, Mar. 28.

ELECTRO-PHYSICS AND MAGNETISM

Electric Waves.—LORD RAYLEIGH.—An abstract of a Royal Institution lecture in which he first dealt with the resonance between electric circuits. By Lodge's experiment of the syntonic jars, he showed that tuning of some accuracy is necessary to obtain good resonance, and that this tuning can easily be effected by altering the self-induction of the receiving circuit. He investigated theoretically the following interesting particular case. Imagine a long circuit to one point of which is applied a periodic e. m. f. of a certain frequency. At a second point, where power is being absorbed, an e. m. f. nearly opposite is applied, and if the circuit be an oscillatory circuit with a rate of its own, this second e. m. f. "may be arranged to tune the circuit and reduce it, as it were, to one possessing resistance merely." But if, instead of absorbing power directly from the first circuit, the power be absorbed from a parallel tuned circuit, the e. m. f. introduced being chosen suitably, then he found that just as much and no less power will be obtained from the second circuit as was obtained directly from the first, however small the mutual inductance is between the two circuits. He then discussed the effect of the curvature of the earth on wireless telegraphy; there is a continuous bending of the path of radiation; this cannot be due to refraction by the atmosphere. If due to diffraction, it would be a species of diffraction quite distinct from that studied in optics, where the bending takes place at a sharp edge. If the optical analogy be sought, then, taking the wave length of the electromagnetic disturbance as 1,000 ft. and that of light as 0.000025 in., a source of light on the surface of a sphere 1 in. in diameter would be a parallel case. It seemed improbable that light could creep round the sphere to a point 90 degrees distant. Of course, the wave-length of the electromagnetic disturbance might be made large by increasing the capacity of the sending apparatus, but the danger then arises "that grip on the ether may be nearly lost."—Lond. *Elec.*, March 21.

Ionic Induction.—HERTHA AYRTON.—A description of various experiments in which an electroscope is discharged or charged by means of a charged body placed at a distance. This most striking experiment is that in which a positively charged glass rod is brought to within 200 c. c. of an uncharged electroscope; a candle, also positively charged, is placed between the rod and the electroscope, but nearer to the rod; the leaves then diverge, and the electroscope is found to have acquired a positive charge. The candle can be replaced by an insulated saucer of cotton wool saturated in turn with ether, methylated spirits and dilute sulphuric acid placed at a distance from the electroscope but not by dry carbon dust. A red-hot platinum wire is capable of discharging an electroscope at a distance of 300 cm.—*Nature*, Feb. 27; abstracted in Lond. *Elec.* March 14.

Recombination of Ions.—LANGEVIN.—An account of an investigation in which he verified the numerical value of Townsend's recombination co-efficient by an entirely independent method. His method consists in creating a uniform field in the gas between two parallel plates and finding the quantity of electricity induced upon one of these plates at the moment when the field is created; also the quantity collected by this plate after the passage of a single Roentgen discharge, and the quantity liberated in the gas by the radiation, and collected in an infinite field. The difference between the two last quantities is due to the recombination of ions.—*Comptes Rendus*, Mar. 3; abstracted in *Lond. Elec.*, Mar. 21.

Spontaneous Ionization of Air.—RUTHERFORD AND ALLEN.—An account of experiments on the spontaneous ionization of air. An insulated charged conductor placed in a sealed tube loses its charge gradually, owing to the spontaneous ionization of the air in the table. Wilson has calculated that about 19 "ions" are formed per second in every cubic centimeter of gas. The present authors deduce from their own experiments the number 15, which is very close to Wilson's result.—*Phys. Zeit.*, Mar. 1; abstracted in *Lond. Elec.*, March 14.

Distribution of Current at the Surface of Cathodes in Vacuum Tubes.—WEHNELT.—An illustrated account of experiments which gave the following results. When the cathode is not completely covered with glow-light, the current flows only through those portions which are covered with glow-light. In cylindrical discharge tubes with circular cathodes normal to the axis at low pressures, the current passes only through those portions to which the rays are visibly attached. The visible point of attachment of the rays at the cathode must be regarded as the origin of the cathode rays.—*Ann. der Phys., No. 2;* translated in Lond. *Elec.*, March 14.

Atmospheric Electricity.—GEITEL.—An abstract of a Hamburg Scientific Congress paper. The general result of atmospheric observations to date show that the earth has a permanent negative charge, and the atmosphere a permanent positive charge. The latter is greatest in the case of fog, which probably prevents a great number of the heavier positive ions from reaching the surface of the earth. The source of ionization may be ultraviolet light of the sun, but he prefers to seek it in the spontaneous ionization of the air. The negative ions, many of which are, no doubt, free electrons, reach the earth's surface sooner on account of their superior mobility, and the negative charge thus imparted to the earth is kept from growing indefinitely by the repelling action exerted by it upon the negative ions. The conductivity of the air is greatest where the air is purest, *i. e.*, in mountains or in high latitudes, on account of the superior mobility of the ions in pure air.—Lond. *Elec.*, March 14.

REFERENCES.

Ionization.—STARK.—An abstract of an article on ionization of gases by ionic shock. After general remarks on the moving ions, he discusses ionization in the interior of a gas and in the limiting surface of a gas, double and simple frontier ionization at the anode, and ionization in the air.—Lond. *Elec.*, March 21.

An editorial entitled, "The electric substance," gives a general review of the theory of electrons.—Lond *Elec.*, March 21.

Stratification of Hydrogen.—CROOKES.—An illustrated reprint in full of his Royal Society paper, which was recently abstracted in the DIGEST.—*Sc. Amer. Sup.*, March 29.

Theory of Electricity.—DUANE.—A mathematical paper on the boundary conditions of the electrical field.—*Phys. Rev.*, March.

Magnetostriction.—SANO.—A mathematical note on Kirchhoff's theory of magnetostriction.—*Phys. Rev.*, March.

Electromagnet.—GRAY.—An abstract of a paper read before the Glasgow section of the Brit. Inst. Elec. Eng., in which he describes a new electromagnet for magneto-optic wrok.—Lond. *Elec.*, March 21.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrical Polarization. REID.—A Franklin Institute paper in which he first gives a review of greatly differing definitions of polarization given by numerous authors. Polarization is a phenomenon accompanying some kind of a change in the condition of an electro-chemical cell, due to the passage of an electric current.

The inevitable effect of the passage of a current is to exhaust or destroy the chemical condition or composition of the cell as it was originally composed, and to produce a cell of different composition having different electromotive force, resistance or concentration. There is an intimate connection between the progressive electro-chemical changes in a cell and its progressive polarization, which points to the conclusion that polarization is most correctly defined as a progressive change in the composition and e. m. f. of an electro-chemical system necessitated by the progressive exhaustion of one or more of the electro-chemical re-agents. All of the so-called phenomena of polarization are merely phenomena, due to electro-chemical exhaustion; that is, phenomena due to the change of substitution of a new electro-chemical system for a preceding one. He examines the intimate relation between the energy evolved or absorbed in electro-chemical reaction and the phenomena of polarization. As an example he gives the Daniell cell; while it gives current, the quantity of the copper sulphate is continually diminishing, while the quantity of zinc sulphate is continually increasing; as the current increases, the original arymmetrical system is progressively converted into a symmetrical system; during this change there is a simultaneous progressive change of the e. m. f. When the amount of copper sulphate has decreased so much that it is insufficient to transmit the current, hydrogen will be deposited instead of copper, as water is more easily decomposed than zinc sulphate. The selective tendency of a current to be transmitted by a compound requiring the minimum absorption of maximum evolution of electrical energy in preference to other equally accessible compounds, is called by him the law of maximum electrogenesis. The recognition of this law makes it evident that in every case the phenomena of polarization are merely phenomena of electro-chemical exhaustion.—*Jour. Frank. Inst.*, April.

Hargreaves-Bird Process.—Walker.—An illustrated article on the Hargreaves-Bird process for the electrolytic production of soda and bleach. It is used on a commercial scale at Middlewich, England. The cells measure internally 5 feet by 10 feet by 1 foot. The cathodes consist of copper wire cloth, each 5 feet by 10 feet, giving a total area of 100 square feet. The anodes consist of pieces of gas carbon attached to frames between the cathodes. On the inner surfaces of the cathodes and in contact with them are diaphragms, 0.25 inch thick, composed of a material the exact nature of which is not disclosed. "It is a hard and non-porous material, composed of silicates, asbestos, etc. It is not in the nature of a filtering medium, but by osmosis allows the soda to pass through to the cathode, but prevents the passage of chlorine or undecomposed salt. (How osmosis can take place through a non-porous material is not explained.) The efficiency of the diaphragm is, of course, the chief success of the process, though the arrangement of the anodes is such that they are not attacked by the chlorine, which is also an important factor. The soda on passing through the diaphragms comes into contact with an atmosphere of steam and carbonic acid, and the resulting solution of carbonate of soda trickles out at the bottom. If no carbonic acid is present the solution consists of hydrated caustic soda. The chlorine is led away to lime chambers, where bleaching powder is made. The brine is being continuously pumped through the anode chamber from the well and back again, so that the strength of the solution is maintained constant. Each cell is capable of decomposing 237 lbs. of salt in 24 hours, producing 395 lbs. of standard bleach, containing 37 per cent. of chlorine, and 578 lbs. of soda crystals. The electrical efficiency (probably meaning in ampere hours) of the cell closely approximates the theoretical. The supply of carbonic acid for the cathode chambers is at present obtained from lime-kilns, and the lime produced is utilized in the bleach chambers. The plant is favorably situated for the supply of lime ready made and limestone for use in the carbonic acid supply. It was originally intended to use the flue gases from the boiler furnaces as a source of supply, and experiments are now being made with mechanical stokers, which will produce the least amount of soot, and with scrubbers, for removing the soot, sulphur and carbon compounds. There is some likelihood also of gas engines being eventually used as a source of power for the dynamos, in which case the carbonic acid would be obtained from the exhaust, and cleansed in the same scrubbers.—*Eng. & Min. Jour.*, April 5.

Electric Energy Direct from Coal.—J. Wright.—An illustrated article, in which he first mentions Armstrong's hydro-electric machine, and then gives a review of thermopiles. This review is summed up by the statement that the thermopile is an extremely inefficient device for the production of electrical energy from heat, and also possesses several inherent defects, which renders it unsuitable for any but a few special requirements. Chief among the drawbacks of this type of generators are: firstly, its necessarily high internal resistance, owing to the fact that the hot and cool junctions must be separated by an appreciable expanse of metal; secondly, the difficulty of preserving, for any length of time, good electrical conductivity at the junction, owing to oxidation and other causes, and, thirdly, the extremely rapid depreciation of the pile, owing to the sudden extremes of temperature to which its parts are adjusted and which give rise to consequent expansion and contraction of the metal, tending to loosen all joints, and, in time, to cause the destruction of the whole pile. He then describes Tesla's and Edison's pyromagnetic generators. Both thermopiles and pyromagnetic generators have the defect that they depend on a primary combustion of coal in a furnace; this, in itself, implies considerable waste, in that many of the elementary bodies contained in the coal are either consumed or pass off in the form of vapor or gas without giving a proportionate return as heat energy. He then discusses voltaic cells with carbon anodes, and describes Reed's process, the Jacques cell and the Blumenberg cell; he mentions Grove's investigations of the gas battery and Borcher's cell. He thinks that the carbon cell or the gas battery may provide a solution of the problem. But "the apparatus will probably prove cumbersome and costly, so that, although the theoretical efficiency might be as high as 70 or even 80 per cent, the great interest on capital outlay would probably be a prohibition to its commercial adoption."—*Cassier's Mag.*, April.

REFERENCES.

Storage Batteries.—Reuterdahl.—An illustrated article, in which he first gives a brief general review of the subject of electric storage cells. He then discusses the lead cell, the Plante and the Faure type, gives the theory in the sense of the ionic theory that charging consists in the transformation of bivalent lead ions into quadrivalent ions, and that discharging consists in the reverse change; he discusses the advantage of lead for storage cells and gives the conditions which a good lead storage battery should fulfill in practice. He then more briefly discusses other forms of storage battery: the lead-copper cell, the lead-zinc cell, the alkaline-zincate type, and the general type which he calls "constant concentration cells," and of which the Edison accumulator is a special example. He then discusses the regulation of storage batteries by the following four method; by the use of equalizing rheostats; by the use of counter e. m. f. cells; by the use of regulating cells, and by means of the booster system. He then gives a review of storage battery applications, and finally formulates the requirements of the future ideal storage cell.—*Cassier's Mag.*, April.

Electric Furnaces.—Blount.—The first part of a reprint in full of his paper, read before the Manchester section of the (Brit.) Inst. Elec. Eng. After a review of novel industrial products produced in the electric furnace, he describes the characteristic features of the arc and the resistance furnace, and gives an account of the history and development of the electric furnace.—*Lond. Elec.*, March 21.

Electricity and Power Direct from Heat.—Asher.—An article in which it is first suggested that thermo-electric batteries may be directly treated by the rays of the sun; "if a thermo-electric battery can transform even 2 per cent. of the total energy into electricity it might be advisable in many cases to erect large solar thermoelectric batteries." He also discusses Edison's pyromagnetic generator, Edison's pyromagnetic motor, and Menges' pyromagnetic motor-generator.—*Sc. Amer.*, March 29.

Catalytic Sulphuric Acid Process.—A long article on the development of the contact process which is now a commercial success. It is non-electric.—*Lond. Eng'ing*, March 28; an abstract of Knietsch's German paper on this process in *Eng. & Min. Jour.*, April 5.

An article by Sackur, discussing this process from the point of view of modern physical chemistry.—*Zeit. f. Elektrochemie*, Feb. 5.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Phase Meter for Three-Phase Circuits.—Arno.—An abstract of a paper read before the Italian Electro-technical Society. He describes a modification of the method suggested by him for measuring the phase difference in three-phase circuits by means of an ordinary wattmeter. If *A B C* represent the three conductors of the circuit, in the original method, the current coil is inserted in circuit *A*, and the pressure coil joined first between *A* and the neutral point, and then between *B* and *C*; the ratio of the two readings then gives the square

root of three times the tangent of the phase difference. The modification consists in having the pressure coil wound double. One coil is joined between *A* and *B*, and the other first between *A* and *C* and then between *C* and *A*, the two being in series in each case. The centre of the coil is then at the same voltage as the current coil, and, if the greater part of the voltage be absorbed in external resistances, there is no large difference of potential in the instrument.—*Elettricita*, Nov. 30, 1901; abstracted in *Science Abstracts*, March.

REFERENCE.

Mercury Interrupter.—An English translation in abstract of the German article on a new mercury-jet break, recently noticed in the Digest.—*Lond. Elec. Rev.*, March 21.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Cables and Coherer.—GUARINI.—The first part of an illustrated article in which he discusses the problem of using the coherer in cable telegraphy, on account of its high sensibility. This sensibility in watts is 10 to the minus 14th power, while that of an ordinary relay is 10 to the minus 6th power. The purpose would be to increase the speed of transmission, to diminish the e. m. f. required, and to diminish the section of the conductor by reducing the current required for the receiver. He first discusses an arrangement in which the coherer is in series with the line, while the relay with a local battery is in shunt with the coherer. He then discusses this arrangement together with condensers in the line. He then suggests a combination of two coherers, by which they act as two selecting relays—Lond. *Elec. Rev.*, March 21.

Type-Printing Telegraph.—A note on the Steljes type-printing telegraph, which is practically a Wheatstone A. B. C. telegraph, modified to print off the messages from a type wheel at both transmitting and receiving ends. A skilled operator can send 29 or 30 words per minute. The average current used is only 10 milliamperes, and although it is alternating, it has no effect on neighboring telephone circuits and it may even be used over a telephone line over which conversation is taking place simultaneously. In the latter case, the metallic circuit of the telephone line is bridged by a differentially-wound induction coil of about 500 ohms resistance and 11 henrys inductance, the middle point of which is connected through the type-printing telegraph to earth.—*Lond. Elec.*, March 28.

MISCELLANEOUS.

Electric Response in Plants Under Mechanical Stimulus.—BOSE.—An abstract of a paper read before the Linnean Society. There exists a perfect parallelism between the response in animal and plant tissues. There are responses exhibiting no fatigue, as in nerves; also responses exhibiting fatigue; and those which show a "staircase" effect. Swaying of a tree by wind gives rise to a radial e. m. f., the current flowing inwards. Ineffective stimuli when superposed become effective. The exact death point of a plant can be accurately determined by electric methods.—*Lond. Eng.*, March 28.

REFERENCE.

British National Physical Laboratory.—An illustrated description of the laboratory and an account of the proceedings at the opening.—*Lond. Elec. Eng.*, March 21.

New Book.

CONGRÈS INTERNATIONALE D'ÉLECTRICITÉ. Rapports et Procés-Verbaux. By M. E. Hospitalier, Rapporteur General. Paris: Gauthier-Villars. 526 pages, illustrated. Price, 20 francs.

The volume before us is divided into two sections. The first, occupying nearly two-thirds of the contents, is devoted to "Preliminary Reports" on a number of topics of importance. These preliminary reports have, in nearly every case, been prepared by men of eminence in their respective departments, and as such present a very good résumé of the state of the art in its various branches; they thus formed an excellent basis for discussion in the various sections into which the Congress was divided.

A considerable part of the time of the meetings of the official delegates was occupied by discussion on the adoption of names for the magnetic units. We note particularly the excellent work done by the American delegates of the Congress, in carrying against considerable opposition, the programme formulated by the American [illegible] Electrical Engineer, namely the designation of the C. G. S. units of magnetic field of magnetic flux, to which the names of Gauss and Maxwell were assigned. Messrs. Kennelly and Mailloux deserve especial mention in this connection owing to their successful advocacy of the measure, and Mr. Mailloux particularly, who, in the absence of Mr. Kennelly, secured at the final meeting, after a lengthy debate, a reversal of prior adverse action on the A. I. E. E. programmes.

We also note that there was quite some discussion on the question of affording protection to those distributing electrical energy, by considering it as "property"; and the Congress expressed the hope that the various governments would take action with a view to affording legal protection to current distributers.

BOOKS RECEIVED.

THE LAWS OF RADIATION AND ABSORPTION. Harper's Scientific Memoirs. Edited by D. B. Brace, Ph. D. New York: American Book Company. 131 pages, illustrated. Price, $1.00.

JAHRBUCH DER ELEKTROCHEMIE. Berichte uber die Fortschritte des Jahres, 1900. By Dr. W. Nernst and Dr. W. Borchers. Halle a. S.: Wilhelm Knapp. 596 pages, 192 illustrations. Price, 24 marks.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual business meeting, New York, May 20; annual convention, Great Barrington Mass., June 18-21, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION Next meeting, San Antonio, Tex., April 18-21, 1902.

Electric Railway and Signal System.

An operating model of a system of propulsion for electric railways designed particularly for tunnel and yard work, is being exhibited by the Acmescope Company, at the works of the Garvin Machine Company, in New York. The conductors from which the motor take current are supported rigidly overhead, and are of sufficient size to carry current to operate one train on a block, each block being fed separately from the feeders; and means are employed for automatically connecting and disconnecting the feed wires from the contact bars from which the motor derives the current. There are two overhead conductors, one being used as the return. The employment of this system leaves the regular rails intact, and permits the use of a signal system which automatically connects the feed-wires to the contact conductors and disconnects them as the train leaves the block. It opens the circuit and deprives the motors of current in case

the block ahead is occupied by another car or train, or there is a broken rail, open switch or open drawbridge; and when the obstruction has been removed the circuit is closed automatically and the train proceeds. This system dispenses with all signal lights in the tunnel and in the yards, except switch lights, as each motor car or electric-locomotive carries its own signal in the cab, where it can be seen by the engineer at all times and under all conditions of weather, in tunnels and in the open.

In the operation of the track signal system, track batteries along the road are entirely dispensed with, all of the necessary current for the signals being supplied by a storage battery carried on the motor-car or locomotive. The system is operated on the closed circuit principle, and in the event of any abnormal condition along the line, cautionary or danger signals are set in the cab, where the engineer can see them at once. There is thus no danger of running by such signals; they are ever-present so long as the danger on the line exists.

The track is divided into insulated sections of any desired length, each section overlapping the one behind by means of an angle-bar or contact-rail, placed parallel to the service-rail, but raised above it. A contact-making device, carried on the locomotive, rolls over the contact-rail, thus disconnecting the signaling apparatus from the section immediately beneath the locomotive or car, and connecting it with the section ahead. At the farther end of each section the two rails are bridged by a high resistance, which, under normal conditions, reduces the current to such a degree that the signal in the cab remains inactive. Any obstruction on the section ahead, however, such as a car, short-circuits the resistance, and the consequent increase in current causes a green signal lamp in the cab to glow. A broken rail, or an open switch or draw-bridge breaks the circuit completely and causes a red lamp to flash—a broken connection anywhere in the circuit is signalized by the red lamp.

In addition to these visible signals, an audible signal—a gong—is provided. The audible signal indicates, by the number of strokes, the nature of the trouble—whether the section ahead is still occupied by a train, or whether there is an open switch or drawbridge.

It is evident from this brief description that under normal working conditions no signals will be displayed or sounded, but the moment a train enters a section that is not clear the fact is indicated at once on either the green or red signal, and by the gong, according to the nature of the obstruction. In connection with the signal system is used a recording device which makes a record of every signal made during the run, and the time of each. In the development of this system it is stated that every contingency that is ordinarily met with in railway practice has been provided for by the inventor, Mr. Robert J. Sheehy.

Breast Plate Transmitter.

For a number of years all the larger switchboards sent out by the L. M. Ericsson Company, Stockholm, Sweden, have been equipped



BREAST PLATE TRANSMITTER.

with the breast-plate transmitter, and it has been successfully demonstrated that much quicker service can be secured by their use.

As seen in the illustration, the mouthpiece on the breast plate can be adjusted to suit the operator, and is always in position whether the operator is sitting, standing or reaching out at one side. All metal parts are of aluminum to insure lightness, and a silk elastic strap with adjustable buckle allows the set to be fitted so as to suit any operator. The transmitters are being marketed in this country by the Ericsson Telephone Company, 296 Broadway, New York City.

Gas Engine Igniter.

The Holtzer-Cabot Electric Co., of Boston, Mass., has recently designed and placed upon the market a new gas engine igniter of the dynamo type, which has several distinctive features, the most important of which are that it does not require the use of a spark coil and is quite independent of speed, the latter feature overcoming the objection to the dynamo type of igniter.

There have been of late great advances made in this size of gas and gasoline engines, while the best practice seems to incline toward the multiple cylinder. These engines, by reason of the nature and volume of the body of gas to be ignited, the high frequency of the spark and also on account of peculiarities in the construction of the make-and-break device, require a large and practically continuous flow of current to produce satisfactory ignition.

It is well known that the strength of magnetization obtainable in the best permanent magnets is for a given weight, relatively quite



GAS ENGINE IGNITER.

small in comparison with that which may be secured with an electro-magnet. It is evident, then, that a machine of the permanent magnet type constructed to deliver any considerable amount of energy would be unnecessarily large and heavy. This igniter has been, therefore, made of the dynamo type for the reasons given. It weighs 19 pounds, and will, if necessary, deliver continuously a maximum output of 50 watts.

As stated, the dynamo is practically independent of speed and at 1,000 r. p. m. will deliver ample current for satisfactory ignition, while the speed may be increased to 2,500 r. p. m. without any danger from burning out. Thus the igniter may be driven from the fly wheel of the engine with the ordinary belt or friction pulley.

The field core is of a solid casting of soft steel, and the armature is of the drum type carefully laminated and wound with double silk-covered magnet wire. The shaft is of high-grade steel, and the bearing sleeves are of phosphor bronze. The brush holders and commutator are large and heavy, while the brushes are of a special composite structure, combining the substantial qualities of carbon with the higher conductivity of the copper.

The machine is rendered quite impervious to dust and moisture by a protecting shield, which fits over the commutator and brushes. This may be easily removed, making the brushes and commutator readily accessible. The body of the machine is mounted on a light hinged base in such a manner that a wide range of adjustment may be effected without using sliding contacts or clamping nuts.

New Type of Controller.

The Electric Controller & Supply Company, Cleveland, Ohio, has added to its line of manufactures a new design of controller, the arrangement and construction of which particularly adapt it to the control of standard cranes and other electrically-driven machinery which is not subjected to excessive overload.

Fig. 1 shows a front view of the controller, and Fig. 2 is a rear view of the slate face showing the resistance units and connections.

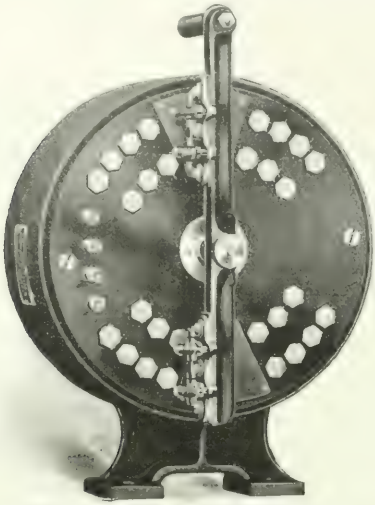
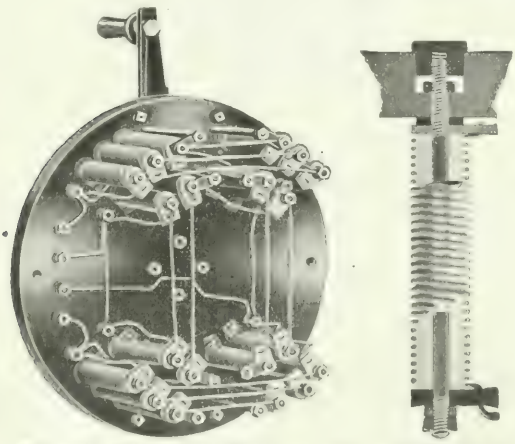


FIG. 1.—FRONT VIEW OF CONTROLLER.

It will be noted that all of the working parts of the controller are carried by the slate face. The frame, which consists of a single casting, serves simply as a protection and support for the working parts. The removal of two screws frees the face from the frame and permits ready inspection of all the controller connections.

Fig. 3 shows in detail the construction of one of the resistance units. The core of the unit is a rod of soft iron over which is placed a heavy tube of asbestos. Caps are provided at either end of the



REAR VIEW OF SLATE FACE. RESISTANCE UNIT.

tube for receiving the ends of the resistance winding, the cap at the rear end of the tube being of insulating material and that at the forward end being of copper threaded on to the iron core. The core is extended beyond the copper cap and passes through the slate face, where it is locked in position by a lock nut working in a counterbored recess. The contact button, which is drop-forged from pure lake copper, has an octagonal head which is grasped with a wrench and screwed in place on the end of the core. It will be readily seen that by this construction the contact button can be removed and replaced without in any way disturbing the resistance unit or its connections. Furthermore, the iron core of the unit performs three functions: First, it carries the forward end of the resistance winding to the rear end of the unit, thus bringing all connections to the various units into one plane; second, it connects the resistance winding to the contact button; and third, it forms the core of a powerful electromagnet of which the turns of resistance material form the exciting winding. By this construction each contact is placed in a powerful magnetic field of its own and an efficient blow-out provided.

A further unique feature in the construction of the controllers is illustrated in Fig. 4. The frame is finished with four bosses set 90 degrees apart. By altering the position of the two screws which hold the face in the frame, the controller may be adapted to a variety of methods of support maintaining the operating lever in a vertical position. To give further flexibility the handle is adapted to be attached to the operating lever in three positions, at right angles to it on either side, or screwed directly into the end of the lever. The



FIG. 4.—THREE DIFFERENT POSITIONS OF CONTROLLER.

controller is also adapted to overhead support and to be operatd from the floor by means of chains or ropes. A powerful spring is provided which returns the arm to the off position when the ropes are released.

"Standard" Bipolar and Multipolar Machines.

A company for the manufacture of dynamos and motors has recently been organized at Erie, Pa., under the style of the Standard Electric Company, by Mr. Carson J. Sturgeon and others. It is now producing various apparatus and we illustrate two types.

The form showing two poles is made either with two or four poles and of 1½, 3, 5, 7½, 10, 15, 20, 25 and 30 horse power, C. P. direct current motors and generators, 125, 250 and 500 volts. The armatures are of the iron-clad type, with coils wound in slots. All two-pole machines have Gramme windings, and the multipolar machines are wound with formed coils, or barrel winding type.

The type of machine shown with four poles is made in the following sizes: 12, 23, 33 and 40 kilowatt, slow-speed generators (belt driven), and 15, 30, 40 and 50 horse power, slow-speed motors. The company also make in this type, medium-speed, belt driven gene-

rators of 16, 30, 45, 50 and 70 kilowatt, and medium-speed motors of 20, 36, 57 and 63 horse power.

All these machines are wire-wound, with formed coils, and only the best grade of insulation is used. The commutators are all made of



drop-forged copper with hand-made mica insulation, and the construction is such that the bars cannot get out of place. By means of powerful compression jigs, the commutators are pressed firmly into place, and are finished and firmly set before removing the jig. The



FIG. 2.—MULTIPOLAR MACHINE.

bearings are all made self-oiling and self-aligning, and are so constructed that no oil will be thrown from them on any other part of the machine. The field yoke of these machines is of cast iron with laminated poles and a cast iron pole shoe surrounding the pole face.

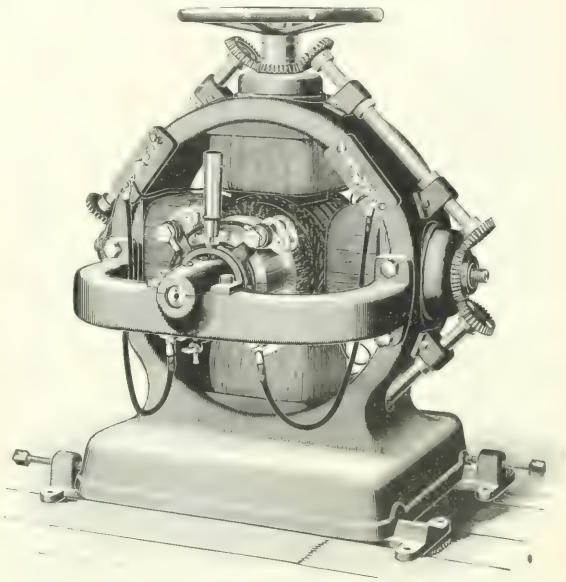
Multi-Speed Motor.

The latest type of the Stow 4-pole, "Multi-Speed" motor is illustrated herewith. This motor has been designed to combine all the advantages of the ordinary multipolar motor with the added advantage of an operative speed range of 100 to 150 per cent from minimum speed, the percentage of speed variation increasing with the size of the machine. The armature rotates in a balanced magnetic field under all conditions of speed, this magnetic balance being secured by a simultaneous radial adjustment of the four "plungers" by means of bevel gearing, a hand wheel, by which the plungers are moved, being located conveniently at the top of the machine.

The design of the pole pieces and the selection of gearing is such that no great effort is required at the hand wheel in order to move the plungers against the tractive power of the field magnets. As the gears are small, and the gear rods lie close to the frame of the motor, it will be seen that this mechanism does not detract from the otherwise symmetrical and pleasing design of the machine. While the cut shows an open type machine, the design is such that if an enclosed motor is desired the armature supporting brackets are removed and the ends of the frame finished so as to receive suitable enclosing heads, in the center of which the armature bearings are arranged.

The 6-hp machine, shown in the cut, is designed for a minimum speed of 700 r. p. m., the maximum speed being 1500 r. p. m., giving a total speed variation of 115 per cent, at any speed between which limits the machine develops its full rated horse-power with an efficiency of but 2 per cent less at its maximum than at its minimum speed. In other words, within the limits of 115 per cent variation, the efficiency of the motor at a given load is practically independent of the speed at which it is operated.

The construction of the pole piece and plunger is similar to that used in the bipolar form, the field strength, consequently the armature speed, being varied in accordance with the position occupied by the pole-piece-cores or "plungers." When the plunger is adjusted so that its inner end comes in contact with the pole shoe, the magnetic circuit is most complete and of minimum reluctance; and, since the



6-HP. MULTI-SPEED MOTOR.

m. m. f. of the field coil remains constant, the magnetic flux becomes a maximum and the speed a minimum, or normal. As the plunger is being drawn away from contact with the pole shoe an air space is interposed which gradually increases the reluctance of the magnetic circuit so long as the plunger continues to be withdrawn. When the plunger reaches the limit of its outward motion, the reluctance of the magnetic circuit, and hence the speed, becomes a maximum.

To those familiar with motors of ordinary type, a variation in speed of 115 per cent by a corresponding variation of magnetic flux would seem impossible of realization on account of the difficulty of securing sparkless commutation when the field strength of the motor is so abnormally reduced. In the present type, however, the design of the pole piece and plunger is such that as the flux of effective magnetism is diminished by the outward movement of the plunger, the remaining magnetic flux is forced more and more in the direction of the pole-tips, thus furnishing a magnetic fringe at all times of sufficient intensity to insure sparkless commutation.

As the speed regulation is effected solely by varying the reluctance of the magnetic circuits, no controller or rheostat is, of course, used in the regulation of the speed, all electrical circuits and connections remaining unchanged through the entire range of speed. The machine illustrated represents a type which is built in sizes of

furnished for varying the speed.

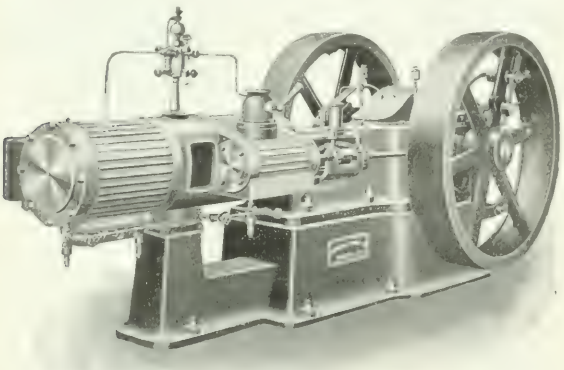
Owing to the design, the special advantages offered by these motors are obtained, it will have been seen, without the sacrifice of any advantageous feature possessed by machines of the ordinary type, the efficiency in every case being fully up to the standard of first-class modern practice. Moreover, the self-regulation of the machine is as close as, and in some cases closer, than the regulation of motors of common form, this being due to the ample size of the armature conductors used in these machines. They also carry full load sparklessly at any speed within their range, commutation being accomplished as well at the highest speed as at the lowest.

It is interesting to note that while in the case of other motors, the number of operative speeds corresponds to the number of steps in the controlling device, the motor herewith described possesses a speed range of absolute continuity; in other words, between the maximum and minimum limits an infinite number of speeds may be obtained, without the use of any controller or rheostat.

Buffalo Tandem Compound Engine.

The cut herewith gives a general idea of the horizontal tandem compound engine manufactured in the engine department of the Buffalo Forge Company's works, and used largely by that concern for dynamo driving. A heavy cast-iron sub-base furnishes a solid support to which to bolt the engine bed, and at the same time raises the engine sufficiently for the fly-wheels to clear the floor or foundations. In the case of dynamo direct connection, this sub-base may also provide a bed for the generator, and in addition carry the outboard bearing. The high pressure cylinder is placed in front, bolted at one end to the head cast to the frame. The other end is bolted to a yoke or connection between the cylinders, which also carries the overhung low pressure cylinder. The foot of this yoke rests upon a pedestal extension of the sub-base with a feather or expansion joint connecting the two. The three movable cylinder heads are so fastened to their respective cylinders as to make feasible their easy detachment with the pistons and rod, if occasion requires. This, with the ready accessibility of all stuffing boxes, is a distinct feature of the Buffalo tandem compound engine. The pistons are single castings cored thin, giving maximum strength with minimum weight and causing but little wear on the bottom of the cylinders.

The crank shaft and connecting rod are of forged steel, the latter of which is fastened to the crank-pin by means of a strap and wedge.



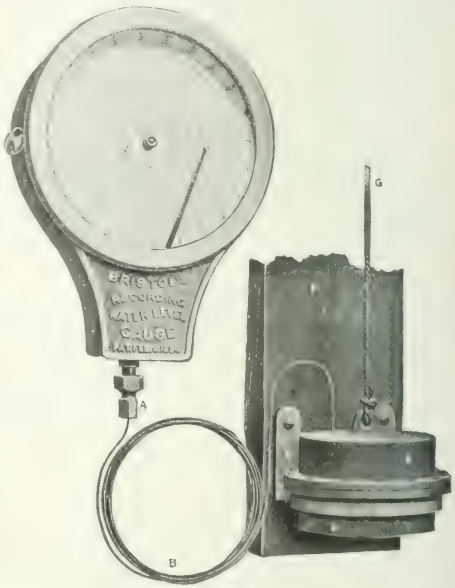
The wedge is completely enclosed by the strap and box and is securely held by two adjusting lock bolts. The high pressure valve is of the piston type, while the low-pressure end is fitted with a balanced D slide valve with a pressure plate. The former valve is under the control of shaft governor, while the low-pressure valve may also be driven by the swinging eccentric, or, according to an alternative construction, by a fixed eccentric, so arranged as to permit alteration of the cut-off at all times. This arrangement is effected by means of bolting the eccentric sheave in such a manner as to permit change of throw and angular advance, and hence cut-off at pleasure. The fly-wheel governor for the high-pressure side is of the most sensitive type. It is provided with three means of adjustment, so that it may be accurately set to control the engine at any given speed; in addition, grease or oil cups are provided on every pin. Indeed, one of the most prominent features of the engine is its thorough system of lubrication.

This engine is enclosed to run in oil, and a positive means of lubrication is thereby furnished for the main bearings crank-pin, wrist-pin and crosshead slides. An ample supply of oil for the wrist-pin is insured by a cup on the pin, which is filled continuously with oil thrown back from the crank disks, and communicates with the rubbing surfaces. Pockets or receptacles located within the bed near the crank disks are kept filled with oil while the engine is in motion, and feed the necessary amount of lubricant to the main bearings. Provision is made for returning the oil to the crank-pit after it has been supplied to the various rubbing surfaces. A light polished hood and two side plates give a perfectly oil-tight construction, and being easily removable, afford ready accessibility to the various moving parts. A large sight-feed lubricator takes care of the cylinders and valve chests. The very best babbitt metal is used throughout this engine at all bearing surfaces, and adequate means are provided for adjustment and taking up of wear.

Recording Water Level Gauge.

The Bristol Company, of Waterbury, Conn., are placing upon the market an adaptation of their recording pressure gauge to an instrument for making a continuous record in ink upon a revolving chart, of the rise or fall of the level of water in a canal, reservoir, well, tank, or variations of sea level.

The construction and operation of the instrument will be readily understood by reference to the illustration shown herewith. *A* represents the union joint by which a flexible capillary tube *B* is connected to the recorder. This connecting tube terminates in the



RECORDING WATER LEVEL GAUGE.

upper portion of the bulb casting *E*, and when the instrument is in operation it is immersed to the depth a record is desired. Between the flanges of the upper and lower parts of the bulb, *E* and *D*, a flexible diaphragm (convex downwards) of thin sheet rubber is firmly held, inclosing the proper amount of air for the operation of the instrument. Near the bottom of the lower casting *D* there are several holes for admitting water, the pressure of which acts upon the lower surface of the diaphragm, producing on the inclosed air a corresponding pressure due to its depth below the surface. The variations of the air pressure thus produced are communicated

by means of the capillary tube to the recorder. The chart on the recorder is graduated into feet or inches head of water, or of the liquid which is being measured, and it may be adapted to almost any desired range.

The upper casting of the air-bulb is provided with an eye for a cable suspension. The air bulb is also shown with a flange resting on a ring bracket *C*. This bracket is designed to be secured to a plank *F*, which may be lowered into the water to any desired depth.

The recorder may be located at any convenient point for observation, either above or below the surface of the liquid to be recorded. The accuracy of the instrument is not affected by the location of the recorder or by the length of the capillary connecting tube. An important advantage that instruments of this form have over those of ordinary type which are operated by floats, is that its continuous performance and accuracy cannot be affected by ice in winter.

Telephone Pay Stations.



CONSECUTIVE COUNTER.

The American Toll Telephone Company, of Cleveland, well-known through the manufacture of telephone pay stations, has just added several new device of this description to its line. One of the new machines makes impossible the common and sometimes fradulent practice of depositing two or more coins at the same time. For instance, if the rate should happen to be 40 cents, the subscriber by dropping a nickel and a dime into the pay station, can produce a jumble of signals, making it impossible for the operator to determine as to the amount deposited. The subscriber can, therefore, make the claim that he deposited 40 cents, and the operator cannot dispute him, as she is aware that more than one coin has been deposited. With the new machine, when the subscriber has deposited one coin, it is impossible to deposit another until the first signal has been given, the second coin simply slipping through the machine and dropping into the pocket shown in the side of the station. The difficulty described is one which has always deeply concerned telephone exchange managers, and has been an objection to the use of pay stations.

Another useful device recently brought out by this company is the "consecutive counter," herewith illustrated. It is used in the exchange for the purpose of taking the peg count, or it may be used for counting poles, insulators, or keeping correct tallies of any kind. It is a very simple and convenient device, with nothing to get out of order.

Chicago Independent Telephone Convention Notes.

A report of the convention proceedings appears on pages 686-688. Subjoined are notes of the exhibits, etc.

Kellogg.—Automobiles were kept in waiting at the Sherman House to take those who wished to visit the factory of the Kellogg Switchboard and Supply Company to that company's plant on the west side, at Green and Congress streets. The company had a small exhibit of telephone parts and switchboard parts in the hotel. It, however, made no pretension to cover its line of goods manufactured in this way, but invited all interested to see its "real exhibit" at the factory. This exhibit consisted not only of a 3,000-line board, equipped for 80 lines and doing actual service in the factory as a means of intervention between different departments, but consisted also of the complete process of manufacturing telephones and switchboards as carried on in its factory. A great many availed themselves of the opportunity of visiting this most extensive and growing plant, and every visitor was impressed with the thoroughness with which every detail is looked after in the process of manufacture. Every department of the Kellogg factory is in charge of a man known as an expert in that particular line of work, and the company is particularly noted for the high-grade of engineering talent it employs. Among the new things which were being shown at the parlor exhibit was a row of jacks such as are being made to go in an 18,000-line, multiple-jack switchboard for Buffalo. These jacks are the smallest yet made for a large multiple board, being three tenth-inch between centers. By using such small jacks, the 18,000 subscribers' lines can be brought within a reach of 35 inches for each operator, which is somewhat less than some boards which are being worked at present. In addition to the 18,000 calling jacks, there are at each operator's position 200 answering jacks on the Buffalo board, which is somewhat more than the usual number, so that taken altogether, this board will contain much more at each position than anything heretofore used. Plugs and answering jacks as small as these can be successfully made, because in the Kellogg system there are only two tip contacts to be made by plugs. The plug when shoved home has a side tension brought upon it by the spring of the jack, which insures good contact with the sleeve. Over the door of the company's parlor was a sign, made of miniature lamps, the interest of which was heightened by the fact that the lamps are a new product of the Kellogg factory, and are soon to be put on the market. This company claims the honor of being the first independent telephone concern in the field to begin the manufacture of its own incandescent lamps for switchboard signaling. These lamps are tipless, and have sliding contacts on the bulb. A corps of twelve efficient engineers and salesmen looked after the Kellogg interests at the convention.

"Ready" put-out reels of single and double deck types, made by the W. G. Nagel Electric Company, of Toledo, Ohio, were found on the floor of parlor 309, exhibited by Harry E. Adams, manager of the sales department of this company. These reels are made to receive readily an ordinary spool or reel and allow it to revolve on a horizontal axis with whatever friction tension-adjustment seems necessary. Nagel pole-houses and line-tools as well as miscellaneous telephone supplies are also handled by this company.

The Farr Telephone Cons. & Supply Co., which does a large business in toll lines and farmer line apparatus, occupied the walls of parlor 318 with different types of instruments. The most prominent feature of this exhibit was the powerful magneto-ringer, which was connected to no less than 35 telephones bridged across the line, and ringing them all strongly. This company is now selling a great many magneto instruments, built somewhat on the external lines of central-energy telephones, with all the apparatus in a single box, on the front of which the receiver and ringing bracket are placed.

The Western Telephone Construction Company had a good line of apparatus on display, including some small switchboards. Ths company has been long known in the independent field. The factory is now located at Winthrop, Ill., although its main offices and salesrooms are in the Fisher Building, Chicago. This company's exhibit consisted of well-known and standard apparatus, which now requires but little description.

The Swedish-American Telephone Company had a novelty on exhibit in the shape of a new magneto-telephone generator, with coils completely enclosed in a revolving cylindrical part, which offers no opportunity for the collection of dust or dirt to interfere with the working. As usual, this company was calling attention to the very strong points of its transmitters and receivers. Plenty of different styles of telephone instruments were shown, and salesmen from the different sections of the country were on hand to look after customers from their respective territories. The Swedish-American have always been noted for the good quality of workmanship bestowed upon them, and the large crowd always to be found at this company's exhibit-room showed the popularity of the company and its apparatus. The menu prepared by this company for the banquet was one of the cleverest pieces of literature at the convention.

The American Electric Fuse Company had a menagerie in full operation during most of the convention, which served to attract visitors who afterwards stayed to learn more about "Protective devices that protect." The protectors and fuses exhibited did not take much space, but made up in interest what they lacked in bulk. The heat plugs, made by this company, are very compact and neat. Any excessive current heats a tiny graphite rod, which conducts enough heat to surrounding parts to cause some fusible metal to let go. Heat coils in place of plugs are furnished those who desire. Double-sleeve twist-connectors, for both iron and copper wire, are another specialty of this company.

[illegible] ment and measured service devices is daily becoming more important with all telephone companies. The American Toll Telephone Company, of Cleveland, maker of "pay stations that pay," had a very complete line of devices for pre-payment and measured service, all of which presented combinations hard to beat, and having features

by which a large percentage of the "slugging" and other schemes used to circumvent "nickel-in-the-slot" machines are being overcome. This company has confined itself mainly to mechanical signals, placed on the subscribers' instruments, which indicate to the central office operator by sound conveyed to the transmitter alone. These instruments are far ahead, however, in the character of the signal they give, which is in all cases very hard to counterfeit, with combs rubbed across the transmitter or the many other common and easily-worked methods of beating the telephone slot machine.

CHICAGO PAY STATION COMPANY.—A new "give back" nickel pay station apparatus, shown by the Chicago Pay Station Company, was one in which this company took much pride. In this slot machine the nickel or other coin must be deposited before the attention of the operator can be obtained. The presence of the nickel in the machine is made known by the operator the instant she plugs in to answer the call, by a sound due to an electrical connection in the slot machine. If the operator is able to get the connection desired the nickel remains in the machine. If she cannot get the connection desired, she throws a releasing current into the subscribers' line, which will allow the nickel to be released by pulling a knob on the slot machine. Another improvement recently introduced in this company's line of machines, is that in case of a pay station where coins of several sizes are provided for the several gong signals. The signals for the three different coins are separate and operated by three different push-buttons, so that if all three coins should be deposited at once, it would be impossible for the calling subscriber to ring the three at once.

MAGNETO AND DYNAMO-RINGING GENERATORS, together with small direct-current and alternating-current motors for driving them, and storage battery charging sets formed part of the interesting exhibit of the Holtzer-Cabot Electric Company. This company's small motors have always been noted for the excellence of their design and workmanship, and the exhibit amply bore out this reputation. A number of these motor-generators sets were shown in operation. The different types of telephone instruments this company makes were also shown, among which should be especially noted the automatic fly-back switch, whereby the switch on an intercommunicating instrument is automatically thrown back to zero when the receiver is hung up after a conversation.

THE STROMBERG-CARLSON TELEPHONE MFG. CO. occupied the most prominent place among the large independent manufacturers at the convention headquarters hotel, having a reception room next to the registration and committee room. Here some of the company's staff were always on hand to receive delegates, and light refreshments were served. For all delegates who wished to visit the company's immense factory at Clinton street and West Jackson Boulevard, carriages were in waiting. Even the best-posted telephone exchange operators could not help expressing surprise at the enormous growth of this company's business within the past few years into the present immense factory, which is even now filled to overflowing, although occupied in full but a short time. The company made no exhibit of apparatus at the hotel, preferring to take visitors to its factory, where both the full lines, apparatus and methods of manufacturing could be shown. Mr. J. J. Nate, of the Stromberg-Carlson Telephone Mfg. Co., was a member of the committee responsible for the convention, and took a most prominent part in all the preparations.

AMERICAN ELECTRIC TELEPHONE COMPANY.—Representatives of the American Electric Telephone Company were found everywhere about the hotel headquarters prepared to accompany visitors to the American Electric Telephone Company's factory at Canal and Jackson streets. This factory is now one of the largest manufacturing concerns in the great west side machinery district of Chicago, and the equipment of this factory for turning out any quantity of work, for which it is noted, is a matter of general interest. At the office and factory special preparations were made to receive visitors and show them over the works.

TELEPHONE BURGLAR AND FIRE ALARM COMPANY.—A combination telephone and burglar alarm system was shown for the first time at this convention. This is a scheme originating in Rochester, N. Y., which is the home of the new Telephone and Fire Alarm Company. Its purpose is to make the ordinary subscribers' telephone circuit serve the double purpose of a telephone and burglar alarm circuit. The idea is to prevent burglary by automatically notifying the central office in case such a thing is attempted. This is accomplished by a simple buzzer device, which is connected up to contacts at the doors and windows at the house to be protected with the burglar alarm circuit. Any attempt to open doors or windows in the protected house will close the buzzer-circuit, which, by means of an induction coil, will send sufficient pulsating current over the line to drop the subscribers' calling signal at the central office switchboard. The operator then plugs in to respond, just as in the case of an ordinary call. The buzzer still being in circuit, the operator upon plugging in receives a loud buzz in the ear, notifying her of the attempted burglary at the subscribers' house. This device is being used in Rochester, and on account of the protection offered to telephone subscribers at a small price, may prove popular.

ELECTRIC APPLIANCE COMPANY.—A number of telephone devices as well as interior telephones of "Eaco" brand were shown by the Electric Appliance Company of Chicago. Indeed, the extent in which this company has entered the telephone manufacturing business proved a surprise to those familiar with its large general supply business who have not kept closely in touch with its telephone department. Among the specialties exhibited may be mentioned the Eaco visual signal metallic-circuit switchboard, the country or party-line switchboards for metallic or grounded circuits, the Eaco plug-switch, for use in connecting grounded country or party-lines or extension bells, and the Griggs adjustable swinging telephone brackets for attachments to desks where a desk telephone is used.

THE NEW PUSH-BUTTON TELEPHONE, made by the American Push-Button Telephone Company of New York, was a neat novelty which attracted much attention. This is a transmitter and receiver combination, for interior telephony, which, when the receiver is hung in its place in front of the transmitter, has the appearance of a large push-button. In fact, the push-button for signaling is located in the back of the receiver. It makes a very neat combination.

THE CHICAGO TELEPHONE SUPPLY COMPANY advertised itself extensively around the hotel, and also exhibited a full line of its telephones in one of the parlors. This company is known as the great mail-order factory, and caters especially to farmers and country toll-line business. Telephones especially adapted to this purpose were shown, and also toll boards and switchboards for small exchanges. A phonograph saved the salesman in attendance the expenditure of much lung energy by continuously expounding the merits of the goods. An unusally strong generator for toll and farmer line ringing was shown. "Crops, Comfort and Telephones" was the suggestive title of a booklet distributed, dealing especially with the advantages and construction of farmers' telephone lines.

STERLING ELECTRIC COMPANY.—"Bell style" telephone apparatus was exhibited in one of the parlors by the Sterling Electric Company of Lafayette, Ind. It is well known that this company has always made a specialty of protective devices, cable terminals of various kinds, and distributing boards. The section of multiple board, with a capacity of 4,000 lines equipped for 2,000 lines, was the most prominent feature in the exhibit. The jacks on this board were spaced ½-inch between centers. This section of board was from that being built for the Rockford, Ill., exchange. The Toledo multiple board, equipped by this company for 6,000 lines has jacks ⅜-inch between centers. On these boards the condensers are placed in rows on a shelf at the top of the back of the boards, where they are out of the way, and at the same time easily accessible.

THE WARNER POLE CHANGER, for taking the place of a constantly-driven generator for central office telephone ringing, was shown in the parlor of the Electric Appliance Company. P. W. Warner, of the Warner Electric Company, of Muncie, Ind., which manufactures this device, was in attendance. The Warner generator is now too well known among telephone exchange men to justify any extensive description here. The generator shown was adapted for selective ringing on party lines, and could be arranged to give either positive or negative pulsating current as well as alternating current.

THE EUREKA ELECTRIC COMPANY, of Chicago, which occupied one of the parlors, made strong claims for its Bell type transmitters. It displayed a great many detailed points, both assembled and apart, as well as its instruments and switchboards. The company makes everything from the central-energy switchboard to the simplest toll-line board, as well as telephones for special service.

THE HIPWELL TELEPHONE was exhibited in various forms at the Sherman House by the Hipwell Mfg. Company, of Allegheny, Pa.

THE VARNEY ELECTRICAL SUPPLY COMPANY, of Indianoplis, had headquarters at the Sherman House.

MR. J. R. WILEY, western manager of the Standard Underground Cable Company, as usual at conventions, made a parlor display of samples, assisted by W. A. Caldwell, superintendent of construction, and W. M. Rogers.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was obtainable with comparative freedom, the closing rates being 4¼@4¾ per cent. for thirty days to six months. In the stock market there was decided activity, standard stocks, railroad specialties and some industrials recording advances. United States steel stocks were steady and well supported; Amalgamated Copper showed strength early in the week, on talk of a settlement with the other copper-producing interests in the Montana litigation. General Electric was very strong on the announcement that the stock is to be increased and a stock-dividend of 50 per cent. or more declared. It closed at 331, a net gain of 5⅛ points, having reached 334 during the week, the lowest figure being 323. The sales of this stock, however, aggregated only 7,400 shares. Westinghouse was another feature, advancing from 195 to 230½, and closing at 226, a net gain of 28½ points. Westinghouse 1st preferred exhibited like activity, and jumped from 201, the lowest figure, to 234, closing at 226½—a net gain of 25½ points. In the traction list weakness prevailed. Brooklyn Rapid Transit closing at 65, being a net loss of ¾ point. Metropolitan Street Railway lost 1½ points net on transactions of 22,500 shares, the closing price being 152½. Western Union is unchanged, at 90½, the price having kept very steady at about this figure all through the week. American District Telegraph closed at 33½, a net gain of ½ point; American Telegraph and Cable, 88, a net gain of 2½ points, and American Telephone and Telegraph, 184, a net loss of 1. In Boston, American Telephone and Telegraph advanced ¼ point, and General Electric was quiet, but closed with a net gain of 7 points. Following are the closing prices of April 15:

NEW YORK.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
American Tel. & Cable..	87½	88¼	General Electric..	325½	332
American Tel. & Tel....	183	180	General Carriage....	[illegible]	[illegible]
American Dist. Tel.....	33	[illegible]	Hudson River Tel....	[illegible]	—
Brooklyn Rapid Transit..	65⅝	65	Metropolitan Street Ry..	165	153
Commercial Cable.....	150	152	N. E. Elec. Veh. Trans..	[illegible]	[illegible]
Electric Boat.....	26¾	26½	N. Y. & N. J. Tel.....	—	—
Electric Boat pfd.....	45	45	Tel. & Tel. Co. America..	4½	4½
Electric Lead Reduc'n....	1⅜	1⅜	Western Union Tel.....	90	90½
Electric Vehicle.....	3	3¼	West. E. & M. Co.....	214	—
Electric Vehicle pfd.....	6⅞	7¼	West. E. & M. Co. pfd..	215	—

BOSTON.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
American Tel. & Tel....	*183½	184	Mexican Telephone....	[illegible]	[illegible]
Cumberland Telephone..	—	125	New England Tel. & Tel.	147	149
Edison Elec. Illum.....	—	252	Westinghouse Elec....	—	111
Erie Telephone	—	—	Western Electric.....	[illegible]	112
General Electric pfd....	—	120	[illegible]	[illegible]	[illegible]

PHILADELPHIA.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
American Railways.....	14¼	[illegible]	Phila. Traction.....	[illegible]	[illegible]
Electric Storage Battery.	74½	77½	Philadelphia Electric....	5½	5¼
Elec. Storage Batt'y pfd.	74½	77½	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	7⅝	7⅜	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Apr. 8.	Apr. 15.		Apr. 8.	Apr. 15.
Central Union Telephone	[illegible]	[illegible]	National Carbon pfd....	[illegible]	*85
Chicago Edison.....	[illegible]	175	Northwestern Elev.....	[illegible]	[illegible]
Chicago City Ry.....	220	*220	Union Traction.....	19⅛	20⅞
Chicago Telep. Co.....	*180	—	Union Traction pfd.....	—	—
National Carbon.....	[illegible]	[illegible]			

*Asked.

GENERAL ELECTRIC STOCK.—It is figured out that the proposition to increase the capital stock of the General Electric Company to $45,000,000 contemplates making the capital practically the same as it was at the start when there were $10,000,000 (authorized) of 5 per cent. debentures, $4,000,000 preferred stock, and $30,000,000 common, or a total of $44,000,000. In 1898 the then outstanding stock, $34,712,000 was reduced 40 per cent., to $18,276,000 common and $2,551,000 preferred. In 1900 the company increased the common stock by $4,415,000 to redeem the then outstanding $5,298,000 debentures, which have been largely converted. The preferred stock has been mostly exchanged for common stock, share for share. The company's stock now stands at $25,242,200, and is practically all common stock. Of the new issue, which stockholders will authorize on May 5, all but about $3,000,000 will be presented to stockholders in restoration of the 40 per cent. cut made in 1898. The holders of the present outstanding $25,242,200 stock will therefore receive a benefit to the extent of 66 2-3 per cent. of their present holdings. This will absorb $16,761,000 of the new stock issue, leaving about $3,000,000 for the treasury. The company's profit and loss surplus on Jan. 1, 1902, was $13,000,000, and by June 1 it is expected to be between $16,000,000 and $17,000,000. This will enable the distribution of the above $16,761,000 stock, which distribution, however, will not take place prior to June 1.

INTERSTATE INDEPENDENT TELEPHONE AND TELEGRAPH COMPANY.—Just previous to the convention of independent telephone men from Illinois and six surrounding states, came the filing of a trust deed, at Joliet, Ill., covering $50,000,000 in bonds of the Interstate Independent Telephone and Telegraph Company. This gave rise to some speculation on the part of the daily press as to whether there was a connection between the convention and the company, and one paper even went so far as to announce that the convention was for the purpose of forming a $50,000,000 telephone combination. Nothing of the kind was contemplated as an immediate result by the promoters of the meeting, however. The Interstate Telephone and Telegraph Company was formed some time ago, to acquire control of various telephone companies. At present it only has control of the Joliet and Elgin (Ill.) independent exchanges and surrounding toll-lines, built by the Northwestern Telephone Company. Bonds, to the amount of $500,000 only will be issued, to purchase this property. The officers of the new company are: President, Harry E. Evans, Aurora, Ill.; vice-president, Frank W. Tracy, Springfield, Ill.; treasurer, Archie B. Conklin, Aurora, Ill.; secretary and general manager, E. R. Conklin, Aurora, Ill.; general counsel, Mazinni Slusser, Chicago.

ELECTRIC COMPANY OF AMERICA.—The announcement is favorably regarded that enough stock had informally assented to carry a proposition at the Electric Company of America annual meeting to make the stock full paid $10, and a net assessment of about $1 per share. The assessment will bring about $400,000 new money into the treasury, and with what is already there will give the company about $700,000 cash funds in hand. The way in which the arrangement came about is understood to be this. The proposition was taken up by certain stockholders, and a following sufficiently large was obtained to secure the co-operation of the management and to secure an arrangement to have the proposition voted on by the stockholders at the meeting. That enough stock is now in favor, to put through the plan, is admitted. The board of directors has hitherto been divided on the question for removing the assessment liability, and E. C. A. is one of the last of the comparatively new stocks to go out of the Philadelphia assessable list, but it has come to be pretty generally recognized, even on that market, that most stocks sell to better advantage now-a-days when they are full paid than when they have the assessable feature.

PHILADELPHIA ELECTRIC REPORT.—The annual report of the Philadelphia Electric for the year ended Dec. 31 shows: Gross income from all sources, $3,295,971; operating expenses, taxes and charges, $2,980,791; balance, added to surplus account, $315,179; surplus for 15 months, ending Dec. 31, 1900. $131,947; total present surplus, $446,677. Lamps connected Dec. 31, 1901: 16 candle-power, 675,995, increase over last period, 89,924; per cent., 15.34. The increase since organization is 35.35 per cent. The advances to subsidiary companies show: Overhead lines, $179,917; boilers, engines and steam apparatus, $218,351; dynamos, storage batteries and electric machinery, $188,039; underground construction, $127,808; real estate, $190,487; miscellaneous, $7,855; total, $912,460. The old board of directors were re-elected, with the exception of P. A. B. Widener, whom Mr. Chas. M. Swain succeeds. President Joseph B. McCall states in his report that the affairs of the company are in a shape to warrant the commencement of dividends on the stock of the company at an early date.

MASSENA POWER.—English investors have found an unprofitable scheme in the power plant at Massena, in northern New York. At this point a nominal capital of $10,500,000 has been expended in developing one of the largest power plants in the world in connection with the St. Lawrence river. The original capital was $6,000,000 of stock, then $3,000,000 of first and $1,500,000 of second mortgage bonds were issued, and nearly all the stock and bonds were sold in London. Practically all of this $10,500,000 has been expended in completing a 50,000-hp plant, but lack of customers for the power has led to the adoption of a reorganization plan, in which the bonds are to be exchanged for stock in a new company. The plant is all right, but full use has still to be found for its current.

ROCHESTER, N. Y.—Plans have been completed for the purchase of the Municipal Gas and Electric and the Citizens' Light and Power companies, both of Rochester, by the Rochester Gas and Electric Company. This will bring all the lighting interests under one control and management.

THE LONDON TRACTION DEAL.—With regard to the latest Yerkes traction financing in London, a special telegram, of April 11, from Baltimore, says: It was announced here to-day that the Baltimore interests, which financed the big London trolley deal, intend to withdraw from the Yerkes syndicate. The details of the plan under which the project is enlarged from a $5,000,000 to a $25,000,000 deal are objected to by these interests. The Maryland Trust Company, which is the fiscal agent for the original plan, is dissatisfied with the proposition now advanced for dividing prospective profits. It holds that this proposition is not in accordance with the agreement made by Charles T. Yerkes, of Chicago, who is directing the deal. Taking this view of the new plan, the trust company has decided to accept the alternative proposition which accompanies it. This is to receive back the cash invested, with 5 per cent. interest. It is likely that all the Baltimore capitalists who were interested also will withdraw their investment.

NEW YORK METROPOLITAN.—President Vreeland says the lease to the Interurban makes available $12,000,000 to $14,000,000 for improvements. At least $5,000,000 will be used this year. The first work will be the change in Ninth avenue, where eight miles of electric road will be built, four miles of double track, from Fifty-third street south to Cortandt Street Ferry. Then will come the change on the Eighth and Fourteenth street lines, and on the lower end of Second avenue.

HAVANA ELECTRIC RAILWAY.—The shareholders of Havana Electric Railway will vote on April 30 on propositions to increase the capital of the company from $11,000,000 to $12,500,000 by the issue of $1,500,000 common stock; also to make a consolidated mortgage securing $10,000,000 bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—According to reports received by the mercantile agencies, it is difficult to define the exact condition of the general commercial situation. Appearances, however, indicate that the check given to distributive trade by the reactionary weather, crop uncertainties and additional friction in industrial circles, is not of an abiding character. Bank clearings, all things considered, are of large volume, and the railroad earnings, as reported by Bradstreet's, point to continued increases over the same period a year ago; and special activity is noted in leading manufacturing lines, particularly iron and steel, lumber, coal mining, machinery making and a host of lesser industries. At industrial centers in the South, iron, coal and coke production is active, while the backward weather conditions are credited with limiting demand in agricultural sections. Iron and steel continued to lead in activity. Prices of Bessemer pig have advanced on the announcement of the closing of very large contracts, for delivery between October next and April next year, aggregating 225,000 tons. Foundry and forge iron are also firmer. Practically all the merchants' furnaces are booked with orders for the balance of the year, while in finished products no promises will be made for deliveries inside of three or four months. For finished products there is no diminution in activity in demand. The building trades also report undiminished activity, which, it is stated, has never before been so widespread. The railway gross earnings for the month of March were 6.7 per cent. more than the same figures for the like period last year. The granger lines and the Pacific Coast roads report a heavy percentage of increase—11.9 per cent. and 13 per cent., respectively. The Central Western and Middle States roads contribute a gain of 7.1, and the Southern lines show an increase of 5.8 per cent., while the trunk lines report an increase and earnings of 3.9 per cent. The business failures for the week, as reported by Bradstreet's, numbered 182, as against 176 the week previous, and 225 in the corresponding week last year. In the metal market, the situation in copper is extremely quiet. The demand is slow and prices show an easy tendency. Quotations are 12@12½c. for Lake, 12@12¼c. for electrolytic, and 11¾c. for casting stock.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended March 29: Antwerp—8 pkgs. machinery, $278; 7 pkgs. material, $831. Argentine Republic—109 pkgs. material, $2,713; 5 pkgs. machinery, $420. Bristol—2 pkgs. machinery, $210. British Australasia—2 pkgs. machinery, $98. British East Indies—129 pkgs. material, $2,975. Bolivia—11 pkgs. material, $235. Bremen—16 pkgs. material, $366. British Guiana—17 pkgs. material, $349. Brazil—110 pkgs. machinery, $10,668; 1 pkg. material, $20. Berlin—1 pkg. material, $80. British West Indies—44 pkgs. material, $505. Cuba—1 pkg. machinery, $75; 49 pkgs. material, $1,177. Chili—15 pkgs. material, $1,106. Cardiff—16 pkgs. material, $405. Central America—1 pkg. material, $25. Dublin—7 pkgs. material, $200. Ecuador—6 pkgs. material, $24. Glasgow—4 pkgs. material, $150; 9 pkgs. machinery, $1,780; 4 pkgs. material, $150. Genoa—38 pkgs. machinery, $4,730. Hull—24 pkgs. machinery, $2,883. Hamburg—3 pkgs. machinery, $400; 22 pkgs. material, $779. London—22 pkgs. machinery, $2,530; 770 pkgs. material, $19,957. Liverpool—242 pkgs. machinery, $15,610; 28 pkgs. material, $1,055. Mexico—63 pkgs. material, $1,315; 6 pkgs. machinery, $56. Manchester—4 pkgs. material, $4,322; 290 pkgs. machinery, $25,433. Milan—1 pkg. material, $10. Naples—12 pkgs. machinery, $353; 7 pkgs. material, $50. Peru—3 pkgs. material, $202; 5 pkgs. machinery, $150. Rotterdam—4 pkgs. material, $27. Southampton—203 pkgs. machinery, $28,700. San Domingo—6 pkgs. material, $63. Savona—4 pkgs. machinery, $258. Zurich—1 pkg. material, $57.

McCLOUD RIVER POWER PLANT.—A special dispatch from Cincinnati states that the McCloud River Electrical Power Company, which is building one of the largest power plants in the West, on the McCloud river, has closed a contract with the Bullock Electrical Manufacturing Company, of Cincinnati, for all its electrical machinery. The Bullock Company has taken bonds of the Power Company for the entire cost of apparatus. Mr. H. C. Wybro, of San Francisco, has been engaged as electrical engineer, and A. J. Wiley, of Boise, Idaho, has entire charge of the hydraulic construction work. The McCloud River Electrical Power Company is capitalized at $1,500,000, and has issued $600,000 30-year, five per cent. gold bonds. The directors of the company are: Robert Gibson, New York; Henry B. Twombley, New York; Wm. R. A. Wilson, New York; George H. Proctor, New York; A. F. Johns, San Francisco; A. Hockheimer, Willows, Cal.; L. S. Barnes, Redding, Cal. The contracts already signed for power guarantee an income, it is alleged, of over $400,000 per annum.

DEVELOPMENT IN SPAIN.—The Commercial Museum, at Philadelphia, has received a communication from Madrid, Spain, calling attention to the formation there of a new electric company, with a capital of 6,000,000 pesetas, or about $960,000, which will utilize for illumination, motive power, traction, heating, etc., the hydraulic energy of a waterfall in the Jarama River, situated about eleven miles from Madrid. About three thousand horse-power will be developed for the work. Extensions are shortly to be made on certain street-car lines, and other roads are contemplating a change from mule power to electricity. These undertakings are of interest to manufacturers of electrical material in this country, as large quantities of such supplies will be needed. The manager of the new electrical company has informed the United States Consul at Madrid that they intend to purchase about 75 per cent. of the material needed by them in the United States.

EQUIPMENT WANTED FOR JAPANESE ROAD.—Inquiries are now being made here for the initial equipment, etc., which is intended to be untilized in the construction and installation of a new electric traction system for Yokohama, Japan. The name of the concern which proposes to build the road is the Yokohama Electric Tramways. The existing capital has been furnished by Japanese, but it is anticipated that foreign money will be introduced into the enterprise later on. The present specifications, which are in the hands of the American Trading Company, Broad Exchange Building, Broad street, and the China and Japan Trading Company, Limited, whose New York offices are at 32 Burling slip, etc., call for an expenditure of 200,000 yen—about $100,000.

BIG CONTRACT FOR SHAW CRANES.—Manning, Maxwell & Moore, of 85-87 Liberty street, New York City, have secured a contract from the Colorado Fuel and Iron Company for the installation in the new extension of the rod, sheet and tin-plate plants at Pueblo, Colo., of 18 electric traveling cranes, to be manufactured by the Shaw Electric Crane Company, of Muskegon, Mich. There will be one crane of 25-ton capacity, to be operated by a 45-hp motor; six 20-ton outfits, each having 40-hp motors; the same number of cranes of 15-ton capacity, to be driven by 25-hp motors; four of 10-ton each, with motors of 18-hp each, and one 5-ton crane, to be worked by a 12-hp motor. The value of the contract is $92,000.

THE MAGNETO ELECTRIC COMPANY will establish a factory at Amsterdam, N. Y., for the manufacture of its apparatus which relates to commercial telegraphy, fire alarm systems, railway semaphores and everything in the signal line. By the Magneto Company's system signals are operated without the use of batteries. The system was described and illustrated in ELECTRICAL WORLD AND ENGINEER of Dec. 1, 1900.

THE MILLER IMPROVED GAS ENGINE COMPANY, of Springfield, O., whose plant was destroyed in the recent fire in that city, has let contracts for the erection of a new plant of double the capacity of the old. The main building will be of brick, 300 x 73 feet. It will be equipped throughout with new machinery, now being ordered, and it is the intention to have the plant in full operation by July 1.

TO EXTEND PLANT.—The Warren Electric Manufacturing Company, Sandusky, O., will build a large addition to its plant. It will be 140 x 40 feet, two stories high, of brick and stone.

BRITISH GOVERNMENT ORDERS FOR AMERICAN MACHINERY.—Charles Churchill, managing director of Charles Churchill & Company, Limited, of London, etc., which concern represents the British interests of over 100 American machine tool manufacturers, and is the largest handler of Yankee labor-saving devices in the United Kingdom, is now on a visit to the United States. In an interview, Mr. Churchill said: "The prejudice which American machinery was subject to a few years ago is now practically a dead letter. I should say that over 300 manufacturing firms in Great Britain use American tools. The government has been quite an extensive purchaser since the outbreak of the war in South Africa, and hardly a day has passed for the last two years without our having secured an order for various American devices to be installed at the Woolwich Arsenal. We have had orders for lines of tools varying from lathes for the ordinance shops to smallest wire twist drills, to be used for making cartridge fuses. Recent contracts call for four No. 2 milling machines, to be built by the Cincinnati Milling Machine Company. The Morse Twist Drill Company, of New Bedford, Mass., is furnishing several twist drills. The Warner & Swasey Company, of Cleveland, O., is supplying some brass working machinery. Ten 16-inch screw cutting lathes, manufactured by the Hendey Machine Company, of Torrington, Conn., are also to be installed in the ordnance shops at Woolwich. The London Mint is also being equipped with some half-dozen annealing furnaces, built by the American Gas Furnace Company, of Elizabethport, N. J. Owing to the war, the demand for tools to be installed in big industrial plants has been somewhat meagre, but the loss in trade was supplied by the increased demand for machinery for arsenal use. Now that hostilities are pointing to a happy termination, we look for a decided revival in business all round. I should say that not one-twentieth of the plants in Great Britain have as yet a single American piece of machinery, so that American manufacturers of labor-saving devices have a wide field before them in the United Kingdom. Contracts lately taken for machine tools to go into British industrial plants include orders for 24-inch, 30-inch and 32-inch lathes, to be installed in large Glasgow engineering works and in the Oldbury Carriage Works. The American Turret Machine Company, of Wilmington, Del., will build them. We have also secured orders aggregating about $75,000 worth of various machinery for installation in the new Rugby works of the British Thomson-Houston Company, Limited." Mr. Churchill, who is making his headquarters at the New York offices, 23 John street, of the American Gas Furnace Company, will next week visit New Bedford, Mass; Providence, R. I.; Worcester, Mass.; Hartford and New Haven, Conn. On the 28th inst. he leaves New York for the West. He will visit Cleveland and Cincinnati, and on his return will stop at Philadelphia and Wilmington. He will sail for Europe May 24.

ANOTHER BIG MEXICAN WATER-POWER SCHEME.—One of the most interesting of the several important enterprises backed with American capital for the purpose of utilizing water power in Mexico for the generating of electricity is projected by the Guanajuato Power & Electric Company, recently incorporated, with a capital of $3,000,000. The company has acquired the franchises originally granted by the State authorities of Guanajuato to Francisco Garcia and Carlos M. Reibio, both of the city of Guanajuato. It is proposed to erect a plant having a capacity of 12,000-hp at a point located about 125 miles distant from the city of Guanajuato. The power will be used for various purposes in eight cities and their vicinities. The existing horse tramways in the city of Guanajuato will be electrically converted and supplied with power from the Cemora plant. The power is also to be made use of for the purpose of operating mines in the neighborhood of Guanajuato, which city has a population of some 60,000 inhabitants and is the center of one of the most important mining regions in the Southern Republic. It is also proposed to supply electric energy for many of the manufacturing plants in and around the city and to furnish power for lighting purposes. In the first instance, it is anticipated that the city of Guanajuato and its immediate neighborhood will utilize 2000-hp. The flourishing city of Leon, also situated in the State of Guanajuato, will also be supplied at the outset with about 2000-hp for the purpose of operating the tramways, which will be changed from the present mule system, and for the several industrial plants which abound in that city, and for light. The growing cities of Penjamo, Irapuato and Salao and their neighborhoods, as well as three other towns located in the State of Guanajuato, will have the remainder of the power distributed among them. The current is to be carried to the city of Guanajuato by a transmission line of 125 miles. This will be the second longest transmission line in the western hemisphere, the record so far being held by the Bay Counties Power Company's line in California, 222 miles in length. While it has not yet been determined on what the exact voltage will be of the Mexican line, it can now be said that it will not be less than 40,000 volts, and that it is likely to be nearly 60,000 volts. The equipment of the Guanajuato Company's plant will include three-phase General Electric apparatus. The contract for the turbines, etc., has not yet been decided upon. The principal parties interested in the Guanajuato Power & Electric Company include Mr. Charles A. Coffin, president of the General Electric Company; Messrs. Curtis and Peck, who are largely interested in Denver electric traction systems; Mr. Bonwright, a prominent Denver banker, and Mr. Adams, a well known Boston capitalist. The entire system is expected to be in working order inside of two years, and is estimated to cost fully $2,500,000.

ELECTRICITY IN RAILROAD SHOPS.—Two important contracts for electrical apparatus for operating railroad shops have been secured lately by Westinghouse, Church, Kerr & Co., including complete generating plants as well as motor equipments. This apparatus will be installed in the new shops of the Union Pacific Railroad Company, at Omaha, and the Oregon Short Line Railroad Company, at Pocatello, Idaho, and will consist of Westinghouse machines throughout—engines, generators and motors. It is proposed to adopt direct-driven tools wherever possible, as it is believed that under this plan better results can be obtained, everything considered, than through any other form of equipment. The plans for the installations provide for up-to-date shops in every particular. The equipment for the Union Pacific Company's new shops, at Omaha, will contain two compound engines directly connected to 250-kw. 250-volt engine-type generators, and one compound engine, directly connected to a 75-kw. 250-volt generator. These engines are to run non-condensing under a boiler pressure of 150 pounds. The contract also covers 21 shop motors of various sizes, from 5 to 25-hp. The generating sets are to be of regular engine-type construction, with bed plates. The Oregon Short Line contract covers two standard engine-type outfits for direct connection to 150-kw. 250-volt generators, and one "Junior" engine for direct connection to one 50-kw. 250-volt generator, the engines to be of the regular Westinghouse construction with bed plates. The contract also covers 12 shop motors of various sizes. These engines will operate non-condensing under a boiler pressure of 100 pounds. Under both of these contracts the Union Pacific and Short Line companies will use Westinghouse motors for all individual direct-driven tools. This means 21 motors for Omaha, ranging from 5 horse-power to 25 horse-power, and 12 motors for Pocatello, ranging from 5 horse-power to 25 horse-power.

HIGH HEAD DEVELOPMENT ON THE PACIFIC COAST.—The long-distance electric power transmission companies of the Pacific Slope are now reaching far back in the Sierra Nevadas for their water supply, and are utilizing the water under extremely high pressures, which a few years since would have been considered impracticable. The latest development is a contract which has been placed with the Abner Doble Company, of San Francisco, by the Bay Counties Power Company, of California, for two water-wheel units of 3,700-hp each, to operate under an effective head of water of 1,600 feet. These will be the largest single tangential water-wheel units ever installed, and will be equaled only by the 5,000-hp turbines at Niagara. The 2,000 kw. 240-rpm generators for these units will be furnished by the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and the main shafts will be made by the Bethlehem Steel Company, of their high carbon, open-hearth, annealed, oil-tempered nickel steel. Throughout, the apparatus will be designed on best engineering lines, with a view of securing the highest possible efficiency.

BELL TELEPHONE OUTPUT.—The instrument output of the American Telephone & Telegraph Company for the month ending March shows a gross output of 96,557 instruments. This is a record-breaking exhibit, the nearest approach to it being that for the month of June, 1901, when the output aggregated 96,300 instruments. The number of returned instruments was, however, considerably in excess of the average monthly returns, and hence the net results were not much beyond the ordinary. The statement, as compared with last year, shows an increase of 19,806 in gross output since Dec. 20. The gross output for the year 1902 was 279,553, a gain of 63,444. The net output was 114,498 and the total outstanding is 2,691,065, a gain of 611,567.

BALL ENGINES.—The Wallaceburg Sugar Company, Limited, of Wallaceburg, Ont., which is building a beet sugar works, will install an electric power plant, consisting of two engines built by the Ball Engine Company, Erie, Pa., and direct-connected to Crocker-Wheeler generators. The Eaton Sugar Company, now building a beet sugar works at Eaton, Colo., has purchased for its electric plant two direct-connected outfits, the engines being built by the Ball Engine Company. The Minneapolis General Electric Company, Minneapolis, Minn., is installing two vertical cross-compound Ball engines, direct-connected to General Electric generators.

SHANGHAI TO HAVE MOTOR CARS.—The Municipal Council of Shanghai have abandoned the idea of the construction of electric tramways, and are now prepared to receive offers for a motor car omnibus concession. Mr. Fearon, of Fearon, Daniel & Company, who is now in China, has acted in several instances as chairman of the meetings held there, for the purpose of considering the matter of adopting occidental modes of transit. The New York offices of the company are at 87 Front street.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—[illegible] to connect La Grange and Cooperstown, Calif., is being promoted by James Mc-[illegible]

SAN FRANCISCO, CALIF.—The San Francisco Board of Supervisors has asked the City Attorney for advice as to their power to grant the telephone franchise which M. Adrian King has applied for. The same promoter obtained and sold a valuable telephone franchise in Los Angeles a short time ago.

LOUISVILLE, KY.—The Louisville Independent Telephone Company will arrange for a $1,000,000 mortgage on its plant in the near future. The company's new exchange will soon be ready for operation.

ST. JOHNS, MICH.—The Union Telephone Company has increased its capital stock from $250,000 to $400,000.

SAGINAW, MICH.—The directors of the Valley Telephone Company, at a meeting held recently, authorized the expenditure of $75,000 in expansion during the next few months. The company occupies the territory in the extreme eastern part of the State.

BELDING, MICH.—The new exchange of the Citizens' Telephone Company here was formally opened April 1. The exchange starts with 120 subscribers, which is a large number for a town of less than 5000 population. Service was not charged for up to April 1, but collections will be made for this quarter.

ALBION, MICH.—A committee of local business men and other citizens is organizing an independent telephone company here. A mass meeting was held at the Opera House recently, which was addressed by Manager E. B. Fisher, of the Citizens' Company of Grand Rapids, and Manager J. B. Ware, of the Detroit Independent Company. Connections with the independent toll line systems of the State are promised if a good exchange warrants them, and enthusiasm is at a high pitch.

DETROIT, MICH.—The Wayne County Circuit Court has granted a mandamus requiring the Michigan Telephone Company to extend to the remaining subscribers of the late Detroit Telephone Company, which was absorbed by the Michigan Company, its full service and connection. A few months ago the Michigan Company installed a new switchboard, raised its rates and cut off from connection the remaining subscribers of the Detroit Company. The Court holds that, as the successor of the Detroit Company, the Michigan Company bound itself to the terms of the Detroit franchise and must furnish service at the rate given by the old company.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, of this city, has booked 800 new orders since December 1. On April 1 the number of telephones connected with the regular exchange service was 4,150, and a large force of installation men is at work in the city, operating in conjunction with a special crew of linemen. A new directory will be issued in May, which is expected to contain nearly 4500 names. This is a large number for an exchange in a city of 90,000 where two companies are operating. The growth is undoubtedly due in part at least to the advance made in the rates by the Michigan Telephone Company, representing the old Bell interests, which took effect Jan. 1.

ALMA, MICH.—The Union Telephone Company, which occupies the independent field in Shiawassee, Gratiot, Isabella, Clair and Saginaw counties, and portions of Ionia and Montcalm counties, held its annual meeting here a few days ago and elected the following officers: President, S. E. Parkill, of Owosso; vice-president, J. P. Gibbs, of Edmore; secretary, Thomas Bonley, of St. Johns; treasurer, Garret S. Ward, of Alma; general manager, C. O. Trask, of Alma. The capital stock was increased from $250,000 to $400,000, and several important extensions and improvements were authorized. This company occupies the field extending through the central portion of the State, from the Grand Rapids & Indiana Railroad to the territory occupied by the Valley Telephone Company's system.

ST. PAUL, MINN.—Amended articles of incorporation were filed at the office of the secretary of state recently by the Central Minnesota Telephone Company, of Willmar, whereby its capital stock is increased to $575,000, of which $50,000 is to be special, $300,000 preferred, and $225,000 common stock. This company operates several telephone systems which radiate from Willmar.

BUFFALO, N. Y.—The Frontier Telephone Company, which is preparing to build an independent exchange in Buffalo, has placed a contract for switchboards with the Kellogg Switchboard & Supply Company. The initial installation will have a capacity of 18,000 lines and, it is stated, will be the largest single multiple board ever built.

PILOT MOUNTAIN, N. C.—The Farmers' & Merchants' Telephone Company is constructing a telephone line from this city to Ararat, N. C. This company is extending its lines in all directions.

RALEIGH, N. C.—The long contested suit of the American Electric Telegraph Company against the Raleigh Telephone Company for a switchboard was compromised recently. Four thousand dollars were involved.

ROXBORO, N. C.—Mr. W. W. Shaw, superintendent of the Interstate Telephone Company, has been in Roxboro, N. C., looking into telephone matters. It is probable that Roxboro may have a telephone system established by the Interstate Company.

RALEIGH, N. C.—The final connections have been made between Greenville and Kinston, so that the long-distance service of the Henderson Telephone Company is now in practical operation to Morehead City, and all intermediate points. The main line of the company extends from Chase City, Va., to Morehead, N. C. The principal points reached by the line just completed are [illegible]

SHELBY, OHIO.—The Shelby Electric Company will build a brick and stone addition to cost $5,000.

MARION, OHIO.—The Marion Telephone Company has increased its capital stock from $5,000 to $10,000. Fred E. Guthery is president and Frank Crow, secretary.

CONVOY, OHIO.—The Convoy Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a 100-line magneto, self-restoring drop board.

HASKINS, OHIO.—The Haskins Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a new magneto system switchboard with 100 drops.

CLEVELAND, OHIO.—The annual convention of the Ohio Telephone Association will be held about the middle of June this year. The exact date and place have not been decided upon.

PEMBERVILLE, OHIO.—The Bradner Telephone Company, of Bradner, has bought the Pemberville exchange, including the lines connecting this place with Woodside, Scotch Ridge and other places.

NORWALK, OHIO.—The Norwalk Local Telephone Company has been incorporated, with $250,000 capital stock, to furnish telephone service in Norwalk and surrounding towns. A. M. Beatty and J. F. Laning, of Norwalk, are the chief promoters.

TOLEDO, OHIO.—J. W. Cherry, manager of the Toledo plant of the Bell Company, has been made manager of the Toledo district, including several counties in Northern Ohio. T. P. Ryan, formerly assistant manager, has been promoted to the position of manager.

CANTON, OHIO.—Mr. George Holmes, manager of the Canton exchange of the Central Union Telephone Company, has been appointed district manager for Stark, Wayne and Holmes counties, including about 12 exchanges. His headquarters will continue at Canton.

DEFIANCE, OHIO.—The Defiance Grocers' Association has adopted resolutions agreeing to drop the service of the Bell Company because it has increased its rates. The business will be given to the Home Company, which now has about 600 subscribers, and is growing rapidly.

CLEVELAND, OHIO.—The Century Telephone Construction Company is installing 200-line common battery boards for the Valley Telephone Company at Waverly, Athens and Sayre, N. Y. It has a large force at work on a 1000-line board for the Utica Telephone Company, Utica, N. Y.

HAMILTON, OHIO.—President Bake, of the new Hamilton Home Telephone Company, states that over 600 subscribers have been secured. A building has been leased for an exchange and work of laying conduits will start at once. The exchange is being built by the Northern Construction Company.

BUCYRUS, OHIO.—The directors of the Bucyrus Telephone Company have decided on important improvements. Contracts will be placed for 5000 feet of overhead cable to supply telephones in the second and third wards. The company has over 700 telephones in use and will install over 100 more when the cables are up.

MARION, OHIO.—The Marion County Telephone Company, which will build an extensive system in Marion County, has placed a contract with the Sterling Electric Company, of Lafayette, Ind., for switchboard, telephones and other equipment. The Marion Company has arranged for exchange quarters in the new Masonic Temple.

MANSFIELD, OHIO.—R. S. Teeple, a taxpayer, has brought suit to secure the forfeiture of the franchise whereby the Central Union Telephone Company operates in Mansfield. He claims that the original franchise, which was secured by the Midland Telephone Company, was never assigned to the Central Union Company; also that the latter is furnishing inferior service.

TOLEDO, OHIO.—The Toledo Telegraph, Telephone & Messenger Company will spend $100,000 in a plant and will operate messenger service wires. It will have branch offices in the surrounding towns and hamlets which will be connected by telephone lines. The business will not interfere with that of the telephone companies. L. P. Harris, J. H. Bellows, A. M. Hough and others are interested.

ROCKY HILL, OHIO.—An important community system is being built in Gallia and Meigs counties, centering at Rocky Hill. Each line is built by a company of 15 persons who furnish their own telephones and material. Lines are being built to Keystone, Camba, Thurman, Berlin and Jackson and others are projected. It is the intention to install an exchange to afford better intercourse among the various lines.

CADIZ, OHIO.—The Harrison County Telephone Company has elected officers as follows: Ralph Cunningham, president; W. W. Wright, vice-president; W. W. Potts, secretary; J. M. Schreiber, treasurer. The above, with A. J. Vereiner and George Probeck, are directors. The company declared its second semi-annual dividend March 1. It is at present engaged in building a toll line from its exchange at Jewitt to Scio by way of New Rumley.

TOLEDO, OHIO.—The Toledo Home Telephone Company has filed a mortgage for $2,500,000. The Central Construction Company built the plant. Securities are now being distributed to Toledo subscribers by the National Bank of Commerce. The Company held its annual meeting a few days ago and elected these officers: E. L. Barber, president; M. V. Barbour, vice-president; James S. Brailey, jr., treasurer; Robert E. Hamlin, secretary-manager.

CANTON, OHIO.—Representatives of the Board of Trade and the Business Men's Association have taken an option on the property of the Stark County Telephone Company, which includes the local exchange. It is proposed to organize a company with practically every subscriber as a stockholder, and purchase the property from the Federal Telephone Company. Members of the Business Men's Association and physicians have ordered Bell telephones taken from their residences and places of business.

ELYRIA, OHIO.—The American Construction & Trading Company, of Elyria, which is building telephone exchanges at Albany, Schenectady and Cohoes, N. Y., for the home companies of these cities, has placed contracts with the Kellogg Switchboard & Supply Company for switchboard apparatus. At Albany there will be a multiple central energy board of 7200 drops capacity and the exchange will start with 2100 lines. The Schenectady board will have a capacity of 4800 lines and 1000 will be installed, and the Cohoes board will have 2400 lines with 800 installed.

SANDUSKY, OHIO.—The Ohio interests of the Central Union Telephone Company have been divided into four divisions, with headquarters in Cleveland, Sandusky, Dayton and Columbus. A. J. Mellen, heretofore manager at Sandusky, has been made manager of the Sandusky division, in charge of exchanges in Erie, Lorain and Huron counties. The past year has been the best the company has ever known in Sandusky, and a large number of new subscribers has been added to the list.

OTTAWA, ONT.—The Bell Telephone Company contends that, under its Dominion charter, it has power to use the streets of every municipality in Canada in perpetuity, but a judge of the Court of King's Bench for Ontario has just decided to the contrary. The judgment was rendered in a stated case of the City of Toronto vs. the Bell Telephone Company and will practically give the whip handle to the municipalities.

CHARLESTON, S. C.—The Southern Independent Telephone Association was formed here recently at a meeting of representatives of independent telephone companies from North and Carolina, Georgia, Florida and Virginia.

AUSTIN, TEX.—The following appointments of officials of the Southwestern Telegraph & Telephone Company, which operates in Texas and Arkansas, have just been announced: Joseph E. Farnsworth, general manager, with headquarters at Dallas; T. L. Powell, superintendent Arkansas division, with headquarters at Little Rock; T. W. Milburn, superintendent North Texas division, with headquarters at Dallas; E. K. Baker, superintendent South Texas division, with headquarters at Austin; C. A. Gates, superintendent long-distance service; P. E. Hurson, superintendent of equipment; B. H. Johnson, superintendent of construction. The offices of general superintendent and superintendent of construction of the South Texas division have been abolished.

AUSTIN, TEX.—The energy and activity of the numerous independent telephone companies which have invaded the Texas and Arkansas field during the past two years has caused the Southwestern Telegraph & Telephone Company to take steps looking to extensive improvements and additions to its system in Texas and Arkansas, in which it operates. Messrs. T. B. Dolittle and Thomas Cotter, of Boston, Mass., who are in the employ of the parent company, of which the Southwestern Telegraph & Telephone Company is a part, are now making a tour of Texas for the purpose of investigating the physical condition of the properties of the corporation with a view to making recommendations and estimates for important extensions of toll lines and a general improvement of the system in that State. These two gentlemen have already completed their inspection work in North Texas and have submitted and had approved by the Boston office an estimate for improvement aggregating $250,000 in the northern part of Texas. It is expected that nearly one million dollars will be expended in Texas and Arkansas within the next year by this company.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company is installing new instruments at the rate of ten a day in Salt Lake and the immediate vicinity. The Company has begun the construction of a line between Great Falls and Ft. Benton, Mont., a distance of 43 miles.

SALT LAKE CITY, UTAH.—The Midway Telephone Company has incorporated in Portland, Ore.; capital, $4,000. Incorporators, H. V. Gates, H. M. Gates, W. E. Pruyn, O. E. Gates and C. Cogswell.

SALT LAKE CITY, UTAH.—The Union Pacific Railroad is constructing an independent telephone line between Laramie and Cheyenne, for local business only. This line will not be associated in any way with the movement of trains.

SALT LAKE, UTAH.—The Montana & Wyoming Telephone Company, which is fighting the Rocky Mountain Bell Telephone Company in the Northern part of Wyoming, has secured a franchise from the Council of Cody, Wyo., to erect and maintain an exchange in that place. The franchise is exclusive for three years.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has started a crew from Blackfoot to extend the Hailey line westward to a connection with Boise, Idaho. Later a crew will work from the other direction to close up the gap of 150 miles which will give Salt Lake connection with all of the Western Idaho circuit.

SALT LAKE CITY, UTAH.—Articles of incorporation have been filed at Spokane, Wash., for the Washington Water Electric Power Company, by which the company takes power to do business outside of the State of Washington, and also to enter the telephone business. The company will install a telephone line to the Cœur d'Alene country, also to a number of towns en route.

SALT LAKE CITY, UTAH.—T. N. Terrell, contractor on the Thunder Mountain (Idaho) telephone line has started work. Work will commence on the Idaho City end and will be pushed as fast as possible. It will follow the present wagon road to Bear Valley, thence to Thunder Mountain. The Rocky Mountain Bell Telephone Company is behind the enterprise.

SALT LAKE CITY, UTAH.—The Utah Home Telephone Company will apply for franchises in the cities of Ogden, Logan, Park City, Burgham and other municipalities in the State. As soon as these franchises are granted the company will commence work, involving an expenditure of at least $1,000,000. The company's charter provides for conducting, besides the business of furnishing telephone service in Utah and all other States adjacent, the furnishing of electric current for light and power and the operation of electric railways.

CHARLESTON, W. VA.—The Charleston Telephone Company, which has recently succeeded the Kanawha Telephone Company, has cut in about 675 lines in its new system, which will have 1200 lines to start with. The system will tap all the coal country in its section and lines will be built to Huntington, to connect with the system of the United States Telephone Company. The company is installing Kellogg apparatus.

ELECTRIC LIGHT AND POWER.

EUFAULA, ALA.—The City Council has under consideration two propositions for lighting the city, and will meet soon to decide the matter. The Atlantic Electric Light Company has also submitted a proposition to build a new plant to be owned and operated by the city.

SAN FRANCISCO, CALIF.—The City Council of Whatcom, Wash., has granted the franchise permitting D. O. Mills, Alvinza Hayward and P. B. Cornwall to erect electric power lines and engage in supplying electric light and power. Current will be transmitted about 42 miles from a 10,000 hp electric power plant, which will be installed at Noaksack Falls. A line will also be constructed to Everett, the distance being about 45 miles. A franchise has been granted by the city authorities of Everett, who have refused to grant a similar franchise to the Snoqualmie Falls Power Company. An electric branch of the Bellingham Bay & British Columbia Railroad will be operated.

CITY OF MEXICO, MEX.—The Governor of the State of Zacatecas, Mexico, has just granted a concession to Cleofas Galvan for the installation of an electric power and light plant at San Geronimo, that State. The plant will have a capacity of 1500 hp. Nearly all of this power has been contracted for by various mining companies of that section. Under the terms of the concession the enterprise is exempt from all State and municipal taxation for a period of 20 years.

SHELBY, N. C.—Shelby is to have a first-class system of electric lights. The plant of the Shelby Light & Power Company has been purchased by Messrs. A. W. McMurry and Hugh G. Miller, and these enterprising young business men will give the town and all subscribers good service.

MONTREAL, QUE.—At the next session of the Quebec legislature, power will be asked to authorize the city of Montreal to force the placing of all electric wires in the city in underground conduits.

NAVARRE, OHIO.—A Council Committee has been appointed to prepare an ordinance and secure estimates for electric lighting.

CLEVELAND, OHIO.—A. L. Clark, treasurer of the National Soldier's Home, Montgomery County, Ohio, has advertised for bids for the equipment for an addition to the lighting plant.

CALEDONIA, OHIO.—The Council is sending a committee to a number of towns in the State to investigate the cost of a municipal lighting plant. A proposition made by Mansfield parties is being considered.

GENEVA, OHIO.—The Geneva Illuminating Company, of Cleveland, has been incorporated by A. M. Snyder, A. A. McCaslin, H. B. Potter, Robert Crosser and L. M. Hildreth. The company is building a lighting plant at Geneva.

COLUMBUS, OHIO.—A bill has been introduced in the Ohio Legislature providing that where a village or town decides on municipal ownership of electric lighting plant, it shall purchase that already established. If the parties cannot agree, the matter is to be left to the Probate Judge.

MARTIN'S FERRY, OHIO.—Bids for improvements to the municipal lighting plant have been opened. The Warren Electric Manufacturing Company, of Sandusky, was given the contract for an alternating current machine. Contracts for engines, boilers and other equipments have not yet been awarded.

JEANNETTE, PA.—A large amount of electrical equipment will be installed in the new plant to be built at Jeannette, Pa., by the Pennsylvania Rubber Company, of Erie. F. A. Wilcox, of Erie, is the engineer in charge of plans.

AUSTIN, TEX.—Messrs. Carl F. Drake, of Austin, and J. W. Maxey, of Houston, have entered into a contract with the City Council of Elgin, Tex., to establish and operate an electric light and power plant at that place.

SALT LAKE CITY, UTAH.—W. W. Stevens, of Grangeville, Idaho, has asked the City Council for a franchise for an electric light and power plant. As a counter proposition Mr. Van Buren, the manager of the present electric light plant, has promised the city free street lighting for one year, with privilege of continuing the same thereafter, provided no new franchise be granted.

RICHMOND, VA.—A charter has been applied for by the Interurban Electric Company, Joseph Wallerstein, T. William Pemberton, John Adams, J. Stanton Moore, Milton E. Marcuse and Allen G. Collins, all Richmond people, composing the company. The charter provides for an electric plant in the city of Richmond and in the counties and villages of Virginia. The company will operate an electric light, heat and power plant. The stock is limited to $300,000.

SEATTLE, WASH.—The Citizens' Light & Power Company, a new company in Seattle, has concluded negotiations for a purchase of a site for a plant.

VANCOUVER, WASH.—The City Council of Vancouver, Wash., has decided to sell the city electric light plant with the exception of the real estate composing its site. Sealed proposals will be received until April 21 for the purchase of the system. The purchaser will be granted an exclusive electric lighting franchise for a period of 15, 20 or 25 years, according to the terms of the bids. He will be required to establish an electric light plant of sufficient capacity for all commercial and city needs. The city is to be furnished with 50 arc street lights and the number increased as the city may require. A number of incandescent lights must be donated to the city.

EVANSVILLE, WIS.—The city is figuring to buy the electric light plant in this city.

RANDOLPH, WIS.—There is talk of a municipal water-works and electric [illegible] plant for the south side is now planned. The plant will take care of the entire commercial requirements and eventually bid for the city street lighting.

CHEYENNE, WYO.—The Union Pacific Railroad will construct a central power, heating and lighting plant for its shops and buildings at Cheyenne. Twelve large boilers will be installed.

THE ELECTRIC RAILWAY.

[illegible] Railway & Power Company will issue bonds to the amount of $2,000,000, and proceed to install an electric power plant on the McCloud River in Shasta County, Calif. The first plant to be installed will have a capacity of about 6,000 hp, and further hydraulic development will increase the capacity to 16,000 hp. An electric railway from Bully Hill to Kennett is projected, which will haul ore from the De Lamar mines to the Southern Pacific Railroad, a distance of about 21 miles. Boston capitalists are backing the enterprise.

SAN FRANCISCO, CALIF.—The directors of the Market Street Railway, which is now owned by the United Railroads of San Francisco, has let the contract for the construction of an additional electric power station. The contract price is $127,500. The company now has three electric power houses, with a combined capacity of 9500 hp. The largest has a 7000-hp equipment. The new station will have room for the installation of a 16,000-hp plant. Contracts have been let for two 1250-kw engine-driven General Electric 13,000-volt 3-phase generators, three 750-kw motor-generators and boilers and engine.

ATLANTA, GA.—The extension of the line of the Atlanta Railway & Power Company from East Point to College Park will begin at an early date, and will be completed by summer. The work will begin early in the spring.

LEXINGTON, KY.—The Blue Grass Consolidated Traction Company, which proposes to build an extensive electric system in central Kentucky, has commenced actual construction work on the line to Versailles. Offices have been established in Lexington and plans are being prepared for an immense power station.

ALBANY, N. Y.—The North River Railroad Company has been incorporated, with a capital of $180,000, to operate a street surface road 18 miles long from Saratoga Springs to South Glens Falls. The directors are Byron J. Town, John W. Howe, William F. Town, F. G. Howland, W. L. Rich, J. P. Wemple, J. H. Mabbett and H. C. Todd, of Saratoga Springs, and J. S. White, of South Glens Falls.

WARREN, OHIO.—The Trumbull Electric Railway has been granted a franchise to extend its line through Warren. The company is building an extension to Leavittsburg.

LIMA, OHIO.—The Western Ohio Railway commenced operations from Lima to Wapakoneta and St. Mary's a few days ago. The line will be opened to Minister in a few weeks.

SPRINGFIELD, OHIO.—The Springfield & Washington Traction Company has been incorporated by D. K. Gotwald, O. F. Dillman, L. B. Corry, Charles Orr, W. D. Riddell, W. A. Fry, and C. N. Slyer; capital stock, $10,000.

DELAWARE, OHIO.—The Delaware Street Railway has been sold to J. G. Webb, representing the Columbus, Delaware & Marion Railway Company, which has had the property under option for some time. The price was $50,000.

SEBRING, OHIO.—The Village Council is advertising for bids for the construction of a railway over route No. 1. This route is desired by the Stark Electric Railway Company, which is building a line from Sebring to Canton and Alliance.

DAYTON, OHIO.—The Dayton & Kenton Traction Company is making rapid progress in securing right of way and making surveys. The line will embrace 125 miles of track. The contract with the Falk Brothers Construction Company calls for the completion of 70 miles of road this season.

MANSFIELD, OHIO.—The recently organized Mansfield, Mt. Gilead & Delaware Traction Company has selected directors as follows: W. W. Stark, W. M. Wisely, W. J. Burket, Frank Fenstermacher, C. E. Fritzinger, C. W. Fritz, of Mansfield, and H. B. McMillian, Mt. Gilead. W. W. Stark is president of the company.

EAST LIVERPOOL, OHIO.—Extensive improvements will be made to the East Liverpool & Rock Springs Railway. A portion of the road will be double-tracked, new trolley wire will be put up, several new cars have been ordered and the trucks in use will be replaced with new McGuire trucks. A faster schedule will be adopted.

WARREN, OHIO.—The Conneaut & Southern Railway Company has applied to the Trumbull County Commissioners for a 50-year franchise for a line to run through Kinsman, Berg Hill, Hartford and Vienna on to Youngstown. The company desires to furnish light and power in towns along the route and agrees to give a five cent fare between two adjoining points.

SCRANTON, PA.—The strike of the street railway employes here, which has been on since last September, was declared off on April 6. All old employes are to be taken back at the present scale of wages; old employes are to have preferred runs; the road is to be an "open" one, and there will be no formal recognition of the union.

NEWPORT NEWS, VA.—The Jamestown, Yorktown & Old Point Railway, which proposes to take in the lower peninsula cities and towns, has about decided upon its plans for the road, plant and equipment. R. T. Pierce is chief engineer for the road.

KENOSHA, WIS.—The Kenosha Street Railway Company has mortgaged its entire property in order to raise funds for completing its road.

MILWAUKEE, WIS.—The town board of the town of Greenfield has been asked for a franchise for the extension of the Milwaukee Electric Railway and Light Company's system at that point.

FOND DU LAC, WIS.—The Fond du Lac Street Railway & Light Company will increase the capacity of its plant in order to supply power for the Fond du Lac [illegible] Railway.

NEW INDUSTRIAL COMPANIES.

THE UNITED MARINE MANUFACTURING AND SUPPLY COMPANY has been incorporated at Albany, N. Y.; capital, $5,000. Directors: A. C. Jahl, New York; C. P. Brooks, East Orange; S. C. Weinberg, Brooklyn.

THE SPENCER AUTO-VEHICLE COMPANY, to manufacture and deal in automobiles and other vehicles, has been organized at Portland, Me.; capital stock, $500,000; president and clerk, Seth L. Larrabee, Portland; treasurer, W. F. Rogers, New York.

UNION RAILWAY POWER & ELECTRIC CO.—At Trenton, N. J., on April 12th, the Union Railway, Power and Electric Company, capital $6,000,000, was incorporated. The company is to furnish and generally deal in electrical, chemical, and mechanical power. The incorporators are Nelson R. Vanderhoof, W. Mands Green, and Edward Cuddy.

PERSONAL.

LORD KELVIN [illegible] among the passengers on the Cunard Line steamer Campania, which sailed from Liverpool on April 12 for New York, were Lord and Lady Kelvin.

MR. HERBERT B. MOSES has accepted a position as electro-chemical engineer with the National Storage Battery Co., at Buffalo. Mr. Moses is a recent graduate from Sheffield and Gottingen, where he studied under Nernst.

MR. C. CALL, of the firm of Call & Combs, of Wilkesbarre, N. C., the makers of locust pins, etc., was in New York last week looking after some large contracts for his firm. Mr. Call reports the company very busy and the outlook most encouraging.

MR. ADOLPHUS BUSCH, president of the Anhaüser-Busch Brewing Company, St. Louis, Mo., has been elected president of the American Diesel Engine Company, of New York. Col. E. B. Meier has been elected vice-president of the same company.

MR. JOHN I. SABIN, president of the Central Union Telephone Company and of the Pacific States Telephone Company, has been elected president of the Cleveland Telephone Company, one of the sub-companies of the Western Telephone & Telegraph Company.

MR. HOWARD D. MAIZE, who makes a business of financing and handling bonds for telephone and other public service companies, was an interested visitor at the independent telephone convention in Chicago last week. Mr. Maize is located in the Gaff Building, Chicago, and is giving increasing attention to independent telephone securities.

MR. PATRICK B. DELANY, of South Orange, N. J., lectured before Silley College, Cornell University, on the 11th inst. The subjects covered were control of vibrators, their use in synchronous telegraphy; and rapid automatic telegraphy, the latter method being demonstrated by apparatus in operation showing a speed of transmission of over 7,000 words per minute.

MR. W. S. BARSTOW, the electrical and mechanical engineer, has been appointed consulting engineer to the Hartford Carpet Corporation to build a power plant at their new factories at Thompsonville, Conn. At the present time he is completing a power house at Hammels, Long Island, for the Long Island Railroad Company, which is gradually extending the use of electric traction.

MR. KERN DODGE and Mr. Charles Day, of Nicetown, Philadelphia, have formed a partnership as Dodge & Day, and they describe their professional business as that of "modernizing engineers." Under this original phrase they are devoting their energies to the design and installation of steam and electrical plants, and more particularly to motor drives for factories. They have already done some very interesting work in this respect. Mr. Dodge is the son of Mr. J. M. Dodge, of Link Belt fame.

MR. JOHN LUNDIE, of New York, the well-known consulting engineer, has just been given by the University of Edinburgh, Scotland, the degree of Doctor of Science (D. Sc.) in recognition of his work and researches in the electric traction field. This degree is comparatively rare as conferred on engineers, and is only granted in recognition of original work. Coming from the university of Maxwell, Tait and Jenkin, the degree is particularly gratifying and is a high testimonial to the work accomplished by Mr. Lundie.

PROF. A. G. BELL, president of the National Geographical Society, gave a dinnner at Washington on April 12 at the New Willard, to Commander C. E. Borchgrevink of the steamer Southern Cross of the last antarctic expedition. Among the notable people present were Admiral Dewey, Admiral Melville, Gen. Greely, Marcus Baker, Assistant Secretary of State Hill, Justice Harlan, Walter Wellman, and C. Hauge, Secretary of the Swedish Legation.

MR. JOS. PLATKY, of Lyons, France, is now visiting this country and is making his headquarters at 171 Mercer Street, New York City. He is now engaged as an electrical engineer and contractor at Lyons, but will be remembered by some as one of the early Edison men, having been engaged on stock ticker work in the seventies before he went into the electric lighting field. Mr. Platky is delighted to make this trip to America, and is picking up several novelties for introduction in France on his return.

MR. MARIO BRAGA, electrical engineer for the firm of James Mitchell & Co., of Rio de Janeiro, Brazil, is now visiting this country, and is making his office with Mr. J. J. Hobbs, at 143 Liberty Street, New York City. He will be here about a month and will visit various cities and plants, besides making an investigation as to apparatus, etc. He brings letters of introduction from Dr. Adolf Aschoff, who is very favorably remembered in America by many old electrical friends and acquaintances, and is now connected also with the above [illegible]

MR. F. L. DAME, who succeeded W. J. Browne as general manager of the Union Electric Company, of Dubuque, Ia., has demonstrated in the reconstruction of the system his ability as an electrical engineer. Mr. Dame went there last May to take charge of the remodeling and reconstruction of the system and the work that has been done, which gives Dubuque to-day one of the best electrical systems in the middle west, has been done under his personal direction. He has been prominently connected in the northwest with Thomson-Houston, General Electric and Westinghouse interests, and has now been expending $150,000 in putting the Dubuque lighting and traction systems into good shape.

MR. S. G. McMEEN, who was for a number of years chief engineer of the Central Union Telephone Company, and who, since the election of Mr. Sabin to the presidency of the Chicago and Central Union Telephone companies, has been connected with the engineering departments of both companies, has recently left the operating field to join the ranks of the engineers of the Western Electric Company, where naturally he feels much at home, having for so long supervised and drawn specifications for the construction of apparatus built by the Western Electric Company for the Central Union Telephone Company. Mr. McMeen was one of the leaders in the founding of the Chicago Electrical Association and is one of the most popular and most resourceful telephone engineers in the middle west.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY of Chicago is sending to the trade this week new catalogues of the Packard incandescent lamps and also a catalogue of full line of Whitney instruments.

WM. J. MURDOCK & COMPANY, Boston, manufacturers of the "solid" telephone receivers, desire to announce that they will open a Chicago office on or about May 1. Mr. V. A. Mayer will be their representative.

GOULD STORAGE BATTERIES.—Among the recent installations of the Gould Storage Battery Co., New York, is that of the Amherst & Sunderland Street Railway Company, Amherst, Mass., which consists of 216 cells type O 513, lead-lined tanks, having a capacity of 100 kw, to be used as a floating battery on the system.

INTERCOMMUNICATING TELEPHONE.—A recent leaflet sent out by the Couch & Seeley Company, Boston, Mass., gives a halftone illustration of an intercommunicating telephone equipped with automatic button switch and automatic re-set. These instruments can be used on either common return or metallic circuits.

AUTOMATIC SWITCHES.—The Automatic Switch Company, 131 Liberty Street, New York, has recently issued two bulletins illustrative and descriptive of the Whittingham mechanically operated reversing switch for electric motors. One style of switch is provided with dynamic break and break resistance. Diagrams show the construction and methods of connecting-up these devices.

MR. A. H. MUSTARD, who formerly represented the Wagner Electric Manufacturing Company in New York, has taken the agency of the Pittsburgh Transformer Company, opening an office at 120 Liberty Street, New York. Mr. Mustard's long acquaintance in the electrical field and his experience in selling machinery bespeaks the success of the Transformer Company in and around New York.

LOUD-RINGING BELL.—The Wotton Electric & Manufacturing Company, Atlanta, Ga., is manufacturing a direct-current bell, constructed on the same lines as the loud-ringing extension bell, for use in noisy places, where the ordinary telephone call-bell cannot be heard. It is operated by two cells of dry batttery, and can be connected to any direct currrent circuit. A circular just issued by the company shows the bell to good advantage.

ELECTRICAL INSULATING CLOTH.—The Mica Insulator Company is sending out samples of its "new process Empire oiled material" for insulating purposes. The base of this material is cloth, which is coated with pure linseed oil. It is flexible and highly finished, and the average breakdown test is stated to be 600 volts per mil. Among the advantages claimed for this material are that it does not crack, harden, become brittle, or deteriorate in any way.

F. B. BADT & CO., Chicago, in addition to the agencies which they have had for some time, including those of the Weston Electrical Instrument Company, and Ward Leonard Electric Company, both of whom have been represented in the west by the firm, have secured the agency for the Osburn Flexible Conduit Company, manufacturers of Flexduct; and for the Perfection Railbond Company, who are making a railbond of the same name. It is claimed that this bond when applied across a railjoint makes a perfect electrical connection.

GARTON LIGHTNING ARRESTERS.—Sales of these arresters are forty per cent greater this year than ever before, and to accommodate its rapidly increased business the Garton-Daniels Company, of Keokuk, Ia., has secured the building next adjoining its present location, and is now occupying the same in addition to its old quarters. With such largely increased facilities it expects to be able to handle orders more promptly than ever, which is saying a good deal, as it claims never to have had an order cancelled in its ten years' history, on account of delay in filling.

PHŒNIX ELECTRIC MANUFACTURING COMPANY.—The Card Electric Company, Mansfield, Ohio, announces that it has sold its manufacturing plant and entire business to the Phœnix Electric Manufacturing Company of that city. The Phœnix Company took possession of the premises on April 1. The change of management brought with it the addition of new capital, which will be employed in the material enlargement of the business, and by the addition of new machine tools and shop equipment it is the Phœnix Company's aim to broaden out into a larger and more extensive field of the electrical industry.

THE NEW EXCELSIOR DRY BATTERY MANUFACTORY, (Salman & McShane, proprietors,) has removed to 32 and 34 Vesey Street, New York City, [illegible] gratulated on its increased business, which warrants its taking much larger quarters. It has succeeded in having its batteries adopted by many of the leading gas engine, automobile and launch manufacturers. Since February more than 20 additional telephone companies have adopted the battery. Its proposition to send its batteries upon six months' approval to telephone companies of responsibility is proving effective.

B. & C. ELECTRICAL CONSTRUCTION COMPANY.—The B. & C. Electrical Construction Company, which was incorporated recently at Utica, N. Y., has elected officers as follows: President, E. J. Brown; secretary, F. B. Chapman; treasurer, B. V. Butts. The directors are the above officers. B. V. Butts will be the general business manager of the company. The firm will deal in electrical supplies and also supervise the construction of electrical apparatus. The members of the firm are expert electricians, having been in the employ of the Utica Electric Light and Power Company for several years, and are familiar with all the details of the business.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has distributed quite a striking advertisement, it being a large sepia print of an African lion in his cage. The connection between caged lions and Warren specialties is not so self-evident but that the advertisement needs some little explanation. The Warren Electric & Specialty Company says: "As the lion is king of the jungle, so is the Peerless manufacturing establishment the king of its kind, ready to maintain its position at all times and against all comers." This explanation is undoubtedly thoroughly satisfactory to everyone who receives one of the lions, as they are really works of art.

THE HAINES & NOYES CO., Chicago, through its private telephone plant department, has recently closed the following contracts: A large inter-communicating telephone system for the Chicago University, Chicago; a private telephone system for the American Cotton Company, Oklahoma City, O. T.; another large system for Wm. H. Taylor Machinery Company, Allentown, Pa.; a large telephone system for Frank M. Andrews, architect, Dayton, Ohio; the George Watson Paint Company, Chicago. It has also sold a number of telephones to the Metropolitan Elevated R. R., Chicago, and has equipped the United Traction Company, Reading, Pa., with a telephone system for its line.

THE STANDARD POLE & TIE CO., of 44 Broad Street, New York, has received the order from the Dayton, Lebanon & Cincinnati R. R. Co. for the poles to be used on its line now under process of construction. This line is being built by the Appleyard-Green syndicate, the parties who have already built the Dayton, Springfield & Urbana Railroad, and the Columbus, London & Springfield Railway. The Standard Pole & Tie Company's Southern white cedar or juniper poles were used on both of these roads last year, and proved so satisfactory that they were ordered for the new line. In spite of the long freight haul from their point of shipment, the Standard Pole & Tie Co. is able to put these poles into Ohio at prices which compare very favorably with the prices for Northern cedar.

PITTSBURG TRANSFORMER COMPANY.—In a recent review of local industries, the "Pittsburg Leader" has an appreciative article on the above concern, describing the apparatus. In the way of historical remarks, it says: "The Pitttsburg Transformer Company was organized in 1897 by Mr. F. C. Sutter, its members being Mr. E. C. Sutter, Mr. R. V. Bingay and Mr. H. G. Steele, and the able management of these has made the product of the company widely and favorably known. The greater portion of the business of the company is done in the United States and Canada, but a considerable foreign trade is handled by its foreign department in New York. Pittsburg transformers are carried in stock at the agencies of the company in Pittsburg, New York, Philadelphia, Chicago, and San Francisco, thus permitting prompt delivery to customers wherever located."

THE INTERNATIONAL MOTOR CAR COMPANY, Toledo, Ohio, manufacturer of steam, gasoline and electric automobiles, has just issued a quantity of interesting literature. In one of the pamphlets the manufacturing plant of the International Company is described in a very interesting manner, the description being accompanied by some very excellent halftones. The frontispiece is a very pretty picture of one of the Toledo steam automobiles climbing a hill, the view beyond being an attractive one. The various parts of these vehicles are clearly illustrated, and the different styles of the carriages manufactured by this company are also shown. Another pamphlet is devoted entirely to reproductions of testimonial letters, from which it is evident that the Toledo steam carriage is a favorite in all sections of the country. Abstracts from different papers regarding different runs of Toledo automobiles, contests, etc., are reprinted in another of the pamphlets. Altogether the batch of literature forms very interesting reading to anyone who is at all interested in automobile progress.

"KEYSTONE" HAIR INSULATOR. An article of exceptional interest to architects, builders and prospective owners of all kinds of structures is "Keystone" hair insulator. The problem of insulating buildings against the extreme temperatures of summer and winter is receiving considerable attention. The question of sound-deadening is also one of increasing importance in the residence, schoool, church, hall, and, in fact, all kinds of buildings. The insulation of ice-boxes, cold-storage compartments and buildings to maintain low temperatures produced by natural ice or refrigerating process is also a problem of great importance. Several materials have appeared for the above purpose, but it is claimed that "Keystone" hair insulator is the most successful and economical thus far. In a paper upon insulation of cold storage presented at the October convention of American Warehousemen, at Buffalo, Mr. John E. Starr demonstrated, it is said, the "Keystone" to be from twenty to forty per cent superior to other materials in the various constructions commonly employed. The exclusive selling right for "Keystone" hair insulator, patented and manufactured by Julius De Long & Co., of Allegheny, Pa., has been secured by the H. W. Johns-Manville Co., which is carrying stocks in various parts of the country for the convenience of their widely extended trade. The H. W. Johns Manvillle Co., 100 William Street, New York City, will be glad to forward circulars and samples.

The copper element is partially submerged and partially exposed to the air in order to absorb oxygen, while the zinc element is wholly submerged, an arrangement by which it is claimed more current and higher voltage are obtained.

696,046. CONTROLLING ELECTRIC MOTORS; W. M. Day, Schnectady, N. Y. App. filed July 12, 1899. A system of motor control having a main generator, two distributing wires and a third wire of intermediate potential, between which latter and one of the outside wires is inserted an auxiliary dynamo giving a voltage half that of the main dynamo.

696,953. TRANSFORMER; A. R. Everest, Lynn, Mass. App. filed Mar. 5, 1901. A transformer core comprising a number of U-shaped laminæ each of which has a long and a short leg, the laminæ being assembled alternately to form two core-legs of the same thickness.

696,958. INSULATOR FOR HIGH POTENTIAL CURRENTS; R. Gaertner, Merkelsgrun, Austria-Hungary. App. filed Jan. 13, 1902. Two bell insulators, one inside of the other, with an air space between.

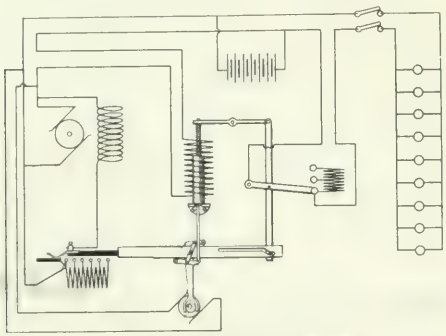
696,963. ELECTRIC SWITCH; G. W. Hart, West Hartford, Conn. App. filed Nov. 19, 1901. Details of a push-switch.

696,969. ELECTRIC SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Aug. 16, 1901. To prevent the circuit breaker from tripping when the circuit is first closed to start a motor without a rheostat, the circuit breaker is provided with means for putting the calibrating spring under increased tension during the moment of closing the circuit.

697,001. INSULATOR; W. H. Nichols, Bennington, Vt. App. filed Dec. 6, 1901. A knob-insulator in two similar parts, between which the wire is clamped, either part being adapted as the base.

697,002. COMBINATION TELEPHONE INSTRUMENTS; J. G. Nolen, Chicago, Ill. App. filed Aug. 7, 1901. (See page 688.)

697,007. CONTROLLING ARC LAMPS; E. Oxley, Brooklyn, N. Y. App. filed Aug. 25, 1900. (See Current News and Notes.)



697,007.—Automatic Electric Controller.

697,009. ELECTRIC TELEPHONE SYSTEM; W. E. Pembleton, Wittenberg, Wis. App. filed Dec. 24, 1900. (See Current News and Notes.)

697,012. CONTROLLER FOR ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Aug. 8, 1898. In a controller of the separately actuated contact type, a contact for connecting the motors in series, another, for connecting the motors in parallel, and a mechanical connection between the contacts, whereby either one is caused to move to its open position, when the other is moved to its closed position.

697,013. ELECTRIC RAILWAY; William B. Potter, Schenectady, N. Y. App. filed Dec. 20, 1900. Details of a stud for a surface contact railway system, providing for the easy removal of the cap for renewal or access to the electrical connection.

697,016. STARTING DEVICE FOR ELECTRIC MOTORS; Robert H. Read, Schenectady, N. Y. App. filed Nov. 29, 1901. To obviate the motor circuit-breaker being tripped, it is short-circuited by the motor starting switch until the motor gets up speeed.

697,035. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 19, 1901. (See Current News and Notes.)

697,051. JUNCTION BOX COUPLING; M. F. Whiton, Hingham, Mass. App. filed Aug. 28, 1901. A locking device is inserted between the end of the conduit and the box.

697,052. JUNCTION BOX; M. F. Whiton, Hingham, Mass. App. filed Aug. 31, 1901. Sheet metal caps are fixed into the openings and adapted to be broken out to admit the end of the conduit.

697,057. REGULATION OF DYNAMO ELECTRIC MACHINES; T. W. Williams, Schenectady, N. Y. App. filed Dec. 4, 1900. (See Current News and Notes.)

697,065. APPARATUS FOR THE TRANSMISSION OF SIGNALS; C. E. Beach, Binghamton, N. Y. App. filed Apr. 6, 1896. One of the claims defines the invention as follows:

A general circuit, a series of separately insulated contacts connected to one side of said circuit, a magnetically controlled selector to successively connect the other side of the general circuit to the contacts, a magnetically-controlled transmitter, an auxiliary circuit jointly controlled by the selector and said transmitter, a shunt around the selector in the general circuit, and a mechanically-retarded relay controlling said shunt and operated by the auxiliary circuit.

697,077. ELECTRIC ARC LAMP; J. Eberhardt, Chicago, Ill. App. filed Aug. 13, 1901. A clutch consisting of a frame carrying a pivoted gripping dog on one side and a roller on the opposite side, and a stationary part against which the roller bears and which is located between the roller and an opening in the frame.

697,123. MEANS FOR TRANSMITTING ELECTRICAL ENERGY; J. E. Woodbridge, Schenectady, N. Y. App. filed Sept. 20, 1901. (See Current News and Notes.)

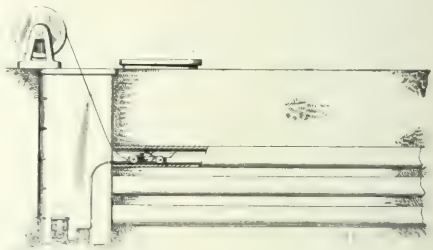
697,132. ELECTRIC CONTROLLER; F. E. Case, Schenectady, N. Y. App. filed July 16, 1900. Means for producing a magnetic field in a direction at right angles to the direction of motion of the moving contact and perpendicular to the face along which contact is made, a blow-cut chamber adjacent to each of the fixed contacts and having an opening for the reception of the arc and a closed wall opposite the opening in the direction of travel of the arc. The whole arrangement is for the purpose of disrupting the arc.

697,144. CIRCUIT CONTROLLER; Edward M. Hewlett, Schenectady, N. Y. App. filed Sept. 9, 1901. A solenoidal core has a free movement over part of its course and is retarded over the remainder of its course by the action of a spring. In the case of an overload the first part of the course is traversed, at the end of which a contact is made which lights a warning lamp. Should the overload become abnormal, the second part of the course is traversed against the action of the spring referred to, and at the end contact is made which trips the circuit-breaker. The specifications describe how the same principle may be applied to a reverse current relay.

697,157. ELECTROLYTIC APPARATUS; F. McDonald, Rumford Falls, Me. App. filed May 20, 1901. Details.

697,161. CONTROLLING ELECTRIC LAMPS; E. Oxley, Brooklyn, N. Y. App. filed Aug. 25, 1900. (See Current News and Notes.)

697,163. ELECTRIC SWITCH; G. B. Painter, Schenectady, N. Y. App. filed May 31, 1901. The cross-head on the key spindle of a lamp socket is fitted thereto with lost motion, but in such a manner as to be rotated by the spindle, thus affording good contact across the terminals.



697,315.—Means for Inserting Cords, etc., into Underground Conduits.

697,192. METHOD OF CHARGING ACCUMULATORS. R. E. Ball, New York, N. Y. App. filed July 1, 1901. (See Current News and Notes.)

697,193. MEANS FOR CHARGING ACCUMULATORS; R. E. Ball, New York, N. Y. App. filed July 1, 1901. (See Current News and Notes.)

697,219. ELECTRIC CIRCUIT PROTECTOR; C. A. Rolfe, Chicago, Ill. App. filed Dec. 3, 1900. Details.

697,267. AUTOMATIC ELECTRIC CONTROLLER; A. McGary and P. Mellinger, Lagrange, Ill. App. filed May 25, 1901. In a plant where the dynamo is driven from a car axle, a variable resistance is arranged for introduction in the field circuit and a traveling bar which controls the resistance is actuated by the axle and a magnet in the main circuit, opposing each other, so that variations of speed will automatically change the resistance in circuit.

697,273. AUTOMATIC SAFETY SWITCH FOR ELECTRIC CIRCUITS; O. L. Plumtree, Chicago, Ill. App. filed Jan. 18, 1901. A snap-switch is controlled by a spring and a magnet in the main circuit opposing each other.

697,277. SIGNALING SYSTEM FOR SINGLE TRACK RAILWAYS; W. W. Salmon, Chicago, Ill. App. filed July 21, 1894. Details.

697,315. MEANS FOR INSERTING CORDS OR THE LIKE INTO UNDERGROUND CONDUITS. I. J. Bergdoll, Philadelphia, Pa. App. filed Jan. 17, 1902. A small motor car traverses the conduit and drags after it a cord or cable.

697,351. ORE SEPARATOR; J. M. McClave, F. H. Kirby, E. R. Cumb[illegible] Co. App. filed May [illegible], 1901. The separator comprises opposed electro-magnets, a drum of non-magnetic material moving between the poles of the magnets, a belt carrying the ore also moving between the magnets and bands of magnetic material supported by the drum, which cooperate with projections from the pole piece of one magnet to deflect magnetic portions of the ore.

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NEW YORK, SATURDAY, APRIL 26, 1902.

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KELVIN.

That electrical engineers and men of science should unite to welcome Lord and Lady Kelvin once more to these shores is one of those fit and proper things, so obvious as hardly to need suggesting, and so much in consonance with public sentiment that even the brilliant success of last Monday night at Columbia University may be taken as a matter of course. Lord Kelvin, indeed, does not belong to England alone, but to the world at large, which his genius has made vastly more habitable and comprehensible. If any other country than Great Britain should claim him, however, it might well be the United States, for to him we owe perhaps more than to any other great mind the achievement constituted by the laying and operation of the Atlantic cable. What nobler work can scientific genius find than bringing mankind into closer and more brotherly relationships? Or if it be in the purely intellectual sphere that such an intellect should labor, regardless of human wants and welfare, surely Kelvin again is the man who has linked together not merely hemispheres, but planets and solar systems by the cables of mathematical reasoning and physical demonstration, weighing even the universe in Kelvin balances.

We are glad to know that keen as was the pleasure enjoyed by all who participated on Monday in greeting the great physicist, it was very thoroughly shared by the distinguished guests of the evening. And best of all has been the wider intelligent recognition in the public prints of the value of such work and services as Lord Kelvin has rendered in his day and generation. No better proof could be given that intellect, rather than wealth or birth, still commands here the profoundest respect; and in a democratic community it would be a sad day when that were not the case. It is too much to expect that Lord Kelvin, hale and hearty as he is at eighty, can sustain again the fatigues of an ocean voyage of 6,000 miles; but we shall venture to believe and hope that the cordiality of his reception here and the benefit due to change of air and scene will add many years to a life so rich in achievement of the highest and finest known to man.

INTERNATIONAL SCIENTIFIC RESEARCH.

Last week we commented on the recent able paper of Prof. John Perry on the waste of natural sources of energy, in which the author suggested that a few millions of dollars intrusted to some of our great scientific leaders might result in a solution of the problem how to utilize practically all of the energy of coal, instead of the few per cent. now obtained. In view of the present and rapidly increasing waste of the potential energy of coal, and the consequent rapid exhaustion of coal beds, the matter indeed becomes one that might well interest the civilized governments of the world. Let us hope that at a not far distant day civilized nations will organize scientific research for purposes such as the one here considered. It would probably pay magnificently to commandeer the scientific resources of any or all countries, organize, equip and foster them, not merely for the prosecution of purely scientific research, which carries no immediately perceptible return, but also for humanitarian aims and purposes. This is what scientific research work is seemingly tending to. There is plenty of work being carried on in a disorganized unmethodical fashion. Every man for himself, and Providence for us all, is the motto, but good results are being achieved. Still better results could probably be obtained by forming a scientific trust or co-operation. The astronomers have already done more work in this way in a decade than

by sporadic undirected effort might have been accomplished in several centuries. By international agreement the leading observatories of the world have assumed the photographic charting of certain lots of heaven, so that by final co-operation every nook and corner of the sky will soon have been fully photographed and charted for future astronomical reference. It seems nearly time for the same international spirit to be deflected from heaven to earth. When the plan is attempted, however, it goes without saying that business men, and not scientists—mere children in commercial affairs, as Cecil Rhodes would say—should be placed in charge of the organization, so that the scientists would be relieved of all duties save those of their immediate study.

Synchronous Reactance.

We publish this week an article by Mr. Baum on "Synchronous Reactance" that merits careful consideration. As is well known, an alternating-current generator-armature possesses at any particular time both a real inductance and an additional virtual inductance. That is to say, the current in the armature establishes magnetic flux that is looped with its own turns, but is not looped with the turns on the field magnets. The amount of this flux, and, therefore, of the real self-inductance of the armature, depends upon the relative positions of the armature and field poles, as well as upon the saturation and reluctance of the local magnetic circuit of the armature turns. It is, in reality, a cyclically fluctuating quantity, capable of being expressed, however, as an equivalent real inductance L, leading to an equivalent real reactance $LI\omega$. But this is not all. The m. m. f. of the armature partially opposes the m. m. f. of the field magnets, the degree of opposition depending upon the lag of the armature current. This produces an effect upon the terminal e. m. f., as though the real reactance were magnified, and the total apparent reactance of the armature is now known as its "synchronous reactance," a term which consequently includes the effects of both real rectance and of armature demagnetizing m. m. f. Mr. Baum's article shows that the assumption of synchronous reactance is only approximately correct, because the demagnetizing vector is not always cophased with the vector of real reactance; but that the error is inconsiderable in computing the effect of regulation. Consequently, the assumption of "synchronous reactance" as the apparent constant reactance of the armature, is sufficiently accurate for practical purposes, if its measurement is carefuly made.

It is claimed that the ordinary method of short-circuiting the armature and determining the excitation that develops full-load current strength is defective, because it necessitates an unduly weak m. m. f. in the field magnets. On the other hand, if this tendency be corrected by employing full excitation and measuring the current strength in the short-circuited armature, the m. m. f. of the armature is unduly great. Another method is, therefore, advocated, of driving the machine as a motor under no load and of super-exciting it until it absorbs the full-load current. There may be some advantage in particular cases of following this method of computing synchronous reactance, but on the other hand it also has disadvantages. The m. m. f. of the field magnets is necessarily above normal, although the m. m. f. of the armature is normal. Moreover, the lag in the machine is abnormal. Experimental comparative data should be collected upon different machines for each of these methods before the value of this plan can be demonstrated.

Massachusetts Central Stations.

The annual report of the Massachusetts Gas and Electric Light Commissioners is always an interesting document, and the volume for 1901, which lies before us, is no exception to the rule. Indeed, [illegible] as containing a discussion of several interesting petitions of the commission. First in order importance comes the matter of "investment," or "capacity," char by electric light companies. This was brought before the commiss by the Woburn Company, to which reference was made at the t in our columns. During the progress of the remonstrance the o inal plan of a fixed charge amounting to three-fourths of previous year's bills, plus a small charge of 5 cents per unit ne meter, was dropped by the Woburn Company, and there was stituted for it a sliding scale of "capacity" charges per month. 6 cents per unit net. To hold the customer to his capacity one automatic limit devices was installed for any consumer under an agreement. The Commissioners look very much askance at an arrangement, but as the main objections were removed when original plan was dropped, they have let the new plan into ser on trial as it were, and await further developments. Their pos seems to be that so long as such a scheme is not made a cloak a rise in prices and is not manifestly unfair to the consumers, are willing to meet it in a spirit of tolerance and give it a fair We must own that we have never fully made up our minds the merits claimed for these plans for charging for capacity broad principles a consumer who makes unreasonable deman the matter of capacity ought to be willing to pay for the priv But on the other hand, public-service corporations are likely t held more and more closely to a uniform basis. If the "capacity "investment" charge were carried to its legitimate conclusion price to certain classes of consumers would become quite prohib [illegible] which the authorities would not tolerate.

A similar question at bottom arose in the petition against the of the Waltham Gas Light Company. In this instance the alleg was that this company had been supplying electric power to Newton Street Railway and gas to two large consumers at less the cost of production, and was recouping itself by extortio charges to the general public. Of course, the fundamental issue the propriety of extraordinarily low rates to certain consume case implicitly found in instances which ought to involve a h capacity charge or its equivalent and yet escape it. The commi censured the policy of the company with respect to the favored tomers, but found that, everything considered, the rates to the p were not much in excess of what they should be, and directed a very moderate reduction in price. In this instance the com was undoubtedly the victim of bad judgment in its railway con made in 1893, without sufficient foresight, and now expired discussing the matter the commission laid down a general rule strikes us as embodying the substantial equities of the situati a very straightforward manner. It runs as follows: "The ge policy of special rates is not to be encouraged, and they ca be justified when they clearly contribute to the general pul vantage." This covers the ground admirably and lead thoroughly rational view of rates. Incidentally, the Waltha showed a fine example of special rates to the municipality some forty per cent. lower than those to ordinary customers raises a nice question of equity and ethics as to the propriety public as a whole receiving concessions to the disadvantage public individually—a question which we leave to the indi casuist. Certainly, most recent rulings tend to encourage el light companies in the adoption of simple and straightfor methods of metering energy, as free as possible from complic not easily grasped by the public. People instinctively distrust ing upon a basis which they do not quite understand.

Another interesting section of the report deals with the e

curring topic of municipal plants, including a brief history of the subject in the State. A brief perusal of this renders it very clear that public sentiment in Massachusetts is, as a whole, against municipal ownership. In fact, the Gas and Electric Light Commissioners have powers in that State sufficient to safeguard the public interests quite effectively. The legal status of municipal plants, too, is such that any municipality where there already is a private plant will think twice before listening to the voice of the tempter and going into the business on its own account. Under the Massachusetts statutes a city or town must buy out the existing plant before it can take up municipal lighting, and while this has been done in a number of cases the provisions of the statute as to the principle of valuation involved are so vague that if the existing plant is worth buying there will certainly ensue a long litigation over the price. One such case has to our knowledge been before the courts actively for the last three years, and is not settled yet. As a rule cities are learning wisdom from the experience of others, and fight shy of the electric lighting business. It is safe to say that no lighting company that keeps in touch with its public and takes a broad view of its obligations will see the municipal spectre looming before it under present conditions. We are bound to say that some of the municipal plants recorded are apparently giving pretty good results; but in this case as in the case of private plants, very little can be judged from the face of the returns. The figures given in these Massachusetts reports are anything but conclusive as to the real condition of the plants to which they refer—not through any fault of the commissioners, but simply because there is no generally received system of bookkeeping which renders the full facts available. The general figures are probably very near the truth, but the details are ofter meagre and inconclusive.

Röntgen Ray Burns

Electricity and its applications are responsible for a few special troubles to which flesh is heir. There are, for example, electric shock, telegrapher's paralysis and telephonist's ear, which have been with us for some time; while of late years we have added Röntgen-ray burns. In a recent article appearing in the Philadelphia *Medical Journal*, by Dr. E. A. Codman (8th and 15th March, 1902), the conditions of somewhat less than 200 cases of Röntgen-ray burns are ably discussed. The fact that there have been so many cases reported shows the reality of the danger that exists, and one instance is mentioned of damages for Röntgen-ray burn having been obtained in a U. S. District Court, last November, for the sum of $6,750. The percentage of Röntgen-ray exposures which produce burns appears to be very small. It is estimated at one-tenth of one per cent. in the past five years, and at one-hundredth of one per cent. during the last year. The frequency of burns seems to be diminishing; partly, perhaps, on account of the shorter exposures that are now necessary for radiographs. The article is written by a medical man for medical men, but contains many items of interest for electrical workers, if only because about one-third of the sufferers have been Röntgen-ray workers, many of whom are electricians and not physicians. Prof. Elihu Thomson at one time nearly lost a finger from a burn by Röntgen-rays in the course of experimental study.

It is stated that the cause of Röntgen-ray burns is not known, but that the primary injury is to the nerves controlling the nutrition of the skin, and there is no reliable evidence to show that injury has ever occurred in deeper tissues without primary interference with the skin. It is a matter of common observation that Röntgen-ray workers frequently develop a "sun-burned" appearance over the exposed surfaces of skin. Moreover, just as acute sun-burning will give rise to blistering and destruction of the epidermis, so a more acute influence of Röntgen-rays will give rise to blistering and ulceration. So far, then, the action of Röntgen-rays is similar to the action of bright sunshine, the difference being a matter of relative intensity. At this point, however, the resemblance appears to cease, because Röntgen-rays occasionally extend to the deeper layers of skin and subcutaneous tissues, even to involving tendon-sheaths and joints. This seems to be accounted for by the greater transparency of the body to Röntgen-rays than to solar rays. A curious property of some of these burns is in their tardiness of appearance. While occasionally injuries have been noticed immediately, the average time of first appearance of the burn, from seventy cases tabulated, appears to have been nearly ten days, while a few cases are stated to run into months. A great deal seems to depend upon personal idiosyncrasy. What would have no apparent effect upon one person seems to be capable of producing a severe burn upon another; in other words, some persons seem predisposed to be burned, and no reasons for the predisposition are yet forthcoming, nor can the elect be identified beforehand. Two methods of prevention are known. One is to interpose a metallic shield, generally a thin grounded sheet of aluminum, between tube and patient (why grounded we do not know); while the other is to limit the time of exposure to that which experience indicates as being safe. Dr. Codman favors the latter method, and to that end has tabulated 44 cases for which the distance and time of exposure are recorded. The most sensitive case on this list is one in which a severe burn occurred in 30 mins exposure, at a distance of 50 centimeters. Since the activity diminishes as the square of the distance from the anticathode, this would correspond to four times 30 minutes, or 2 hours, at one meter. Referred to this distance as standard, all the other recorded cases took much more time, the average record showing many hours at a meter.

It is pointed out, however, that the figures are not reliable, because many of them give the distance from the skin to the tube, whereas what is important is the distance from the skin to the anticathode focus. However, it is urged that if the worst case took 2 hours, referred to a meter, a still shorter time, at standard distance, ought to be safe. The article suggests 5 minutes at 10 inches, which means about 77 minutes at a meter. For convenience of memorizing, we may call this safe exposure one hour at one meter, which is half that of the most sensitive recorded case. Since 20 centimeters is a common range between anticathode and skin, the corresponding time of exposure at this range would be the twenty-fifth part of one hour. This is fortunately amply sufficient for the ordinary purposes of either fluoroscopy or radiography, and the principal danger lies in repetition, because the results appear to be cumulative. It seems, therefore, to be clear that where Röntgen-rays are employed therapeutically up to the danger limit, over a particular and localized area of skin surface, it would be well to interpose a stout metallic shield between the tube and the rest of the patient's body.

The tabulation of results on the basis of exposures at inverse squares of distances presupposes that the Röntgen-ray source is equally powerful in all cases, and this is obviously improbable, if not impossible. It is in this direction that research is most needed. The burns are stated to have been caused by tubes that were excited both by static machines, by Thomson induction coils, and by other induction coils. Very little seems to be known as to the conditions of Röntgen-ray source, or of its excitation, which tend to accelerate burning. By all those who use Röntgen-rays frequently, Dr. Codman's articles will be read with interest.

Portrait of Lord Kelvin.

We publish as a special supplement to this issue, a portrait taken this week of Lord Kelvin, who has been kind enough to sit for that purpose at our request to Falk Brothers, in their well-known Waldorf-Astoria studio. It is some years since the familiar photograph of the great scientist was taken, so that we believe our subscribers will welcome this recent picture. Lord Kelvin was kind enough when sitting to express his thanks for the interest thus shown in him in America, and to say how sorry he was not to be able to meet in person all who would look at the picture in a country where electricity through their work had made such wonderful strides. We desire to add that if any of our readers wish to secure copies of the original photograph mounted, they are referred to Falk Brothers direct. Great as are the merits of the reproduction in half-tone, the original photograph, which has been approved by Lord and Lady Kelvin, is also a strikingly faithful piece of work.

Mr. Morgan and London Electric Traction.

It is announced from London that Mr. J. Pierpont Morgan will finance, to the extent of several million pounds, a new underground railroad system in London, which will rival Charles T. Yerkes's scheme of obtaining possession of all the intramural transportation. Combined with the Morgans are Siemens Brothers and other large British interests. The promoters expect that they will meet with but little difficulty in obtaining the permission of the House of Lords Committee for the construction of their lines.

The importance of the scheme consists chiefly in the amalgamation, effected at the end of last week under the Morgans' auspices, of the various projected tubes. These, when constructed, will extend forty miles in a continuous line north, and to the west and southwest of the metropolis. These lines, in turn, will connect with ninety miles of surface roads, the London United Electric Tramways being also a member of the new syndicate.

A special cable dispatch from London, of April 22, says: Clinton E. Dawkins, a member of the firm of J. P. Morgan & Co., testified yesterday before the House of Lords Committee, which is investigating the whole question of London underground transit.

Mr. Dawkins referred to the world-wide character of the financial transactions of the Morgans, who, he said, would guarantee to find the capital for the entire new underground system.

There was no doubt, continued Mr. Dawkins, that the necessary money could be found in England, but if money was cheaper in America it could be raised there. Arrangements had been made to supply the rolling stock without having recourse to America.

Mr. Dawkins referring to the tendency of the population to move away from the congested districts to the outer fringe of London, said he thought this ought to be encouraged on the ground of public health, and pointed out that the only way to relieve the central congestion was to offer rapid transit facilities.

At the resumption of the sittings of the London County Council yesterday strong protests were made by many of the members against the Government's persistent ignoring of the Council's application for powers to build tramways and to give London an organized system of traction. This, it was declared, had resulted in the metropolis being now handed over to the Yerkes and Morgan interests. It was suggested by John Burns, M. P., and others, that the Government should appoint a Royal Commission on this subject, or take other measures for the regulation of municipal traction in order to prevent difficulties arising from the plans of competing foreigners.

The general opinion of the Council, however, seemed to be that it was now too late to appoint such a commission, and after a debate lasting two hours no definite decision was reached.

Electrical Engineers of the Day—XLIII.

H. G. Reist.

Mr. Henry Gerber Reist was born on May 27, 1862, near Mount Joy, Lancaster county, Pa. He is descended from Swiss ancestry, and [illegible] the earliest settlers in the State. His early education was obtained in the common and normal schools near his home, and he graduated from Lehigh University in 1886 with a Mechanical Engineer's degree.

Immediately after graduation Mr. Reist obtained a position in Harrisburg, Pa., with the Harrisburg Car Company, manufacturers of engines, boilers and steam-road rollers. His work was in the foundry and machine departments, and consisted of draughting, testing and erecting of machines. In the summer of 1887 he was made assistant superintendent, which position he held until May, 1889. Such a position as Mr. Reist held while in Harrisburg afforded exceptional opportunities for experience in mechanical design and construction, and that these opportunities were not thrown away has been fully demonstrated in his subsequent machine design.

In May, 1889, Mr. Reist resigned his position with the Harrisburg Car Company, in order to accompany the American Society of Mechanical Engineers on their memorable European trip of the summer of that year. About this time his attention was drawn to the probable rapid advancement in the electrical field, and he determined to become identified with that branch of the engineering profession. Following his determination he went to Lynn, Mass., and took a position with the Thomson-Houston Electric Company in the "Expert Course"—as it then was called. A man with Mr. Reist's education and mechanical skill could not remain long in obscurity; he was quickly promoted, and after a few months was assigned to the engineering staff, with charge of development of continuous current



railway generators, the sizes of which were at that time being very largely increased.

When the Thomson-Houston Electric Company and the Edison General Electric Company consolidated in 1893 and formed the General Electric Company, Mr. Reist was one of the first engineers to be assigned to duty at Schnectady, N. Y., the headquarters of the new company. In 1894 he was appointed engineer of the alternating current department, which position he now holds with conspicuous ability. Under his direction most of the modern types of the General Electric Company's apparatus have been developed, ranging in size from fan motors to generators for Niagara Falls, with a capacity of 7,500 kilowatts.

Mr. Reist has taken out a number of important patents, most of them being for detailed improvements in design and construction of the machines which he has brought out. He has read papers before many important engineering societies, notably the American Society of Mechanical Engineers, National Electric Light Association, Ohio Electric Light Association, and Engine Builders' Association of the United States.

Mr. Reist is a true lover of nature, and the search for wild growing things and the study concerning them form his principal and pleasantest pastime. His never failing courtesy and kindly good nature have endeared him to a host of acquaintances and personal friends. He is a member of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, the Franklin Institute, and the American Association for the Advancement of Science.

A Central Station Isolated Plant.

THERE is a degree of sameness about the average isolated plant which often renders descriptions of the same monotonous and uninteresting, especially when there is such a profusion of very large and important plants being installed, many of them on very original lines. The writer believes, however, that a description of the power plant of the Peruna Drug Mfg. Co., of Columbus, O., which is the text of this article, will prove interesting to a large number of readers in view of the high-class of the installation, the diversity of its service and the numerous special devices and their applications.

The plant operates 24 hours a day, and is really a small central station, but supplies a much larger variety of service than the average central station is called upon to furnish. The plant supplies 3,600 16-cp incandescent lamps, 130 enclosed 220-volt arc lamps and an aggregate of 130 hp of motors. Lighting and power are furnished to the Hartman building, Hartman sanitarium, hospital, Peruna factory and shipping buildings, and also to the various stores and shops which occupy ground floor portions of the above buildings. Current is supplied to the various departments and stores by meter, there being 72 Thomson wattmeters on the system. Eighteen arc lamps, burning all night every night, are distributed through the surrounding alleys and passageways, affording no small measure of police protection. In the summer season 85 desk and ceiling fans serve in the various departments. The machinery in the main factory

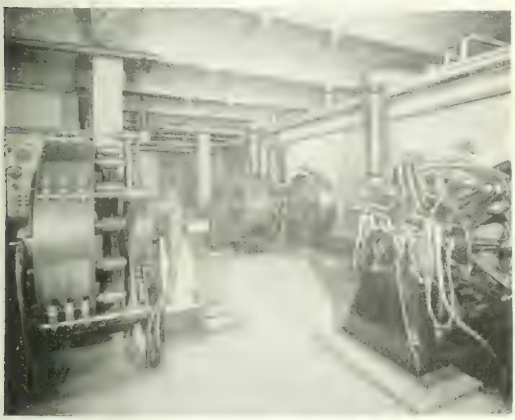


FIG. 1.—GENERAL VIEW, ENGINE ROOM.

building is driven by a 60-hp Corliss engine, which is at present supplied with steam from the power plant boilers about 350 feet distant. This engine will be superseded by a number of line shaft and direct-connected motors.

The various buildings are connected by means of an underground tunnel, a view of which is shown in Fig. 5. The tunnel is 7 feet high and 4 feet wide inside, and 385 feet in length. The small piping on either side are conduits which carry the lighting and power feeders. The arched ceiling of the tunnel carries a 10" heating main, a 6" high-pressure steam line and also smaller piping for the distribution of hot and cold water and compressed air. The tunnel is built of shale brick, plastered and floored with cement, and the tunnel walls and all covered piping are painted with white enamel, the bare piping being finished in black.

In the engine-room, shown in Fig. 1, are three Siemens and Halske, compound-wound, 250-volt generators, which are direct-connected to Ball self-oiling, simple engines, operating at 225 r. p. m. Two of the units are of 75 kw output. Under each generator is a semi-circular pit affording access to the lower brushes. The floor of the engine-room is of mosaic, and the walls, ceiling and all piping are finished in white enamel. Both the boiler and engine-room ceilings are covered with two inches of K. & M. magnesia plastic to prevent the radiation of heat to the store rooms above. There are no out-of-door openings in the engine-room, and the ventilation is effected by a 60-in. Buffalo disc fan, direct driven by a 7½-hp motor, at 400 r. p. m. There are 107 toilet rooms in the Hartman building, which are ventilated by a steel plate exhauster, driven by a 6-hp, slow-speed motor.

The switchboard, shown in Fig. 2, occupies a corner of the engine-room, being bent around the angle of the adjoining walls. The feeder-panel at the right contains 29 switches for lighting feeders. The panel at the extreme left contains 14 power-feeder switches,



FIG. 2.—SWITCHBOARD.

carrying capacity, proper size of fuse, length of feeder and the location of the distributing cabinet which each feeder supplies. Upon the panel across the end of the switchboard are mounted a total recording wattmeter, a recording voltmeter, a recording steam gauge and also a direct-reading steam gauge. The three generator panels are at the center of the board, the one for the large machine being placed across corner at an angle of 45 degrees from the others. One ammeter indicates the total lighting current and another the total power



current. The board is equipped with separate busses for lighting and power, and the generators being equipped with double-throw switches, can be connected to either bus. A switch on the large generator panel parallels the two busses so that lighting and power can be supplied from one generator during periods of light load. The board is equipped with two illuminated dial potential indicators and one voltmeter, which are controlled by double-pole switches for connecting the various instruments to either bus or to any gener-

ator. The voltmeter switch is equipped with extra contacts and connection to ground for measuring insulation resistance. Below the voltmeter is a metal-cased card giving the value in megohms of the various voltmeter readings. The board is of 2-in. white Italian marble and is bordered with a moulding of Scagliola.

In the boiler-room, which is shown in Figs. 3 and 4, are three 72-in. x 20-ft. return tubular boilers, which are connected into the stack by a steel overhead breeching. The smock-stack, which is 4 feet square inside and 150 feet high, passes up through the interior of the building adjoining the freight elevator shaft. The boilers are of 7-16-in. steel with triple-riveted double butt-strap joints, and the shells are fitted with 6-in. tubes riveted into ½-in. flanged heads. The boilers are adapted for 125-lbs. working pressure, and one is equipped with the Hawley down-draft furnace.

There are twenty-four running fountains distributed through the various buildings which are supplied by an 8-in. well 89 feet in depth, the well pump being shown at the left in Fig. 3. The waste water from the various fountains is returned to the vertical drum at the left of the boiler-room stairway, and is delivered to a roof tank by an automatically controlled pump. The waste tank water is again used for boiler feed, for flushing closets and in the various janitors' sinks. The power plant waste and drips are delivered to a hot

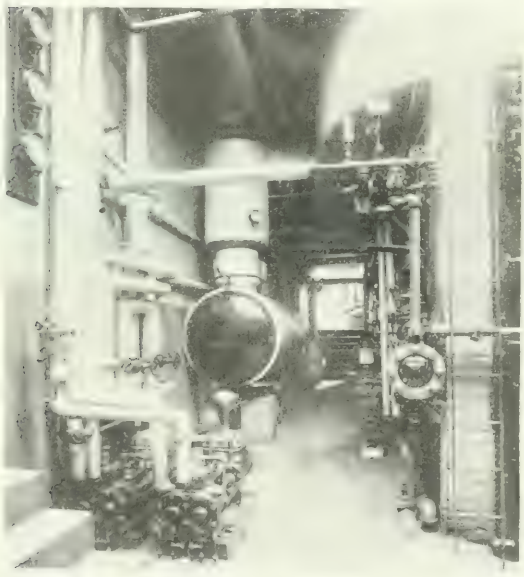


FIG. 4.—BOILER-ROOM.

well in the boiler-room and are pumped into the city sewer, the boiler-room floor being several feet below the sewer level. On the face of the column in the boiler-room is placed a draft gauge which is connected to each boiler beneath the damper and also into the breeching near the stack. A Hohmann & Maurer pyrometer is placed in the breeching just beyond the last boiler for reading the flue gas temeperatures. A Worthington duplex direct-acting air compressor in the boiler-room supplies the sanitarium, bath rooms and bottle-filling department with compressed air service. An auxiliary air receiver near the compressor is connected with the engine-room and with the rear of the switchboard, providing for the use of compressed air for cleaning the inaccessible parts of the generators and switchboard.

Underground cisterns are provided under the three larger buildings for the storage of rain water; the one under the shipping department being 62 ft. x 26 ft. x 16 ft., that beneath the Peruna building 38 ft. square and 18 ft. deep, and the one beneath the sidewalk of the Hartman building 68 ft. x 18 ft. x 14 ft. Pump suctions from the various cisterns are connected to the power plant, and the large capacity of the storage cisterns insures very soft feed water for considerable periods of time. The depth of water in the various cisterns [illegible] of the pneumatic gauges

shown in the left of Fig. 4. Duplicate 6 in. x 4 in. x 6 in. boiler feed-pumps are provided, which are so cross-connected that water can be drawn from any of the cisterns, from the roof tank, from the heater or from the city water mains. Water can be delivered without pumping to the heater direct from the well pump, and also from the

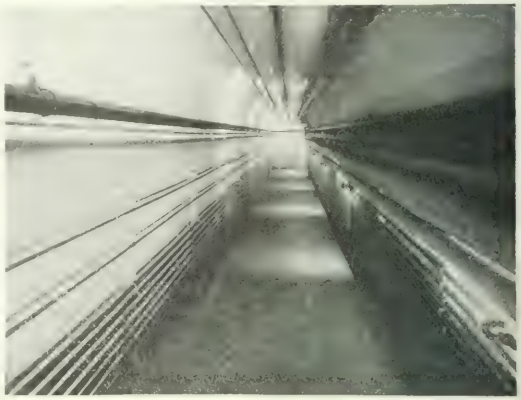


FIG. 5.—UNDERGROUND TUNNEL.

roof tank and from the city water mains. There are about 32,000 square feet of radiating surface distributed through the various buildings, the Warren and Webster system of steam heating being used. The radiators in the sanitarium and factory building are controlled by means of Powers thermostatic valves, the radiator valves being opened and closed by means of compressed air, which is supplied by a small Marsh direct-acting compressor placed in the boiler-room.

Practically all of the exhaust steam, and in extreme weather some live steam, is required for the heating system, all the condensation being returned to the boilers by a duplicate set of direct-acting vacuum pumps. All of the high-pressure drips are carried to an automatic pump and receiver placed beneath the feed water heater, which returns the same to the boilers. In the main feed water line is connected a Ross marine-type filter, which extracts the oil from the steam-heating returns. Immediately above the filter is a 2-in. Worthington hot-water meter for measuring the feed water. An H. & M. thermometer is placed in the feed water main near meter. The connections of filter and meter are so arranged that feed water can be introduced through the meter without the filter, or vice versa.

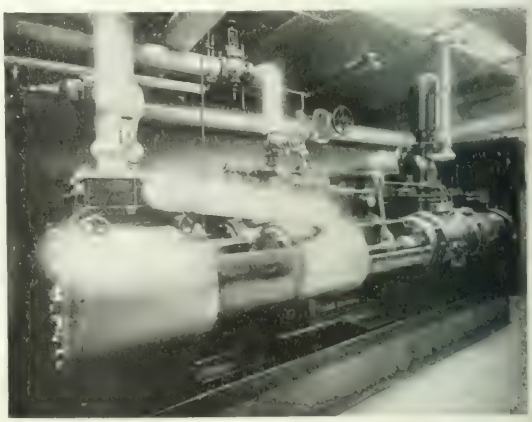


FIG. 6.—ELEVATOR PUMP.

or through both in series. Both devices can be by-passed. A detail of the meter and filter piping and the scheme of connections is shown in Fig. 11.

All high-pressure steam piping is of standard weight pipe and connected with screwed fittings. All valves not used for throttle

valves are Chapman medium-pressure gate valves, fitted with removable bronze seats. The boilers are connected by 6-in. leads into a 10-in. main, which passes over the boilers and around two sides of the engine-room, terminating in a drip leg at the extreme end of the main. Six-inch taps are taken from the top of the main and connected to the engines through a direct separator placed over the engine throttle, a gate valve being placed at the top from steam main. The pop-valve openings on the boilers are fitted with

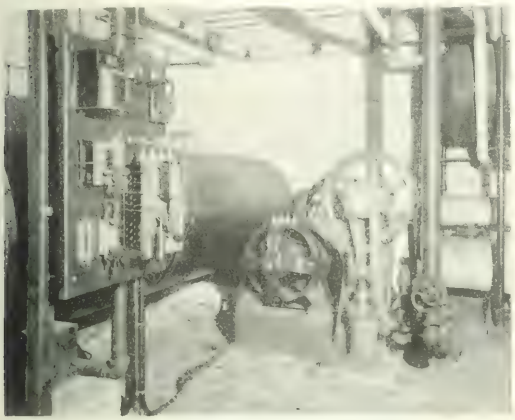


FIG. 7.—PUMP AND CONTROL PANEL.

tees, the pop valve being placed on the top of the tee; the branch outlet of each tee is connected through a gate valve to an auxiliary steam line which connects to the large unit in the engine-room and to the pumps. By means of the auxiliary steam line, any boiler can be connected to the large unit and the pumps, the entire main steam line and its connections being out of service. All hot piping is insulated with magnesia covering, and is finished with white bath-tub enamel. The exhaust from the engines and pumps passes through an 800-hp Hoppes heater, thence through an expansion drum which is mounted over the heater, into a by-pass connection which enters the main exhaust stack immediately below the back pressure valve. The exhaust main, by-pass connection and the 110-ft. exhaust stack are of 14-in. pipe. The blow-off main from the

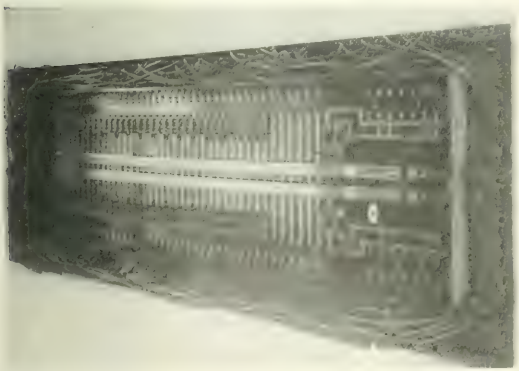


FIG. 8.—[illegible]

boilers is connected with the hot well and also directly with the city sewer.

In the Hartman building are two high-speed Crane hydraulic elevators, one for passengers and one for freight. The elevators travel 370 feet per minute and are fed from a compression tank 84-ft x 18 ft., placed in the basement. The compression tank is served by an automatically-controlled 14 x 20 x 12 x 15 Worthington duplex compound pump, which is fitted with outside packed plungers. The elevator pump, which is set in a heavy cast iron pan, is shown in Fig 6.

The wiring throughout is on the two-wire, 220-volt system, the total drop from switchboard to lamps at full load being 2½ per cent. All wiring is of Habirshaw, double-braided, rubber-covered cable, run in conduits, which are concealed except in the basements. Loricated conduits and Bossert square steel outlet boxes are used throughout. Conduits are fastened into outlet boxes by means of lock nuts, and not more than three bends were permitted in one run of conduit without a straight way box. All conduits are electrically connected and grounded. No wire smaller than No. 14 is used, except in fixtures, and all sizes, including Nos. 14 and 12, are stranded. Practically all of the incandescent lights are on fixtures, there being very few drop cords in use. Many isolated plants after installing a first-class wiring system in conduits, make changes and extensions in a slovenly and unsafe manner with cleat or molding work. The contrary policy has been pursued in this plant, all changes being carried out in accordance with the high class of work in the original installation. The cabinets, one of which is shown in Fig. 8, consist of a ¼-in. sheet-steel box, in which is mounted a tablet board of marbleized slate, removable without disturbing the box or cabinet frame. Where lighting and power feeders enter the same cabinet, they are connected to separate busbars, and the cabinets in the various store rooms are supplied with two sets of busbars, the window lights being connected to one bus and the store lights

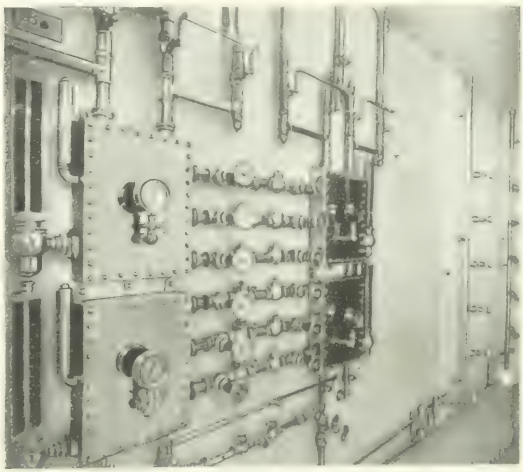


FIG. 9.—BATH CONTROLLING STAND.

proper to the other bus. The cabinet doors are of ornamental iron, plate-glass or mirror as the location demands. All distributing circuits are protected by asbestos-covered fuses, and controlled by a double-pole knife switch. All wiring entering cabinets larger than No. 10 have terminal lugs sweated on.

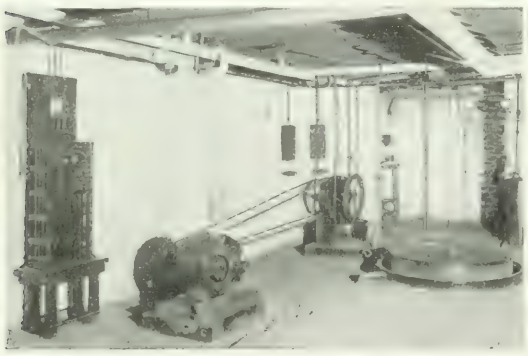
In the factory building is located a 50-number Stromberg-Carlson telephone switchboard. There are 36 central energy telephones distributed through the various departments of the manufacturing plant. The three-wire system is used, and all wiring is of dampproof office wire, run in loricated conduits. A motor-generator set furnishes current for the ringing circuits, and a storage battery supplies the talking circuits. A 200-number Kellogg desk-pattern switchboard is located in the Hartman building, and is connected with 165 central energy telephones, which are distributed through the various departments and suites of the sanitarium. The switchboard is of the lamp-signal pattern, and has trunk connections with the factory switchboard and with the local telephone exchange. The ordinary factory whistle has been superseded by buzzers placed in the offices, and 6-in. gongs placed in the factory rooms, all of which are operated at starting and stopping hours from a Western Union clock, located in the engine-room.

In the sanitarium building are located two large and very elaborately furnished bath departments, one for women and one for men. The water service for the bath rooms is supplied by the 5½ x 8 triplex

pump, which is driven by a 10-hp compound-wound motor. The pump is shown in Fig. 7; the motor control panel being shown at the left of the illustration. The pump delivers water into the compression tank, shown near the pump, from which a cold water main is run directly to the bath rooms. The compression tank serves two 9-ft. Toby heaters, which supply hot-water service to the bath rooms, and also serve a refrigerating chamber which supplies the ice water to the bath rooms.

Electric motors are in use in the various departments of the sanitarium and hospital for driving mechanical massage machines, ventilation fans, ice cream freezers, dish and grocery elevators, sewing machines, etc. The applications of electricity in the bath rooms are numerous, one of the most interesting being the use of incandescent lamps in hot cabinets. A large cabinet is arranged for the introduction of the patient, leaving only the head protruding. The cabinet is lined on all sides with mirrors and evenly distributed on all four sides are 120 16-cp incandescent lamps. These lamps are arranged in circuits of ten each, affording an easy graduation of temperature within the cabinet. It is claimed that the light from incandescent lamps possesses many of the properties of daylight, and the above treatment is said to afford all the benefits of a genuine sun bath.

The sanitarium and hospital have a very complete equipment for the application of electricity to surgery and medicine. A 10-plate 30-in. static machine is used for the Roentgen-ray work, and also for direct applications to the patients. The machine is furnished with a large assortmentment of special electrodes, and by means of a large insulated platform from six to ten persons are often given treatment at the same time. For the application of direct current, a special rheostat is used, the patient is connected in shunt to the main resistance so that he is never subjected to more than the voltage required for current to be applied. The rheostat is equipped



with a large circular commutating switch, reversing switch, polarity indicator, milliampere meters and an automatic adjustable circuit breaker. It has two ranges controlled by a special switch, one range giving 43 variations of current between 0 and 60 volts for sensitive work, requiring small current, and the other gives 43 variations between 0 and 120 volts for large currents, and is capable of furnishing 250 milliamperes at 70 volts pressure. The rheostat is also equipped with two special current interrupters, one for high and one for low frequencies.

In the low frequency interrupter the current is broken by means of a clock-driven pendulum, which is equipped with an adjustable weight and gives interruptions from 6 to 600 per minute. The high frequency interrupter is a special form of the ordinary vibrator, the contact being mounted on a swinging arm, which is adjustable so that its position relative to the point where the spring is fastened can be varied. This device gives a very wide range in the higher frequencies. For the application of alternating current a special form of faradic coil is employed which is equipped with two secondaries, one having 5,500 returns and the other 750 returns, the resistance of the former being 350 ohms and the latter 2½ ohms. The pressure in the secondary is regulated by varying its position with reference to the primary windings, a rack and pinion serving to move the secondary back and forth over the core.

The cautery outfit consists of a rotary and a static transformer. The direct-current side of the rotary is wound for 225 volts. Taps from various points of the secondary windings of the static transformer are carried to a circular commutating switch, by means of which the amount of secondary in circuit is varied. By this arrangement the pressure can be varied from 0 to 10 volts, this range being divided into 50 equal steps. The outfit supplies current sufficient for heating the large electrodes to full working temperature. An auxiliary secondary coil is connected directly to a set of terminals for the connection of four-volt examination lamps, which are entirely independent of the regulation of the cautery loops. The above apparatus is all special, and was made to the specifications of the engineer.

In the basement beneath the sanitarium is located a plant for the generation and compression of chemically pure oxygen gas, which is used in the sanitarium and hospital in connection with the administration of anesthetics and also in various forms of treatment. The gas plant, which is shown in Fig. 10, consists of a 2½ x 5 electrically-driven, single-stage compressor, a gasometer, generator and filtering apparatus. The cylinder and valve chambers of the compressor are submerged in running water. The compressor is driven by a 3-hp, slow-speed motor, which is controlled by a speed-regulated rheostat. The gasometer, shown in the right of the illustration, has a

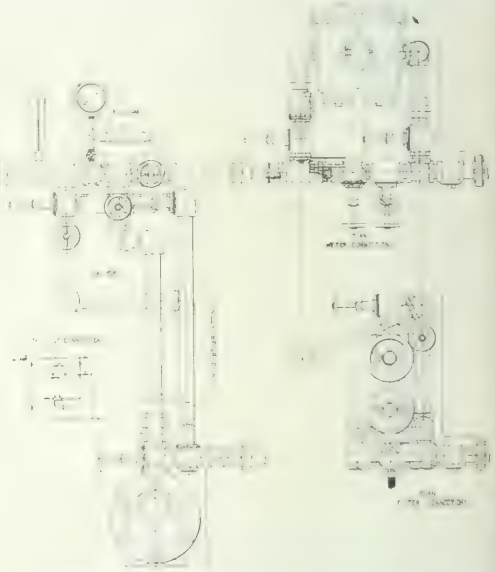


FIG. 11.—DETAIL OF METER AND FILTER CONNECTIONS.

capacity of about 75 cu. ft., and the movable member is over-counterbalanced in order to create a partial vacuum in the filter, which greatly facilitates the flow of gas through the same. The filter consists of a series of large glass jars filled with various acid solutions, and through which the gas is passed.

The gas generator consists of an inclined cylindrical iron retort, which is enclosed in an oven-like case. An iron flame plate is placed beneath the retort to prevent the gas flame from impinging directly upon the retort. To prevent an explosion of the retort the blank end of the same is fitted with a thin cast-iron diaphragm which will rupture at about four pounds pressure. The chemicals are introduced into the retort through the free end of the cylinder, which is closed when in operation by a flanged head fitted with a ground joint. The gas generated from each retort charge is carefully analyzed, and after it has been found to be chemically pure, it is compressed to a pressure of 250 pounds per square inch into small steel cylinders.

When the engineer assumed charge of the work, the generators, engines and boilers had been contracted for, the boilers being already in place. The operation of high-pressure tubular boilers beneath a valuable building in which several hundred persons lived or were employed was, in the opinion of the engineer, an almost criminal practice. Shortly after the plant was started the management, which

is very progressive, consented to change the boiler plant in accordance with the engineer's recommendations, and three 175-hp Babcock & Wilcox cross-drum-type boilers were purchased. From the overhead breeching, carrying gases at 400 to 600 degrees Fahr., considerable heat was radiated to the store rooms above, although the breeching was heavily insulated; it, therefore, was decided to use a down-draft and an underground smoke flue to the stack. One tubular boiler was removed through an opening in the sidewalk, and a water-tube boiler erected in its place, the plant in the meantime operating on the two remaining tubulars. The arrangement of the steel building columns and piping compelled the removal of the boiler farthest from the stack first. This necessitated the construction of a smoke tunnel across beneath the tubulars in operation. Corrugated iron false bottoms were built in the soot chambers, and the rear half of the tubular boilers in operation; the adjacent building wall and the 150-ft. brick stack were supported on I-beams, while the new smoke tunnel was built and connected into base of the stack, a temporary false bottom being built in stack to prevent inter-



FIG. 12.—HARIMAN BUILDING.

ference with the draft through overhead breeching. The smoke tunnel footings are 31 feet below the sidewalk level. The first water-tube boiler was placed in operation and the remaining tubulars were removed, and the new battery of water-tube boilers installed with the utmost dispatch. To avoid changes in the position of fittings in the steam line, the new boilers were connected by special bends of extra heavy pipe. The smoke tunnel is of brick and oval in section. The new boiler settings are faced with white enamel brick.

..In connection with the new boiler plant a conveyor system will be provided, which will handle coal and ashes to and from the adjoininig alley, thus avoiding the dust and dirt incident to the handling of fuel in front of the building.

The piping and wiring systems, switchboard, etc., and the details of the entire installation were designed by Mr. Fred W. C. Bailey, a consulting engineer of Columbus, Ohio, to whom considerable credit is due for the successful manner in which the boiler plant changes were effected without accident or interruption of service.

American Capital in London.

A special cable dispatch from London, on April 18, to a New York daily newspaper says: During the course of to-day's session of the Select Committee of the House of Lords, appointed to inquire into the merits of the various proposed railroad schemes for London, the opponents of some of Charles T. Yerkes's plans objected to the introduction of American capital, contending that all orders for the machinery and equipment required for Mr. Yerkes's schemes were going to the United States. Lord Knutsford, formerly Colonial Secretary, and a member of the committee, interposed and remarked that the committee did not care whether the capital was American or British, so long as the committee was satisfied that the lines would be properly financed.

The Divergence of Long Plumb Lines at the Tamarack Mine.

By Prof. F. W. McNair.

In September last it was my fortune to be present, together with Professor James Fisher, of the College of Mines, at a "Plumbing" of No. 5 shaft of the Tamarack mine. The plumbing was under the direction of Mr. J. B. Watson, the chief engineer for the Tamarack Mining Company.

The method employed was the well-known one of transferring an azimuth from surface to some underground level by means of two plumb lines hung in the shaft. The remarkable feature lay in that the depth of the chosen level, and, consequently, the length of the lines were greater than in any previously recorded instance. The lines as hung were 4,250 ft. in length; they were of No. 24 piano wire, and the bobs were of cast iron, weighing 50 pounds each. The latter were swung in pails of cylinder oil for damping the vibrations. Great care was taken that the lines should be free, and that they should be protected at the bottom from dropping water, of which, indeed, there is not a great deal in the shaft. No attempt was made to completely stop vibration. Scales were erected behind each wire, and its mean position determined by observing the extent of the swing.

When the wires had settled into a state as near quiescence as it was expected they would come, a check measurement was taken between them at surface, and between their lower extremities at the 29th level. The upper measurement was 16.32 ft., that below 16.43 ft., showing a divergence of the lines to the amount of 0.11 ft. As the west wire, which had been lowered in the center of the shaft compartment in which it hung, had been moved to the east until it was about half a foot from the dividers between that and the next compartment, it was inferred that some projecting object might be interfering with its freedom. A careful exploration of the shaft, occupying between two and three hours, revealed no such interference. To make certain, however, this west wire was moved westward toward the center of the compartment 1.26 ft. When all was quiet again, measurements as before were taken, showing a distance at surface of 17.58 ft., and at the 29th level of 17.65 ft., there being yet a divergence of 0.07 ft.

Possible causes were at once freely discussed among those who were present. Gravitation being suggested, I drew attention to Newton's theorem of the attraction on a mass within a closed spherical shell, adding that the same must be true in a tube of great length. I was inclined to explain the divergence on the theory that the air pipes in the west end of the shaft (of which there are two, a 16-inch in the northwest corner, and a 4-inch one near the southwest corner) were acting as magnets, and, because of its proximity, were attracting the bob on the west wire out of its normal position. The distance from the west bob to these pipes was something like seven feet. The east bob being 24 or 25 feet away would of course be affected to a much less degree. The behavior of the west wire seemed to confirm such a theory. There was considerable torsional vibration in both wires, and it seemed that a slight horizontal polarity in the west bob, which would at times coincide with, and at others oppose the field created by the pipes, might account for the observed irregularity in the vibration of this wire when compared with the vibration of that hanging in the east compartment. The latter remained remarkably steady throughout the entire time it was under observation. Under the circumstances I advised the use of lead bobs in a plumbing of No. 2 shaft, which took place about a week after that at No.5. I did not advise a change to wire of non-magnetic material, for it did not appear to me that polarity in the wire, which would of course exist, could develop sufficient force to bring about the observed divergence.

To my surprise, Mr. Watson reported that the wires hung in No. 2, although about 120 ft. shorter than in No. 5, and although lead bobs had been used, yet showed a divergence of 0.10 ft., and, further, that, from comparison with other surveys, he had reason to believe that the azimuth of the wires at the bottom was considerably greater than at the top. At the surface they were 12.60 ft. apart. An examination of the magnetic conditions yielded a possible explanation of the greater azimuth in that the air pipe in the southwest corner of the shaft terminated not far below the bob on the west wire. A repulsion between the lower end of this pipe and the lower end of the west wire, presumably of the same north polarity, might account for

the increased azimuth. It could not, however, account for the divergence.

The publication about this time in the Portage Lake Mining *Gazette* of the fact that a divergence in the plumb lines had been observed, attracted considerable attention, and brought forth many attempts to explain its existence. Those most familiar with the conditions had no satisfactory theory to offer. To them it was evident that more data must be secured before the cause could be correctly assigned.

Among the proffered explanations, two are worthy of notice. The first was that the divergence was due to the greater attraction of the material at the end of the shaft for the bob hanging nearest it. It is remarkable how many trained persons, engineers and others, held to this view. There seems to exist a general lack of appreciation of the forces of gravitation, except in the single instance of the force between the earth and objects upon it. It is, of course, true that the attractions on each bob toward the ends of the shaft are different, the stronger being toward the end nearest to which the bob hangs. Further, these differences tend to diverge the wires, but their amounts are so insignificant as to put them quite out of consideration. The sum in this case is only a few hundredths of a grain, and the consequent divergence about a thousandth of a foot.

The second explanation worth notice was offered by Professor William Hallock, of Columbia University. This was that of mutual repulsion between like poles at the lower extremities of the wires.

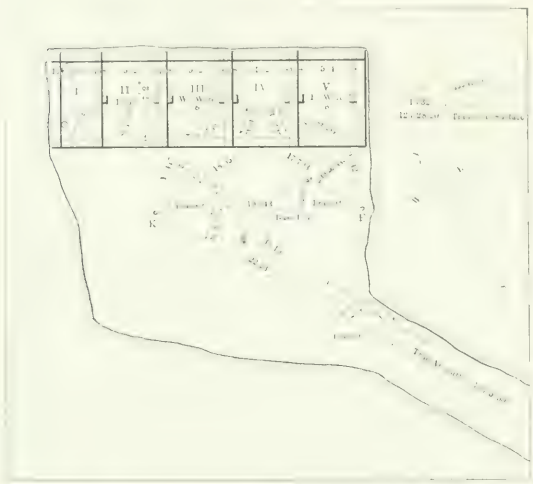


FIG. 1.—HORIZONTAL CROSS SECTION, NO. 5 SHAFT.

It was subsequently modified (see ELECTRICAL WORLD AND ENGINEER, Feb. 8th, 1902) to include as well repulsion between like consequent poles distributed along the wires.

Meantime the management of the Tamarack Mine, with its characteristic interest in scientific things, had granted me permission to carry on further experiments in No. 4 shaft. This shaft is particularly adapted to experiments of this kind, especially as it is much freer from magnetic material than any of the others. Mr. Watson entered heartily into the project, and the experiments which were conducted were hardly less under his direction than mine. The actual work was shared by Professor Fisher and Instructors N. S. Osborne and E. D. Grant, of the College of Mines, and by Mr. Slock, assistant engineer at the mine. Phosphor bronze wire No. 20 B. & S. gauge was chosen for the lines; 60-pound lead bobs were hung at the bottom, first in oil, but subsequently in water, the latter being found by far the most satisfactory medium. These lines were hung as far apart as the conditions in the shaft would permit, and were approximately 4,440 ft. in length from point of suspension to bottom of the bob.

Means were taken to locate the wires in a horizontal plane. At first a base line was laid off for each wire. The wire was observed by transits simultaneously from both ends of the line, and the two wires were under observation at the same time. This scheme was almost immediately abandoned for the simpler one of a single base line common to the two wires. A transit was mounted at either end of the base, and it observed alternately each wire. The method is exhibited in Fig. 1, which is a horizontal cross-section of No. 5 shaft at the 29th level, and also in Fig. 2, a cross-section of No. 4 shaft at the 11th level. In each figure W and E are the positions of the wires, while K and F in the one and F' and C' in the other are those of the transits. In each case the base line was tied to permanent marks in the neighborhood of the plat at which the observations were taken. Scales were erected behind the wires in a position perpendicular to the line of sight and as near the wires as was convenient. Most of the time a scale in sixteenth inches numbered decimally was used. At first the wires were allowed to vibrate as they would, but for most of the observations they were set vibrating parallel to the scale on which it was desired to read mean position by drawing them aside from half to three-quarters of an inch, then allowing them to swing freely. An odd number of readings was taken, as in the method of determining the zero point of a balance by observing the vibrations of its pointer. Great care was taken to protect the wires as far as possible from disturbing influences, such as currents of air and dropping water.

As showing the constancy of the mean positions of the wires, it may be of interest to quote an example from observations at No. 4 shaft, and one from No. 5. I quote, from the note book, observations at No. 4 shaft, Jan. 9, 1902:

Station C1. east wire, McNair.

Left.	Right.
56.6	63.4
58.1	64.3
60.5	65.5
59.0	62.8
60.7	65.4
59.3	62.2
57.0	

Mean position, 61.3.

Station C1. east wire. Watson.

Left.	Right.
51.0	74.5
57.5	67.5
55.0	68.0
50.5	70.5
56.0	67.0
59.5	66.5
57.3	64.2
	66.8

Mean position, 61.7.
Mean of the two sets, 61.5

The interval of time between the above sets is not recorded in the note-book, but is remembered as being between one and two hours.

Again, from the note-book, No. 5 shaft, Feb. 23, 1902.

Station F, west wire, Osborne.

Left.	Right.
44.5	60.6
45.3	60.2
45.0	58.7
49.2	56.6
49.0	56.4
49.1	56.0
48.8	

Mean position, 52.8; time, 11:40 *a. m.*

Station F, west wire, Fisher.

Left.	Right.
47.3	58.3
49.7	57.8
49.0	56.2
52.0	54.6
	54.7

Mean position, 53.0; time, 3:40 *p. m.*
Mean of the two sets, 52.9.

It will be seen from these examples that the mean positions of the wires were very constant for considerable periods of time.

The angles in the figures were read by repetition to some mark of the scale near to the mean position. They were afterwards corrected for the difference between the mark chosen and the mean

position of the wire assumed from the observations. Check measurements of distances from instruments to wires were taken, the wires being held as near as might be in the mean positions. It is thought that the distance between the mean positions of the wires was determined with an error not greater than 0.003 ft.

After hanging the bronze wires in No. 4 shaft and finding a small convergence, it was decided to hang the steel wires in this shaft in the same position at the top as the bronze lines, and note their positions at the bottom, both with lead bobs and with iron bobs. The bobs were first in oil, subsequently in water. The results for distances between the wires are exhibited in the following table:

Plumb Lines in No. 4 shaft, Tamarack Mine.

Date.				Distances in Feet		Convergence.
1902	Wires.	Bobs.	Medium.	Surface.	11th Level.	In feet.
Jan. 3	Bronze.	Lead.	Oil.	15.089	15.061	0.028
Jan. 6	Steel.	Lead.	Oil.	15.089	15.074	0.015
Jan. 6	Steel.	Lead.	Water.	15.089	15.074	0.015
Jan. 6	Steel.	Iron.	Water.	15.089	15.062	0.027
Jan. 9	Bronze.	Lead.	Water.	14.607	14.611	*0.004

*Divergence.

Whatever might be the cause for the slight convergence observed, the results of these observations seemed to afford ample experimental proof that neither gravitation nor magnetism could account for the divergence originally observed in No. 5 shaft. The shorter distance between the bronze wires as hung the second time was due to the necessity for moving the western one to avoid contact with pieces of steel wire which were lodged in the west compartment on the breaking of the line which had hung in this compartment on the 6th of January. After the compartment was supposed to be clear, the west wire was moved east to ensure further its freedom.

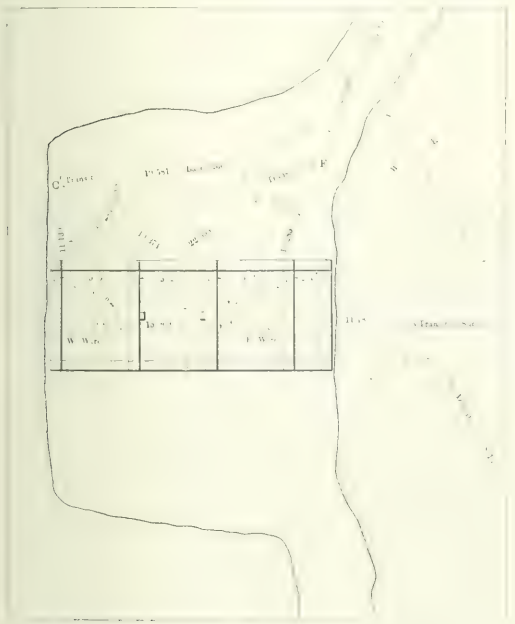


FIG. 2.—HORIZONTAL CROSS SECTION, NO. 4 SHAFT.

About the middle of January, the bronze wires were hung in No. 5 shaft as near as might be in the positions occupied by the steel ones in September. The distance between them at the top was 16.709 ft., while at the bottom the observations gave 16.850 ft., showing a divergence of 0.141 ft. This divergence it will be noted is greater than that observed in the case of the steel wires in September. We were now convinced that the behavior of the wires was to be explained by assuming that one or both of them were deflected from the normal position by the currents of air which circulated in the shaft. This suggestion of air currents had been made early in the work. It was treated with scant courtesy in the beginning, because it did not seem probable that the currents of air could be steady enough, both in volume and direction, to permit the constancy of mean position which had been observed. However, the hypothesis once admitted, it appeared that it might account for all of the observed phenomena. Desiring to make the proof as complete as possible, it was decided to hang the brone wires once more in No. 5 shaft, but this time to place the west wire in the compartment next the air shaft rather than in it.

It should be remarked here that during the sinking of this shaft, and until it is connected with some other portion of the mine, its ventilation is accomplished by dividing it into two parts by means of a tight casing between Compartments II. and III., Fig. 1. Compartments I. and II. form the so-called air shaft. An up-draft is induced in this air shaft, causing a down-cast in the other three compartments. At the time of the September and January plumbings there existed at different levels a number of openings in the casing. These openings permitted a rush of air from the down-cast side into the up-cast compartment. The effect of these currents of air would be to move the west wire toward the west. If these openings were closed off and the west wire hung in the compartment next the air shaft, No. III. of the figure, it seemed that the divergence would disappear, provided it were due to the assigned cause. They were hung in these positions on February 23, the east wire hanging as near as might be in the position occupied in September and January, the west one as near as might be in the center of the compartment next the air shaft. The positions are shown in the figure. Communication between the air shaft and the down-cast portion had been carefully stopped off as far down as the 29th level. Further, to prevent circulation as much as possible, the shaft was covered at the top as soon as the wires were in position. It was quickly evident that circulation could not be wholly stopped. There was yet a considerable convection current down close to the casing of the air shaft, and up in the two eastern compartments, the cause for this current being the difference in temperature between the top and the bottom of the shaft. Its distribution is explained by the fact that before the shaft was covered, the down-cast current was strongest close to the casing. As the covering failed to stop circulation, the strongest portion of the down-cast naturally maintained the position it already occupied. The measurements between the wires were, at top 11.944 ft., at bottom 11.962 ft., showing a divergence of 0.018 ft. This divergence was easily accounted for by the convection current above described.

The difference between the divergence of the steel wires in September, and of the bronze wires in January is readily accounted for by the fact that the circulation in the warm weather of September was much less vigorous than in January, and, further, that the steel wires afforded the smaller surface to be acted upon.

Consideration of the currents in No. 2 shaft, which is down-cast, accounts for both the divergence and the increased azimuth there observed. The small convergence observed in No. 4 may likewise be accounted for by the swirl of the currents as they enter this shaft, which is up-cast. Although an effort was made to stop these as far as possible during the actual observations, it was not practical to entirely cut them off. The contour of the walls of the plats above the 11th level in this shaft is such that the air currents from the cross-cuts hugging the outside of the curve will on actually entering the shaft have a tendency from the western wall toward the center, and this tendency will apparently be stronger close to the western wall than a little distance from it. Consequently, when the west bronze wire was moved away from this wall the wires hung more nearly parallel than when it was close to the wall.

It seems, therefore, that a very simple cause was at the bottom of the divergence which attracted so much attention. The remarkable fact is that the currents of air should be so constant in their action. When, however, the great depth of the shafts is considered, also the constancy for considerable periods of time of the temperature which may influence these currents, it seems after all reasonable that this steadiness should exist. The experiments have shown that the engineer who has before him the problem of plumbing a deep shaft has very considerable difficulties to overcome in the matter of the influence of the circulation of air in the shaft on his line. He should study this circulation very intently before deciding where to hang them, and in order to estimate the dependence that is to be placed on his results when the lines have been hung.

Synchronous Reactance.

BY F. G. BAUM.

IN using the "synchronous reactance" in calculating the regulating characteristics of a generator at different power factors we are, of course, replacing the demagnetizing effect and the effect due to self-induction by a single term. As I have not seen any method given to show the probable error due to using the synchronous reactance, one is here presented.

Suppose the generator to be running at normal speed. Short-

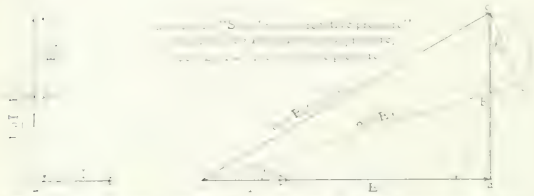


FIG. 1.—GENERATOR ON NON INDUCTIVE LOAD ON SHORT-CIRCUIT, RESISTANCE PRESSURE NEGLECTED.

circuit the armature and raise the excitation to such a value that full load current flows in the armature. Suppose the resistance pressure to be small in comparison with the total pressure. Let Ef (determined from the exciting current) be the number of volts to force *full load current* through the armature. Then if $L\omega$ is the synchronous reactance and I the current we have $L\omega I = Ef$. (Fig. 1). Let Ed be the number of volts corresponding to the demagnetizing ampere turns of the armature and the true e. m. f. of self-induction.

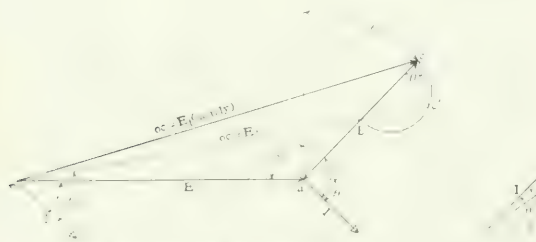


FIG. 3.—GENERATOR ON INDUCTIVE LOAD.

The pressures Ed and ab are in opposition to Ef. Fig. 1 shows these relations.

Now suppose we connect the generator to an external non-inductive load and raise the excitation Ef so that we again have full load current in the armature, but with a pressure $E = Oa$ on the external load (Fig. 2). Let us assume that the reactive pressure ab remains the same (this will not be strictly true, because the reactance depends on the position of the armature coils with respect to the poles, and also upon the magnetic density). The demagnetizing effect is in direct opposition to the pressure developed. It can easily be shown that the magnitude of the demagnetizing effect varies practically as $I \sin \theta_o$, θ_o being the angle of lag of the armature current behind the developed pressure. If in Fig. 2 we draw a semi-circle on bc and draw the line ob and then project c on ob, we get $bc' = cb \sin \theta_o$. The direction of the generator pressure is ob, and the generator must be excited for the value $E = oc'$. But oc' is practically equal to oc, since cc' is at right angles to oc'. That is, for a non-inductive load we may use the synchronous reactive pressure ac in place of the geometric sum of ab and bc'. Hence we may, for a non-inductive load, without appreciable error use the synchronous reactance in place of the true inductance and the demagnetizing effect. The angle between the current and the pressure developed is θ_o; the angle we get by using the synchronous reactance is the angle between oa and oc.

If the current in the external circuit lags behind the pressure E by the angle θ, then the line ac will rotate through the angle θ, Fig. 3. bc' is again equal to the demagnetizing effect $I \sin \theta_o$, and $oc' = Ef$. But oc' is again practically equal to oc.

If the current in the external circuit leads the pressure E by the angle θ, then the line ac will rotate in the opposite direction from the vertical through the angle θ, Fig. 4. The demagnetizing pressure $bc \sin \theta_o$ has reversed, and the armature ampere-turns are now acting to magnetize the generator. The pressure corresponding to the magnetizing effect is bc'. The pressure developed is $oc' = Ef$. But again we see from the figure that oc and oc' are practically equal.

Thus we see that, so far as the determination of regulation of the generator is concerned, we may use the synchronous reactance without appreciable error. If we do not neglect the armature resistance, the conclusion we come to is the same, since the pressure to overcome the synchronous reactance is large in comparison with the resistance pressure.

The synchronous reactance is usually determined from the short-circuit current of the generator. This determines the synchronous reactance with a weak field or abnormal armature current, and will usually give a value larger than that corresponding to the working pressure and current. The following is a method which is believed to have some advantage over the usual method:

Run the generator as a synchronous motor, but with no load. Set the excitation for a normal working value. Now raise the excitation applied to the motor, until one-half to full-load current flows in the motor (too large a current in the armature may distort the e. m. f. wave developed, which may produce hunting. If the distorting effect is small and no hunting is produced full load current may be drawn). Since the motor is running at no load with large armature current, the pressure applied and the pressure developed by the motor will be practically in opposition, as shown in Fig. 5. E_1 is the pressure applied to the motor, E_2 is the pressure developed by the motor, and E' is the resultant pressure forcing the current through the motor. As shown in the Figure, $E_1 - E_2 = E'$ practically. The synchronous impedance is thus E'/I.

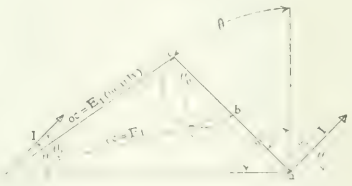


FIG. 4.—GENERATOR ON CAPACITY LOAD.

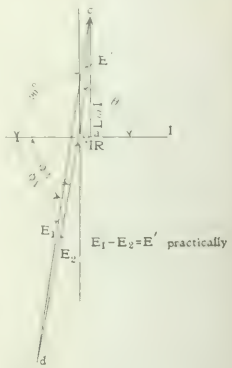


FIG. 5.—DETERMINATION OF SYNCHRONOUS REACTANCE.

In Fig. 5, $R\,I$ is the resistance pressure and $L\,\omega\,I$ the synchronous reactive pressure. The angle Θ is usually nearly 90°, and since there is no load on the motor the angle ϕ_2 will be nearly 90° also. Hence, E', E_2 and E_1 are nearly in the same line. The synchronous reactance is

$$L = \sqrt{\left(\frac{E'}{I}\right)^2 - R^2}$$

By this method we get the synchronous reactance when the machine is developing normal pressure and, hence, should give more accurate results than is obtained by short-circuiting the armature, because by the latter method we have either weak fields or abnormal armature current.

Fanning Island.

Material for cable structures on Fanning Island is now, it is said, being bought in San Francisco. A cable station is to be established there in the line of the British Pacific cable. On it the Pacific Cable Board will expend $120,000. The plans provide for quarters for the telegraphic staff, including an operating room, a dwelling for the superintendent of the station, a carpenter shop, bath houses, a lamp room, kitchens, and a large reservoir for catching and preserving rain water for drinking purposes. The walls of these structures are to be of coral obtained on the island, but all the other material will come from San Francisco. The cable station will be located at English Harbor, the only shipping entrance on the island.

A British Refuse Lighting Plant.

FROM time to time we have noted in our columns the construction in Great Britain of refuse incineration plants, or "Dust Destructors," in connection with electric light stations. According to a recent list of British central stations, 15 of these are supplied with destructor plants, and of stations now under construction, three will be similarly equipped. In some cases the destructor plant is merely an auxiliary service, while in other cases it furnishes the principal source of heat for raising steam. Among the latter class is a plant recently built in the suburbs of Glasgow, to supply the Burgh of Partick, of which we give below a description.

As will be seen by reference to the accompanying ground-plan (Fig. 2) there are two main buildings and a smaller building for offices. The destructor house has its own fan and pump house, with stores, coal store, etc., and although adjoining, is kept distinct from the electrical portion of the station. The engine-room is 55 ft. x 40 ft. x 25 ft. high to the roof principals, and is served by a 10-ton crane. The room is well lighted from the roof, and the north wall is temporary, for although there is still space inside the present engine house for considerable extensions, plenty of room has also been arranged for extending the buildings.

The destructor house is 88 ft. x 62 ft. x 24 ft. from clinkering floor to roof principals. The chimney is 153 ft. high, and is lined with firebrick throughout, an air-space of 2 in. being left between the fire-brick and ordinary brick in the chimney and in the main flues. The chimney is surrounded at the base with a dust-separating chamber, and it is built on a block of concrete, 36 ft. x 36 ft. x 6 ft. deep, in the bottom of which is buried a raft of steel girders placed across each other at right angles and bolted together. There are in all some 54 girders, 36 ft. x 6 in. x 5 in. x 24½ lbs. in this raft.

The destructor consists of three "units," each composed of a water-tube boiler and two cells—*i. e.*, six cells and three boilers in all. Each cell is capable of consuming 10 tons of refuse per day, with a forced draught equal to a head of 3 in. of water. There is, besides, a fourth boiler, which is arranged for coal firing only. The four boilers each have a heating surface of 2,010 sq. ft., with a grate area of 39 sq. ft. Each is provided with dead weight safety valves and high-steam and low-water alarms. The three boilers included in the

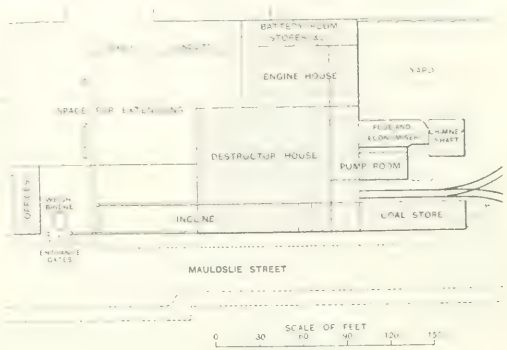


FIG. 2.—GROUND PLAN.

destructor proper have a cell on either side of them, with dampers in the side walls just over the ordinary coal grate, so that the boilers can be fired by coal or refuse or the two together. It is, however, not intended to adopt the last alternative, and it is expected that coal will only require to be used on exceptional occasions, such as on Sundays, when there is no refuse to burn. Each boiler and cell is provided with forced blast by two fans driven by single-cylinder enclosed engines, capable of delivering about 8,000 cu. ft. of air per minute under a head of 3 in. of water. The draught is regulated by a valve on each cell and boiler, the air duct being carried

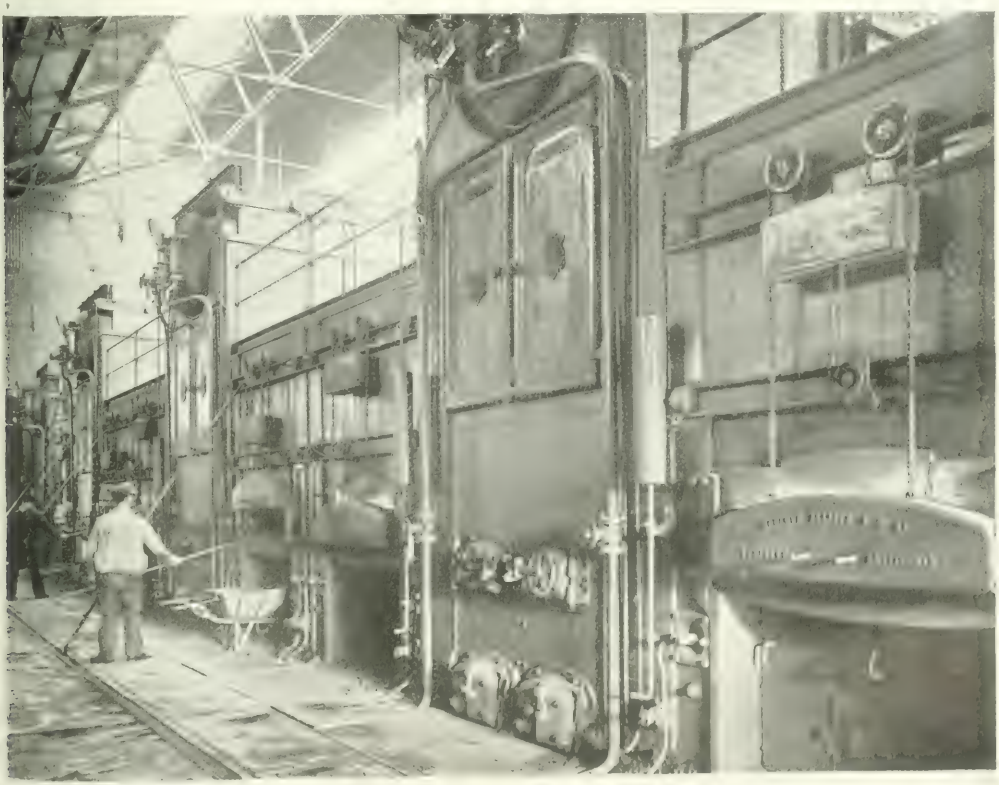


FIG. 1.—THE DESTRUCTOR-BOILER AT PARTICK, GLASGOW.

right under the boiler. There is also a third fan and engine, exactly similar, for a stand-by in case of accident. A steam jet apparatus is also provided for each cell.

The feed pumps are two in number, and are capable of delivering

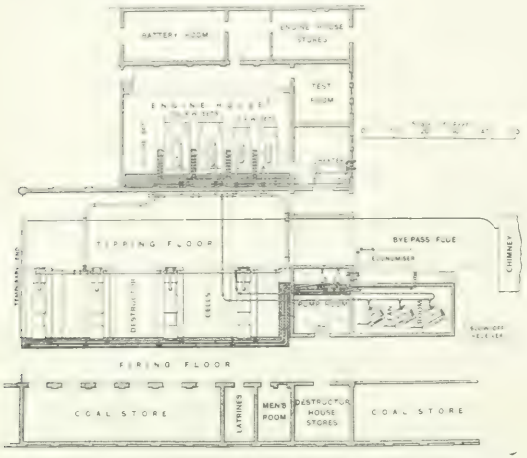


FIG. 3.—PLAN OF GENERATING STATION AND DESTRUCTOR.

1,700 to 2,700 gallons of water per minute respectively. The feed pipes are in duplicate, each boiler being independently connected to each range. The feed water is taken from the Glasgow Corporation mains, a storage tank of 10,000 gallons capacity being provided in case of failure of the supply. This storage tank has a heating coil placed in it, through which the pumps and fan engines exhaust, and in addition to this the exhaust from the main engines passes through a feed-water heater. Owing to the cost of the town water supply and the expense of arranging for any other supply of water, condensing has been dispensed with at the outset.

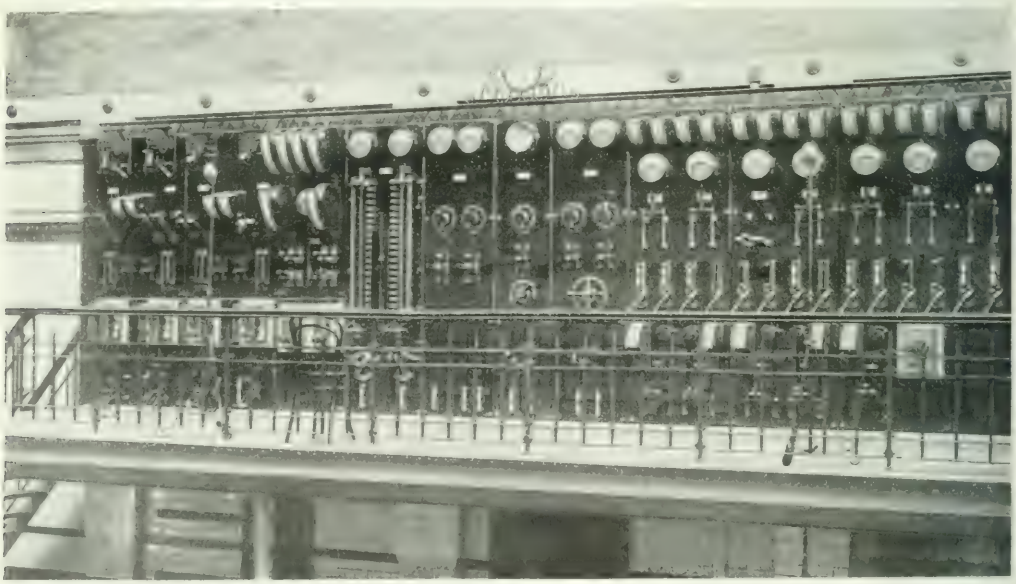
The steam piping is in the form of a ring main, placed wholly in the boiler room, branches being led through the wall to each engine. The steam pipes are of mild steel, and the steam valves have cast-steel bodies. The exhaust and feed-pipes are of cast iron.

The generating plant at present consists of two 150-kw and two 75-kw Belliss-Peebles generating units. The two smaller ones are of the two-crank, two-cylinder enclosed compound type, running at 500 r. p. m., while the two larger ones are of this firm's latest pattern of three-crank, three-cylinder, triple-expansion design, with cranks at angles of 120 degrees. The cylinders are fitted with piston slide valves, and are designed to be self-draining. Oil is supplied to all bearings by means of a simple form of pump, without valves or packing, discharging at a pressure of 10.20 lb. per sq. in. through a specially arranged system of oil channels. The oil escaping from the bearings drains into a crank pit, to be used over again.

The dynamos are of the standard four-pole type, shunt-wound, generating at a pressure of 480 to 520 volts. The balancer consists of two 15-kw machines coupled together, and the booster of two 15-kw dynamos on the same shaft with a 30-kw motor, the motor being placed in the center. All the machines are four-pole machines, shunt wound, and the four 15-kw machines being all the same size reduces the number of spare parts to a minimum. The booster generators are provided with reversible switches in circuit with the shunts.

A double battery is installed, consisting of 284 Tudor cells, capable of discharging at 75 amperes for eight hours, or 180 amperes for three hours. The battery-room measures 33 ft. 6½ in. x 16 ft. 6½ in., and the cells are arranged one-half on the floor and the other half supported on steel girders, carried from wall to wall, giving some 7 ft. clear headroom, a gangway being arranged all round the upper tier for inspection. This is a far better and more convenient arrangement than the usual method of two-tiered stands. The lugs of the plates are all burnt up together, and the cells are mounted on oil insulators, while the stands themselves are further mounted on large oil insulators. A booster is provided for "bringing up" separate cells if necessary.

The main switchboard is fixed on a high gallery and is of enamelled slate with T-iron framework. The generator panels consist of four slate tablets, two positive and two negative, the two 75-kw generators being connected to one pair of panels, and the two 150-kw generators being connected to the other pair. All four



circuits are similar, and consist on one pole of an automatic cut-out and watt-hour meter; on the other pole are 160- and 350-ampere main switches and fuses and circuit breakers, together with field regulating and breaking switches. The next panels are devoted to measuring purposes, on the upper panel there being six edgewise Kelvin voltmeters and a polarized ammeter and short-circuiting and isolating plugs; the lower panel contains at present

simply two watt-hour meters. The battery panel comes next; the upper tablet contains the two battery regulators and main switches and two 200-ampere ammeters; the lower tablet contains the two battery and booster switches and fuses.

On the booster panel, which is next, the upper tablet contains two 150-ampere ammeters, and also the two field break and reversing switches and field regulators; the lower panel contains only the four fuses. The booster motor panel has on the top tablet a 75-ampere ammeter, shunt regulator, and breaking switch and main regulators, while on the bottom tablet there is a main switch and two fuses. The balancer panel has two 50-ampere ammeters, two field regulators and breaking switches, and a main regulator, the bottom tablet having a main switch and two fuses. The next four panels are the feeder panels, each panel having the fittings of two feeders on it; the fittings for each feeder are as follows: Two edgewise ammeters, a voltmeter, and double-pole main switch and duplex fuses on each pole, with change-over switch on each. The fuses are covered with mica shields to retain the melted fuse metal when it "blows." On the lower tablets are placed the controlling gear for the arc circuits, consisting of an edgewise ammeter, double-pole switch regulating resistance and plug substitutional resistances, each equivalent to one lamp. The switches are of the double-bladed knife type.

The distributors and feeders are all triple concentric and lead-covered. The feeder cables are drawn into Doulton conduits, but the distributor cables are laid on the solid system in earthenware troughs filled in with pitch. There are six feeders laid from the generating station to different parts of the town, as follows:

No. 1 to corner of Dumbarton Road and Byres Road.			0.3
No. 2 to corner of University Avenue and Byres Road.	0.3,	0.2,	0.3
No. 3 to corner of Minard Road and Hyndland Road..	0.2,	0.16,	0.2
No. 4 to corner of Hamilton Terrace.....	0.1,	0.06,	0.1
No. 5 to corner of Gordon Street.....	0.2,	0.16,	0.2
No. 6 to corner of Maudslie Street.....	0.1,	0.06,	0.1

The feeders terminate in a feeder pillar instead of the ordinary manhole. Provision is made in each pillar for one feeder and six distributors. Two porcelain fuse switches are provided for each main, and all the neutrals are fixed direct to a common bus-bar. All the fittings are mounted on two enamelled slate tablets. A useful adjunct is provided in a demand indicator, and arrangements are made enabling this to be plugged into any of the mains, which give a useful means of determining the distribution of the load over the system. The feeder pillars have doors both back and front, and where they do not block the foot-paths there can be no doubt of their greater conveniences than manholes. The total length of feeders laid amounts to about 6 miles.

All the distributors are 0.1 by 0.1 by 00.6 sq. in. in section. Disconnecting boxes are provided at all street corners, and it is intended to use fused disconnecting boxes at all important junctions. The total length of distributors laid at present amounts to about eight miles. Besides this there are some four miles of arc cables.

The public street lighting consists of 47 12½-ampere double-carbon arc lamps of extra long type. Substitutional resistances are not provided for each lamp, but the circuits are run back to the engine room, where resistances are provided, which can be put into circuit should any of the lamps cut themselves out; an equivalent resistance to three lamps is available. In all the lamp pillar bases an automatic switch is fitted, which at midnight cuts out the arc lamps and switches on two incandescent lamps of 25 cp each, placed on brackets on each pillar. In the majority of cases the arc and incandescent lamp fittings are carried on the tramway poles, but in places where the trolley wire is carried from rosettes attached to the buildings, independent poles are provided.

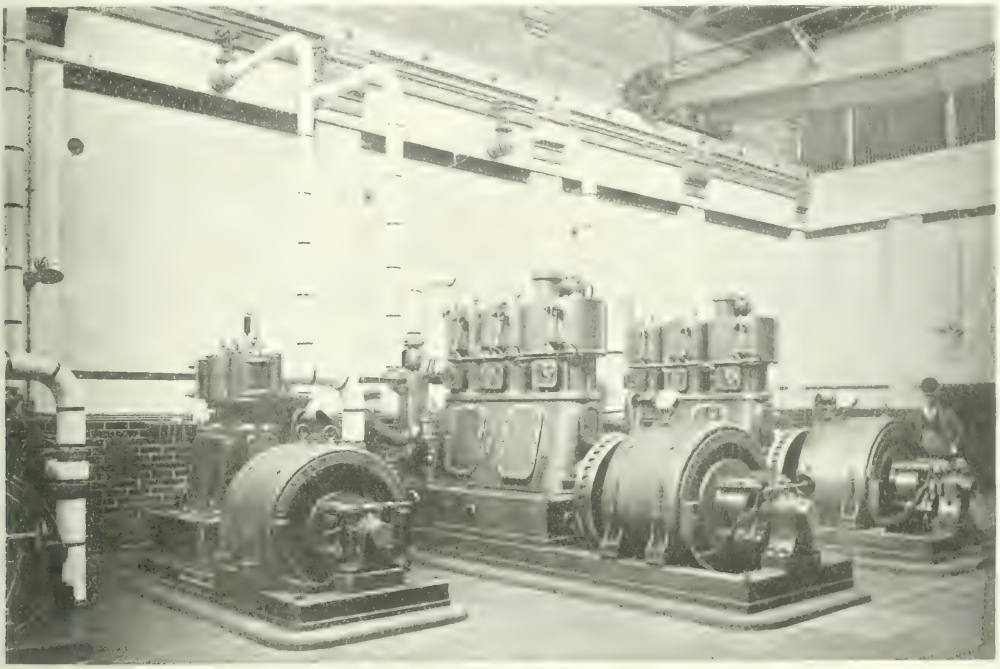


Fig. 5.—Generating Room, Burgh of Partick, Plant.

Up to the present, some 7,000 8-cp lamps have been applied for, besides the street lamps. Two workshops are also taking 85-hp for motors. There seems a probability of this load being more than doubled before next winter, as a number of prospective consumers will not wire till the summer clearing is being done. One circumstance which has been very much in favor of the undertaking starting with so satisfactory a load is due to the fact that for a year or more past, portions of the residential district have been supplied with current purchased in bulk from the Glasgow Corporation, whose mains adjoin.

The total cost of the combined buildings and plant is about $325,000—$250,000 for the electricity works and $75,000 for the destructor. Soon after the contracts for the various works were fixed, the council appointed Mr. H. B. Maxwell as the residential electrical engineer, under whose personal supervision the entire work has been carried out.

Cost of Construction and Maintenance of Telephone Plants.

At the recent independent telephone convention, in Chicago, Dr. H. I. Kerr, of Ottumwa, Ia., read a paper, giving some much-needed data on the cost, construction and maintenance of telephone plants.

The cost of a telephone plant can, he said, be quickly estimated approximately, at the present prices of material and labor, on a basis of the number of instruments installed. For example, an exchange of 500 stations installed within a radius of one or one and a half miles and no conduit or cable work, but up-to-date construction, will cost approximately $65 a station, or $32,500; this will come so near to the real cost that a company can base its calculations on it with a degree of certainty. As the number of stations increases, the radius or distance from the exchange will also increase, and therefore, the cost. In estimating on one thousand stations installed, we must take into consideration some aerial cable, and more substantial construction and much more costly equipment, and therefore there would be a material increase in the cost per station. Without conduit work, a safe approximate would be $85 per telephone.

Where the demand for telephones exceeds one thousand, and quick, up-to-date service is required, it is absolutely necessary to be equipped with central energy and multiple switchboards, and when in towns where electric light and electric street cars are used, requiring many additional appliances to overcome the interference caused by them, and where it is necessary to construct conduits, we cannot with safety calculate less than $100 per station installed; that is, 1,000 stations under such conditions would cost to install, approximately, $100,000. These prices are only approximate, and may vary 10 or 15 per cent., according to local conditions. In large cities where 5,000 to 10,000 subscribers are connected, the cost will approximate from $150 to $200 per station installed.

Very few who are engaged in the independent telephone business knew the expense of operating or the cost of maintenance approximately, when they entered into the business; much less did they consider that the expenses increased, not only approximately to the number of subscribers, but in an arithmetic progression. To explain, the expense of operating an exchange of 1,000 subscribers is much more than twice the expense connected with an exchange of 500. At first thought we naturally say that if you can give service to 500 subscribers at $1 per month, you can give service to 1,000 for less. Practice proves just the reverse. The reasons why are many, some of which may be plainly understood from the following:

When there are 500 subscribers connected with an exchange, each subscriber can call up 500 others, and by the time every subscriber calls up every other subscriber there are sent through the exchange 250,000 calls; when there are 1,000 subscribers and every subscriber calls up every other subscriber once, there are not only twice as many calls sent through the exchanges as there were when only the 500 were on the board, but four times as many, making 1,000,000 calls, which is the ratio in increase of the use of the telephone with the increase of subscribers. This requires four times as much labor to take care of one thousand subscribers as to take care of five hundred, four times as much wear and tear on the apparatus, and much more central machinery or apparatus to do it with.

The same is true of outside construction. Consider that the first 500 subscribers are within a radius of one mile from the exchange, with an average of one-half mile of pole lines, and in full metallic circuit, it means one-half mile of wire out and one-half mile in; the second 500 come within a radius of two miles from the exchange, making an average distance of one and one-half miles for poles and wires, or three half miles out, and three half miles in, making the amount of construction to reach the outer 500 three times that of the first 500, and four times that required to serve the first 500 will be required to give service to 1,000.

I doubt whether this covers it all when we consider the amount of territory that must be covered by poles and wires as the circle increases. The territory to be covered in a radius of one mile is only a fraction less than four square miles. The territory covered in a radius of two miles is four times that, or 16 square miles, requiring 12 square miles to be covered with poles and wires to serve the second 500, which added to the cost of the first 500 would make three times as much pole cost to serve 1,000 subscribers as it requires to serve 500. To serve the out-districts the wires can pass over the poles of the first districts, but the poles will have to be much larger and cost more. The amount of cross-arms and wire and insulators is the same as if all the wires were put on separate poles from the central office out.

There appears to be a general impression among those who think but once that after a telephone line or telephone system is built the work is done for all time. But that is not the case. Decay and trouble begin as soon as the poles are set. The average life of the white cedar poles as we get them to-day is from 15 to 20 years. Galvanized iron wire in towns and cities cannot be counted on for a period much beyond six or seven years. In the country this is much longer. The life of a switchboard is from 15 to 25 years, owing to the constant repairing and replacing of parts giving out or wearing out as time goes on. Telephones have been an uncertain quantity till within a few years. There are a few telephones that have been used many years, proving that durable, efficient telephones can be made. But there are many that have been thrown away in a very few years, which is in accord with poor construction in everything. The best is what we want.

The expense of maintenance when good up-to-date appliances are used, with the very best of construction, should not and does not exceed three per cent. to five per cent., so that we are on the safe side of our investment when we make a five per cent maintenance fund and a six per cent. dividend. As we have already stated, the cost of maintenance increases much more rapidly than the number of subscribers. This is being understood by many and is evidenced by the franchises granted in different cities, containing a clause granting the privilege to increase rate for telephone service as the number of subscribers increase.

By examining the Bell rates of 1889 or 1890, and comparing them with the actual condition and experience of the independent people, Dr. Kerr has come to the conclusion that the rate should have been established at about three-fifths of that of the Bell companies, all things being equal, which would give a bare remuneration on capital invested. It would not have been a "get-rich-quick" business, but a clean investment, and justice would have been done to all.

The independent people have reduced the rate of telephone service, and by so doing the telephone has come into general use and become a public necessity in place of a public luxury. True, it has cost much money, but the independent companies have this faith in the people, that they will stand by the company that has served them best.

British Telegraph Operators.

Some of the telegraph operators in this country have an idea that government ownership would bring the millenium for them. The following special cable dispatch to the New York *Sun*, of April 19, may enlighten them on the subject: The House of Commons was occupied for several hours last evening in discussing the grievances of post office and telegraph employes. When a vote was taken the government escaped defeat by a majority of only 31 votes. There are well-founded complaints that pressure was brought by the organized civil servants upon members of Parliament, and on the other side there are dark threats of disfranchising every one in the government service. But these charges are really made to obscure the issue; for it is beyond doubt that the lower grades in all sections of the British civil service are scandalously underpaid.

A few years ago, for instance, the Controller of Telegraphs in London, Sir Henry Fisher, in giving evidence before a committee of inquiry, declared that the junior telegraph operators were not paid enough to live upon. Yet nothing has been done since to remedy such a shameful state of things. This system of official sweating has driven the telegraph operators and other post office employes to organize for the redress of their grievances, and there are now five trade unions in that government department with an aggregate membership of 50,000. One of these days there may be a great strike which will paralyze the business of the country.

The humbler employes in other departments of the state service are all underpaid. There has been formed this week an association styled the Civil Service Writers' Guild, the sole object of which is to obtain for members work after office hours, which will enable them to supplement their meagre official pay so that they may live in [illegible] Inadequate pay is not their only [illegible] in every department of the public service.

The Reception to Lord and Lady Kelvin.

The reception to Lord and Lady Kelvin, planned by the American Institute of Electrical Engineers, was given with great success at Columbia University, in the gymnasium, on the evening of Monday, April 21. The distinguished guests arrived on the preceding Saturday, and having received, while still at sea, by means of the wireless telegraph, an invitation to attend the exercises at Columbia, proceeded thither almost immediately after landing, and were prominent among those who participated in the inauguration of President Butler. During the forepart of Monday, Lord Kelvin took part also in the proceedings at the university of the American Physical Society, then holding its annual meeting, and he and Lady Kelvin were afterwards entertained by Prof. Crocker, Dr. Pupin, Prof. Sever and Prof. Townsend, of the electrical engineering department. They were very much pleased and delighted to notice the evidences of growth which characterized the university since they last visited it some four or five years ago.

As has already been mentioned in these columns, the reception was held at Columbia in order to secure a hall that would be large enough for the purpose, and because the authorities were desirous of showing special honor to the leading scientist of Europe, who, while wonderfully hale and hearty, may not be able to stand the fatigues of another trip across the Atlantic. Finding that other societies were desirous of extending hospitalities to Lord Kelvin, and as the time of the visit in this country is very short, the Institute invited to co-operate with it the American Physical Society, the American Association for the Advancement of Science, the American Mathematical Society, the Astronomical and Astrophysical Society of America, and the New York Academy of Sciences. Other bodies were anxious to join, but in view of the large membership thus covered it was deemed pertinent to go no further. The Committee on Arrangements consisted of Dr. F. B. Crocker, chairman; Mr. C. W. Rice, secretary; Dr. R. S. Woodward, Mr. F. P. Keppel, Secretary of the University; Dr. A. G. Webster, Prof. James McA. Cattell and Mr. T. C. Martin. To the chairman and the secretary great credit is due for the large amount of thought and work put upon the affair, and for the success which attended their efforts; and special praise is due to Prof. Crocker, who is by no means in the best of health, but assumed cheerfully the burdens of the work and represented both the Institute and the University most admirably.

The proceedings in the gymnasium began at 8:30, and the special addresses were timed for 9:30, in order to give the audience opportunity to assemble and to get into its seats before the speaking began. An excellent band of music was provided, and a very pleasant hour was spent; the gymnasium answering its purpose excellently, being very cool and comfortable in spite of the fact that all the lights were going brilliantly and that nearly 2,500 people were assembled within its walls. The auditorium and the platform were handsomely draped with the Columbia colors of light blue and white, while trophies of flags and other decorations were suspended around the semicircle facing the stage. Nearly 2,000 seats were in readiness on the floor, while some 400 were reserved on the deep platform for the officers and committee members of the various co-operating bodies. Back of the platform again was a large foyer, looking out on the house, which served as a social rendezvous and as a means of communication between the two sides of the house.

The gathering of notables was remarkable, and it would take a full page of this paper merely to enumerate the well-known men present prominent in the various branches of art and science. The American Institute of Electrical Engineers was out in force, the members feeling that the credit of the affair would be largely theirs, and desiring to do honor to one whose work has gone so far to create the arts with which they are connected. Among those present may be named: Messrs. T. A. Edison, Nikola Tesla, George Westinghouse, Frank J. Sprague, C. S. Bradley, S. S. Wheeler, C. Batchelor, P. B. Delany, W. J. Hammer, J. W. Lieb, T. E. Murray, N. F. Brady, F. B. Hertzog, C. F. Scott, R. T. Lozier, C. P. Poole, C. T. Child, W. S. Andrews, J. M. Wakeman, F. R. Upton, W. S. Mallory, Luther Stieringer, Prof. R. B. Owens, of Montreal; E. H. Mullin, J. Sachs, John Bottomley, W. F. Willcox, R. W. Pope, T. Wolcott, G. S. Dunn, R. D. Mershon, C. A. Terry, M. I. Pupin, F. Townsend, G. F. Sever, C. E. Knox, Wm. Maver, T. R. Taltavall, E. D. Adams, Sir P. Sanderson, British Consul-General.

Shortly after half-past nine Prof. Crocker escorted Lord Kelvin to the platform amid salvos of applause, and Mrs. A. G. Webster, who sat next to her, presented Lady Kelvin with a handsome bouquet of white roses tied with streamers of light blue silk ribbon, a graceful little act which elicited warm approval from the audience.

Dr. Crocker, as chairman of the committee of arrangements, then announced the purpose of the gathering, paid a handsome eulogy to Lord Kelvin, and introduced Dr. Nicholas Murray Butler, to make the address of welcome as president of Columbia University.

Dr. Butler was enthusiastically applauded as he arose. He said that he was proud to share with the American deans and living masters of science the honor of welcoming one of Great Britain's greatest teachers and inventors. Lord Kelvin, he said, had not only gone out to more points in the unknown than most men, living or dead, but had made his information practical and easily understood. Dr. Butler elicited warm applause by remarking that such incidents were among the strong bonds tending to unite more closely America and the Mother Country.

Prof. Elihu Thomson, on behalf of the American Institute of Electrical Engineers, was the next speaker, and delivered its welcome with all his wonted felicity and grace of expression. He rehearsed the career of Lord Kelvin, dwelling upon each of his achievements in the electrical field and pointing out that the genius which began with the submarine cable was still busy creating new apparatus and elucidating new ideas and principles in electricity and physics. Prof. Thomson, referring to a cable episode as being according to his boyish recollections in 1866. Lord Kelvin jumped up like a flash and said it was 1865. This instantaneous evidence of mental alertness and keeness of memory brought down the house, while Prof. Thomson scored neatly also by saying that while correction at Lord Kelvin's hands was always a pleasure, he welcomed it now because it made him one year younger.

Dr. Arthur Gordon Webster followed, on behalf of the American Physical Society, of which he is vice-president, and gave one of the best speeches of the evening, making some good points as to the relations of the physicist and engineer, and dwelling upon Lord Kelvin's work as a physicist. He was followed by Dr. R. S. Wood ward, past-president of the American Association for the Advance ment of Science, who spoke for that body and the remaining ones that had joined in the reception. Three rousing cheers were then given for Lord Kelvin, who with great vigor and animation, spoke for about half an hour, dwelling upon his earlier work and paying a warm tribute to the memory of Cyrus W. Field.

"Science," he said, "has advanced greatly during recent years among all lines, and one of the greatest achievements is that of Marconi and wireless telegraphy. It is a great achievement to send a message inland from 100 miles out at sea, or for several hundred miles. The work that he has done indicates that the time will come when messages will be sped over the ocean without an intervening wire. But, my friends, we must not forget the great achievement which gave us submarine telegraphy, which will continue to serve us well, even with wireless telegraphy as a commercial success.

"As I said before, Americans of all others, must not forget the work of Cyrus W. Field. I always got inspiration from the time I first came to America. The first time I landed on this continent was in 1866, and my landing was in Newfoundland. One might not believe it, but I got wonderful inspiration from Newfoundland. Ten years later I came over to your Centennial Exposition, and America had given to the world then a triumph of science in the telephone. I got inspiration on that visit from meeting and talking with Alexander Graham Bell.

"The next time I came was in 1884, and then I found the great achievement of Edison perfected and New York as bright by night as by day through his invention."

There was great applause at the mention of Mr. Edison's name, and he was at last compelled to rise and bow.

Lord Kelvin spoke finally of the inventions which made possible the transmission of power at high voltage and the harnessing of Niagara. Of this he said: "Beautiful as is that wonderful work of nature, it would be more beautiful still if those waters fell upon turbine wheels every one of which was turning the wheels of industry." He then referred in terms of high praise to the recent work done in California in transmitting current in large volume at high pressures over 220 miles, lauding the men and methods that rendered such a thing feasible; and he recalled the predictions he had made

some years ago as to the possibility of such work at 300 miles and more.

The stated exercises, which lasted about one hour, were brought to a fitting close by three tremendous rounds of cheering for Lord Kelvin, and the band then resumed its programme. In view of the large attendance it had been deemed by the University authorities inadvisable to attempt to serve any collation, as the audience would have had to leave the gymnasium and proceed to another part of the University and then return to secure hats and coats—a formidable undertaking in view of the fact that there were nearly a thousand ladies and more than fifteen hundred men present. It was also deemed, for much the same reason, inadvisable to attempt a regular presentation to the guests of the evening, but many of the audience were not to be denied, and as soon as the proceedings were over they took the big platform by assault, and for some 15 to 20 minutes Lord and Lady Kelvin were the somewhat helpless occupants of the center of a human maelstrom. They extricated themselves from this crush good-naturedly, and about 11 o'clock were driven back to the Waldorf-Astoria, one of the handsomest electric coupés in New York City having been retained for their service during the evening by the New York Transportation Company. The whole affair marked a red-letter night in the annals of the Institute, and will be long remembered by those who had the honor and pleasure of participation.

The Dutch-German Cables.

It has just transpired, according to the New York *Times*, that a secret protocol was entered into between Germany and Holland shortly after the Spanish-American war, with a view to maintain the strict neutrality of cable lines in time of war. The presence of the protocol became evident owing to the wording of a bill recently presented by the Dutch Government before the States General. The main features of the bill furnish the two signatory powers with the requisite authority to establish a new telegraphic communication between Germany and Holland, on the one hand, and their Atlantic possessions on the other, by means of cables, which shall be under the joint control of the two powers and independent of the British cable companies concerned. It is proposed to accomplish this end by the formation of a German-Dutch Cable Company, the seat of which will probably be at Cologne. This cable company is to obtain the exclusive concession for laying telegraph cables from Menado, the chief place of Northern Celebes, to the Island of Guam, belonging to the group of the Marianas, now in the possession of Germany, and from Guam to Shanghai. At Guam these cables will connect with the American Pacific cable between San Francisco and the Philippines. The Dutch Government having undertaken to lay a cable between Menado and Balik Papan, in Borneo, where a telegraphic communication already exists with Java, the result of the whole scheme, when completed, will be the establishment of an independent German-Dutch cable communication with the colonies of the two States in Asia, and with China, by way of San Francisco.

The German-Dutch Cable Company to be formed at Cologne, with articles of association to be approved by the Governments of the two States, will receive during a period of at most twenty years, an annual subsidy, which, in the case of Germany, will amount to about $250,000, and in the case of the Netherlands to about $70,000. But up to 90 per cent. of the receipts of the company will be used for the purpose of reducing the annual subventions. The joint control of the two powers will be exercised by an international directorate, one-quarter of the directors being German subjects and as many again Dutch subjects.

Just how the secret protocol which is added to the treaty may enforce the neutrality of the cables, may only be guessed at, for, it is added, in regard to the treaty, that in case of disputes concerning its interpretation, the signatory powers agree to invoke and abide by the decision of the International Court of Arbitration at The Hague.

German Storage Battery Syndicate.

A special dispatch from Berlin states that the Storage Battery Syndicate has been dissolved and that the prices of storage batteries have been reduced from 10 to 20 per cent.

Electric Traction for Swiss Railways.

Mr. Henry M. Morgan, U. S. Consul at Aaran, Switzerland, sends the following data as to the operation of all the Swiss railroads by electricity:

Two months ago, an interesting study was published by L. Thormann, a Zurich engineer, on the possibilities of substituting electricity for steam on the Swiss railways. The idea itself is not a new one, but it has never received such expert investigation. The fact that Switzerland is dependent on foreign countries for all the coal she consumes—not an ounce thereof being produced in the country—has drawn attention to the great unemployed water power, and has given rise to many propostions tending to promote the country's independence in traffic and industry. It is also not entirely beyond the limits of possibility that some of the coal-producing countries from which Switzerland draws her supply may pass laws prohibiting the export of coal, and thus force her to buy at ruinous prices. Engineer Thormann proves that it is quite possible to raise sufficient water power to operate all the Swiss railways, but at the same time he shows that it is a mistake to believe that the expenses of the traffic would be thereby decreased to any considerable extent. The cost of the transformation and reconstruction would be heavy, and an amortization of the invested capital would be impossible.

The five principal Swiss railway lines demand about 30,000 horse-power a day. To guarantee this, 60,000 horse-power of high-tension alternating electric current would be required, to which the necessary reserve would have to be added. The question whether the available water power of the country would be capable of supplying this power is answered in the affirmative. Thormann, without taking into consideration the powerful waterfalls, names the following works, which are either in course of construction or designed.

Name of Works:	*Horse-power.*
Sihlwerk, near Einsiedeln	20,000
Laufenburg on the Rhine	10,000
St. Maurice	5,000
Wangen on the Aare	5,000
Beznau on the Aare	5,000
Wäggithal (Schwyz)	5,000
Fribourg-Hauterive	4,000
Rheinau	3,000
Hagneck, near Biel	2,000
Doubs, near Puntrut	2,000
Vallorbe (Jura)	2,000
Lungernsee (Unterwalden)	2,000
Montbovon (Vaud)	1,500
Kander (Bernese Alps)	1,500
Sense (Fribourg)	1,000
Gurtnellen	1,500
Göschenen	1,500
Ritomsee	8,000
Giornico	4,000
Marobbia	1,000
Verzasca	1,000
Total	86,000

As this would be more than sufficient, the surplus could be used for industrial purposes.

The cost of the establishment would be very great. The writer calculates it at 161,000,000 francs ($31,073,000), viz.: Rolling-stock, 40,000,000 francs ($7,720,000); conducting cables and miscellaneous, 70,000,000 francs ($13,510,000); and generating stations, 51,000,000 francs ($9,843,000). He shows, however, that although the direct saving would not be important, the country would profit enormously, as the commercial balance of Switzerland would become more favorable and the vast amount expended for coal would remain in the country. The general utilization of water power throughout the country would also mean a valuable encouragement for other industries.

The study of Mr. Thormann has attracted much attention. That the project is no longer regarded as Utopian is proved by the meeting of electrical engineers referred to in one of my previous reports—

January 23, 1902—and more recently by the fact that the "Maschinenfabrik Oerlikon" has made an application to the Federal Government for a concession to establish a line of 20 kilometers (12.4 miles) of electric standard-gauge railway for experimental purposes. There is no doubt that this concession will be granted.

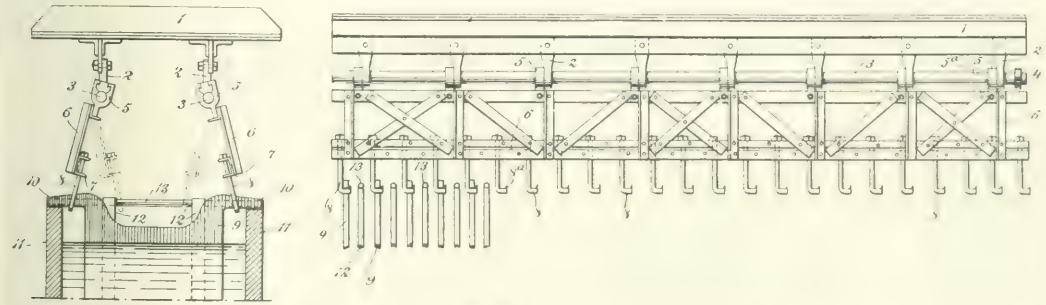
Metallurgical Crane.

A patent, issued April 15th, figures and describes the form of a metallurgical crane which is used for handling the anode and cathode in the refining tanks of the Raritan Copper Works, near Perth Amboy, the device being the invention of Mr. David Wesley Blair.

The accompanying cuts, reproduced from the patent drawings, show the new construction in side and end elevation respectively. It comprises a supporting frame *1* for the parallel horizontal shafts *3*, which extend, as shown, above the vats and are mounted in bearings in hangers *2*. Other bearings *5* upon the shafts support two skeleton frames *6*, and these in turn carry upon brackets *7* the hooks *8*, *8a*, for engaging the electrodes. The shafts *3* are free to rock in their bearings to the position illustrated in dotted lines, and also to move longitudinally therein to an extent represented by the two positions *5*, *5a* of the bearings, and coinciding with the spacing of the electrodes in the vat.

This double movement permits the crane to perform a double function; the hooks may be swung outwardly to engage all of the anodes *9*, as shown in full lines in Fig. 2, and after the removal of these may be swung inwardly to their dotted position under the supporting bars *13* of the cathodes *12*, the longitudinal movement of the shaft bringing them into engagement therewith.

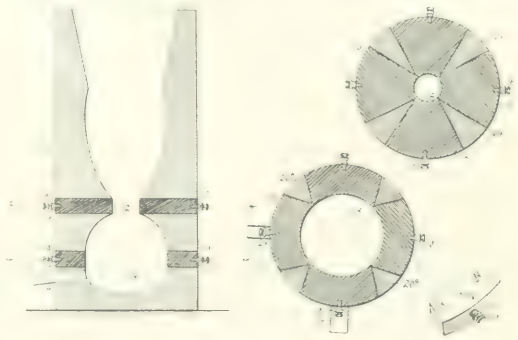
The net result is a decided simplification of the structure, a reduction of the number of parts, and the provision of means for bringing the hooks into engagement with all of the anodes or cathodes of a vat by a single movement of the support.



Electric Furnace.

The electric furnace shown in the accompanying figures in vertical section and in cross-section upon the lines *3*, *3* and *4*, *4*, respectively, is the invention of Michael R. Conley, of New York, and the property by assignment of the Conley Electric Furnace Company, of the same place. The novelty of the construction lies in the use of a plurality of horizontal zones wherein heat is developed by the incandescing action of the current upon a belt of carbon and upon the charge itself.

The furnace is a fire-brick structure, provided with a contracted portion *12*, below which is a hearth *13* for the reception of the reduced metal and slag, which in operation are tapped respectively from the runners *14* and *14a*. At the contracted portion of the shaft the first heating belt is placed, formed of a number of segments *15*, of the usual graphite-clay mixture, mounted loosely between pillars *19a* of the fire-brick structure, preferably forming a continuous band around the inner wall of the furnace chamber, and capable to a considerable extent of adjustment to compensate for wear. Electrical connections from both terminals of the dynamo are made through binding posts *16*. Around the walls of the hearth, and at a considerable distance below the belt referred to, a substantially similar structure *17*, *18*, *20a*, is placed. The effect of the arrange-



ELECTRIC FURNACE.

ment is to produce a furnace, certain zones of the walls of which may be rendered incandescent at will and to the degree desired, by the passage of the current. In such a construction a variety of operations are of course possible, but the inventor contemplates mainly the reduction of iron ores or the production of ingot steel.

International Association of Municipal Electricians.

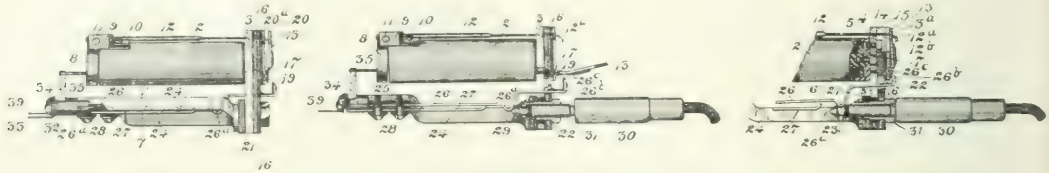
The seventh annual convention of this association will be held at Richmond, Va., Tuesday, Wednesday and Thursday, October 7, 8 and 9, 1902. The following papers will be prepared and presented at that meeting: "Municipal Inspection and Control," Walter M. Petty, Rutherford, N. J.; "Relation of Electrical Interests to Other Branches of the Municipality," Capt. Wm. Brophy, Boston, Mass.; "Classifying of Records of Electrical Departments, and Standard Specifications, for Supplies and Contracts," Edw. F. Schurig, Omaha, Neb.; "Report of Committee on Rules for Electrical Inspection and Control," especially with reference to the occupancy of streets, Morris W. Mead, Pittsburg, Pa.; "Joint Use of Conduits," Chas. F. Hopewell, Cambridge, Mass.; "The Telephone Service in Connection with Fire and Police Signal Systems," Jerry Murphy, Cleveland, O.; "Electrical Government in Small Cities," A. S. Hatch, Detroit, Mich. In addition to the papers, Mr. Hopewell, of Cambridge, Mass., will give an "Illustrated Lecture" on Fire and Police Telegraphs.

Trolley Car Propagandism.

It is noted that during the recent disturbances in St. Petersburg, the students availed themselves of the street cars, from the tops of which they managed to distribute a mass of incendiary literature among the struggling crowds and police below.

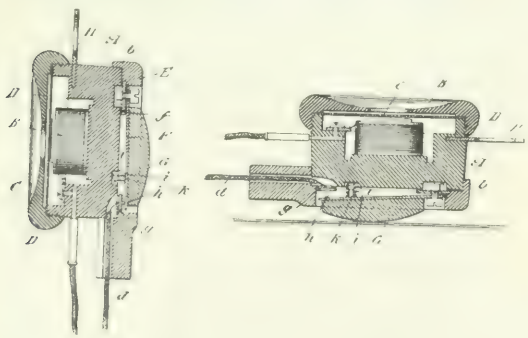
New Telephone Patents.

The issue of the Patent Office for April 15 contains two telephone patents, one relating to a switchboard detail, the other to the irrepressible receiver. Mr. Kempster B. Miller, of Chicago, patents and assigns to the Kellogg Switchboard and Supply Company, a combined jack and drop in which the line signal is mechanically restored by the insertion of the plug in the jack. The drawings illustrate the device so clearly that little description is needed. Referring to the diagrams, Fig. 1 shows the drop and jack in normal position, Fig. 2 the drop fallen and the plug partly inserted, and Fig. 3 the plug inserted and the drop restored. It will be seen that the line-spring *26* of the jack is extended through a slot in the frame and its end bent upward so as to impinge immediately below the drop-shutter. The bent end *26b* of the jack-spring may be lined with insulating material *26c*. When the plug is inserted the tip *29* forces the depression *26a* in *27* upward and so raises *26b* and effects the replacement of the drop-shutter, which is held by the hook *12a* on the end of the armature lever *12*. The raising of spring *26* breaks contact with spring *27*, and so cuts the drop-coil out of circuit.



FIGS. 1, 2 AND 3.—MILLER'S COMBINED JACK AND DROP.

Mr. Aristide Neri, of Hoboken, patents a watch-case receiver, particularly designed for interior service, with a spring circuit closer, the object of which is to prevent the exhaustion of the batteries when the receiver is left off the hook. Figs. 4 and 5 show the details of this device. At the back of the case is bolted a metal plate *F* covered by a cap or button *G* of insulating material. The plate *F* by a contact point *h* makes contact with a plate *g* when pressure is applied to *G* the contact being held normally open by the spring *i*.



FIGS. 4 AND 5.—NERI'S WATCH CASE RECEIVER.

When the receiver is in use the circuit is closed by pressing on *G*, and when it is not in use the spring *i* holds the circuit open, and there you are.

Clarkson School of Technology.

Following are some of the subjects of graduating theses, in June, of the graduating class of the Clarkson School of Technology, Potsdam, N. Y., of which Prof. W. S. Aldrich is director: "Development o fthe Water Power of High Falls on Deer River," "A Study of the Possibilities of the Development of Water Power on the Indian River," "A Design for a Power Plant on the Indian River," "Investigation of the Properties of Liquid Condensers," "In fluence of Chemical Composition on the Electric Conductivity of Wrought Iron and Soft Steels," "Performance of a Motor Generator Set *vs.* a Rotary Converter of the Same Capacity," "The Design, Construction and Performance of an Eexperimental Polyphase Transmission Line," "An Experimental Study of a Single-Phase Induction Motor," "In stallation of, and Experiments on, a 15 hp Otto Gas Engine," "Experiments on the Flow of Steam through Rectangular Orifices," "Design of Compound Marine Engine," "Development of the Water Power of High Falls on Deer River."

Proposed Independent Telephone Manufacturers' Association.

An organization of independent telephone manufacturers at Chicago has been talked of for some time, and on April 16 about a dozen manufacturers and representatives met at the Oxford Hotel, Canal and Adams streets, at the call of Mr. J. E. Keelyn. The meeting was presided over by Mr. Keelyn, who outlined his ideas of what the association might be, after which came a general informal discussion of what the objects of such an association should be, whether entirely for the purposes of good fellowship or whether it should go further and attempt to regulate business matters.

As there was considerable difference of opinion on the points, and as there was a general disinclination to pledge membership to such a manufacturers' organization until the objects and requirements were definitely settled, a committee of five was appointed to draw up rules, and report at a meeting at the same place, Tuesday noon, May 6, 1902. The committee for framing these rules consists of F. G. Jones, Geo. A. Briggs, L. G. Bowman, J. E. Keelyn and H. E. Procunier.

CURRENT NEWS AND NOTES.

ENGINE BUILDERS' ASSOCIATION.—The spring meeting of the Engine Builders' Association of the United States will be held at Hotel Schenley, Pittsburg, Pa., on May 22 and 23. Specially prepared papers will be read on the first day, and on the afternoon of the second day a visit will be made to the plant of the Westinghouse Machine Company. A banquet will be held the same evening.

GUTTA-PERCHA AND RUBBER IN GERMAN NEW GUINEA.—Consul-General R. Guenther writes from Frankfort, as follows: Two years ago, the German Colonial Society offered a prize of 3,000 marks ($714) for the finding of a plant in the German colonies furnishing gutta-percha suitable for cable purposes. A telegram from German New Guinea says that gutta-percha, as well as rubber, has been found in large quantities.

ELECTRICITY AND WESTERN ROADS.—The *Wall Street Journal* has the following: Perhaps the most elaborate undertaking now occupying the attention of electrical engineers, is the project of President J. J. Hill, for utilizing the forces of the mountain torrents now going to waste in the Cascade range to haul loaded trains over the mountain passes from Eastern Washington to the Pacific slope, and back again. With this purpose in view, engineers of the Westinghouse Company are now considering the resources at their command, preparatory to making plans for the practical realization of what is in Mr. Hill's mind. Explorations have been made in the Cascades and numerous water courses discovered which may be utilized for the creation of energy. The project of harnessing the Spokane Falls and the transmission of the power thus generated across the plains of Eastern Washington to the mountains is even considered a feasible and practicable plan. Not only is the waste power of the waters to be utilized, but steam generated at coal mines in the Cascade range is to be used to create electrical energy for the same purpose.

CHICAGO ELECTRICAL ASSOCIATION.—The May meeting of the Chicago Electrical Association to be held May 7, at 1739 Monadnock Block, is to consist of a discussion of "The Central Station vs. the Isolated Plant."

STATUE OF LIBERTY'S LIGHT TO SHINE.—Secretary Root has made arrangements to maintain a light in the Statue of Liberty, on Bedlow's Island, and in New York Harbor. The electrical apparatus belonging to the lighthouse establishment and used by it in lighting the statue will be employed for that purpose. This action is the result of a personal conference with the Secretary of the Treasury, and was taken with the approval of the President.

THE ELECTRIC TOWER.—It has been recently reported that the Electric Tower of the late Pan-American Exposition had been bought by the city of Denver, and would shortly be removed to that city. This report has called forth a great amount of protest from the public-minded citizens of Buffalo, with the result that efforts are now being made and contributions offered for the purpose of retaining the structure as a permanent memorial of the late Exposition, in the city of Buffalo.

ASSASSINATION AND TROLLEYS.—The Russian Minister of the Interior, M. Sipiaguine, has been assassinated by a Socialistic student. A cable dispatch from St. Petersburg, of April 15, says: The death of Sipiaguine may materially affect the chances of Murray A. Verner, the Pittsburgh contractor, of securing the St. Petersburg tramway franchise, as the dead man was a notable supporter of Mr. Verner's proposition, and overruled the committee which had recommended the Westinghouse offer. The matter, possibly, is now indefinitely postponed.

RAILROAD TELEGRAPHY.—The Delany rapid telegraph system, which has been in regular operation by the Pennsylvania Railroad between Philadelphia and Altoona for the past six months, is to be immediately extended to Harrisburg and Pittsburg. The new apparatus was ordered some time ago, and is ready to be installed as soon as the Pittsburg station is ready. About 500 messages, equivalent to 1,000 ordinary commercial messages, are sent daily by the Delany method over the Philadelphia-Altoona wire, which includes a telephone circuit in constant use without in the least interfering with conversation.

WIRELESS TELEGRAPH CONFERENCE.—A cable dispatch from Berlin, of April 16, says: Great Britain has accepted Germany's proposition for an international conference to regulate the use of wireless telegraphy. The other powers to which the proposition was made, namely, the United States, France and Russia, have not yet responded, but the officials here confidently expect favorable answers, especially from the United States, which has taken much interest in the matter. Germany's suggestion embraces merely the calling of a conference without definitely formulated propositions for discussion. However, Germany has asked the powers to set forth in their answers if they wish Germany to formulate propositions to lay before the conference, or leave the matter entirely to the conference.

CHICAGO TELEPHONY.—A telegram from Chicago says: A thirteen-year extension of the Chicago Telephone Company franchise in return for an agreement to the readjustment of rates which will give the public much cheaper service, is the proposition that the special Council Committee on Telephones has put to the telephone officials. If the company refuses to agree to the plan, the committee will recommend to the council the readjustment of telephone rates without the franchise extension, and will ask that the new and lower rate be enforced. It is considered likely that an agreement will be reached. The company's franchise expires in seven years. The telephone company officials have discussed for some months the advisability of seeking an extension before making further improvements.

ELECTRICAL STEERING APPARATUS.—Lieut. Bradley A. Fiske in a patent dated April 15 describes a method for operating steam steering engines by electrical means. Geared with the steering wheel is a small induction motor, conductors from which go to a similar motor at the steam steering engine. A pin on the shaft of the latter engages with a lever connected with the reversing valve of the steering engine, and normally held in mid-position by two opposing springs. When the steering wheel is turned, the current generated in the wheel motor produces a torque in the engine motor, which operates the valve lever and raises or lowers the valve according to the direction of motion of the steering wheel. When the steering wheel stops, current is no longer generated and the springs above referred to bring the lever and reversing valve back to mid-position, thereby cutting off steam from the steering engine.

"MODERN MACHINERY."—The crazy product of a decadent art school is thus spoken of in a New York *Tribune* dispatch from Paris, describing the present Salon: The picture likely to hypnotize the public is "La Machine," of which the artist is Jean Veber. It is a large work, superb in color and superbly drawn. A huge dynamo is in rapid motion. On a steel cylinder is perched a nude female figure whose red hair stands on end by the force of electricity, while the ponderous fly-wheel is crushing to atoms hundreds of human bodies, the victims of industrial trusts and commercial syndicates, while a river of blood flows beneath. This apocalyptic machine picture has an irresistible fascination, in spite of the repulsive subject and the artist's baneful misconception of modern civilization and progress. "Modern Machinery" is to this year's Salon what Jean Beraud's scarlet "Christ at the Pillar" was in last year's Salon. It is a socialistic atrocity, but every one gazes at it, every one talks about it. It arouses anger and indignation, but Veber's most caustic critics admit that among the younger generation of French painters there is not one that can equal him in warmth and brilliance of color. It is a pity he cannot find better employment for his skill.

ELECTRIC TRACTION IN GERMANY.—A cable-dispatch from Berlin, of April 9, says: Herr von Thielen, the Prussian Minister of Public Works, speaking in the Diet to-day on the railway budget, referred to the application of electricity to broad-gauge, long-distance railways. He reviewed the recent experiments on the Wannsee and Zossen roads, and said that traffic on the former, which is a Berlin suburban line, has been abandoned because electricity as a motive power was twice as expensive as steam and less secure from accidents. The insulation was never wholly perfect, and he was, therefore, convinced that the high-power, long-train system could not be adopted for general introduction. The Minister said, however, that the authorities were negotiating with an electrical company to introduce electrical traction on all trains between Grosslichterfelde (seven miles from Berlin) and the capital, with prospects of better success. Referring to the single car experiments on the military road between Berlin and Zossen, where a speed of 100 miles an hour was reached, the Minister said he hoped for increased speed through the strengthening of roadbeds, though he was still doubtful as to whether high-speed electrical traction was profitable. He said it must be confined to passenger traffic.

THE PACIFIC BRITISH CABLE.—The British Pacific cable has reached the Fiji Islands. The laying of the cable was decided upon at the Colonial Conference, held in London in 1887, but the survey was not completed until 1899. After the report was published in 1899, an agreement was entered into by the imperial government with Canada and the Australasian colonies for the construction, laying and maintenance of an all-British Pacific cable. It was arranged that the cable should be vested in a Board of Commissioners, to be appointed under the authority of the Imperial Parliament, and that the governments concerned should appoint administrators in proportion to their shares in the undertaking, the Imperial Government and Canada each taking five-eighteenths, and New South Wales, Victoria, Queensland and New Zealand one-ninth each. The board, it was arranged, should issue debentures for the payment of capital and interest, which would become a first mortgage on the cable property and its earnings. All the landing points are to be on British territory. The highest estimate of the cost is $10,000,000, and it is thought that the interest on this sum at 2½ per cent. (that is $250,000 a year), with the cost of repairs and the charge for a sinking fund for the replacement of the cable, might be easily covered by the probable earnings, even at a very low tariff as compared with the existing one.

A MOTOR LOCKING DEVICE.—A patent issued April 15 to W. B. Potter describes an arrangement whereby current cannot be turned on railway motors faster than is desired, but which has no effect on the backward movement of the handle. Two magnets control a circuit-breaker, the function of which is to lock the controller should a current pass higher in value than a predetermined amount. When the motors are in series relation, the two controlling magnets are in series; and when the motors are in parallel relation, the two magnets are in parallel—an arrangement on the controller producing these combinations. When the current passing rises above the predetermined value, the magnets open a shunt circuit, the result of which is to cause the controller cylinder to be locked until the current again falls to a safe value.

PACIFIC CABLE STATION.—The Pacific Commercial Cable Company, on the advice of Vice-President Geo. G. Ward, has selected the landing for the Pacific cable at a point about one-half mile south of the Cliff House. Seven miles of underground conduits will be required to carry the wires from the landing to the offices of the Commercial Cable Company, in San Francisco. The first section of the cable, extending to Honolulu, will be about 2,100 miles in length, and will probably be completed during November of this year. The cable is being manufactured in England at the rate of 20 miles per day, and will be laid by the cable-ship Silvertown. The ocean between San Francisco and the Hawaii is nearly three miles in depth. The Philippine section of the cable is expected to be completed early in 1904. Communication will also be opened with Japan and China. The United States steamer Nero is now engaged in surveying the route.

MAGNET RAZOR SHARPENER.—It is claimed in a patent granted April 15 to Oscar Newhouse, that a razor may be sharpened by merely placing the cutting edge in close proximity to the surface of a bar magnet. The inventor claims that the effect of the magnet is to draw into line the minute teeth or projections of the sharp edge, which normally are at different inclinations to the blade. He states that after tests lasting for months he has found that the beneficial effect is very marked, so much so that a razor can be used a great many times without stropping or honing, it being only necessary to place the razor in proper position relative to the magnet after shaving, and allow it to remain for a period of time until it is used again. He adds that the action of the magnet has practically the effect of stropping or resharpening, and that indeed a much truer and better cutting edge is thus obtained than can be secured by resharpening. As a bar magnet is used of about the length of the razor blade, it would be interesting to know what explanation the inventor might offer to account for the sharpening of the part of the blade which is over the middle of the magnet.

ELECTROLYTIC RECOVERY OF METALS.—The idea of electrolyzing an ammoniacal solution of nickel at the cathode of a divided cell, while employing as the anode a soluble metal other than nickel, preferably the crude nickel-copper matte, and as the anolyte, a solution of common salt forms the basis of a patent issued April 15th to Hans A. Frasch, of Hamilton, Canada. The apparatus used was patented about a year ago, and was illustrated and described at the time; it comprises a tank over the bottom of which the matte is distributed in comminuted form, and above it a layer of sand which serves as a diaphragm. Anode connection is made to the matte through rods of carbon projecting through the sides of the tank, while the cathode plates are suspended in the electrolyte above the sand. In the operation of the method the matte dissolves at the anode to form a mixed chloride solution which is withdrawn by a circulation system, and the disposal of which forms no part of the method as now disclosed; in practice, however, it has been subjected to a further electrolytic treatment for the separate precipitation of the contained metals. At the cathode nickel is said to separate out in reguline form, while the ammonia, simultaneously liberated, is available for the production of additional quantities of the nickel-ammonium salt, which constitutes the catholyte. There would be also, it would seem, an ever-increasing quantity of sodium-hydrate present at the cathode, but with reference to this and its disposal the patent specification is silent.

CONVERTER DAMPER.—In a patent granted April 15 to E. J. Berg, another form of damper is added to the already long list of these devices, having for one object the prevention of hunting of rotary converters. The specification states that where bridges of conducting material are used between the pole pieces of alternating current machines for the purpose of securing uniformity of rotation, a wasteful production of eddy currents results when the armature is provided with teeth, as is usually the case. These eddy currents are to be distinguished from the occasional or periodic currents which are set up in the bridges only when the machine hunts or when there is some other cause producing changes of armature reaction. Such eddy currents have no useful effect, and in some cases appreciably reduce the efficiency of the machine. To obviate this objection the bridge of conducting material between pole pieces is provided with slots parallel to the slots of the armature and of a width and pitch equal to the width and pitch of the slots in the armature. It is stated that by this construction the teeth in the armature as they pass across the face of a bridge, are so related as to produce in each of the bars of the bridge, e. m. f.'s of practically equal intensity and of the same direction. Owing, however, to the absence of conducting material between the bars, no short paths are provided for resulting currents. The slotting of the bridge, therefore, has the effect of reducing the eddy current loss, though not necessarily eliminating it wholly.

TESLA SPLIT-PHASE PATENTS.—The United States Circuit Court of Appeals of the Sixth Ohio District has rendered a decision sustaining the Tesla split-phase patents of Dec. 26, 1893. The decision was on an appeal from the lower circuit court in a suit for the infringement of the above patents as applied to a fan motor. The defence in both cases was that the invention of the above-mentioned patents had been the subject of an earlier patent issued to the same inventor Dec. 3, 1889, on an application filed May 20, 1889. The applications for the first mentioned patents were filed Dec. 8, 1888. The court held that the earlier patent relates to the construction of motors and circuits capable of utilizing the properties of self-induction and the resistance in the circuit, to effect the delivery of alternating currents such as to induce a sustained rotation of the motor. The claims are for special means or apparatus designed to be employed in carrying out the inventor's method of operating his motor as described in the later patents. Since the invention of the specific means covered by these claims, and the generic invention of the later patents were for independent inventions, and neither had been given to the public, the court held that it was competent for the inventor to take out a patent for each; and that in such case it is not material that the taking out of one patent was prior to that of the other. The subject matter of the later patents—that is, the invention covered by them—was not a component part of the former invention, but was an independent invention not necessary to the composition of the first, or included in it.

MULTIPLE CONDUCTOR SYSTEM.—A patent granted April 15 to A. D. Lunt describes a multiple conductor system in which, by the employment of two rotary converters, a large number of combinations of different e. m. f.'s may be obtained in connection with a two-wire direct-current supply circuit. The direct-current side of a converter is connected with the supply mains, and the alternating current leads are connected to two compensators or inductance coils, the middle point of these coils being connected by a common conductor, which is thereby maintained at a neutral potential with respect to the armature winding. The inductance coils are tapped at a number of points, which connect with the points of a switching device, so arranged as to co-operate with these taps to connect predetermined portions of the length of each inductance coil to a set of alternating current leads extending to corresponding collector rings on a second rotary converter. To the brushes on the direct-current side of the second converter are connected two working conductors. In the system as described, there are, therefore, five conductors, namely, the neutral above referred to; the two conductors from the second converter and two conductors connected with the direct current source of supply. By manipulating the switch above referred to, the two conductors connected with the brushes of the second converter may have impressed upon them different e. m. f.'s; in this manner the e. m. f. of these conductors may be varied so as to approach that of the neutral conductor, or to approach or even exceed the e. m. f. of the two conductors connected with the source of direct current supply. By this method and using two converters and two compensators or inductance coils, a large number of combinationsof different e. m. f.'s may be obtained between the five conductors constituting the multiple conductor system.

PUPIN COILS.—In a patent granted April 15 to Prof. Pupin and S. W. Balch, an ingenious mechanism is described for winding the type of annular induction coils used in connection with the Pupin system for reducing the attenuation and distortion of telephone currents. The coils—designated as "ballast" coils—have an annular core, usually of an interior diameter of about one-half the exterior diameter, and having a cross section either approximately circular or square with the corners rounded. On this core there are two windings, each extending nearly half way around the core, and the machine provides that each winding shall contain only the exact number of turns necessary.

MOTOR GENERATOR REGULATION.—A patent issued April 8 to T. W. Williams describes a means for regulating the direct-current circuit of a motor generator driven by a synchronous motor. In series with the field of the direct-current generator is a small direct-current dynamo direct-connected to a small induction motor. Across one of the two angularly displaced windings of the induction motor is shunted a circuit having in series an inductance and capacity, the values of which are such as to exactly neutralize each other when normal transmission exists upon the alternating-current line. Under these conditions the currents in the two windings are in phase and there is no rotation of the motor. Should the frequency of the alternating-current circuit be increased, the current in one of the induction motor coils will be displaced in phase from that of the other coil, and the motor will operate; an e. m. f. will then be generated in the small direct-current generator, which e. m. f will act in opposition to that of the field, thereby lowering the voltage. When the frequency falls below normal, the e. m. f. will act in conjunction with that in the field, thereby increasing the e. m. f. of the field. The patent also describes another method for accomplishing the same purpose, consisting of an arrangement like that of Baxter. for cutting in and out field resistance by means of a centrifugal governor attached to the motor-generator shaft.

LETTERS TO THE EDITORS.

Genesis of Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—I note in your issue of April 19 an article on the genesis of Hertzian telegraphy. I have been very much interested in reading carefully this summary of what has been actually achieved in the art, and welcome it as a well-judged effort to enlighten your readers on the status of a matter which has been greatly beclouded by conflicting claims. As I read your article, it is an effort to point out and summarize what has actually been done in perfecting an art available to the public as distinguished from a mass of experiments which have not led anywhere. If it were not for this belief in your purpose, which is obviously sincere and disinterested, I should be very much inclined to object to the omission of the names of such men as Dolbear and Tesla, both of whom, it seems to me, have presented claims in regard to this work, entitling them to a consideration. I think some of your readers beside myself, interested in this great new field of work, would welcome a little further elucidation of the distinction which you make in your article between performance and achievement.

BOSTON, MASS. C. L. RAINFORD.

[With regard to the objection and comment on our editorial of last week, we can only say that it was dictated in response to numerous inquiries which have reached us with regard to the validity of many of the statements made recently touching wireless telegraph work. The assertions in the daily newspapers, many of them attributed to well-known men, have been so extraordinary as to well deserve notice of some kind, and we felt that we could hardly let them pass without endeavoring to clear up the situation so far as it presents itself to our view. It was distinctly our aim, as the editorial shows for itself, to emphasize progress in the "creation of an art" as distinguished from a mass of speculation and experiment, in regard to which only failure has been noted, or with respect to which only the future can determine its worth. Our readers perhaps do not realize the amount of work that has been done in this new field, but we may note that the admirable work of Dr. Turpain on telegraphy with electric waves enumerates the names of no fewer than 135 separate inventors and experimenters, and we could ourselves supplement his list with at least a score more. In our necessarily brief review of the "art" we mentioned—with the single exception of Crookes—only those who had distinctly contributed to it, and whose principles and apparatus are actually embodied in the systems which one can use and pay for. Prof. Dolbear's interesting work has virtually been disposed of in the courts as to its value. We have great hopes as to the success that Mr. Tesla will attain in his efforts. But although his published speculations in this field go back to 1893-4, and although several patents have been issued to him, and although sundry newspapers have had a good deal to say on the subject of what he proposes to do, we do not know of any authentic wireless telegraphic work of Mr. Tesla, nor can we point to any article in our own or any other electrical journal showing that he has ever sent ten words ten yards through the air or earth. It is quite possible that such authentic records exist, but failing their publicity, it is obviously impossible to include them in the review of a commercial art such as was made in our editorial.—EDITORS OF ELECTRICAL WORLD AND ENGINEER.]

Production of Gutta Percha.

To the Editors of Electrical World and Engineer:

Sirs.—My attention has been called to what seems erroneous in Major J. Orton Kerbey's article in your paper of Feb. 3d. The article is very interesting and seems encouraging in some ways, but if you have correctly printed his figures, his estimate of the value of gutta, and of rubber trees seems calculated to boom a planting syndicate. The estimate of total exportation is nearly 50 per cent. higher than any statistics I have before seen, and the estimate that it has cost the life of 150,000,000 trees, which were cut and all of the gum taken from them to produce 300,000,000 pounds of gutta-percha, an average of two pounds per tree is probably proportionally correct. The Chinese, who have charge of this, know enough to take the tree at its prime, and if so how could it produce 10 times as much in each year for 20 years? I think that 2 pounds per year would be nearer the mark, and I doubt the possibility of getting anything like $10 worth per year from the best trees.

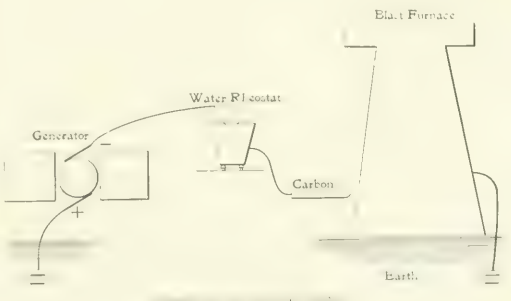
NEW YORK CITY. HY. A. REED.

Burning from Arc Rays.

To the Editors of the Electrical World and Engineer:

Sirs.—The many readers of your valuable paper may be interested in an account of a severe case of burning of the tissues of the skin from prolonged exposure to a powerful electric arc.

I have been experimenting with a process for burning out chilled iron at our blast furnaces here by means of the electric arc, using



the current from a Siemens-Halske 300-kw, machine-wound for 250 volts, connecting it up in the manner illustrated by the accompanying diagram. Using a carbon 2½ inches in diameter and 72 inches long, the current varied from 1,200 to 1,400 amperes. The voltage was kept from 180 to 200 volts, and the current penetrated

rough iron mixed with dirt and slag, making a 6-in. hole at the rate of about 30 inches per hour.

I protected my eyes by using triple glasses of the deepest orange tinge, but had several men laid up from trying to look at the arc with the naked eye. After the first trial, in which I personally manipulated the carbon and was exposed probably for an hour and a half, I found on rising the next day that the entire skin of my face, arms and neck—in fact all parts exposed to the light of the arc—were red and inflamed like a severe sunburn. The effect continued to grow worse, acting in a similar manner to a Roentgen-ray burn, and only yielded to treatment after a long time, when the flesh peeled off, leaving the face very tender and sore.

I think that a mask of material impervious to Roentgen rays would prove a protection, and I am having one made for future experiments. Very probably this account may prove of benefit to others who are experimenting along the same line, or in any manner in which they are exposed to a powerful arc light.

LORAIN, O. C. H. HINES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Self-Exciting Compound Alternator.—LATOUR.—An illustrated article, which is a continuation of his articles on self-exciting series and shunt alternators recently abstracted in the Digest. In a direct-current shunt-wound dynamo the brushes are at no load placed in a direction perpendicular to the direction of the poles. When the dynamo is loaded, the brushes must be moved in the direction of the movement, and there is a drop of voltage due to certain magnetic effects of the current in the armature. Fischer-Hinnen and Ryan have long since found a method for counteracting these effects by placing in notches on the pole-pieces of the machine, conductors through which the total armature current flows in such a sense that it counteracts the magnetic effects of the armature. This method will exactly fulfill the desired purpose, if the field of a shunt dyanmo has the annular form of a stator of a rotary field motor. The field would be provided with a winding indentical with that of the armature. He calls this method, known under the name of Ryan winding, the "rational" compounding of the shunt dynamo, in distinction from the ordinary method of compounding by placing thick wire coils on the field coils or on projecting poles. The rational compounding annihilates the flux due to the armature not only in magnitude but also in direction; a shunt dynamo with an annular field has an invariable position of the brushes and constant e. m. f. for varying load. This rational method of compounding is essentially applicable to the self-exciting shunt alternator (Digest, April 5). As shown

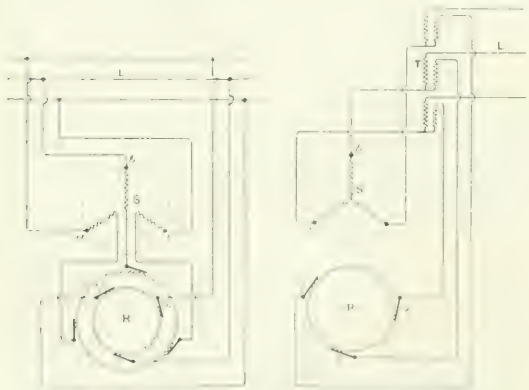


FIG. 1 AND 2.—SELF-EXCITING COMPOUND ALTERNATOR.

in Fig. 1, it is sufficient to add on the primary rotor of the alternator, a series winding with special collector to the shunt winding of excitation. The star connected windings of the stator are closed in delta fashion in this auxiliary rotor winding by means of three brushes properly placed. By means of this composite excitation the brushes can be fixed, the frequency remains constant and so does the e. m. f. induced in each phase. The alternator could even be loaded in two phases only and become a single-phase alternator; it would remain compound. This is, therefore, a general and safe method of compounding; but the two windings and the two collectors on the primary rotor, would complicate the alternator and increase the copper weight of the primary. Fortunately the superposition of the series excitation and the shunt excitation can be obtained in a very simple way in the same winding, by means of a compound transformer *T*, as shown in Fig. 2. He does not give the mathematical theory of this arrangement, but states that it enables the brushes to be fixed.—*L. Ind. Elec.*, March 25.

Direct-Current Motors with Variable Speed.—HUNDT.—An illustrated article. The regulation of the speed of a shunt motor by means of inserting resistance into the armature circuit, is not economical on account of the large energy losses; and the speed also depends much on the load with this kind of regulation. A better method—especially with reference to the efficiency—is the method of shunt regulation by which the current in the field magnet windings is changed with a resulting change of the field flux; but this method of regulation is limited by the consideration of sparkless running of the brushes. A much better method of regulation is claimed to consist in the change of the air gap between armature and poles; and it has the advantage that when the air gap is increased, and, therefore, the speed is increased, then the number of ampere turns required for the induction in the air gap is increased, which is of advantage for sparkless running. Besides this it then becomes possible to use this method together with shunt regulation. He gives diagrams of a two-pole, 6-hp, 500-volt motor, the speed of which can be varied between the limits of 350 and 1,500 revolutions with a nearly constant efficiency of 83 per cent. With a constant exciting current of 0.4 amp., the speed is varied between 350 and 1,000 revolutions by varying the air gap; the speed is further increased up to 1,500 revolutions by reducing the exciting current to 0.28 amp. The variation of the air gap is produced by means of a cam encircling the motor, a revolution of the handle by 70 degrees, corresponding to a displacement of each pole by 16 mm.—*Elek. Zeit*, March 20.

Armature Interference and Brush Position.—HOBART.—The conclusion of his article. He made some tests on a 10-pole, 90-revolution, 550-volt, 550-kw generator. Tests of the excitation regulation were made with the brushes set successively in the neutral position, and with 4, 8 an 12 segments forward lead. The increase in excitation from no load up to one-half full load, required to maintain 550 volts, was 16.5, 21.0, 25.0, 33.0 per cent. for 0, 4, 8, 12 segments lead of brushes, respectively. The machine was one constructed on the ordinary lines, and not for operation with backward lead. For that purpose lower reactance voltage and higher armature strength would be required. A number of excitation regulations curves are given in diagrams.—Lond. *Elec. Rev.*, March 21.

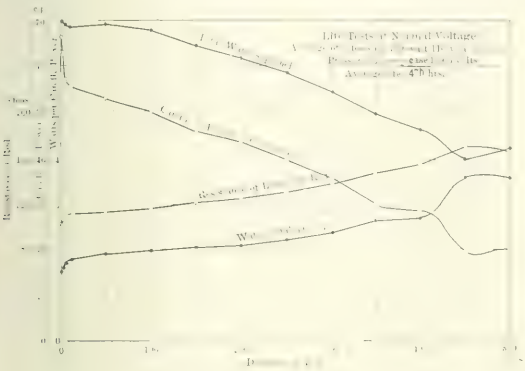
REFERENCE.

Direct-Current Armatures.—ARNOLD.—A long and profusely illustrated mathematical paper on the theory of equipotential connections in the armatures of direct-current machines. The article cannot well be abstracted, as it is very theoretical. He recommends the equipotential connections, especially for multipolar dynamos. They are used to a great extent by Lahmeyer & Co.—*Elek. Zeit.*, March 13, 20.

LIGHTS AND LIGHTING.

Nernst Lamp.—HULSE.—An illustrated abstract of a paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng., giving an account of tests of the "1902 model" of the Nernst lamp, fitted with 100-watt, 110-volt burners (evidently made by the Gen. Elec. Co. of Berlin). They were tested with continuous current only,

from a storage battery, the pressure being steady within half a volt. The behavior of the Nernst lamp is given in the adjoining diagram, the curves representing the average of three lamps. They broke down after 509, 490 and 425 hours. The end comes in all cases by the breakage of the platinum contact at the positive end of the rod. It is evident from the diagram that the lamps are done within about 40 hours, but that a very fair economy is retained almost up to that point. The natural life is very close to the "economic life"; therein it differs greatly from the ordinary incandescent lamp, which, if not removed, goes on running long after its efficiency has departed. As regards the Nernst lamp, the conclusion is that it will pay to get a new "burner" after 350 hours. Nernst lamps cannot be overrun, as the iron resistance protects the burner from excessive pressure; and there is no use to attempt it, as the watts per candle are very little less, while the life comes down to 200 hours, when the pressure is 116.5 volts for a 110-volt lamp. If underrun, the life is enormously prolonged. A lamp on 105.8 volts may last 1,200 hours, but it is then giving 9 candles instead of 50, and taking



CURVES OF NERNST LAMP.

6 watts per candle. At 600 hours it takes 3.48 watts per candle, or is hardly better than an ordinary incandescent lamp. He believes that under-running might pay where current is cheap; a peculiarity is that the current, and with it the candle-power, are liable to fluctuate. The financial side of the matter is summed up as follows: "The Nernst lamp will give on the average throughout a life of 400 hours at least .48 cp per watt expended, as against not more than .28 cp per watt in the case of good glow lamps. The cost of renewals would appear to be not more than three times as much for the Nernst as for the glow lamp, allowing for the shorter life of the former. In a 100-watt Nernst lamp the total energy used is over 35 units during economical life, and at 8 cents a unit this costs $2.80 or, say, not more than $3.75, when all expenditure due to renewal of the burner is taken into account. Thus the Nernst lamp will furnish 1,000-cp hours at a cost of 22 cents; while 30 cents is the approximate cost of the same amount of illumination from good glow lamps. In this comparative estimate the cost of renewals in each case has been included, the price per unit assumed to be 8 cents, while the glow lamp has been taken at an average of 3.6 watts per candle-power throughout a life of 700 hours." He anticipates a wide field of use for the lamp where fairly large candle-powers are required and power is not cheap.—Lond. *Elec. Times,* April 3; an illustrated reprint in full of the paper is begun in Lond. *Elec.,* April 4.

Mechanical Equivalent of Light.—Angstroem.—A short article describing some recent researches which he made. After referring briefly to the work of Thomson and of Tumlirz (see *Electrical World,* April 20, 1901), he describes his own experiments which were made with a Hefner amylacetate lamp. He gives the figure of Tumlirz for the total radiation in a meter candle as 0.0000148 gram calories per second, and the light effect of the radiation 2.4 per cent. of this; he claims, however, that the method of measuring the light effect, by absorption in water, is fundamentally wrong and must give values that are too high; an early determination by the author showed agreement with this figure for the total radiation. In his present method he determined the total radiation and then the ratio of the light radiation to the total. The former he determined by a compensation "spyrheliometer," which he constructed; he measured it at 500 and at 100 cm, and obtained concordant results; the mean value obtained for a distance of one meter was 0.00129 gram calories per minute, with a possible error of 3 per cent. (he does not state what solid angle this comprised). The light effect of the radiation was measured as follows: The beam was passed through a spectroscope, and by means of a screen the non-luminous rays were cut off while the luminous rays were passed through a cylindrical lens which united them, forming a white light again, and this was thrown on a photometer screen. A second and identical lamp was placed at the other end of the photometer bar and adjustment made for balancing the two. There were thus two radiations which were physiologically of equal strength and composition, one containing only the light rays, while the second contained the total rays. The photometer screen was then replaced by a bolometer or thermocouple, with which the energy of the two radiations and their ratio could be determined. A water screen between the cylindrical lens and the photometer screen cut off the heat rays coming from the screen. As a means of several determinations of the light effect he found the ratio of these to the total radiation to be .90 per cent (that is slightly less than 1 per cent.) with a possible error of .04 per cent. From these determinations he calculated the energy of this unit of light, namely the energy of the light rays on 1 sq. cm at a distance of 1 cm, and the unit of illumination, that is, the energy of the light rays on 1 sq. cm at a distance of 1 m; for the former he found 81,000 ergs per second, while for the illumination equal to one meter candle he obtained 8.1 ergs; the mechanical equivalent of the unit of illumination is, therefore, in round numbers, 8 ergs per second. For the acetylene flame he obtained as the ratio of the light to the total radiation, 5.5 per cent, which is only about one-half of that obtained by Stewart and Hoxie, whose measurements he considers faultly.—*Phys. Zeit.,* March 15.

Power.

REFERENCES.

Angular Speed of Prime Movers.—Cornu and Blondin.—A paper by Cornu describing an investigation of the variations of the angular speed of the fly-wheel of an Otto gas engine by the stroboscopic method. Another paper by Blondin, on the methods of measuring the angular deviation of a machine, and especially on the stroboscopic method of Sartori.—*Bull de la Soc. Int. des Elec.,* Jan.

Starting Gas Motors.—Schindler.—An article illustrated by numerous diagrams. When an electric generating station contains gas motors, a means must be provided for starting them. This is often done by running the dynamo as motor from another source of current, for instance a storage battery; he gives several diagrams of connections suitable for this purpose.—*Elek. Anz.,* March 30.

Traction.

Three-Phase High- Tension Railway.—Golwig.—A long, illustrated description of the first Austrian three-phase high tension railway, in regular satisfactory operation near Vienna. It is only a short line, which connects a government ordnance factory with a railway station. In that factory a 3,000-volt, 42 periods, three-phase current system has been in use; for that reason it was decided to operate the railway, which was formerly operated by steam, by three-phase current, and at a voltage of 3,000, in order to use this road at the same time as an experiment. The locomotive is provided with one 50-hp, 3,000-volt three-phase current induction motor. The currents of two phases are supplied to the locomotive through two trolley poles which take off the currents from two copper trolley wires; the rails are used for the third-phase. There are two sets, each of two trolley poles, on the top of the locomotive; each set corresponds to a certain direction in which the train runs; hence one set is always lowered. The 3,000-volt currents are supplied to the stator. The motor has a speed of 600 revolutions, and is geared to the axle, the ratio of the gearing being 1 to 6. The secondary or induced currents in the rotor have a maximum e. m. f. of 300 volts when the secondary circuit is open. The secondary currents are taken off from the motor by means of slip-rings and are led to a water rheostat, consisting of brass plates of different length suspended in an alkaline solution. When one wants to cut out resistance, the solution is pressed upwards by air pressure, in such a way that the inserted resistance is a minimum when the level of the solution has reached the highest position. At this moment when the motor reaches full speed, a floater which floats on the rheostat

liquid, closes the valve of the air pressure, with the result that a metallic short circuiting arrangement is set into operation which short-circuits the three poles of the rotor entirely. The air pressure is regulated by an air compressor driven by a 100-volt, 2-hp, three-phase motor. The current for this motor and for the lighting of the locomotives is obtained from a small transformer, the primary terminals of which are connected to the 3,000-volt supply circuit. Special safety devices are in use. The system, which has been installed by Ganz & Co., has been in regular service for a month, and works to entire satisfaction. A remarkable feature is the very smooth starting of the locomotive, due to the gradual adjustment of the water rheostat.—*Zeit f. Elek.*, March 16, 23.

Trolley Wire Hangers Used in Minneapolis.—An illustrated description of a type of trolley wire hanger for a bracket pole, designed to avoid the possibility of breakage of the insulator on the ordinary hanger, due to its rigid adjustment to the bracket. The hanger has two clips mounted on the end of a wooden stick about 1⅜ inches square. The stick is suspended from the bracket or span wire by a square link, which fits loosely over the stick, so that the latter can move back and forth through the link. This movement, however, is limited to 3 inches by spilt pins. This hanger is said to have given such satisfactory results on bracket center-pole construction that it is now used on both bracket and span-wire construction.—*St. R'y Jour.*, April 5, and *Int. Ed.*, April.

REFERENCES.

Electrolytic Destruction of Pipes by Return Currents of Tramways.—Ulbricht.—An illustrated mathematical discussion of this problem. He finds that it would be hazardous to try to avoid the electrolytic destruction of the pipes by connecting them with the return feeders. He seems to favor the insertion of insulating sections into the pipes.—*Elek. Zeit.*, March 13.

Tests on Power Consumption in Liverpool.—A table giving the power consumption in running two trains, one slowly and the other faster. The watt hours per ton mile were 110, in the first case, and 137 in the second case.—*St. R'y Jour.*, April 5, and *Int. Ed.*, April.

Multiple Unit Systems.—The first part of a well illustrated article. After some general remarks the Sprague system is described.—*L. Ind. Elec.*, March 10.

Statistics of Tramways in Great Britain and Ireland.—Tables are given showing the capitalization, length of track, cars, passengers carried, gross receipts and operating figures of the different tramways in the United Kingdom.—*St. R'y Jour.*, April 5, and *Int. Ed.*, April.

Installations. Systems and Appliances.

Central Station Statistics.—Ross.—An abstract of a paper read before the Electrical Society of Vienna. He first gave some statistical results of the development of the gas industry in 25 large cities in Germany and Austria, from 1890 to 1900. During this time the population increased by 24 per cent.; the production of gas by 49 per cent.; the percentage of gas consumed for lighting purposes was 93 in 1890, and 70 in 1900; the percentage of gas consumed for power purposes and heating was 7 in 1890 and 30 in 1900. Of the 25 cities included in his statistics, 21 have electric plants, 35 per cent. of the electrical energy being used for lighting, 24 per cent. for power purposes, and 41 per cent. for traction; the first cost of installation of those 21 stations per kilowatt capacity of station varies between $190 and $500, while the first cost of installation per kw-hour sold (during what time is not stated) varies between 17 and 80 cents; of these the number 17 refers to a Dresden station, which generates current for traction only. The system used does not seem to be of any marked influence, as far as his statistics go. In rationally-operated plants the cost of fuel is about one-half of the total true cost of operation; it is, for instance, 61.6 per cent. in Berlin, 56.8 in Frankfurt.—*Elek Zeit.*, March 13.

Wires, Wiring and Conduits.

A New Method of Wiring.—Peschel.—An illustrated paper read before the Electrotechnical Society of Berlin. The method described is to be used for a 2 x 220-volt three-wire system, the two outers are protected against contact with each other by earthed metallic tubes; the system of tubes is used as a bare middle wire. There is no danger in using a bare middle wire in houses. This is done in Stuttgart with good success. In the discussion which followed, Passavant confirmed the success of the use of a bare middle wire in Stuttgart, but remarked that in another city in northern Germany the bare middle wire deteriorated greatly; he thinks this is due to the difference of the composition of the mortar used. In Stuttgart gypsum is used mainly, while in the other city it was mortar containing lime; the corrosion is due to the electrolytic action of small currents caused by the difference of potential between the middle wire and earth.—*Elek. Zeit.*, March 6.

REFERENCES.

Pole Lines.—An article on "an extraordinary composite pole line system," giving a description of the pole line systems of the Standard Electrical Company and the Bay Counties Power Company in California, by which power will be transmitted from Colgate to San Francisco, 212 miles distant.—*Jour. of Elec.*, March.

Conduit System in Troy.—Schermerhorn.—An article on the installment of underground telephone and telegraph wires in Troy. The construction of the conduits is described.—*The Polytechnic*, March 28.

Electro-Physics and Magnetism

Temperature Variation of Electric Resistance.—Williams.—An abstract of a (Brit.) Phys. Soc. paper on "the temperature variation of the electrical resistances of pure metal and allied matters." He makes an attempt to correlate the periodic variations which the pure metals exhibit as regards their atomic weights, chemical valencies, melting points, and electric resistances. He puts this relation in the form of a mathematical formula which holds good for most of the metals, but not for all. The temperature resistance co-efficients of pure metals are not equal to 1.273, as might have been supposed; an expression for the change of resistance with temperature is deduced, which holds approximately for many metals.—Lond. *Elec.*, March 28.

Natural Earth Currents.—Jahr.—An account of the results of experiments in which he measured the natural electric currents in earth and water, at several places near Berlin. He placed two plates of cleaned metal as electrodes in the earth, at distances up to 1,000 meters, and connected them by a wire; he measured the current and the e. m. f. The greatest voltage and the greatest current were obtained, when the two plates were arranged in line with the magnetic meridian and at the angle of the magnetic inclination, so that the northern plate is deeper in the earth than the southern plate. An oxide film on metallic plates changes the current and the e. m. f. considerably.—*Elek. Zeit.*, March 6.

Magnetization of Steel at Liquid Air Temperatures.—Trowbridge.—An account of experiments in which he obtained the following results. Approximately the same magnetic moment is obtained whether a bar of tungsten steel or carbon steel is magnetized at normal or at liquid air temperature, other conditions being the same. The initial loss in the magnetic moment, due to change of temperature, of a bar of steel magnetized at 185° C., and then heated to 20° C., is much greater than when the bar is magnetized at 20° C., and then cooled to 185° C., a considerable loss occurring in both cases. There is a certain amount of unstable magnetization in a newly-made steel magnet, which tends to pass off at the first change of temperature in either direction from that at which magnetization takes place, much more of the unstable magnetization passing off by heating than by cooling.—*Phys. Rev.*, March.

REFERENCES.

Electrons.—O. Heaviside.—A mathematical "note on the size and inertia of electrons." He gives a concise review of the experimental work of various investigators; the results obtained are not in very close agreement. He points out that "it is a matter of fundamental philosophical and scientific importance to know whether an electron has mass independently of the electromagnetic inertia."—Lond. *Elec.*, April 4.

Light Absorption.—Wood.—An abstract of a (Brit.) Phys. Soc. paper describing experiments which have led him to believe that he has found a new type of light absorption which it may be possible to refer to the electric resonance of minute metallic particles for waves of light.—Lond. *Elec.*, March 28.

Terrestrial Magnetism.—The March number contains an article by Littlehales on forthcoming advances in the terrestrial magnetism of Antarctica; a paper in German, by Elster, on measurements of the electric potential drop on Spitzbergen and Juist; a report, by Bauer, on the magnetic observations made in North America during the total solar eclipse on May 17, 18, 1901; and a biographical sketch,

with portrait of Prof. Franz Exner.—*Terr. Magn. and Atm. Elec.*, April.

Electro-Chemistry and Batteries.

Artificial Graphite and Platinum Iridium for Anodes.—Foerster.—An account of an experimental investigation. While natural graphite is not suitable for anodes on account of the non-uniformity of the structure and of the high percentage of ash, he formerly obtained excellent results with artificial graphite electrodes made by a French company by the Girard and Street process, and has now also found that artificial graphite electrodes made by the Acheson process are at least of the same high quality. Acheson graphite is not less porous than the French graphite; the volume of the pores of the Acheson graphite was found to be 22.9 per cent. of the total; the percentage of ash is very low, namely 0.83 per cent. Artificial graphite electrodes of Acheson were first used as anodes in a neutral 20 per cent. solution of sodium chloride, in the presence of the chromate, at a temperature of 60 per cent.; the attack of the anodes is very small; in two experiments this attack corresponded to 6.3 and 8.4 per cent. of the total ampere-hours; the percentage of carbonic acid in the escaping gases was corresponding low. This high chemical viscosity is also maintained by a graphite anode at relatively high current densities for a longer time. He then used graphite anodes in sulphuric acid; as has been known before it is not well suited for this purpose as the graphite anode is destroyed by oxidation; this destruction is not smaller than for anodes of amorphous carbon. He then used the graphite anode in sodium hydroxide; at a temperature of 20° C. the graphite anode was found to be practically indestructible. For this purpose graphite anodes are very suitable and very much superior to amorphous carbon. From all his experiments he draws the following general conclusion: "The difference in the oxidation of the graphite and of amorphous carbon is not constant, but the higher the concentration of the hydroxyl ions of an electrolyte and the lower therefore the anode potential at which oxygen is formed at the anode, the more is graphite superior to even the best amorphous carbon. At such a high anodic potential, as occurs in dilute sulphuric acid, the difference has disappeared; nearly the total oxygen formed by the current is used up for oxidation of the carbon anode." As graphite anodes are not entirely indestructible in the electrolysis of alkaline chlorides, he believes that platinum or platinum iridium is the ideal anode material for this purpose; very thin plates of this material were formerly found to break easily. Heraeus has found that this was due to ruthenium contained in the material; when this is removed, alloys of very pure platinum and iridium are very tough and firm, and can be rolled into extremely thin sheets. Such sheets are used in Heraeus platinum electrodes, the mechanical construction of which has already been described in the Digest. (See also the abstract of Denso's article).—*Zeit. f. Elektrochemie,* March 6.

Platinum Iridium Electrodes.—Denso.—An account of long tests of platinum iridium electrodes, as made by Heraeus, concerning their chemical resistivity in the electrolysis of alkaline chlorides for a longer time. These electrodes have a thickness of 0.007 mm, and consist of a platinum iridium alloy containing 7.6 to 15 per cent. iridium. Their weight was 5 to 10 grams. In three cases a loss of 3 milligram was found; in two cases no loss whatever; in four cases losses of about 1 milligram or below. In the cases where the greatest loss was found, it was found to take place at the beginning of the electrolysis. There is no essential difference between electrodes containing 7.5 or 15 per cent. of iridium. The general conclusion of the article is, that platinum iridium electrodes rolled to thickness of 0.007 mm have sufficient chemical resistivity to be used in electrolysis of alkaline chlorides on an industrial scale.—*Zeit. f. Elektrochemie,* March 6.

Storage Battery with Constant Electrolyte.—An abstract of a patent of Michalowski. In cells of the oxygen lift type *K O H* or *Na O H* are used. He substitutes for this a solution of an alkali aluminate. When current flows through this solution it is practically not changed, if the active mass of both electrodes is insoluble in the electrolyte. The current produces *K O H*, and simultaneously acts as a reducing agent, while at the anode it forms alumina and acts as an oxidizer; when the electrodes are close together, the alumina combines at once again with the potassium hydroxide and forms the original potassium aluminate again. This electrolyte enables spongy zinc to be used as material for the negative electrode, as zinc oxide is insoluble in the aluminate solution. This makes the substitution of zinc for cadmium possible, which cannot be done in other electrolytes.—*Centralbl. f. Accum.*, April 1.

Bright Metallic Electro-Deposits.—A description of a method by Darmstaedter, for improvements in the methods of obtaining bright metallic coatings by electrolysis. Insoluble materials, such as sawdust, sand, pumice-stone, in a fine state of division, or the salt composing the electrolyte—which in this case must be saturated—are added to the bath and the contents are kept in continual movement by mechanical means. The effect of this finely divided insoluble matter, held in suspension in the liquid, is to loosen any bubbles of hydrogen clinging to the surface of the cathode, and also to act mechanically as a burnisher. The production of bright metallic deposits is said to be greatly aided by the use of this method; and it is hoped that it may be especially useful in zinc extraction. But this is doubtful, as it has not yet been proved that the formation of spongy zinc is due to hydrogen bubbles deposited together with the zinc.—*Zeit. f. Elektrochemie,* Feb. 13; abstracted in Lond. *Elec.*, April 4.

Units, Measurements and Instruments.

Modified Mance Test for Submarine Cables.—Stephens.—An illustrated article. The error due to earth current is eliminated in Mance's method by taking two tests to instrumental zero with different current strengths. This can be done by two methods: the first is to alter the battery power or the resistance in the battery circuit; the second is to alter the resistance in the ratio arms. Of these, the first necessitates the use of a milliammeter or galvanometer, unless testing with a battery of accumulators. The second gives a fairly simple formula for even ratios, but a complicated one for uneven ratios. There is, however, a third method of altering the current strength, namely, by the insertion of a resistance in the line circuit when taking the second test, keeping the ratio arms, battery power and resistance in the battery circuit, the same for each test. By making this resistance equal in value to that of the ratio arms, a simple and handy formula can be evolved for either even or uneven ratios, thereby ensuring greater accuracy. The formulas show that this method can be readily used as a check upon the method for the "reversals" test, or inversely. The article is discussed in an editorial note; the modified test is said to have two points in its favor: the greater simplicity of the formula and the slightly easier method of manipulation. But the first of these depends upon the added resistance being equal to the bridge ratio arm adjacent to it, and the necessity for making it so tends to limit the useful range of the current ratio. Moreover there is no provision in this class of test, when batteries with small plates are used, for ascertaining with sufficient precision that the currents used have the required values—which is important. For this reason the milliammeter method in which the actual currents are measured, and a formula used based upon precise knowledge of the true ratio, is undoubtedly the best, and is not superseding all other tests in which the calculation of the ratio is an indispensable preliminary.—Lond. *Elec.*, March 28.

REFERENCE.

Resistance of Rail Joints.—A summary, illustrated by diagrams, of various methods for measuring the resistance of rail joints.—*Elek. Anz.*, March 16.

Telegraphy, Telephony and Signals.

London.—The conclusion of the long illustrated article on the City Exchange of the Post Office Telephone Department; also some editorial notes. The central or common battery system is used. The exchange, when it has its full complement of 14,000 subscribers, will be one of the largest built on this or any other system. "The Post Office was well advised to adopt the most modern and efficient method of working, and if there is room for criticism, it is rather that they have adopted a system with all its details en bloc from America without attempting to modify it to suit the particular circumstances in London. . . . The peculiar circumstances would almost seem to have justified an experiment with a divided multiple board system, on lines similar to that in operation at St. Louis, for it would appear possible to combine it with the central battery and luminous switchboard system of working." While it is agreed that for long-distance working the solid back transmitter is hard to improve upon, there is is no doubt that for ordinary exchange working a hand microphone is by far the most convenient to the subscriber. "There is at least one pattern of this instrument which will produce excellent speaking on central battery exchanges, and it is remarkable that American telephone engineers are still partial to the fixed transmitter"—Lond. *Elec.*, April 11

of wireless telegraphy between Europe and America. Marconi says he can transmit at present 22 words per minute. Even when wireless telegrams would be sent continually day and night, only a small part of the present traffic could be accomplished by wireless telegraphy. The erection of several stations with a system of tuning is limited. If Marconi wants to compete in earnest with cable companies, he must send at least 6 to 10 telegrams at the same time. But as Braun has said, in this way wireless telegraphy would commit suicide, as it would prevent wireless telegraphy from ship to ship and from land to ship. Instead of trying to break the record in overcoming large distances, inventors should improve the reliability of the apparatus and cheapen them so that small vessels could be provided with them.—*Elek. Zeit.*, March 13.

New Books.

Les Decharges Electriques Dans les Gaz. By J. J. Thomson, D. Sc., F. R. S. Translated from the English, with notes by Louis Barbillon. Preface by Ch.-Ed. Guillaume. Paris: Gauthier-Villars. Price, 5 francs.

This little volume is a well done translation of Professor Thomson's English brouchure of similar title, with some valuable explanatory notes by the translator, and an interesting historical preface by M. Guillaume, giving an excellent idea of the growth of the subject. Professor Thomson's researches are well-known to our readers and are admirably presented here, as in the parent English book. They are peculiarly interesting to the French physicist by reason of the very important part which the latter have played in the development of the knowledge of what one may term *occult radiations*. The subject is one peculiarly neglected by our own countrymen, and which is deserving of close study.

Professor Thomson's work may logically be divided itno two parts —the phenomena of discharges in gas and the physical bearing of these phenomena on the constitution of matter. The former is of great practical interest, but the latter are of so profound physical importance as to demand the best energies of a host of investigators. The knowledge of occult radiations is steadily increasing, but it is still discursive, still incapable of leading to exact conclusions. More than anything else the matter needs the most persistent attacks from the chemical side. The corpuscular hypothesis, in the absence of exact or even proximate knowledge of the nature of the so-called "electrical" stresses and strains, must remain in a most dubious and unsatisfactory state until it is confirmed or confuted by researches along other than electrical lines. Moreover, chemical aid is needed in furnishing further means of investigation. In all the work on occult radiations photography takes a very important part. It is almost inconceivable from the standpoint of chemical theory that salts of silver should be the only ones really effective for such purposes. It is more than likely that for the radiations with which modern science is dealing other sensitive media can be found, capable of giving an immensely greater working range than ordinary photographic plates. Here is a line of investigation that should be pursued industriously in order to extend the available means of investigation in the lines which Professor Thomson has so brilliantly inaugurated.

Elementary Electricity and Magnetism and Their Applications. By Professors Dugald C. and John Price Jackson. New York: The Macmillan Company, 1902. Pages VII, 482. Price, $1.40.

Static electricity is here briefly and tersely discussed in the opening chapters covering some 27 pages, and the topics of relative potential and potential difference are illustrated and explained in an exceptionally clear manner. A singular innovation is the employment of hydraulic analogies in explanation of the frictional electrical machine. In a modified way this was done by Lodge some years since, but in general literature these analogies have been reserved for the explanation of batteries and dynamo machinery. There are in reality no hydraulic phenomena of relatively enormous head and exceptionally minute flow which may adequately serve as an illustration of the Holtz machine, for example. This false analogy has led the authors into a discussion and definition of the ampere and the volt under the heading of static electricity, which is not only unusual, but questionable. Following this is a pleasantly written chapter on batteries in which the barest elementary principles of the voltaic cell are clearly discussed. The use, however, of the term "electrochemical depolarizer" in the action of the Daniell cell is scarcely in good form; for properly speaking such polarization is not due to the ionization of the copper; the depolarization is rather by "deposition" and is as truly a chemical phenomenon as the instances included by them under the name of "chemical depolarization." A meager description of electrolysis follows, and this is succeeded by a barely satisfactory description of the nature and properties of magnetism.

Again, in the discussion of the properties of electrical circuits, the authors are too insistent upon hydraulic analogies. To attempt an explanation of divided and series-multiple circuits by a resort to similarly connected systems of water pipes, results only in added confusion. Electrical resistance and the resistance to the flow of water in pipes have practically nothing in common, except that each causes a loss of potential. Effective hydraulic resistance is a phenomenon of skin friction and inertia. It is only fair to mention that the authors partly realize this inconsistency (page 85). Also in the discussion of the energy units of the electrical circuit hydraulic analogies can be employed correctly only when the two classes of quantities are equated through their heating effects. The failure of the authors in these respects leaves the readers with not one, but with two sets of facts for explanation.

A section embracing some fifty pages is given to galvanometry and the methods and apparatus for the measurement of electrical resistance, current, potential and power. Here the selection of apparatus is good, and the illustrations for the most part are diagrammatic and show the essential parts and their arrangement. This is a pronounced excellence and calls for strong commendation. The explanatory text is clear and even a casual reader must gain a proper material conception of arrangement and parts. But the authors go no further; and while the section is successful as mere description, it is practically valueless for imparting knowledge. As this is indicative of the character of the entire book; the work is the mere description shell of the subject, and it lacks the vital principle of the matter which it includes, and this vital spirit can only be imparted through mathematical or quantitative discussion. Without it the best written text book is nothing but a more or less entertaining catalogue of the skill of man and the wonders of Nature.

About one-half of the book is devoted to topics of elementary matters of electrical engineering proper; and as these subjects are treated in a precisely similar manner and spirit, their discussion need not be enlarged upon, though evidently the book was undertaken more especially for such discussion and description.

The proofreading appears to have been done with unusual care, but yet a most singular oversight has evidently occurred, where on page 336 the classical message of the Morse experiment is made to read, "What hath God wrought?" and the punctuation reduces the reverent exclamation to the ridiculous.

One is led immediately to compare this book with the generally popular "Lessons of Electricity and Magnetism," by S. P. Thompson. Though the present book follows this largely in method and arrangement, it fails of the very qualities which have made the other a textbook; it has the form, but has omitted the vital elements, which are the quantitative expressions of the relation of the facts in the phenomena discussed. For a text on elementary electricity and magnetism the work is inferior to the small book by Perkins; and in the discussion of the principles of mechanically generated electricity, both the student and the non-technical reader would find the series of books by Houston and Kennelly clearer and more helpful. The present authors are evidently indebted to the latter for many suggestions.

The paper, letter press and the binding are excellent, and many of the illustrations are exceptionally fine. The authors have in almost all cases shown apparatus so as to bring out its essentials of construction and operation. Great pains have been taken in the illustrations and diagrams to develop the circuits, connections and essential relations, and the result is one of unusual merit. A few illustrations are, however poor, such as Fig. 315, an ocean cable operating set; and several are badly out of proportion to the page, or, as on page 404, to other illustrations. It is a piece of affectation, too, to name an illustration as Fig. 324 is called: "Weber Photometer standing on Reading Room Table in Library of University of Wisconsin." One fails entirely to grasp the part that such a location plays as a function in the measurement of the intensity of illumination. Then, too, it would have been advisable that some skilled person should have made the drawing for illustrations of such kind as are shown

in Fig. 283, and thus avoid the kindergarten portrayal of a man, which is so out of place in a book generally well illustrated.

A book of this character is apt to owe its inspiration to the publisher rather than an intellectual impulse for expression of what has been developed in the thought and experience of the writer. However, the problem of writing such a book is commendable, and the present authors, while showing neither originality nor distinction, have performed their task in an interesting manner. The book is not properly an elementary work on electricity and magnetism, but it is more correctly a work descriptive of their numerous industrial applications, and it is a mistake to entitle it a textbook designed for high and manual training schools. As a book for reference it might prove useful, but as a text one is led to wonder what information, not to speak of the idea, a student would gain from such discursive lines as are to be found making up the topics of the transformer (page 261), the rotary converter (page 270), or the ballistic galvanometer (page 208), which have been selected at randon as illustrations.

A School Chemistry. By John Waddell, B. A. (Dal. Coll.), B. Sc. (Lond.), Ph. D. (Heidelberg), D. Sc. (Edin.), New York: The Macmillan Company. 278 pages, 90 illustrations. Price, 90 cents.

This is a capital school text-book of inorganic chemistry. It is very clearly written and systematically compiled. The experiments are arranged for laboratory repetition and a list of chemicals and apparatus for the experimental work precedes the text. Commencing with the elementary chemistry of water, the air, acids, alkalis, common salt, and the metals are successively considered, in a total of twenty chapters. The symbolic notation in the chemical equations shows at a glance the physical states of the substances considered, whether solid, liquid or gaseous. The metric system is, in most praiseworthy style, employed throughout, and with neither apology nor introductory tables, it being taken for granted apparently that the reader knows the meaning of such terms as litres, and grammes. To an elementary student the book will be most welcome, either for class-work, or home study if he carries on the experiments described.

BOOKS RECEIVED.

Magnetismo E Elettricita. Hoepli Manual, 1902. By F. Grassi. Milan: Ulrico Hoepli. 608 pages, 280 illustrations.

Transactions of Pacific Coast Electric Transmission Association. Fifth Annual Convention, 1901. San Francisco, Calif. 209 pages, illustrated.

The Beacon Biographies. Samuel F. B. Morse. By John Trowbridge. Boston: Small, Maynard & Company. 134 pages, frontispiece portrait. Price, 75 cents.

Marshall's Logarithmic Tables of the Measures of Length. By Thos. W. Marshall. New York: The Engineering News Publishing Company. 106 pages. Price, $2.00.

Elektrotechnik in Einzel-Darstellungen. By Dr. G. Benischke. Heft I, Die Schutzvorrichtungen Der Starkstromtechnik Gegen Atmospharische Entladungen. Heft 2, Der Parallelbetrieb von Wechselstrommaschinen. Braunschweig: Friedr, Vieweg & Son. 42 pages, 43 illustrations; 55 pages, 43 illustrations. Price, each, 1.6 marks.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 18-21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Engine Builders' Association of the United States. Next meeting, Pittsburg, Pa., May 22 and 23, 1902. (See Current News and Notes.)

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27.

Ohio Telephone Association. Next meeting June, 1902.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Pennsylvania State Street Railway Association. Next meeting, October, 1902.

New Electric Tonneaus.

In illustrating herewith the new Waverley electric tonneau of the International Motor Car Company, of Toledo, O., we may note incidentally that, judging by the experience of this company, the mooted question as to the proper side for the operator to occupy is answered by building both styles of automobile. For instance, Waverley electric carriages are built controlling from the left side, while Toledo steam carriages are operated from the right, and the gasoline touring cars have been built with the levers on either side to meet the requirement of different customers. The general preference is, however, to locate the operator's seat on the right, thus the control levers are actuated by the right hand, which certainly seems preferable for a gasoline driven car.



FIG. 1.—ELECTRIC TONNEAU.



FIG. 2.—[illegible]

The new electric tonneau built by the Waverley department at Indianapolis has attracted general attention, although it was first exhibited only a month and a half ago at Chicago. The elastic

running gear, now the standard Waverley equipment, makes a great improvement in electric carriages. The novel spring suspension, doing away with the necessity for reaches, etc., relieves the vibration, and at the same time compensates for road inequalities, thus materially increasing the life of the battery and the comfort of the passengers. These improvements are opening up a new field for the automobile, adapting it to country requirements and minimizing prejudices against electric carriages for business purposes.

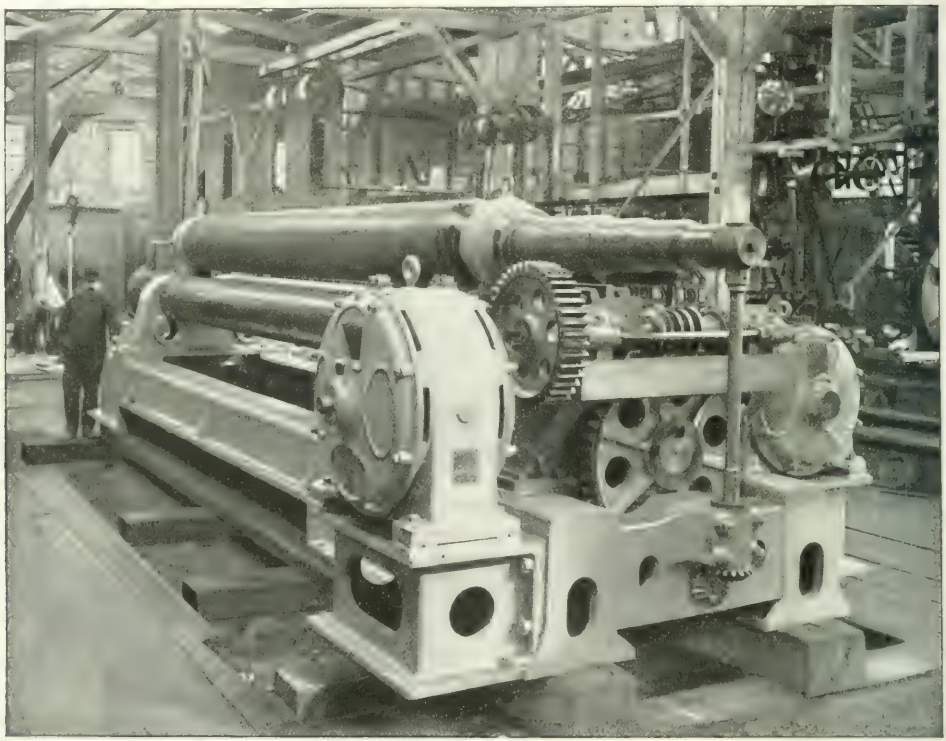
Motor-Driven Plate Bending Rolls.

The continental Iron Works, of Brooklyn, recently installed a new machine, designed for bending heavy plates for boiler shells. The rolls measure 16½ ft. between housings; they are three in number and are composed of steel forged at the Bethlehem Works; the top roll, which is the idler, weighs 10 tons, and measures 21 in. in diameter, while the two lower rolls, which are operated, are each 17 in. in diameter. This machine was built by the Continental Iron Works for their own shops, to meet requirements of a special character in unusually heavy work, and it was designed by Mr. Warren E. Hill, the vice-president and general manager of the company. In order to insure a sufficient factor of safety the plans were drawn upon a basis providing a capacity for bending a 16-foot plate 1½ in. in thickness intoa cylinder 5 ft in diameter. In actual practice the machine bends 7⁄8-inch plates, and it performs its work with the utmost smoothness and regularity.

In general appearance these rolls resemble others intended for similar work, but they embody several distinctive features. Although these rolls are very heavy and powerful, they are very compact, and the gearing is so designed and arranged as to occupy comparatively little space. This feature is clearly illustrated in the accompanying cut, which is an end view, showing the frame on which the motors are mounted, and the arrangement of the driving-gear. The motors are Westinghouse variable-speed, and develop 40 and 50 hp respectively. The larger motor drives the two lower rolls, and the smaller motor is employed to raise and lower the top roll. Both of these movements are regulated to a nicety. The motors take polyphase current at 220 volts, 60 cycles, and are controlled by an operator stationed on a platform above the motors and gearings. By means of levers the operator regulates the speed and direction of motion of the motors, and the raisinig and lowering of the rolls, so that a wide range of speeds may be had. A feature of this equipment that commands itself especially is that very little attention is required by these motors; they are easily regulated and respond quickly to the varying demands for power as well as the variation in speed, and the regulating mechanism is positive in action. The speed is greatly reduced by the gearing; that of the driving mechanism being brought down to 840 revolutions per minute, at the motor to 3⅜ turns to the rolls.

The top roll has an extension, shown in the cut, which plays an important part in the operation of the tool, by exerting a counter-strain when plates are being adjusted or unshipped. A vertical rod is connected to this tail-piece, and is employed to adjust the position of the upper roll and to lift it when unshipping.

It has already been mentioned that these rolls were intended for heavy work, and that they were designed to bend a plate in cylindrical form. It is necessary in such work to have a convenient arrangement for unshipping the shell, after it has been bent, from the end farthest from the gearing and driving mechanism, and to meet this requirement it was deemed advisable to design a special end-bearing for the upper roll that could be easily removed, at the same time providing for keeping the free end of the roll entirely clear of contact with the lower rolls. This special end-bearing was designed to be readily unlocked and slipped off the roll, and then lowered until it is entirely out of the way, thus permitting the cylinder to be withdrawn; when the shell has been removed this end piece is raised to its former position, slipped back over the end of the roll, locked in place, and the machine is ready for operation again. The lowering and raising of the end piece is controlled by hydraulic power. While this end piece is withdrawn, the upper roll usually sags a couple of inches, but the counter strain is provided for at the other end, and the form of the free end is such that the supporting piece can be readily slipped back without any difficulty whatever.



Motor Driven Bending Rolls.

Automatic Telegraph Repeater.

The instrument illustrated herewith has just been brought out by Messrs. J. H. Bunnell & Co., New York. Its principal advantages, as pointed out by the firm, are that it requires no extra local batteries, no extra local magnets, and is as simple in its construction and operation as the time-honored button repeater.

The two illustrations show the transmitter in perspective, and a diagram of the circuits. The principle involved in the new apparatus is that an armature on being drawn towards a magnet becomes itself magnetic by induction, and that the closer it approaches the

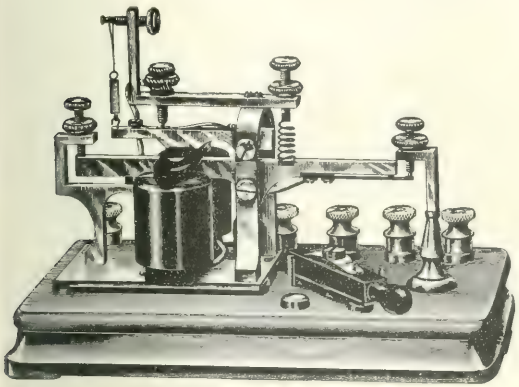


FIG. 1.—AUTOMATIC TELEGRAPH REPEATER.

magnet cores the stronger the magnetization becomes. It will be noticed that besides the ordinary armature with spring contact, the transmitter is provided with a second armature mounted above the regular one. The lever of this second or superposed armature also carries a spring contact so arranged that it makes contact with its back stop the instant that the armature begins its upward movement, and does not break contact therefrom until its downward stroke is almost completed; so that with two circuits connected to the contacts of the transmitter armatures one of them is always closed before the other is opened, by the movements of the armatures.

The second armature is adjusted so that on closing the local circuit of the transmitter the regular armature must reach its front stop before the magnetization induced in it is sufficiently powerful to draw the second armature from its back stop. The object of this

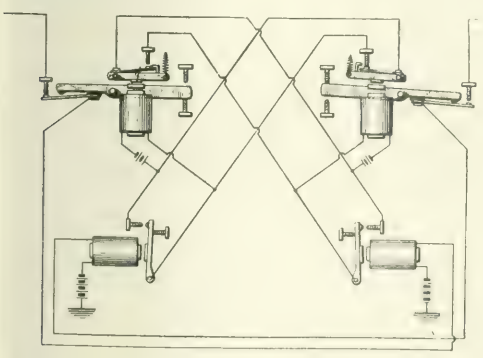
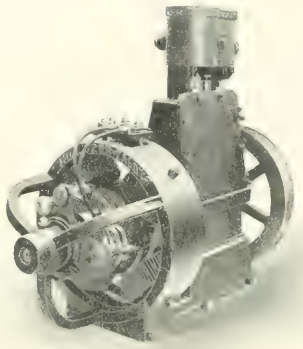


FIG. 2.—DIAGRAM OF REPEATER CIRCUITS.

is to allow a sufficient margin of time between the closing of the main circuit by the downward movement of the first armature, and the opening of the shunt circuit by the subsequent downward movement of the second armature, to permit a relay in the main circuit to close its local contacts before the shunt circuit around them is opened. This margin of time between the closing of the main circuit and the opening of the shunt circuit enables these repeaters to work well even on leaky lines, under which conditions the relays usually act sluggishly.

New Marine Generating Set.

The marine generating set shown in the accompanying cut has been designed to meet a demand for a small and compact outfit, extreme lightness being especially desired. Aluminum is used very extensively in the construction in portions where great strength is not required. The dynamo is of the multipolar type, the ring and



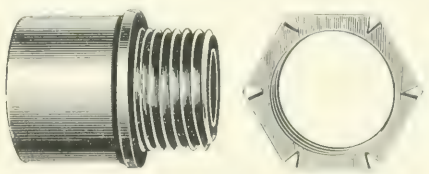
MARINE GENERATING SET.

poles being of a grade of wrought iron selected on account of its high permeability. It is reduced in weight to as great an extent as can be done without interfering with the efficient performance of the machine.

The armature is of the drum-wound type and well laminated. It is mounted upon the engine shaft. The brush holders are of the radial type, such as are used on all Holtzer-Cabot motors. Self-oiling and self-aligning bearings are used. In the cut the dynamo is shown in direct connection with a Herreshoff engine of a recent type, which has been brought out especially for this class of work. It is of the slide valve type, with throttling governor. It will be observed that all working parts are completely enclosed and run in oil. This set weighs about 298 lbs., and will supply 30 16-cp lamps or 5 watts sets is being manufactured by the Holtzer-Cabot Electric Company, of Boston, Mass.

Outlet Bushing.

The outlet bushing, illustrated herewith, and manufactured by S. B. Condit, Jr., & Co., Boston, Mass., is said to thoroughly ground a conduit system to the outlet boxes. It has the advantage that the



OUTLET BUSHING.

conduit need not necessarily be cut to the exact length where it enters a box, as the bushing fulfills the part of a coupling. On the lock-nut the points or projections are sharp, and where the nut is screwed up tight the lock washer cuts itself into the box and makes a reliable electrical connection, at the same time springing enough to lock itself firmly in place.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a good supply of money and a moderate business, the closing rates being 4 per cent. for 30 to 60 days, 4¼ per cent. for 90 days and 4½ per cent. for four, five and six months. On the stock market there was greater activity in speculation. One of the prominent incidents of the week was the reduction of the quarterly dividend on Amalgamated Copper from 1 per cent. to ½ per cent., although this result has been generally expected, and in spite of very unfavorable talk about the stock and the copper situation generally, the covering of shorts caused a moderate improvement in the price. United States Steel stocks were quiet and firm pending the carrying out of the bond issue and the retirement of a portion of the preferred. One of the sensational features of the week was the advance in International Power stock from 107 to 163 on the declaration of a quarterly dividend of 2½ per cent. In the traction list there was nothing specially noteworthy—Brooklyn Rapid Transit closing with a net gain of 1½ points, and Manhattan Street Railway with a net loss of ½ point. The former stock closed at 66, which is within ½ point of the highest figure of the week, and Metropolitan at 153. There was a reaction in General Electric, resulting in a net loss of 8 points, the closing price being 323. This stock fluctuated between 322¾, the lowest point, and 330. the sales aggregating 4,300 shares. Westinghouse Electric also closed weaker, with a net loss of 4 points on the common and ½ point on the preferred, the closing prices being 222 and 226, respectively. Western Union showed some activity and made a net gain of 3⅜ points, closing at 94¼. American Telephone and Telegraph dropped off 5 points, closing at 179, and American Telegraph and Cable gained 4 points, the closing price being 92. There was a slump of 12¼ points in Commercial Cable, which kept at 152 throughout the week, closing at that figure. Following are the closing quotations of April 22:

NEW YORK.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
American Tel. & Cable..	88¼	93	General Electric.....	329	326
American Tel. & Tel....	180	—	General Carriage.....	—	—
American Dist. Tel.....	—	—	Hudson River Tel.....	—	—
Brooklyn Rapid Transit..	64½	66¼	Metropolitan Street Ry..	153	153
Commercial Cable.....	152	—	N. E. Elec. Veh. Trans..	1	—
Electric Boat.....	28¾	30	N. Y. Elec. Veh. Trans..	12	—
Electric Boat pfd.....	4	10	N. Y. & N. J. Tel.....	—	—
Electric Vehicle.....	15	15½	Tel. & Tel. Co. America..	4½	4
Electric Vehicle pfd.....	5¾	6¾	Western Union.....	93	94¼
Electric Vehicle pfd.....	7¼	6¾	West. E. & M. Co.....	—	—
			West. E. & M. Co. pfd..	—	—

BOSTON.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
Amer. Tel. & Tel. Co....	178	178	Mass. Electric Cos.....	2¾	2¾
Cumberland Telephone...	125	—	New England Tel. Co....	149	144
Edison Elec. Illum.....	253	—	Westinghouse Elec.....	111½	—
Lou. Gas & Elec. pfd....	—	—	Westinghouse Elec. pfd..	112½	—
Union Gas Co.....	—	—			

PHILADELPHIA.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
Am. Gas & Elec.....	44¼	47	Phil. Traction.....	98	98
Lehigh Valley Transit..	7¾	8¼	Philadelphia Electric....	5¼	5½
Lehigh Valley Transit pfd.	27½	—	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	7⅜	7⅜	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
Central Union Gas.....	30	30	Northwest Elec. Co.....	50	50
Chicago Edison.....	151	168	Northwest Elec. Co. pfd.	—	—
Commonwealth Edison....	104	104½	Union Traction.....	20⅞	21¾
Chicago Gas Co.....	24	24	Union Traction pfd.....	—	—
Chicago Gas Co. pfd....	24⅛	24⅛			

*Asked.

THE SAFETY INSULATED WIRE AND CABLE COMPANY was incorporated at Trenton, N. J., last week, with a capital stock of $1,500,000. There will remain in the treasury of the company $500,000 of the capital stock and $1,000,000 of an authorized $1,250,000 first mortgage 6 per cent. sinking fund gold bonds will be issued, the balance being also left in the treasury, not to be used except to acquire additional property or working capital. A submarine cable for a foreign government is now in course of construction by the company, and other foreign contracts are pending. Other details have already been given in these columns.

LOUISVILLE GAS AND ELECTRIC.—It is understood preliminary arrangements have been completed for the amalgamation of the Louisville Gas Company, the Kentucky Heating Company and the Citizens Electric Company. The Louisville Electric Company goes with the Louisville Gas, which owns all the stock. The city owns $1,000,000 of stock in the gas company. When satisfactory terms are arranged for the sale of this stock, a definite arrangement will be made. It is understood the Louisville City Railway will ultimately be taken into the combination, and the majority control of the stock is already being secured.

CONSOLIDATION AT ATLANTA.—The Mercantile Trust Company of Baltimore, Md., and New York and Boston capitalists have completed the merger of all the street railways and light and power interests of Atlanta, Ga., by the organization of the Georgia Railway & Electric Company, which will have the following capitalization: First mortgage 5 per cent bonds, $7,850,000; preferred stock, $1,800,000; common stock, $5,000,000. The company will absorb the

INTERNATIONAL POWER.—Directors of the International Power Company declared a quarterly dividend of 2½ per cent. on the common stock in addition to the 6 per cent. on preferred. Mr. J. H. Hoadley authorizes the statement that his purchase of the New England Vehicle Company ,of Boston, and of the charter of the General Carriage Company, has been for his own personal account, and not for account of the International Power Company.

CONSOLIDATED STORAGE BATTERY.—The Consolidated Storage Battery Company has been chartered, at Trenton, N. J., with a capital of $10,000,000, to deal in electric motors of all kinds, pneumatic, chemical and mechanical machinery, and the like. Incorporators are: Frank H. Lord and George T. Holmes, New York, and Oscar L. Gubelman, Jersey City. Two-thirds stock and not two-thirds stockholders will control company's affairs.

NEW ENGLAND TELEPHONE AND TELEGRAPH.—A special meeting of stockholders of the New England Telephone and Telegraph Company is called for May 5, at the New York office of the company, to act upon the recommendation of the directors that the capital stock of the company be increased from $20,000,000 to $30,000,000. The annual meeting of the company will be held upon the same date to elect directors.

WASHINGTON CAPITAL TRACTION COMPANY.—The annual report of the Capital Traction Company, of Washington, D. C., shows: Gross earnings, $1,231,683; operating expenses, $560,171; net earnings, $671,512; total net, $691,189; surplus after charges and dividend (4 per cent), $99,389.

Commercial Intelligence.

THE WEEK IN TRADE.—According to trade advices received by the mercantile agencies, the weather conditions have not been altogether favorable for prices of staples on the exchanges, and distribution of merchandise through regular channels. Continued low temperatures and dry weather have lessened confidence in the winter wheat yield, and prices of provisions of all kinds have been advanced, ostensibly and apparently because of reduced receipts. The basic features in general industry, however, remain favorable. Earlier reports of good trade and large distribution of merchandise are confirmed by the gross earnings of railways for the first week in April, showing an increase of 6.5 per cent., over the same period a year ago, and less than 15 of the roads reporting, note decreases. February net returns are equally favorable, showing an increase in gross receipts of 4.8 per cent., and in net, 2.4 over last year, and this in a month notable for bad weather and interruption of traffic. In iron and steel, production and consumption are apparently at a maximum. Pig iron is quoted at $1.00 per ton higher than a week ago, the demand for scrap material improving as a consequence. The carriage of Lake ore this year is estimated at 22,000,000 tons, the transportation of 75 per cent. of which has already been arranged for. Hardware and builders' materials are in very active demand. The number of business failures during the week, as reported by Bradstreet's, was 193, as against 182 the week previous, and 212 the same week last year. Trading under the standard copper contract was inaugurated at the New York Metal Exchange during the week, and it resulted in a comparatively active business in copper, the trade showing an interest in the movement. The closing quotations were 12⅛c. for Lake; 11⅞c. for electrolytic and 11¾c. for casting stock.

WIRE FOR THE ST. LOUIS FAIR.—The American Steel and Wire Company has secured the contract to furnish waterproof and rubber covered wire for the electric distribution at the World's Fair.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended April 4: Antwerp—1 pkg. machinery, $35; 10 pkgs. material, $1,006. Amsterdam—1 pkg. machinery, $108. Argentine Republic—3 pkgs. material, $146. Bremen—5 pkgs. material, $1,030; 5 pkgs. machinery, $220. British Possessions in Africa—1 pkg. material, $46. Bilboa—1 pkg. machinery, $50. British East Indies—26 pkgs. material, $2,433. Brazil—159 pkgs. material, $5,671; 18 pkgs. machinery, $930. British West Indies—32 pkgs. material, $661. Cuba—50 pkgs. material, $913. Central America—18 pkgs. material, $730. Dundee—1 pkg. material, $22. Ecuador—2 pkgs. material, $36. Genoa—29 pkgs. machinery, $2,500; 1 pkg. material, $16. Glasgow—1 pkg. machinery, $77. Hamburg—45 pkgs. material, $750. Havre—29 pkgs. material, $13,858; 20 pkgs. machinery, $295. Konigsberg—1 pkg. material, $50. Liverpool—305 pkgs. machinery, $30,993; 16 pkgs. material, $606. London—299 pkgs. machinery, $14,875; 192 pkgs. material, $7,802. Mexico—22 pkgs. material, $420; 26 pkgs. machinery, $10,000. Manchester—2 pkgs. machinery, $528. Newfoundland—60 pkgs. material, $505. Newcastle—10 pkgs. machinery, $764. Nova Scotia—3 pkgs. machinery, $130. Peru—37 pkgs. material, $2,072. Rotterdam—3 pkgs. material, $160; 5 pkgs. machinery, $1,436. Southampton—2 pkgs. material, $1,312; 1 pkg. machinery, $25. Santo Domingo—7 pkgs. material, $162. U. S. Colombia—10 pkgs. material, $150; 4 pkgs. machinery, $325. Venezuela—205 pkgs. material, $1,203.

RAILWAY EQUIPMENT.—E. P. Roberts & Co., Cleveland, O., consulting engineers for the Muncie, Hartford & Ft. Wayne Railway Co., have recently closed all contracts for the entire equipment of the line as follows: OO trolley wire, National Conduit & Cable Company; brackets and insulators, Ohio Brass Works; aluminum transmitters and feed wire, Pittsburg Reduction Company; high-tension insulators, Fred M. Locke; ties, Union City Lumber Company; poles, The Valentine-Clark Company; bridges, Indiana Bridge Company; interurban cars, John Stephenson Company; trucks, Peckham Mfg. Company. The power equipment will consist of two 500-kw. three-phase, 25-cycle revolving field, general electric generators, direct-connected to cross-compound condensing Cooper- Corliss engines. There are three Stirling 300-hp boilers, equipped with Jones underfeed stokers; space being provided for another set of similar capacity. The rotaries in the station are to be two 400-kw. and two 200-kw. capacity are to be used in substations. Four 50-hp G. E. motors will be used on the cars.

LIGHTING PLANT FOR A SULTAN'S PALACE.—The palace of the Sultan of Linga, who rules over a small island of the same name in the Malay Archipelago, is to be installed with a complete electric lighting plant of Yankee manufacture. The Crocker-Wheeler Company, of Ampere, N. J., has secured an order for a 30-kw generator for direct-connection to a 40-hp high-speed automatic engine, built by the Ames Iron Works, of Oswego, N. Y. There will also be an Ames horizontal tubular boiler of the same horse-power. The Ames people have also been alloted an order for a 100-hp high-speed engine, which is to be direct-connected to a 50-kw. motor, manufactured by the Sprague Electric Company, of 527 West Thirty-fourth street, New York City. This outfit is intended to serve as equipment for an electric light plant at Singapore, Straits Settlements. These contracts were placed in the United States through the instrumentality of the American electrical engineering and contracting firm of Bagnall & Hilles, from that concern's Singapore offices.

CROCKER-WHEELER CRANE EQUIPMENTS.—This company reports a very satisfactory increase in the demand for its crane motors and equipments. Several new sizes have lately been added to this line, which is now in such shape as to supply machines of from 1 to 60 hp. The various types are designed to fulfill the several crane applications which call for trolley, bridge and hoist work. The following recent shipments from the works at Ampere, N. J., show the variety of outputs that have been ordered in the past few weeks: 4 motors, 50-hp output; 11 motors, 30-hp output; 25 motors, 15-hp output; 4 motors, 10-hp output; 11 motors, 7½-hp output; 14 motors, 2½-hp output.

ELECTRICAL DEVELOPMENT IN PARAGUAY.—Mr. Wm. Mill Butler, general manager of the Paraguay Development Company, Witherspoon Building Philadelphia, has secured a 25-year franchise from the government of Paraguay, for an electric-lighting plant in the city of Asuncion, which has a population of over 50,000. The city has also contracted for 200 city arcs, at $172 per year for ten years, with an agreement to renew the contract at the expiration of that time, the payments being guaranteed by the National Government. It is also the intention to lay down an electric railway with rotary converter substations. Mr. Butler is vice-consul of Paraguay, in Philadelphia.

NEW GENERAL ELECTRIC LYNN FACTORY.—It is stated that the General Electric Company has purchased 100,000 feet of land adjoining its present Lynn factory, on which it will erect a structure three stories in height, 80 x 250 feet. Motors and instruments will be manufactured in the new building and will give employment to 2,000 additional hands. The company at present employs 5,000 hands, and this increase will give it a working force of 7,000. Additions will also be made to the river works and the company will have a weekly payroll of $50,000. The company owns more than 35 acres of land in Lynn, besides many large factories.

PITTSBURG TRANSFORMERS FOR HOLLAND.—The Pittsburg Transformer Company, of Pittsburg, Pa., is shipping its specialties to Kopmann & Co., of Amsterdam, Holland, through its managers for foreign sales, the Goudey-McLean Company, of 88 Maiden Lane, New York City. The Pittsburg concern has opened a New York office under the management of A. H. Mustard, formerly of the Wagner Electric Manufacturing Company. The new office, which is located in the Beard Building, 120 Liberty Street, will take care of business in New York, Northern New Jersey and the Northeastern States.

FOR MANILA POLICE TELEPHONE AND FIRE ALARM SYSTEMS.—Several orders for various material, which is intended to be utilized in the construction of the police telephone and fire "alarum" systems in Manila, have recently been placed, through the A. J. Coffee Company, of San Francisco. The John A. Roeblings' Sons Company, of Trenton, N. J., have been allotted an order for 75 miles of insulated wire, and the American Electrical Works, of Providence, R. I., are to supply about the same quantity. A fair-sized order for insulators has been placed with the Western Electric Company.

BALL ENGINE ORDERS IN CHICAGO.—An electric power plant will be installed in the building on the southeast corner Washington and Peoria Streets, Chicago. The Ball Engine Company, Erie, Pa., furnishes the engine, which will be direct-connected to a Western Electric generator. The Ball Engine Company is also installing two horizontal cross-compound direct-connected engines, aggregating 1,200-hp, in the power plant of the Chicago University.

ST. LOUIS EXPOSITION CONDUITS.—Mr. Henry Rustin, the chief mechanical and electrical engineer, informs us that the Exposition has just closed a contract for six hundred thousand lineal feet of three-inch pump log conduit with the St. Louis Refrigerator and Wooden Cutter Co., of St. Louis. This will be used to supplement the 4,200 feet of wooden subway in the distribution of electric wires about the Exposition grounds.

ALUMINUM WIRE.—The Pittsburg Reduction Company has recently sold 21 miles of aluminum wire to the Lewiston & Auburn Electric Company, for the transmission of electric power. It has also sold 20 miles of aluminum wire to the Boston & Maine R. R., for use at Concord, N. H. Electric light companies are now using it, the Boston Electric Light Company having recently ordered 100,000 pounds.

CALIFORNIA EQUIPMENT.—The Stanley Electric Manufacturing Company has closed contracts with the Valley Counties Power Company for two 2,000-kw generators, for the new generating station which will be built to utilize the water rights acquired from the Cherokee Mining Company in Butte County, Calif. Step-up and step-down transformers are included in the contract.

STORAGE BATTERIES FOR YOUNGSTOWN, OHIO.—The Cleveland office of the Electric Storage Battery Company of Philadelphia has secured a contract from the Mahoning Valley Railway Company, of Youngstown, for a storage battery equipment, consisting of 264 cells, regulating booster and switchboard, to be installed in the Youngstown power house of the company.

SHAWINIGAN FALLS PLANT.—The Dayton, O., Globe Iron Works have just received an order from the Royal Aluminum Company at Shawinigan Falls, Quebec, for a third turbine unit, to be installed at the Falls. It will consist of one pair of 59½-in. wheels, guaranteed to develop 3,200 hp under 125 feet head, making their total installation 9,600 hp.

FIRE ALARMS IN GERMANY.—U. S. Consul-General F. H. Mason, of Berlin, reports that the Gamewell Fire-Alarm Telegraph Company, which exhibited at the firemen's exposition in Berlin last summer, is putting in a full equipment for the city of Hanover, and will probably establish a branch office in Berlin.

BUCKEYE ENGINE WORKS.—The charter of the Buckeye Engine Works, Salem, Ohio, has been changed from Ohio to New Jersey and the capital stock increased to provide for extensive improvements. The personnel of the company remains as heretofore.

BIDS FOR EQUIPMENT.—The Union Block Company, Anderson, Ind., is advertising for bids on boilers, engines, pumps, dynamos, two freight and three passenger elevators, for its new block. Contracts will be closed in about two weeks.

ST. LOUIS FAIR SUBWAYS.—The contract for the construction of the electric subway at the World's Fair, St. Louis, has been awarded to the Barwick Construction Company.

ELECTRICALLY-DRIVEN TOOLS FOR INDIAN RAILWAY SHOPS.—The Lillvoah Carriage and Wagon Shops, of the East India Railway, are to be equipped with a number of American wood-working machines, to be driven by motors. The contract was secured by the J. A. Fay & Egan Company, of Cincinnati, through its London representatives, the Projectile Company, Limited. The Cincinnati Milling Machine Company, of Cincinnati, has also secured an order for its specialties, to be installed in Indian railroad shops. This order was obtained through Charles Churchill & Company, Limited, whose manager-director, Mr. Charles Churchill, it will be recalled, is now in the United States. The introduction of American labor-saving devices into British India is of comparatively recent date. Manufacturers seeking to secure such contracts, not only for tools but for electrical machinery, should be represented in London, as most of the big Indian Railways have their head offices in the British metropolis. Regarding the interview with Mr. Charles Churchill, which appeared in the last issue of the ELECTRICAL WORLD AND ENGINEER, it would be well to state that the contracts for various American machine tools, etc., for the British Government Arsenal, at Woolwich, and the London Mint, were placed with his firm as a British firm. The company is registered under the English Limited Liability Acts, and has been chosen as contractors, among others, of machinery, etc., to the British Government. Though the concern handles American machinery exclusively, the British authorities have no official knowledge of the fact. The Churchill catalogue is on file in the various purchasing departments of the government, and the order is sent for such and such a machine at such and such a price. No American machinery firm is on the British Government purchasing lists, and it would be impossible, apparently, for an American concern to get a direct order from the English authorities. This rule applies to all foreign firms. Should the Government officials find that a machine of foreign make be essential for a particular purpose, arrangements are usually made with an English concern to acquire the English patents and manufacture the specialty in Great Britain, as in the case of the Belleville boiler, with which several of the British men-of-war are equipped. The boiler is a French invention, and arrangements were made by the Admiralty for its manufacture by a London marine engineering firm.

PLANT FOR SOUTH AFRICA.—Contracts have been awarded recently for a complete electric power plant including the buildings and a refrigeration plant for the De Beers Explosives Works, Cape Town, Africa. The generating units consist of three 300-kw Parsons steam turbines, with their electric generators and exciters. There are over 1,000 horse-power of three-phase induction motors throughout the works. The boilers are equipped with mechanical stokers, coal and ash handling apparatus, fuel economizers, and induced draft. They furnish superheated steam to the turbines, which are operated condensing with surface condensers and cooling towers. The engine room also contains a large air compressor, steam-driven, and a smaller one motor-driven. The refrigeration plant contains two 50-ton compressors, motor-driven. The power house building is of brick with steel roof trusses. C. A. Parsons & Co., Newcastle, England., furnishes the turbines and generators. Sherriff, Swingley & Co., New York and Johannesburg, furnish the boilers and mechanical draft, traveling crane, etc. Fraser & Chalmers, of London, furnish the coal and ash handling plant, air compressors and building. C. A. McDonald, Chicago and Cape Town, furnish the refrigeration plant. Ledward & Co., London, furnish the condensing plant. The contract cost of the entire plant is £43,776. Mr. H. H. Humphrey, of St. Louis, Mo., prepared the plans and specifications.

SALES OF IDEAL ENGINES.—A. L. Ide & Son, Springfield, Ill., report the following recent sales of Ideal engines: One 14—22 x 16 d. c., Northern Pacific R. R., Livingston, Mont.; two 24 x 20 belted, Ashland Iron & Steel Co., Ashland, Wis.; one 15 x 14 d. c., Mich. Soldiers' Home, Grand Rapids; one 18 x 16 d. c., Manhattan Light, Heat & Power Co., St. Paul; two 12—18 x 14 d. c., W. H. Schott, Chicago, for the Illinois Hospital for Incurable Insane; two 15—22 x 16 d. c., A., T. & S. F. R. R., Albuquerque, N. M.; one 11—18 x 14 belted, Champion Copper Co., Painesdale, Mich.; one 17 x 16 belted, City of Harrisburg, Ill.; one 14 x 14 belted, City of Altamont, Ill.; one 13 x 12 belted, Arnold Electric Power Station Co., Chicago, for C. & A. R. R., Springfield; one 11—18 x 14 d. c., Bingham Consolidated M. & S. Co., Salt Lake; one 14 x 14 d. c., The Ogemaw Co., Bay City, Mich.; three 14 x 14 d. c., Hecla Coal & Cement Co., Bay City, Mich.; one 15 x 14 belted, University of Wisconsin, Madison, Wis.; one 13—22 x 16 d. c., Michigan Alkali Co., Wyandotte, Mich.; two 13 x 12 belted, Allis-Chalmers Co., Chicago, for Mexico; one 10—16 x 12 belted, Leland Stanford University, Palo Alto, Cal.; two 16 x 16 belted, C., B. & Q. R. R. Shops, Deadwood.

ALLIS ENGINE SALES.—Following are some of the principal sales of the Allis-Chalmers Company during the month of March: Virginia Electrical Railway and Development Company, Richmond, Va., one 20-in. and 40-in. x 42-in. steeple compound direct-coupled Reynolds-Corliss engine; The Milwaukee Electric Light and Railway Company, Milwaukee, two 28-in. and 60-in. x 48-in. vertical cross-compound direct-coupled Reynolds-Corliss engines; Fond Du Lac Street Railway and Light Company, Fond du Lac, Wis., 20-in. and 40-in. x 48-in. 1890 frame cross-compound direct-coupled Reynolds-Corliss engine; Twin City Rapid Transit Company, Minneapolis, Minn., 46-in. and 94-in. x 60-in. vertical cross-compound direct-coupled Reynolds-Corliss engine (second order); Richmond Passenger and Power Company, Richmond, Va., one 18-in. and 36-in. x 48-in. 1890 frame cross-compound direct-coupled Reynolds-Corliss engine.

LIGHTING PLANT FOR COREAN MINE.—The Oriental Consolidated Mining Company, incorporated some time ago under the laws of the State of West Virginia, with a capital of $5,000,000, for the purpose of acquiring a number of gold mining properties in Corea, has just placed a contract through the Allis-Chalmers Company for an outfit to light an 80-stamp mill, which the latter concern is furnishing. The equipment will be supplied by the General Electric Company. Though it will only be a 200-light plant, it is expected that the other mills of the Orient Company, which aggregate 160 stamps, will be electrically lighted in the near future. The order just placed will mark the first introduction of an electric lighting equipment into Corea for the mining regions. The New York offices of the company are at 38 Broad Street.

GOULD STORAGE BATTERY PLANTS.—Among the recent contracts secured by the Gould Storage Battery Company, is a "floating" battery of 245 cells for the Uniontown station of the Pittsburg, McKeesport and Connellsville Railway Company, Pittsburg, Pa. This installation is of 171 kilowatts, and is to be used as a floating battery on the present direct-current equipment. It will ultimately be increased by the addition of 60 cells, with a plate capacity of 212 kilowatts and a tank capacity of 318 kilowatts, when it will be used in connection with rotary transformer station. This is the first plant of seven to be installed by the Pittsburg, McKeesport & Connellsville Railway Company, which will eventually use alternating current with rotary transformer substations.

ELECTRICAL DEVELOPMENT IN NICARAGUA.—The Safety Electric Manufacturing Company, of New Orleans, La., has secured a contract for installing a 600-hp, 2,300-volt, two-phase plant at Managua, Nicaragua, which in addition to lighting will supply power for the waterworks company and other motors to be installed. Bullock alternators and Skinner engines will be used. It is expected that within a short time the Tipitapa Falls, 20 miles distant from Managua, will be developed for lighting and power purposes. About 2,500 horse-power will be generated and transmitted at 15,000 volts to Granada, Masaya and Managua. The latter plant is to be finished within a year and a half, when the steam plant about to be installed in Managua will be removed to Leon, 50 miles distant.

THE SPRAGUE ELECTRIC COMPANY has found it necessary to move its Boston office into new and larger quarters to enable it to handle the increasing business in the New England district, and has taken a suite of offices in the Weld Building, 176 Federal Street, which is one of the most desirable office buildings in Boston. The location is extremely good and is convenient to the South Terminal Station, which is almost opposite. The tenants include many well-known firms and engineers. Mr. H. C. Farnsworth continues as manager of the Boston office. He has recently added to his staff Mr. George D. Simmons, who was formerly superintendent of the Hawks Electric Company.

ST. LOUIS WORLD'S FAIR.—The contract for the erection of the Machinery Building has been awarded to Smith & Eastman, for $496,957. This building will house the big electric light and power plant to be put in by the Westinghouse Electric and Manufacturing Company, consisting of four 2,000-kw units, together with a switchboard 107 feet long, from which electrical energy will be distributed to all parts of the grounds. The distribution wires from the board will reach the subway through two towers, each 8½ x 18 feet. These towers will be fire-proof. The building will be traversed by an electric crane.

FOR ELECTRIC AMBULANCES.—Several large gifts have just been made to the Mount Sinai Hospital, in New York City, to establish and maintain an electric ambulance service. Murry Guggenheim, one of the directors, has given the largest sum, which is $20,000. The income of this is the nucleus of a permanent fund to be used when the hospital moves into its new building, at 100th and 101st Streets, between Fifth and Madison Avenues. Henry R. Ickelheimer has given an ambulance to the hospital, and Jefferson Seligman has signified his intention to pay for the maintenance of an ambulance as long as the hospital remains in its old quarters.

GENERAL ELECTRIC CO. has had a large but brief strike at its Schenectady works, arising from a dispute in the polishing department, as to piece-work.

General News.

THE TELEPHONE.

LOS ANGELES, CALIF.—The Home Telephone Company, which is installing an independent system in Los Angeles, is pushing the work of laying conduits in Seventh Street in advance of the paving of that street. The new central office will be equipped with a multiple switchboard.

SAN FRANCISCO, CALIF.—In the recently-issued directory of the Sunset Telephone & Telegraph Company, the following announcement is made: "All the stations of the Pacific States and Sunset Telephone & Telegraph Companies are being equipped as rapidly as possible with Morse telegraph instruments in order that a regular telegraph business may be done over the lines of the companies. Telegrams should be accepted by all agents and employees whenever offered for transmission. If there are no telegraph instruments at your office, the message will be telephoned to the nearest office equipped with instruments, so that it may be forwarded by telegraph from there to its destination. All employees are particularly cautioned against refusing to accept any such messages." It is stated that this action was taken in order that the Sunset Company may enjoy certain privileges that, as a telephone company, it cannot now exercise. Under the "Post Roads Act" telegraph companies are privileged to erect poles and wires on all post roads. This act, it has been ruled recently, does not apply to telephone companies, because at the time of its enactment telephones were not in existence. As a consequence the telephone companies are now preparing to do a crtain amount of legitimate telegraph business in order to enjoy similar privileges to those of the telegraph companies. It is explained that a war with the telegraph companies it not at all intended.

FLORENCE, COLO.—The Colorado Telephone Company is arranging to supply the farmers here and at Canon City with a telephone service.

STREATOR, ILL.—The Benson Telephone Company has been incorporated with a capital stock of $10,000.

BRIMFIELD, ILL.—The telephone company recently increased its capital from $500 to $5,000 and is now wiring the whole township.

DUQUOIN, ILL.—The Illinois Central Railroad telephone system is completed between this city and Centralia. Three districts of the Illinois Central are now equipped with the telephone, Carbondale to St. Louis, Kankakee to Chicago and Duquoin to Centralia. Work commenced last week extending the system from this city to Carbondale, and only a few days will be necessary to complete the work. The district between Centralia and Kankakee will next be equipped with the telephone.

CARROLLTON, IND.—The Carrollton Telephone Company, capital $900, has been incorporated.

RISING SUN, IND.—The Ohio River Telephone Company, capital stock $45,000, has been incorporated. Directors, S. Beymer, G. I. Moore, Wm. M. Green and others.

ANGOLA, IND.—The Steuben County Electric Telephone Company installed 100 new telephones during March. The company now has out about 800 instruments in use.

INDIANAPOLIS, IND.—Tillman Mitchell has brought a suit against the Central Union Telephone Company to recover $10,000 damages for injuries received by being run down by the city fire chief's buggy in an alley where, he alleges, the company has unlawfully erected a pole which obstructed his view and was thereby the direct cause of his injury.

INDIANAPOLIS, IND.—The following telephone companies were incorporated recently: The Porter & Horning Ridge Telephone Company, of Hancock County, capital $3,000; president, John W. Jackson, Greenfield; the Leamon's Corner Telephone Company, of Hancock County, capital $1,400; directors, Robert and John Scott and O. H. Wyant; the Worthington Telephone Company, capital stock $10,000; directors, W. B. Squire, W. B. Harrah and others, and the Yellow Jacket Citizens' Co-operative Telephone, of Poplar Ridge, with a capital stock of $2,500. The directors are Alexander McHargue, Charles Searing, S. A. Moore, J. M. Thompson and others.

WYOMING, IA.—The Wyoming Telephone Company was granted a franchise at the city election.

BOONE, IA.—The Hawkeye Telephone Company is constructing a line connecting Berkeley with this city.

GUTHRIE CENTER, IA.—The Guthrie Center & Northwestern Telephone Company has increased its capital stock from $2,000 to $5,000.

TULSA, I. T.—The Indian Telephone and Construction Company, capital $25,000, has been incorporated by R. H. Hall, James N. Hall, and Luther D. Marr.

ALTOONA, KAN.—The Altoona Co-operative Telephone Company, capital $21,000, has been incorporated.

TOPEKA, KAN.—The Kansas & Missouri Telephone Company will erect an exchange building on West Sixth Avenue, between Jackson and Van Buren Streets.

BANGOR, ME.—The New England Telephone & Telegraph Company of this city will construct a new exchange soon.

HOLTON, MICH.—The Rural Telephone Company has been established at Holton with a capital stock of $3,500.

JACKSON, MICH.—The Trist Telephone Company has been incorporated with $2,000 capital. Andrew Reithmiller is president. It operates lines from Trist to Munith.

DETROIT, MICH.—It is probable that the People's Telephone Company of this city, which has already expended $400,000 in the construction of the plant and had to quit, will be sold to local interests.

DETROIT, MICH.—Business men are dissatisfied with the increased rates announced by the Michigan Telephone Company on private switchboards and extension telephones. Many of them have been ordered out.

HUDSON, MICH.—The Rollin Telephone Company, which covers nine townships and gives connection with all the towns in this vicinity, is extending its line to Jackson, Hillsdale, Jonesville and Coldwater. It has over 300 telephones in use.

DETROIT, MICH.—The Detroit Co-operative Telephone Company has called for an assessment of 20 per cent on stock subscriptions. Secretary Williams states that if assessments come in liberally work on the construction of the plant will be started at once. If they do not, the project will be given up.

PONTIAC, MICH.—At the annual meeting of the Oakland County Telephone Company the following officers were elected: Peter I. Meloy, president; J. A. Graley, vice-president; A. G. Griggs, secretary; F. G. Jacobs, treasurer; C. S. Bartlett, James H. Lynch, Walter Knox, A. Parker, J. W. Martin and the officers, directors.

ST. PAUL, MINN.—The Twin City Telephone Company will extend its service to the lake region and will commence building at once.

BRAINERD, MINN.—The City Council has granted the Mille Sacs Telephone Company permission to extend its lines into this city.

MINNEAPOLIS, MINN.—The Minnesota Telephone Company, of Minneapolis, has been incorporated with a capital stock of $50,000. The incorporators are A. B. Kerlin, Park Rapids; W. N. Carroll, C. P. Wainmann and D. F. Morgan, Minneapolis.

MINNEAPOLIS, MINN.—The Minnetonka Telephone Company, of Minneapolis, has been incorporated with a capital stock of $50,000. The incorporators are A. B. Kerlin, Park Rapids; W. N. Carroll, C. P. Wainman and D. F. Morgan, Minneapolis.

ST. PAUL, MINN.—The Twin City Telephone Company has been granted a franchise by the Council of Excelsior for a telephone system. It is the intention of the company to build the line direct to Excelsior from Minneapolis and operate an exchange there.

ELLIOT, MO.—The Dix Telephone Company, capital stock $3,000, has been incorporated.

ST. LOUIS, MO.—The contract for erecting a new building for the Kinloch Telephone Company in this city has been awarded to E. A. Slininger, subject to certain modifications that may be made in the selection of materials. The price is about $37,000.

UNION, NEB.—Plans are being made by the Independent Telephone Company for an exchange.

SOUTH OMAHA, NEB.—The Excelsior Electric Signal & Manufacturing Company is installing an independent telephone system in South Omaha under a franchise granted some years ago. Douglas County, in which South Omaha, Omaha and several other good towns are located, makes this the most desirable territory in the West that has not been entered by independent companies. This move insures connections with some twenty counties in the southeastern part of Nebraska, thus enabling stock growers in that section to have communication with the stock yards and packing house industry at South Omaha. This is the first move toward opening Omaha and Council Bluffs, Ia., up to independent systems.

TRENTON, N. J.—The Wyoming Valley Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are E. E. Pryor, Charles F. Wagner and Philip Kingsland. The headquarters of the company are at Camden.

ITHACA, N. Y.—The New York and Pennsylvania Telephone & Telegraph Company will construct a direct line between Hornellsville and Bath.

BUFFALO, N. Y.—The Local Telephone Company of Buffalo has been incorporated, to operate between villages in Western New York. Capital, $10,000.

UTICA, N. Y.—The contract for the construction of the entire system of the Utica Home Telephone Company has been let to the Central Construction Company of Wauseon, Ohio.

DUNKIRK, N. Y.—An exchange will be built here by the new telephone company which filed a certificate of incorporation with a capital stock of $10,000. Edw. Randall and F. S. Porter, of Buffalo, are among the directors.

ROCHESTER, N. Y.—The Consolidated Telephone Company is at work on long-distance lines connecting Rochester, Syracuse and intermediate towns. The company has an exclusive contract with the Rochester Telephone Company for long-distance connections.

NEWBERN, N. C.—The Telephone Company of America has been granted a franchise here.

MARSHALL, N. C.—The Madison Telephone Company is constructing a line from Marshall to Alexander via Weaverville.

CHARLOTTE, N. C.—The building of a new telephone line from Whiteville to Wilmington, N. C., is being agitated. J. D. Maultsby, of the former town, can possibly give information.

STRATFORD, N. C.—It is proposed to organize a telephone company to construct a line from Sparta to Scottville. This will give a direct line from Sparta to Jefferson via Healing Springs.

LEIPSIC, OHIO.—The Mutual Telephone Company has commenced stringing wires into Leipsic and will install an exchange here.

YOUNGSTOWN, OHIO.—The Beaver Telephone Company is purchasing the required equipment, and work on the exchange will start in the near future.

MARION, OHIO.—The Marion County Telephone Company is receiving large supplies of overhead equipment and will commence stringing wires at once.

BRYAN, OHIO.—The Bryan Telephone Company is making arrangements to extend its system throughout the surrounding farming district this spring. The company is rushed with new business.

PAINESVILLE, OHIO.—The Council has granted an ordinance to the Painesville Telephone Company, permitting it to fix its rates at $12 and $20 for residences and $24 and $36 for business offices.

HICKSVILLE, OHIO.—The Hicksville Telephone Company will issue more stock and devote the new capital to building a line from here to Maysville. It expects to secure a large list of farm telephones along the route between these two points.

CINCINNATI, OHIO.—The Fitzsimmons Telephone Manufacturing Company, which claims to hold a franchise for an independent system in Cincinnati, recently applied to the Board of Public Service for permission to use a line 100 feet long, owned by another company; the owners' consent having been obtained. The corporation counsel advised the board to refuse the permit, as he claims the company has no valid franchise.

DAYTON, OHIO.—Local parties interested in the Dayton Home Telephone Company have taken up the option on the Everett-Moore interests in the property and the system will be completed by them. It is understood that about $90,000 was paid for the Everett-Moore interests. The property will probably be conducted in connection with that of the Columbus Citizens' Telephone Company, which has been virtually secured by the same interests.

ASHLAND, OHIO.—The Central Union Telephone Company is suing in the Probate Court to force the Council to grant a franchise for a local exchange. The Village Council claims the company was granted a franchise in 1883, which it abandoned and refused to operate, hence is not entitled to another franchise. It is also claimed that the independent service now given is satisfactory and that another exchange would be a hardship. The court has the matter under consideration.

CINCINNATI, OHIO.—It is stated that independent telephone companies are knocking hard for admission to Cincinnati. Those companies with applications now in are: Kentucky Telephone Association, Cynthiana, Ky.; Old Kentucky Telephone & Telegraph Association, Winchester, Ky.; Mt. Vernon Telephone Company, Mt. Vernon, and the Fitzsimmons Telephone Company, which has been refused a permit on the streets of Cincinnati. Some believe this latter concern has a valid franchise.

CLEVELAND, OHIO.—The bankers committee in charge of the affairs of the Federal Telephone Company has given options on eight of the twenty-three constituent companies of the Federal Telephone Company as follows: Canton, Portsmouth, Findlay, Lima, Bowling Green, Columbus, Dayton and Detroit. In each case the prospective purchasers are the local parties who hold the minority interest in the respective companies, and the options were given with the understanding that there shall be no sale or consolidation which shall place the exchanges in the hands of the opposition. It is generally understood that if several of these sales are effected the remaining Federal properties will be reorganized.

OTTAWA, ONT.—The Ottawa City Council has decided to advertise for tenders for a telephone service with a capacity of 4,000 subscribers, rates not to exceed $20 per annum. The cost of the Bell telephone plant, which at present serves only 2,500 subscribers in Ottawa, was $185,000. The annual revenue is about $70,000, of which $30,000 is set aside for maintenance, etc. This leaves $40,000 net earnings, and represents a profit of over 21 per cent.

OTTAWA, ONT.—The Bell Telephone Company of Canada has again got its bill, authorizing the doubling of its present capitalization, before the Dominion Parliament. The obnoxious clauses of the bill, which brought about its defeat in the Canadian Senate last year, have been eliminated from the new bill. One object for which the present increase of capital is asked is to enable the company to extend the long-distance telephone to the Northwest.

MARCHAND, PA.—The Farmers' Telephone Company is building a line from Rochester Mills to this place.

YORK CITY, PA.—The Chartiers Telephone Company, of McDonald, has been incorporated with a capital of $1,000.

CHESTER, PA.—The new system of the Delaware and Atlantic Telephone Company in this city is now in operation.

ANNVILLE, PA.—The United Telephone and Telegraph Company has extended its service to Myerstown. Other lines are being built.

POTTSVILLE, PA.—The charter for the Carbon Telephone Company has been filed. The company will operate a telephone system in Carbon and Schuylkill counties.

YANKTON, S. D.—The Western Electric Telephone system proposes to build a line from Tabor to this city.

STAR CITY, TENN.—The Star City Telephone Company has been chartered with a capital stock of $10,000.

MEMPHIS, TENN.—The Memphis Telephone Company of Memphis, which recently constructed a system here at a cost of about $500,000, now has its system in operation.

GLEASON, TENN.—The Cumberland Telephone Company has taken charge of the local telephone system and is making many improvements. The system has heretofore been operated by the Weakley County Company.

AUSTIN, TEX.—The Roberts Telephone and Electric Company, of Abilene, capital stock, $50,000, has been incorporated.

COLLINSVILLE, TEX.—A local telephone system is being put in here, with between twenty-five and thirty subscribers, also a line from this place to Ethell, five miles east of here.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company and the Montana & Wyoming Telephone Company are still fighting in the northern part of Wyoming. The latter company has secured franchises in Cody, Red Lodge and Meeteetsé, but was turned down in Thermopolis.

FOND DU LAC, WIS.—The Little Wolf River Telephone Company has passed into the hands of a receiver.

MADISON, WIS.—The Iowa County Telephone Company of Cobb has been incorporated with a capital stock of $6,000; incorporators A. E. Thomas, A. Livingston and C. R. Fox.

ELECTRIC LIGHT AND POWER.

LODI, CALIF.—There are three projected plans of electric current for lighting this place. Cary Brothers intend to install an electric plant which will supply lights next fall.

SAN FRANCISCO, CALIF.—The Northwestern Improvement Company has been granted a franchise for the construction of light, heat and water conduits and telephone lines in the town of Cle Elum, Wash.

SAN FRANCISCO, CALIF.—The Northern California Power Company recently petitioned the Board of Supervisors of Glenn County for a franchise for the extension of its electric transmission line to Willows.

SAN FRANCISCO, CALIF.—The Central California Electric Company, which is allied to the South Yuba Water Company, recently asked for a franchise for its electric transmission line in Nevada County. Grass Valley and Nevada City are the objective points.

SAN FRANCISCO, CALIF.—The San Antonio Water Company recently petitioned the trustees of Oxnard, Calif., for an electric light and power franchise. Current will be supplied from the company's electric transmission plant which is in course of construction.

RIVERSIDE, CALIF.—The Riverside Power Company, which has contracted to supply electric lights for the city of Riverside, has declared its intention to issue bonds to the amount of $250,000. The lighting contract with C. G. Baldwin has been cancelled by the city trustees, as he was unable to place the bonds for his electric lighting project.

LOS ANGELES, CALIF.—The Arizona Power Company, of which F. J. Thomas, of Los Angeles, is president, has secured capital to carry out its plans. Electric power will be generated on Fossil Creek, near Verde, and 55 miles from Prescott. It is estimated that about 4,000 hp can be generated and transmitted to the mining districts surrounding Prescott.

SAN FRANCISCO, CALIF.—The Mount Whitney Power Company, Wm. Hammond, president, will construct a power line from its Porterville electric station to the wells of the Sunnyside Water Company. The line to Plano will be extended in a southerly direction. An additional 1,000 hp development will be made at the generating station on the Kaweah River in California.

SAN FRANCISCO, CALIF.—The Standard Electric Company recently tested the electrical apparatus in its new San Francisco sub-station and every thing was found to be satisfactory. Current from the Bay Counties Power Company's Colgate powerhouse was used in testing, the distance of transmission being 223 miles—the longest on record. The Standard Company's powerhouse at Electra will be in operation by May 1.

SAN FRANCISCO, CALIF.—The Utica Mining Company will increase the capacity of its electric power plant which supplies Angels, Calif. An additional pipe line will be laid. The power station is located about 6 miles from Murphys and has room for three 1,000-hp units, each consisting of a generator and water-wheel. A second Westinghouse two-phase generator of 1,000-hp capacity will be installed. The Utica mine and other points will receive current.

VAN HORN, IA.—Mr. J. A. Uicke, of Van Horn, expects to have a franchise granted early in May, and if he gets it will put in a plant at once.

BALTIMORE, MD.—The Lynchburg Water Power Company, recently organized at Lynchburg, Va., has purchased the dam and other property at Reusens, four miles above the city, and will improve it for an electric plant, which will furnish 4,000 horse-power for manufacturing purposes.

MONROE CITY, MO.—The City Council is consulting with several electricians and getting an estimate of the cost of an electric light plant for the city. As soon as estimates are secured a special election will be ordered for the purpose of voting on the proposition to issue bonds to pay for a plant.

ST. LOUIS, MO.—The St. Louis Transfer Company is to supply the power for operating the staff plant and sawmills of Goldie & Company, who have the contract for constructing Electricity Building for the World's Fair. A contract was signed a few days ago by Goldie & Company with the Sprague Electric Company of New York for a 30-hp 500 volt motor.

WELLSTON, MO.—The *Iron Age* reports that J. M. Nelson, Jr., president of the recently organized Wellston Gas, Water & Power Company, Equitable Building, St. Louis, Mo., is in the market for entire equipment for their proposed new plant, and that they would be pleased to hear from parties familiar with the erection and installation of gas, water and electric plants. The company have secured a franchise and will erect a plant at Wellston, a suburb of St. Louis, capable of furnishing gas, water and electricity to a population of about 15,000.

VIRGINIA CITY, NEV.—The Utah mine near this city is about to install an electric hoist.

BLOOMSBURG, N. J.—The Convertible Car Co. is to put up new works at Bloomsburg, with the machinery all driven by electricity. The power plant will include three 260-hp direct connected generating units.

NEW BREMEN, OHIO.—The village will vote on the proposition to issue $15,000 bonds for the purpose of building a municipal lighting plant. The proposition will probably carry.

CRIDERSVILLE, OHIO.—W. P. Freeman, formerly of Hamilton, will open a factory in this place for the manufacture of electric novelties and will install a lighting plant sufficient to illuminate the village.

SPRINGFIELD, OHIO.—The Citizens' Heating and Power Company, with a capital of $10,000, has been incorporated by Walter L. Weaver, John L. Zimmerman, Frank P. Torrence, William W. Keifer and Frank H. Clarke of this city.

FOSTORIA, OHIO.—Officials of the Baltimore & Ohio, Ohio Central, Nickel Plate and Hocking Valley railroads have decided to install an electrically-operated block system at their crossings in this city. An electric light plant is to be installed, which will illuminate the stations and yards of the companies as well as [illegible] for the interlocking switch.

HAMILTON, OHIO.—The first trip of canal boats on the Miami and Erie canal, drawn by an electric motor, was made recently. Six boats in line, laden with material for building the line to Cincinnati, were drawn easily to Port Union, a distance of five miles. Material will be transported in this way daily as the track laying is extended toward Cincinnati. The line is expected to be open for traffic from here to Cincinnati early in June.

LAWTON, OKLA.—Mr. Ed. Wagemann is installing a plant at Lawton, including a 90-kw single-phase Westinghouse generator, a 120-hp Russell engine, a 100-hp boiler and 40 enclosed alternating arc lamps for the streets.

OTTAWA, ONT.—Several Toronto gentlemen are petitioning the Dominion Government to incorporate the Dominion Power Company. The purpose of the company is to generate and transmit power for lighting, heating, power, etc. The capital of the company will be $5,000,000. The company also proposes to run an electric railway between Niagara Falls and Toronto.

PITTSBURG, PA.—The Monongahela Light Company has been incorporated here with a capital of $1,000.

PAWTUCKET, R. I.—Work has commenced on the addition to the plant of the Pawtucket Electric Company. The contract for new machinery has already been placed, and will be delivered as soon as the new building is ready to receive it.

MEMPHIS, TENN.—The conditional sale of a majority of the stock of the Memphis Light & Power Company, capitalized at $500,000, was made on April 14, the purchasers being Anthony Brady, of New York, and C. K. G. Billings, of Chicago.

NEWPORT NEWS, VA.—McClare, Hamilton & Rumner, of New York, have sold a complete electrical equipment to the Warwick Brewing Company, of Newport News, Va., to develop 150 kw.

RICHMOND, VA.—The Electrical Construction Company of Virginia, of Emporia, Va., has been awarded the contract for the erection of a large electric plant in the town of Emporia, in Greensville County.

THE ELECTRIC RAILWAY.

WILMINGTON, DEL.—The Delaware Electric Traction Company has been incorporated at Dover, Del., with a capital stock of $1,000,000.

TAMPA, FLA.—Application has been made for a charter for the Tampa Municipal West Coast Development Company, capital $1,000,000. The purpose of the company is to build a street railway and electric lighting plant in Tampa.

BRUNSWICK, GA.—An electric street car system will probably be established here.

WABASH, IND.—The Wabash Traction Company has completed the purchase of the city lines of Logansport, Ind. The company is operating 18 miles of line between Wabash and Peru, and will at once extend its interurban line to Logansport, a distance of 14 miles.

LEXINGTON, KY.—The first step toward the building of the proposed electric railways throughout the Blue Grass region was taken recently by the Consolidated Traction Company, a concern capitalized at $7,000,000.

SAGINAW, MICH.—At a meeting, on April 8, of the directors of the Saginaw Valley Traction Company, it was decided to make extensive improvements to the system. Several cars will be purchased, the old cars will be rebuilt, and a new 500-hp unit will be installed in the power station.

MINNEAPOLIS, MINN.—The Mankato & St. Peter Railway & Lighting Company has been incorporated, capital stock of $300,000, for the purpose of building and operating a street railway in Mankato with an extension to St. Peter, Kasota and other points. It will also maintain a public electric lighting and heating plant and a gas plant. W. L. Hixon is president; W. D. Willard, vice-president; N. F. Clark, secretary, and W. G. Hoen, treasurer.

ALBANY, N. Y.—The Auburn Interurban Electric Railway Company, Auburn, N. Y., has increased its capital from $250,000 to $1,000,000.

NEW YORK, N. Y.—The Metropolitan Street Railway Company is changing the old Ninth avenue horse-car line over to the electric conduit system.

ALBANY, N. Y.—The Tuscarora Valley Railroad Company, of Painted Post, has been incorporated with a capital of $200,000 to construct an electric surface railroad, nineteen miles long, between Addison and Jasper, Steuben County.

CANTON, OHIO.—Work has been started on the power house of the Canton-Akron and Canton-Massillon lines at Canton. The equipment for the station was ordered some months ago, when it was intended to build a station between Canton and Akron. It is about ready for delivery, so that work on the building will be pushed.

EAST LIVERPOOL, OHIO.—The United Power Company, which operates the local street railway lines, has placed contracts for an addition to its power house.

DAYTON, OHIO.—The Dayton, Lebanon & Cincinnati Railway Company is securing right of way from Lebanon Junction into Dayton, a distance of five miles. The road is owned by the Appleyard syndicate, and is to be connected with the Dayton, Springfield & Urbana Railway, to form part of the through line from Columbus to Cincinnati.

CELINA, OHIO.—The Western Ohio Railway Company has its trolley wires stretched within about one-half of a mile of this city, and it also has most of its rails laid. The company expects to have cars running into Celina within 30 days. This will be the terminal point of the road for the present, but later on, it is currently reported, it will extend its line to Indianapolis, Ind.

CLEVELAND, OHIO.—The Cleveland City Railway Company is now pushing work on an addition to its power station. The company has recently contracted for 20 double and 10 quadruple Westinghouse No. 49 equipments to be placed on 15 Kuhlman and 15 Brill 14-bench open cars. Contracts have beeen closed for 18 Brill and 17 Kuhlman 30 ft. double truck closed cars for fall delivery.

HAMILTON, OHIO.—The board of control recently granted a franchise to the Millcreek Valley Traction Company, enabling it to reach the center of the city, passing the measure over the previous veto of the mayor. Immediately afterward, certain property owners brought suit to enjoin the company from building, on the grounds that the action of the board of control was illegal. The company has been working for several years to secure this grant.

CLEVELAND, OHIO.—Needham, Reynolds & Company, promoters and brokers of this city, claim to have completed a deal for the consolidation of the Youngstown Park & Falls Railways Company of Youngstown; the United Power Company of East Liverpool; the East Liverpool & Wellsville Street Railway of East Liverpool; the Chester Street Railway Company, of Chester, W. Va.; and the Wellsville & Steubenville Traction Co. of Wellsville. The consolidated company will be known as the Ohio River & Youngstown Railway Company. Bonds to the amount of $4,000,000 are to be issued. It is the chief aim of the project to build an interurban line from Youngstown to East Liverpool, a distance of 55 miles; also a line from Wellsville to Steubenvilllle.

CLEVELAND, OHIO.—At the instigation of Attorney Minor G. Norton, Senator Harris has introduced a bill in the state legislature authorizing the construction of elevated or subway railways throughout Ohio under certain conditions. Such roads can be elevated, or in subways, or both. Over private rights of way they are given the right of eminent domain. If they run over streets they must obtain consents of property owners. They are empowered to make traffic arrangements with other similar companies providing they are not competing lines, but they may not consolidate with or make traffic arrangements with surface lines. Permission to build such lines must be secured from municipalities or county commissioners. Mr. Norton admits the bill is especially designed for Cleveland, with a view to providing speedy traffic through the city as well as entrance for suburban lines.

MANITOWOC, WIS.—Not only will the new electric railway between Manitowoc and Two Rivers be open by May 1, but the proposed extension from Two Rivers to Mischiott will be built during the coming summer. Next summer the line will also be extended from Mischinott to Kewanee.

OTTAWA, ONT.—The Shawinigan Falls Electric Railway Company is preparing to extend its electric lines through the town of Shawinigan Falls, Que.

OTTAWA, ONT.—Estimates have been asked for an electric railway, about eleven miles long, to connect Maple Lake station with Port Cockburn and Rousseau, Ont. Two waterfalls along the line of the proposed railway will furnish all the power needed. The road will be extended to Parry Sound eventually, thus giving a railway twenty-six miles long.

PHILADELPHIA, PA.—Notice has been published of the proposed incorporation of the Philadelphia Rapid Transit Company, which will undertake the construction and operation of the subway under Market street and the management of the Union Traction Company.

NEW INDUSTRIAL COMPANIES.

THE MUNICIPAL ELECTRO CHEMICAL COMPANY of Jersey City, N. J., has been incorporated; capital, $100,000. Incorporators: Osborn Congelton, Henry F. West and Geo. H. Cook, all of New York City.

THE CEDARBURG & MILWAUKEE MOBILE COMPANY has been organized at Cedarburg, Wis., with a capital stock of $10,000. The company will run an automobile stage line from North Milwaukee to Cedarburg.

THE COLONIAL SIGN COMPANY of Akron, Ohio, has been incorporated with $25,000 capital stock. The company will manufacture electric signs on a number of features for which it has obtained patents. It is preparing to locate a factory in Akron.

THE NORTHERN ELECTRICAL CONSTRUCTION COMPANY has been organized at La Crosse, Wis., with a capital of $100,000 for the purpose of financing companies and constructing electric light plants, power plants, telephone exchanges and street and interurban electric railways. M. J. Berger is secretary and G. L. Saunders engineer.

THE ST. LOUIS GLASS MANUFACTURING COMPANY has filed articles of incorporation. Its capitalization is $50,000, and its purpose is to manufacture gas, electric and combination fixtures, lighting appliances and mantels. The company is a consolidation of the General Lighting Appliance Company and the Phœnix Gas & Electric Fixture Manufacturing Company. Its temporary location will be at 1607 Oliver Street. The officers are G. A. Pleus, president; Alfred C. Einstein, vice-president; Charles M. Wentner, secretary, and Edwin F. Guth, treasurer.

LEGAL.

VAN CHOATE ELECTRIC COMPANY.—The property in Foxboro, Mass., of the Van Choate Electric Company was sold at public auction on April 14 to the Attleboro Savings Bank for $58,000.

POSTAL IN COLORADO.—The Supreme Court of Colorado has decided that the Postal Telegraph Company may construct lines along the right of way of the Union Pacific Railway.

OBITUARY.

MR. JACOB WEINHEIMER, president of the St. Louis Electrical Supply Company, St. Louis, Mo., died in that city on April 7. He was born in St. Louis in 1837.

PERSONAL.



[illegible] W. ROSSNAY, [illegible] of a number of expert telegraphers selected by the managers of the American Bell Telephone Company early in telephone history to do the pioneer work incidental to introducing the telephone in a practical way for commercial and social purposes. His first assignment was to install an exchange in Kansas City, Mo., in 1879, which was followed by exchanges in St. Joseph, Mo., Atchison and Leavenworth, Kan., then the larger towns in Kansas. All of these were successfully constructed and operated under his supervision and management until 1884, when he was transferred to Eastern territory with simi- [illegible] In 1885 a flattering offer from Mr. Edison to enter his service induced him to leave the telephone field, which he re-entered shortly after the expiration of the fundamental Bell patents, again taking up pioneer work in connection with the independent telephone movement. His previous training and experience in the telephone business and other branches of electrical work closely allied therewith, peculiarly fitted him to enter this field with advantage to his employers. His first connection with the later telephone manufacturing interests was with the American Electric Telephone Company, with which concern he remained about four years, holding the title of assistant general manager, and materially assisting in building up the business of that company. He subsequently accepted a position with the Kellogg Switchboard & Supply Company, with which company he is at present engaged as manager of the Eastern District, with headquarters in Philadelphia, Pa.

MR. B. E. SUNNY, Western manager of the General Electric Company, has recently been elected president of the Civic Federation of Chicago.

COL. ALLAN C. BAKEWELL, general manager of the Sprague Electric Company, has recently been elected second vice-president of the Pennsylvania Society of New York.

MR. CHARLES A. TINKER, general superintendent of Western Union, Eastern Division, has resigned, and Mr. B. Brooks, superintendent at Denver, has been appointed to succeed him.

MR. DUFFIELD PRINCE, formerly with the Brooklyn Edison Illuminating Company, and an old associate of Mr. W. S. Barstow, has joined the office force of that consulting engineer, at the Bowling Green Building, New York City.

MR. LEWIS McKISICK, the Western Union Telegraph Company's assistant manager of the Pacific Coast lines, has been called to Chicago, where he will hold a very responsible position. He has been stationed in San Francisco for the past twelve years.

MR. J. B. HAMILTON, general manager of the Leeds Corporation Tramway, has been visiting this country to inspect American traction systems, and has now sailed for England, after an extensive tour of investigation. He was formerly assistant manager of the Glasgow system.

LORD AND LADY KELVIN left New York on Tuesday morning for Washington in the private car of Mr. George Westinghouse, by whom they will be entertained in that city. They are then to visit Rochester, Cornell University and Yale University before returning to New York, to sail for home on May 10.

MR. R. H. KLAUDER, St. Louis representative of the Electric Storage Battery Company, addressed the Engineers' Club, St. Louis, Mo., April 16, on "Present American Storage Battery Practice." Mr. Klauder dealt with the use of storage batteries in power plants. The address was illustrated by stereopticon views.

MR. J. Z. RISCH, Cz., of Delft, Holland, a recent graduate of the electrical engineering course of the American School of Correspondence, Boston, Mass., has been appointed instructor in electrical drawing and design in a technical school at Leyden. Mr. Risch is also a graduate of the American School's marine engineering course.

MR. L. GRIMESY, manager of the Yokohama offices of the American electrical engineering and contracting firm of Bagnall & Hilles, which concern has recently secured some important contracts for American equipment for various Japanese traction and lighting plants, is now in the United States. He expects to remain in this country for some two months. He may be found at the New York offices of the General Electric Company.

HON. L. J. FORGET has resigned from the directorate of the Shawinigan Falls Water & Power Company of Montreal. He opposed the bringing of power to Montreal by that company, but was overridden by the other directors. Senator Forget is a director of the Montreal Light, Heat & Power Company, and, as the Shawinigan power will conflict with the latter company's business, he decided that as the two interests clashed, he would resign the Shawinigan directorate.

MR. E. W. STEVENSON, who is the electrical engineer of the Hazard Mfg. Co., at Wilkesbarre, Pa., has been lecturing there with great success on telegraphy. Mr. Stevenson has been intimately associated with this branch of the business from his infancy, his father having been one of the pioneers connected with the Great Eastern expeditions and the Telegraphic Maintenance & Construction Company, which has laid 75 per cent of the cables now in existence. Mr. Stevenson's reminiscences were also very entertaining, being full of anecdotes of his personal experiences in different parts of the world. The description was well illustrated by drawings which served to make the lecture very clear and lucid. Mr. Stevenson reserves the wireless telegraph as the [illegible]

Trade Notes.

THE STANLEY INSTRUMENT COMPANY will move to 156 Broadway, New York, on or about April 26.

THE AKRON ELECTRICAL MANUFACTURING COMPANY, Akron, Ohio, will enlarge its facilities by adding another story to its factory.

CHAS. E. FELT & COMPANY have opened an office as mechanical and electrical engineers at 1155 Monadnock Block, Chicago. D. Avery Kimbark is consulting electrician.

MR. T. J. CALLINAN, Williamson Building, Cleveland, Ohio, has taken the exclusive American and foreign agency for the Barrett rail bond, which, for some time, has been manufactured by the Cleveland Bronze & Brass Works.

MERWARTH METALLIC GASKETS.—To meet the demand of increasing business, the Merwarth Metallic Gasket Company has moved from 107 Liberty Street, into larger quarters in the Beard Building at 120 Liberty Street, Rooms 604 and 605.

THE CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has purchased a block of property which is to be used for enlarging its plant. The company is in great need of more factory space. It is exceedingly busy, as usual.

THE M. M. MAYER ELECTRIC COMPANY, which has had a great deal of success in exploiting its motors for varied power work, has recently moved to 216 Centre Street. This brings it more nearly into the heart of the business section of New York City.

PACIFIC COAST AGENCY.—John Martin & Company, of San Francisco, have taken the Pacific Coast agency for the electric motor department of the Lorain Steel Company. An order for street railway equipments has been received from the Pacific Electric Railway Company of Los Angeles.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, it is reported, is having a large call for its new long-lever gravity telephone switchhook. It is said the "International" switch may be readily placed in practically any make of telephone, it being less than one inch in width and all parts self-contained.

GARTON LIGHTNING ARRESTERS have been on the market for several years and are regarded as standard goods. The Garton-Daniels Company, Keokuk, Ia., has just issued a very complete and well-illustrated catalogue of its latest improved lighting arresters for electric light, power and railway circuits of any voltage, direct or alternating current.

REMOVAL.—The Le Valley-Vitæ Carbon Brush Company will, on May 1, remove its offices from 45 Broadway to 119 East Forty-second Street, New York. At the new location the company will have, in addition to its offices, a storeroom, where it will carry a large quantity of its brushes, so that it will be in a position after that date to make prompt delivery of almost any size of brush used.

THE STANDARD POLE & TIE COMPANY, 44 Broad Street, New York City, advises us that on May 1 it will move into larger quarters. It has been very badly crowded for some time, and the volume of business which it is handling makes it absolutely necessary to secure more space. It will still have offices in the General Electric Building, and invites its friends to call at its new rooms.

THE FORT WAYNE ELECTRIC WORKS have recently issued Bulletins 1020 and 1021, the former dealing with belted direct-current multipolar generators. This type of machine is illustrated complete and in parts, and a general description of the machine is given, together with tables of dimensions. Bulletin 1022 describes and illustrates in a similar manner belted direct-current multipolar motors.

DIRECT-READING OHMMETER.—The Illinois direct-reading ohmmeter, manufactured by the Illinois Electric Specialty Company, Chicago, Ill., is evidently giving satisfaction to those who are using it, judging from some testimonial letters published in a circular sent out by the company. This instrument is recommended for quickly locating troubles, either in lines, instruments or cables.

THE CENTRAL ELECTRIC COMPANY of Chicago has published a 1902 addition to its fan motor catalogue, in which is listed a full line of desk, bracket and ceiling fans for all currents and voltages. This catalogue also includes power motors, sewing machine motors, battery fans, ventilating fans, etc. Anyone desiring a copy can procure it by addressing a request to the Central Electric Company.

MECHANICAL DRAFT.—Anyone not familiar with the subject of mechanical draft can find out what it is and what it does by addressing the B. F. Sturtevant Company, Boston, Mass, and asking for a copy of a little pamphlet just issued on that subject. Besides giving this fundamental information, there are illustrations and general descriptions of plants in various places equipped with mechanical draft on the Sturtevant system.

THE ST. LOUIS BRANCH of the H. W. Johns-Manville Company reports having secured the contract for pipe covering in the new Bank of Commerce Building, southeast corner Broadway and Olive Street, St. Louis, Mo. The material used on all main pipes and risers is Asbesto Sponge moulded covering, and the breechings and hot water tank will be covered with magnesia. The total cost of the above contract will be close on to $1,000.

PLAIN MILLING MACHINES.—The Garvin Machine Company, New York, in a catalogue just off the press, shows illustrations of a full line of plain milling machines, the principal features of the machines being pointed out. A comprehensive telegraph code is also given. The Garvin Company has issued a series of catalogues, to be revised as occasion requires, in order to keep its customers in touch with its latest improvements and additions.

EMERSON FANS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., is sending out a new booklet entitled "Emerson Fans, and Why We Recommend Them." This booklet is intended to stimulate the demand for

these goods throughout the country. The title exactly describes its contents, and the argument contained therein is an earnest one in favor of Emerson machines. Besides this there are various illustrations showing the different styles of fans manufactured by this company.

CHARLES H. BESLY & CO., Chicago, Ill., report numerous sales of their Gardner grinders. Within the past week shipments of these well-known machines having been made to Oregon, Wisconsin, Connecticut, New York, and Massachusetts. They are receiving many orders from agricultural implement builders for their "Badger" and "Bonanza" oil cups, and are making many shipments of "Helmet" oil through all parts of the country. Their 300 page illustrated catalogue will be mailed free to any address upon application.

AUTOMATIC SWITCH COMPANY.—On the night of April 14 the offices and factory of the Automatic Switch Company, of 131 Liberty Street, New York City, were extensively damaged by fire, the stock and machinery being injured to such an extent as to necessitate practically a new equipment of the main floor of the machine shop. Immediate steps have been taken by the company to put the plant in running order, and it is expected that not more than one week will be required to effect it, after which orders will be filled with the usual punctuality.

STORAGE BATTERY FOR VOLTAGE REGULATION.—The advantages of using storage batteries for voltage regulation on electric railway lines are pointed out in Bulletin No. 70 of the Electric Storage Battery Company, Philadelphia. Curves show the results obtained by the use of a battery on the line of the Chestnut Hill branch of the Union Traction Company, Philadelphia. A statement exhibiting comparative results with and without the battery shows a saving of $22,500 in first cost, and a reduction of $1,100 in annual charges in favor of the battery installation.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is sending out a handsome souvenir mailing card illustrative of the ability of the American engineer to design steel structures of great strength and pleasing architectural effect. The card contains eight illustrations of bridges, buildings and ornamental iron work, on which Dixon silica-graphite paint is used for the prevention of corrosion of the metal. It is stated that this paint has been very extensively used in the South, West and seacoast sections of the United States, also in Mexico, Australia, China, West Indies and Philippine Islands, and has proven its protective and wearing qualities in all climates.

WATCHMAN CLOCKS.—The Waggoner watchman clock, manufactured by the Waggoner Watchman Clock Company, Grand Rapids, Mich., is completely described and illustrated in a pamphlet issued by that company. Among the claims made for this device is the unique manner of registration. The record is printed on the back of a dial by means of a vibrator actuated by an electric current, ordinary push-buttons being used to make the contact. The registration is stated to be entirely secret. This secrecy of registration is stated to be a positive protection against the manipulation of the clock. The features of this system, as set forth in the catalogue, include an automatic watchman's alarm, an automatic fire alarm, and its simplicity and reliability are especiallly pointed out.

CORRESPONDENCE INSTRUCTION BY TELEGRAPH.—A telegram received by the American School of Correspondence, Boston, Mass., from the superintendent of an electric plant in one of the sections affected by the recent floods requested information regarding the treatment of dynamos that had been submerged. An answer was sent immediately by wire, followed by fuller details by mail, so that by the time the water had subsided enough to permit him to work the superintendent knew what should be done. The American School has a "Special Inquiry Department" for answering practical engineering questions, and the frequent requests for information such as this show how the privilege is appreciated by the students.

THE BUFFALO FORGE COMPANY of Buffalo, N. Y., inventor and manufacturer of the Buffalo forges, has just issued its new catalogue for distribution among the trade. It is a handy little book, envelope size, illustrated with half-tone engravings throughout, describing in detail the many different types and sizes of its portable, blacksmiths, machinists, boiler makers, tool makers, riveting, jeweler's forge, bench forge for light work, railroaders and prospectors, bellows, foot-power, brazing and melting forges, and folding forges for marine service. It also includes descriptions of its Buffalo hand blowers, power and hand drills, punches, shears, bar cutters, tire benders and tire upsetters. This catalogue is a handsome effort and well worth securing.

"THE MIDNIGHT SUN" is the title of a pamphlet issued by the Sterling Electrical Manufacturing Company, Warren, Ohio, manufacturers of incandescent lamps. The various types of lamps manufactured by this company are illustrated and their principal features noted. The "Sterling Special" lamp gives full-rated candle-power at all light-giving points of the bulb. The filament is mounted in double spiral form, from which the radiation of light is said to be equal in all directions. In the "Sterling" regular lamp the old type of oval loop-anchored filament is used. The "Phœnix" lamp is the repaired part of the company's product. This lamp is said to equal the new. The company's New York office, at 26 Cortlandt Street, is in charge of Mr. Francis Granger.

TRAVELING ELECTRIC HOISTS.—Pawling & Harnischfeger Company, Milwaukee, Wis., in Bulletin No. 7, describes and illustrates its line of traveling electric hoists. It may be pointed out that the hoists not only hoist but travel also, thus giving full hoisting capacity at the place where needed. Another feature is the ease with which these hoists are installed, only requiring sufficient head room and strength of roof trussing. The runway can be made straight or curved, machines being made for either form. The advantage of the curved runway is that it permits of covering a large part of an extensive plant. The machines are suitable for both inside and outside service; in the latter the mechanism being fully protected by an iron cover and the operator's cage housed in sash. The use of an I beam bridge with these hoists is of value, and the bridge can be readily adapted to the transfer type for application in any plant. The catalogue includes a partial list of users. It is pointed out that the machines are in no sense an experiment.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 15, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

697,158. ELECTRIC CIRCUIT REGULATING DEVICE; G. P. McDonnell, St. Louis, Mo. App. filed Oct. 28, 1901. The principle of operation of this device is a rotating element provided with a series of terminals which are designed to pass a brush, whereby the derived circuit is made and broken periodically and with rapidity, the position of the contact-brush with respect to the axes of rotation of the moving terminals being such that the length of interval of the break may be regulated so that the value of the derived current may be increased or diminished at will. (Issued April 8.)

697,432. BRUSH HOLDER; N. C. Bassett and J. W. Hill, Lynn, Mass. App. filed Aug. 31, 1900. Details.

697,439. ELECTRIC ARC LAMP; H. Bremer, Neheim, Germany. App. filed Sept. 26, 1900. (See Current News and Notes.)

697,445. ELECTRIC CONTROLLER; F. E. Case, Schenectady, N. Y. App. filed June 22, 1898. There is a mechanical connection between the regulating and the brake switches, such that the movement of the regulating switch handle brings the brake switch to one of two operative positions and the further movement of the handle actuates only the regulating switch.

697,458. ELECTRIC LAMP AND LAMP HOLDER; H. J. Dowsing, London, England. App. filed Oct. 28, 1901. The socket contains two pins and the lamp neck two corresponding holes for establishing connection when the lamp is within the socket.

697,469. METHOD OF MANUFACTURING INCANDESCENT ELECTRIC LAMPS; E. S. Gardner, Boston, Mass. App. filed July 22, 1901. The method consists in the manner of mounting a reflector inside of the lamp and surrounding the stem.

697,482. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed Oct. 23, 1900. Details of construction of a lamp adapted for headlight purposes.

697,507. ELECTRIC CONDENSER; G. F. Mansbridge, Wimbledon, England. App. filed Nov. 16, 1900. Consists of two strips of paper wound up together in the form of a roll, each strip being coated on one side with finely divided metal.

697,515. COMBINED JACK AND DROP; K. B. Miller, Chicago, Ill. App. filed Nov. 8, 1901. (See page 731.)

697,528. TELEPHONE; Aristide Neri, Hoboken, N. J. App. filed June 12, 1901. (See page 731.)

697,529.—METHOD OF RENDERING SHARP AND EVEN CUTTING EDGES OF IMPLEMENTS; O. Newhouse, San Francisco, Calif. App. filed March 23, 1901. (See Current News and Notes.)

697,530. THERMO-ELECTRIC SWITCH; J. G. Nolen, Chicago, Ill. App. filed Sept. 12, 1901. Details.

697,533. CIRCUIT BREAKER; W. E. Pimlott, Chicago, Ill. App. filed Sept. 22, 1900. Relates to the means for adjusting the apparatus so as to break the circuit only when the current attains the desired strength.

697,534. MEANS FOR ELECTRICALLY CONNECTING RAILWAY RAILS; W. E. Pimlott, Chicago, Ill. App. filed April, 1901. The fish plates are grooved on their inner surfaces to receive a conducting strip which they hold in contact with the rail end.

697,572. TROLLEY HARP; T. N. Turner and G. R. Mitchell, Springfield, Ohio. App. filed Sept. 11, 1901. The wheel is in a frame pivoted to the end of the pole, permitting it to swing laterally, anti-friction balls being inserted between the two frames.

697,589. ELECTRIC FAN; J. J. Wood, Fort Wayne, Ind. App. filed Feb. 25, 1901. The armature and field magnet are surrounded by two shells separated on a plane transverse to the armature shaft and having means for supporting the field magnet.

697,619. TELEGRAPH SOUNDER; G. A. Green, Duxbury, Mass. App. filed April 15, 1901. The armature of the sounder moves a hammer to strike a drum.

697,628. INSULATOR AND ATTACHMENT FOR ELECTRIC WIRES; C. C. Johnston, Scranton, Pa. App. filed Sept. 11, 1901. The cap of the insulator, in screwing on to the body portion, clamps the wire between the two parts.

697,654. TRAIN SIGNAL; A. Novak, Trenton, N. J. App. filed Nov. 30, 1901. Circuits are completed by two trains approaching each other on the same track to operate signals in the cabs of both engines.

697,660. WINDING MACHINE; M. I. Pupin, New York, N. Y., and S. W. Balch, Montclair, N. J. App. filed Aug. 31, 1901. (See Current News and Notes.)

697,670. ALTERNATING CURRENT MOTOR; F. Schrottke, Berlin, Germany. App. filed Jan. 6, 1900. (See Current News and Notes.)

697,671. ALTERNATING CURRENT METER; F. Schrottke, Berlin, Germany. App. filed Feb. 12, 1900. (See Current News and Notes.)

697,674. AUTOMATIC TROLLEY CATCHER; T. B. Shanahan, Gloversville, N. Y. App. filed Aug. 7, 1901. A spring drum controlling the trolley cord.

697,696. MACHINE FOR MAKING MICA BOARD; H. F. Watson, Valparaiso, Ind. App. filed Feb. 19, 1901. A machine for turning out mica board in quantities built up of small sheets of mica.

697,698. MAGNETO BELL RINGER; E. E. Yaxley, Chicago, Ill. App. filed [illegible]

697,708. LAMP HOOD AND SWITCH; H. Etheridge, McKeesport, Pa. App. filed July 23, 1901. A construction affording protection to the wires connecting with the hood.

697,727. SWITCH FOR ELECTRIC LAMPS; J. F. Krayer, Philadelphia, Pa. App. filed March 10, 1899. The key is in line with the axis of the lamp socket, the latter being mounted on a gas fixture so that the key appears in the same position as the key of the gas valve.

697,733. MULTIPLE CONDUCTOR SYSTEM; A. D. Lunt, Schenectady, N. Y. App. filed Sept. 27, 1901. (See Current News and Notes.)

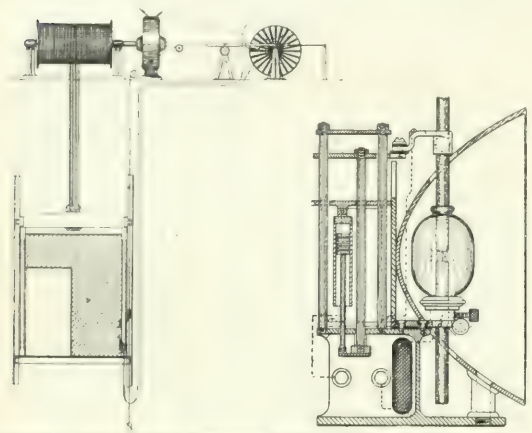
697,734. SAFETY DEVICE FOR CIRCUIT CLOSERS; F. Mackintosh, Schenectady, N. Y. App. filed Aug. 26, 1901. A locking device arranged to cooperate with the line switch and controlled by the rheostat arm so that it is released when the arm stands in the starting position, but is set for operation when the arm is moved to cut out the resistance coil; with this device it is impossible for the line switch to be closed unless the resistance coils are in circuit.

697,749. CONTROLLING DEVICE FOR ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Aug. 29, 1898. (See Current News and Notes.)

697,755. ALTERNATING CURRENT METER; G. Stern, Charlottenburg, Germany. App. filed Aug. 23, 1900. (See Current News and Notes.)

697,756. ALTERNATING CURRENT METER; G. Stern, Charlottenburg, Germany. App. filed Aug. 23, 1900. (See Current News and Notes.)

697,757. GLOBE HOLDER FOR ARC LAMPS; G. E. Stevens, Lynn, Mass. App. filed Sept. 15, 1899. A supporting yoke for a globe holder split longitudinally of its axis to form two jaws, a cylindrical socket between the jaws



697,[illegible] Electric Circuit Regulating Device. 697,782—Electric Arc Lamp.

for the stem of the globe holder, and a set screw to compress or spread the jaws.

697,767. SYSTEM OF ELECTRICAL CONTROL; G. T. Woods and L. Woods, New York, N. Y. App. filed May 18, 1901. A system of control wherein all of the motors on a car or train are controlled from a single point through the medium of a power-actuated controlling apparatus, the mechanism being such that any one or more of the motors may be cut out if disabled without affecting the control of the others, and each motor car is a unit in itself and may be disconnected from a train and run individually.

697,782. INSULATOR; A. N. Berg and E. E. Bechtold, Chicago, Ill. App. filed Aug. 19, 1901. Details.

697,783. DYNAMO ELECTRIC MACHINE; E. J. Berg, Schenectady, N. Y. App. filed Aug. 25, 1899. (See Current News and Notes.)

697,788. METALLURGICAL CRANE; D. W. Blair, Perth Amboy, N. J. App. filed Jan. 17, 1902. (See page 730.)

697,810. ELECTRIC FURNACE; M. R. Conley, New York, N. Y. App. filed Dec. 5, 1901. (See page 730.)

697,817. DEVICE FOR ELECTRICALLY CONNECTING RAILS; G. Deharde, Wiesbaden, Germany. App. filed Jan. 11, 1900. A hollow split plug is used to fasten the ends of the bonds in the rail.

697,825. NURSERY MILK WARMER AND NIGHT LAMP; J. M. Fisk, Malone, N. Y. App. filed July 27, 1901. An incandescent lamp is surrounded by a jacket into which liquid may be placed to be heated, a small orifice being formed in the jacket for rays of light.

697,826. ELECTRICAL STEERING APPARATUS FOR SHIPS; B. A. Fiske, United States Navy. App. filed Oct. 17, 1900. (See Current News [illegible]

697,828. TROLLEY POLE; E. L. Fowler, Philadelphia, Pa. App. filed July 11, 1901. The pole is jointed in the middle in such a way that one part can rotate on the other, thus affording lateral movement to the wheel.

697,831. METHOD OF RECOVERING METALS BY ELECTROLYSIS; H. A. Frasch, Hamilton, Canada. App. filed March 7, 1901. (See Current News and Notes.)

697,832. ELECTRIC TRANSMISSION OF POWER; E. M. Fraser, Yonkers, N. Y. App. filed Nov. 6, 1900. Two sets of motors of two each have their armatures of each set mechanically connected while the armature of a motor of each set is in series with an armature of a motor of the other set; the fields are similarly connected and there are means for varying the field of one of the motors of one set. When the field of one of the motors of one set is varied, the speed of one set will be increased and the other decreased, thereby utilizing the current to the best advantage.

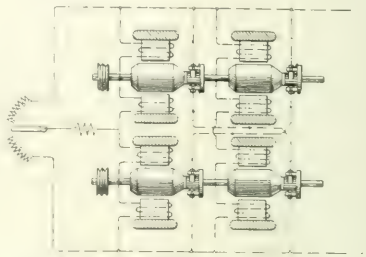
697,834. CIRCUIT CONTROLLER; J. J. Ghegan, Newark, N. J. App. filed Aug. 20, 1901. A compound circuit controller comprising an electro-magnet and its armature, with a second armature actuated by the magnetism induced in the regular armature, the said armatures being provided with contact points. (This instrument is described and illustrated on page 743.)

697,845. CONDUIT FOR ELECTRIC OR LIKE CABLES; C. A. W. Hultman, Stockholm, Sweden. App. filed Jan. 9, 1902. A conduit for electric cables comprising a plurality of tubes, transversely arranged bars interposed between said tubes, longitudinally arranged rods connecting the free ends of said bars and a protecting mass inclosing the tubes.

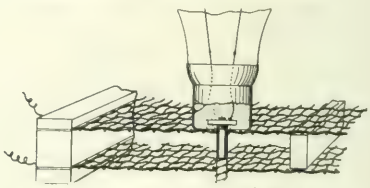
697,847. ELECTRIC ELEVATOR SYSTEM; J. D. Ihlder, Yonkers, N. Y. App. filed Aug. 21, 1901. Controlling means for an alternating current motor, which are operated by rectified current obtained from alternating current instead of being operated as usual by alternating current.

697,849. INDICATING MECHANISM FOR POST OFFICE BOXES; T. F. Kelly, Adair, Iowa. App. filed June 10, 1901. An indicator for mail boxes showing the subscriber when the rent is due.

697,856. CONTACT FOR ELECTRICAL GLOW LAMPS; A. Lefebre, Paris, France. App. filed Nov. 11, 1901. Two sheets of wire mesh, one behind



697,832—Electric Transmission of Power.



697,856. Contact for Electrical Glow Lamps.

the other and respectively in circuit with the positive and negative mains, are arranged to support lamps whose bases are fitted with pins adapted to pass through the mesh, one pin contacting with one mesh and the other pin with the other mesh, to establish a circuit through the lamp.

697,884. TROLLEY POLE; W. Pullman and C. C. Field, Sodus, N. Y. App. filed Oct. 11, 1901. Details.

697,890. RAIL BOND; B. C. Rowell, Chicago, Ill. App. filed July 21, 1900. A slotted conical hollow plug for holding the end of the bond.

697,892. TROLLEY WHEEL; W. Sellers, Haverhill, Mass. App. filed Jan. 31, 1[illegible] Details.

697,928. MOTOR CONTROLLING APPARATUS; G. T. Wood and L. Woods, New York, N. Y. App. filed Sept. 3, 1901. The system in general is indicated by the following claim:

The combination of a train having a plurality of electrically equipped cars, each of such equipments having a motor controller with spring-pressed contacts and a commuting switch to energize the controller section by section, and means adapted to make a direct electrical connection between the commuting switch on car and a like device on another car independently of the sequence of the equipped cars.

697,930. RAIL CHAIR AND INSULATOR; W. D. Young, Baltimore, Md. App. filed March 5, 1901. An insulator and support for a third rail.

697,934. RAILWAY SAFETY BLOCK SYSTEM; G. W. Cohen, Allegheny, Pa. App. filed Aug. 8, 1901. An automatic system in which the trains set and release the signals at the ends of the blocks.

697,935. PLURAL FUSE CUT-OUT; C. J. Dorsey, Baltimore, Md. App. filed Nov. 26, 1900. Details of a magazine fuse block.

697,937. TROLLEY WIRE HANGER; I. L. Edwards, Aurora, Ill. App. filed Jan. 29, 1902. A trolley wire hanger having shiftable means for engaging a stringer wire comprising a bar having hooks, a slotted screw-threaded stud, and a nut on the stud to directly engage the stringer wire, the hooks and slot in the stud being in alignment, whereby bending or kinking of the wire is obviated.



KELVIN

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ELECTRICAL WORLD AND ENGINEER.

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NEW YORK, SATURDAY, MAY 3, 1902

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REMOVAL NOTICE.

Dating from this issue, the editorial and business offices of ELECTRICAL WORLD AND ENGINEER will be located in the fine new Engineering Building, 114 Liberty Street, New York City, next door to the present offices. The new and larger quarters will afford every facility for the proper care of a growing business, and occupy the tenth floor, extending through to Cedar Street, being thus in the very heart of the electrical and machinery district of New York. The readers, patrons and friends of the journal are cordially invited to visit it in the new home.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Few technico-industrial bodies in this country have done so much good work as the National Electric Light Association, and the long series of transactions extending back over twenty-four conventions is a witness to the persistent endeavor made to bring under discussion before the body all the great questions affecting the welfare of the electric light and power industry in America. It cannot be said that at all times the selection of topics has been the most judicious or that the papers and discussions have all been the best; in fact, the work has been curiously uneven, touching great heights and descending to occasional depths of puerility; ranging from the magnificent experiments and speculations of Nikola Tesla to the kindergarten explanations of some of the easiest details of lighting systems and central station practice. But such a range is inevitable in the work of a body whose underlying art advances so rapidly and changes so frequently; and, on the whole, the Association may well be proud of what it has done and will do.

Of late there has been an inclination in some quarters to suppose that the Association had begun to outlive its usefulness, and to shrink and crystallize, but never was a supposition further from the truth. Greater opportunities for the Association exist than ever before, with a larger membership, a larger field to draw from, a larger investment to represent, and a larger variety of important problems. If any doubt existed on these points a mere glance at the excellent programme, formulated through the energy and intelligence of President Doherty, would suffice. It is evident that at the Cincinnati convention this month some forty or fifty of the leaders in the field will be found addressing their fellows on an equal number of vital and interesting topics, and that an amount of data, instruction and experience will be forthcoming never surpassed, and probably never equalled as to electric light and power supply.

Under these circumstances, an unusually large attendance may be expected to celebrate the twenty-fifth meeting, and we believe that not only many of the veterans will make the resolve to attend, but that many central station men who have not made a practice of attending the conventions or are newer in the field, will be glad to seize so auspicious an occasion. It is late in the day to harp upon the advantages afforded by such gatherings, greater now than ever. We might dwell, too, if it were necessary, upon the social features, for a cordial welcome awaits in Cincinnati. We will, however, satisfy ourselves with an earnest recommendation to all to witness the beginning of the Association's second quarter century of meetings, and to do all in their power to promote its influence and usefulness by active, personal participation.

The General Electric Report.

We publish in our pages this week in extenso the admirable report presented by the General Electric Company for the year ending with Jan. 31. It is a most interesting document, illustrative of the great expansion in the electric arts, and highly illuminative as to the special features of modern development in electric light and power. The fact that the product billed outward should have risen in five years from $12,360,000 to $32,338,000, or about 2½ times, is significant of the general growth of electrical production, while the variety of new and large work is most impressive. Equally striking is the fact that the old traditional method of taking large blocks of stocks and bonds in payment for lighting and railway plant should have been so entirely abandoned, that in 1902 they were only 0.1 per cent. of the total terms. The company must be heartily congratulated not merely upon its conservative way of doing business, but upon the exemplary frankness with which it discloses its financial condition, in which it has good reason for taking pride.

Regarding the report from a technical standpoint, three items of interest are immediately disclosed. The first of these is embodied in the list of chemicals, for the making of which apparatus was sold during the year. It includes 16 articles. Another item is that which notes the sale of transformers to operate at 80,000 volts, and the consequent transmission of water power over distances of 200 miles. The third item deals with the sale of the largest generators ever built—three of 10,000-hp each—for the Canadian side of Niagara Falls. An additional item of export interest, too, is the sale of 3,600 kw in generators, 250 car equipments, and other details, for Tokio, Japan, constituting the largest electrical plant in all Asia.

Telpherage.

One of the earliest proposed applications of the electric transmission of power was telpherage, or the electric transportation of material. This system ordinarily requires considerably less power than any electric railway system for the transportation of persons. One horsepower expended in telpher motors may be sufficient for a respectable telpher system of light materials, whereas the power required for the transportation of the first passenger in an electrical vehicle might be 100 hp. Of course, heavy telpherage at high speed and grades involves problems and constructions akin to those of electric traction systems. Electric telpher systems seem destined to flourish and expand. They can be made automatic and economical. They can respond to rapid fluctuations in demand or in schedule speed. The system has great flexibility. It seems probable that electric telpherage will in future find generous application, not merely to canal haulage, mine haulage and factory haulage, but also to high-road haulage and even to general rural haulage, such as logging, plowing and sowing. Where cheap electric power can be obtained animal muscle works to its own exclusion.

Mr. C. M. Clark's paper, read at the last meeting of the American Institute of Electrical Engineers, is principally devoted to a simple commercial system of telpherage, employing trolleys and dust-proof motors of the direct-current type. The direct-current motor has certainly the advantage over the alternating-current motor of requiring only one pair of supply wires. It is interesting to note that the word "telpherman" has recently come into use, signifying a man in charge of a telpher plant, and frequently traveling in a telpher-car. In the latter case, the system closely approaches that of the ordinary electrically operated traveling crane as used overhead in large machine shops.

Wireless Telegraphy.

It is interesting to notice that the United States Weather Bureau has recently been testing Prof. Fessenden's system of wireless telegraphy at Roanoke Island, N. C. The wireless telegraph might be of especial use to the Weather Bureau, by enabling inaccessible or remote localities to be telegraphically reached without involving the expense of carrying and maintaining a wire or cable. Moreover, for the business of making weather reports only a few daily words are necessary, and in cases where no other business is forthcoming, a telegraph wire or cable might be prohibitively expensive. The Fessenden system is particularly different from the Marconi system in not employing a coherer for the detection of the incoming electric waves. The two systems also differ materially in other respects. It is interesting to observe that Prof. Fessenden is reported as stating that the waves of wireless telegraphy do not penetrate appreciably beyond one foot below the surface of the sea and three feet below the surface of the land traveled over. Pupin, we believe, takes a similar view.

Transformer Patents.

In our issue of March 29, an account appeared of a transformer patent granted March 18, 1902, to Messrs. Thomson & Houston, on an application filed Feb. 19, 1887. Among the patents of April 22 is another on the same subject granted to Prof. Elihu Thomson, on an application filed as far back as Nov. 2, 1885. The latter patent claims a system of electrical distribution consisting of a number of transformers having secondary working circuits, and with the primaries in multiple on a single supply circuit. The claims of the previous patent were for transformers arranged in multiple, and for a system wherein the currents supplied by the secondaries to the working circuits are of greater amperage and less potential than the current in the primary. It may here be recalled that the Stanley patent, recently sustained by the courts, related to the self-regulation under variable loads of the secondaries of transformers connected in multiple. Should the actual importance of the first-mentioned patents correspond to the time required to get them through the Patent Office, it seems likely that they will give rise to another Berliner situation. In view of the fundamental claims of these belated transformer patents, they promise to provoke an interesting litigation in which, in all probability, the question will again be taken up as to the validity of patents covering fundamental principles of an art, which patents were not issued until many years after the art they would control had become highly perfected and of world-wide application.

Alternating-current versus Direct-Current Elevator Motors.

Professor Sever, in his paper on this subject, read last week before the American Institute of Electrical Engineers, afforded an excellent opportunity for a contest between the advocates of direct-currents and alternating-currents. The facts he presented are very interesting. He says that there are approximately 3,300 electrically operated elevators in New York City, of which about 91 per cent. are run by direct-current motors, and 9 per cent. by alternating-current motors. Of course, as the paper points out, New York is, on the whole, a city of direct-currents, so that these proportions are not a criterion of the relative advantages and selectiveness of the two types. Nevertheless, it is held by many that the alternating-current motor is at a peculiar disadvantage with respect to the direct-current motor in regard to hoisting and elevator service, and this in turn is responsible for a large number of converters that otherwise had never been installed on alternating-current supply systems for the ultimate delivery of direct currents.

A remarkable feature of the results contained in the paper is that the power-factor of the alternating-current elevator motor, contrary to popular impression, is much higher when starting than when running—namely about 0.88 at starting and only about 0.36 when running. In the ordinary induction motor, properly installed, this is not the case, and the power-factor at full speed is considerably greater than the power-factor under acceleration. It seems, however, that in order to be prepared for all emergencies, the alternating-current elevator motor has to be installed of relatively large capacity for its ordinary duty, not possessing the same inherent reserve for overload as its direct-current prototype.

According to the data of the paper, the average alternating-current multiphase-elevator motor takes about 20 per cent. more power for its operation by the month than does the direct-current motor. This, however, in the ordinary large dwelling house, or apartment house, is not a very serious matter, because the total energy required for the daily supply of such a motor is not very large. The more serious difficulty in the case of the motors considered is the relatively larger starting currents that they consume, and which fall heavily upon the pressure-regulating capacity of the conductor system to which they are connected.

The defects implied in Prof. Sever's paper are surely not ineradicable. They will, let us hope, be removed at some time in the future. Even now the Heyland induction motor bids fair to bring up the power-factor under running condtions to nearly unity; although the starting power-factor may not yet be much improved. It should also not be lost sight of that in the comparisons of Prof. Sever, the apparatus of a comparatively old and highly-perfected direct-current motor application is contrasted with an alternating-current motor application of recent date, and one which thus far has received little or no attention from the leading designers.

Some Recent Lamp Tests.

Two notes in this week's Digest afford food for reflection on the subject of lighting. One is a report on a most elaborate series of tests on 200-volt lamps, the other a note on tests of Nernst lamps. There seems to be little doubt that the use of high voltage incandescent lamps is on the increase. Foreign, especially English, practice has tended strongly in this direction for some time past, and although comparatively few central stations in this country are operated on this basis, there are numerous isolated plants worked at 200 volts or more, and a good many lamps are used on the outside wires of Edison systems for 110 volts, merely as a matter of convenience. The stubborn opposition of the insurance people has very greatly hindered an extension of the practice, but this characteristic attitude will yield in course of time if the high-voltage lamp proves to be worth fighting for. In the tests described, lamps from four prominent German makers, to the number of 150, from each, were put through careful life and efficiency tests. The results, to tell the truth, were not particularly encouraging, as it appeared that such lamps were subject to rather rapid deterioration, and ended their useful life at about 400 hours. The average consumption of energy was about 4.5 watts per candle, which is certainly nothing to brag of. The extreme tenuity of the carbon filaments in lamps for such high voltages seems to increase the chances of deterioration and breakage very greatly, and they undoubtedly work best in the larger sizes; 24 or 32-cp lamps should do on the whole materially better than those of less capacity, and they are freely used in some of the high voltage plants.

But the evidently low efficiency at once raises the question of equity as between central station and consumer. Of what advantage is it to the everyday patron of the central station to use 220-volt lamps at 4.5 watts per candle and a dubious life? On the whole, we believe that American incandescent lamps are materially better than those made abroad, but as between 220 and 110-volt lamps there is about the same outstanding difference here and there. Are central station managers who, to help their distribution systems, wish to use 220-volt lamps, prepared to concede to consumers employing such lamps a discount large enough to fully cover the working decrease in efficiency? Otherwise where does the consumer come in? Of course, in cases where a capacity charge or its equivalent is made, the station could readily put on a certain pressure to favor the 220-volt lamp, but could not go far in this direction without getting into litigation for discrimination. It is safe to say that general rates cannot be raised successfully by this or any other device, assuming the load to be metered; but if the circumstances of a central station permit a discount to users of high voltage lamps great enough to cover the difference in efficiency, we fancy there would be little objection save from those chronic kickers—the underwriters. Assuredly economical distribution in a large modern city requires more than 110 volts even on a three-wire system, and so long as one sticks to continuous current, distribution remains a very serious matter. The modern plan of substations with rotaries relieves the situation somewhat, but still there is no doubt that the introduction of high-voltage lamps in a way to compete on even terms with those now in use, would be welcome enough in many places.

And now comes the Nernst lamp with no small claims to consideration and some compensating disadvantages. It is particularly suited to high-voltage distributing circuits; but has a strong preference for alternating ones; it must be used, so far as American practice goes, in a minimum unit of about 50 cp; it has a high initial efficiency and a good color; as to life, that is a matter which remains for practical operation to determine. Abroad, as witness the Digest article, some progress seems to have been made in adapting it to use on continuous current circuits, a claim of 350 to 400 hours' life, and an average efficiency of 2 watts per cp being made. This on its face is a very great improvement over a 200-volt incandescent with a life of 400 hours at 4.5 watts per candle. No figures on the costs of renewals are available however, nor any on the first costs of the German lamps. In this country the prices of the Nernst lamps are comparable with those of arc lamps, and the repair and renewal bill is a very uncertain quantity. There seems to be a wide difference between recent tests of Nernst lamps of different manufacture, which suggests the probability that the device has been worked out along somewhat different lines by the various licensees, so that data must be restricted in their application to the lamps from which they were obtained. Some of the tests which have been published show the efficiency of the Nernst glower as falling off in almost exactly the same way as the efficiency of a Welsbach mantle, so that the effective life is limited and the average efficiency nearly 3 watts per cp; while others show a longer life and fairly steady efficiency at 2 watts per cp. If the results we have quoted above as obtained on continuous current circuits were confirmed, the Nernst lamp would certainly be a serious factor in the incandescent lighting situation. If other tests are typical of its average performance, it will cut out a field of its own—as it doubtless could. It would be an excellent thing for some of our larger institutions to get after the Nernst lamp in earnest the coming season, and to make such a series of tests with examples of American and foreign make, as would leave no doubt as to the present state of the art. At present we have information in stock to suit any conceivable taste, but in general, it is most decidedly of a very hopeful cast.

National Electric Light Association.

[illegible] Passenger Association have confirmed the rate of a fare and one third made by the Central Passenger Association for delegates attending the Cincinnati Convention of the National Electric Light Association, to be held May 20, 21 and 22. A reception committee has been formed at Cincinnati, including prominent members of lighting and manufacturing companies, and is actively at work planning entertainment for the ladies attending the convention. A trolley ride to Rookwood Pottery has been arranged, a visit to the Museum of Fine Arts, a trolley trip through the city and suburbs to the Cincinnati Zoological Gardens, where a luncheon will be served. The Bullock Electric Manufacturing Company have arranged to take members by special train to and through their works. The programme for the meeting will include, in addition to subjects announced, papers and discussions on "Boiler Firing with Oil," "Best Efficiencies for Incandescent Lamps," "Advantages of Gas Engines," "Signs and Decorative Lighting," "Steam Turbines," "Protection of Long-Distance Transmission Lines," "The 220-Volt Lamp." The Question Box already contains over twenty inquiries that will be answered, in addition to those answered by the papers, discussions and reports on the programme.

Electro-Therapeutic Congress at Berne, Switzerland.

We have received from Mr. R. G. Brown, U. S. member of the International Committee, a copy of the advance circulars on the Second International Congress on Electro-Therapeutics, to be held at Berne, September 1-6, this year. It promises to be a very interesting affair. The first congress was held at Paris in 1900. At that time it was voted to hold an International Congress periodically every three years, but, to avoid clashing with other congresses, it was resolved that the second congress be held in 1902, and at Berne. The following international committee were then elected, and charged with the arranging of future congresses: M. Tripier, Paris, President; E. Doumer, Lille, Secretary; A. Moutier, Paris, Assistant Secretary; Boisseau du Rocher, Treasurer; Benedikt, of Vienna; R. G. Brown, of Brooklyn, N. Y.; Chatzky, of Moscow; Dubois, of Berne; Grunmach, of Berlin; La Torre, of Rome; Leduc, of Nantes; Provost, of Geneva; Schiff, of Vienna; Weiss, of Paris; W. Salomonson, of Amsterdam.

The details of organization of this second International Congress have been entrusted to a local committee, and already an excellent programme has been prepared. The men at the head of the local organization are M. Pasche, director of the Institute of Radiography in Berne, and Mr. Oppikofer, director of the city electrical works. There will be an exhibition of apparatus pertinent to the subject. The programme is as follows: (1) The present state of electrodiagnosis, by Dr. Cluzet (Toulouse), Dr. Mann (Breslau). (2) Surgical electrolysis, by Dr. Guilloz (Nancy). (3) Radiography and Radioscopy of the internal organs, by Dr. Béclère (Paris), Prof. Grunmach (Berlin). (4) Accidents caused by X-rays, by Dr. Oudin (Paris). (5) The danger of industrial electric currents, by Dr. Battelli (Geneva). There will be other papers and discussions. The report of the previous congress makes an octavo volume of 860 [illegible]

More New York Tunnels.

In connection with the instruction of the New York Rapid Transit Commission, the chief engineer, Mr. Parsons, will begin at once to consider plans for an underground railroad up the east side of the city. As is well known, the city's finances at present are such that a contract for a new subway is not immediately possible, but the commission has power to have its engineers prepare all the plans with a view of building the tunnel as soon as conditions permit, or as soon as special laws may be enacted to make possible an extension of the debt limit.

Electrical Engineers of the Day—XLIV.

M. H. GERRY, JR.

Martin Hughes Gerry, Jr., was born in Boston, Massachusetts, October 16, 1868. While still young his parents moved West. In 1890 he graduated from the University of Minnesota, taking degrees in both mechanical and electrical engineering. Afterwards he entered Cornell University, taking post-graduate work in mechanical and electrical engineering, and special work in alternating currents, and securing a Master's degree.

Previous to entering college, Mr. Gerry had had considerable practical experience in drafting, mechanical construction and railway work. His first work, after graduation, was with the Sprague Electric Railway Company. Later he was with the Thomson-Houston Company, and for several years located at St. Paul in the railway and power department of this company. During this time nearly all the electric railway and many large power plants were constructed in the Northwest. Mr. Gerry was connected more or less with the design and construction of these pioneer plants, including the street railways of St. Paul, Minneapolis, Duluth and the North Pacific Coast cities. After the consolidation of the Thomson-Houston and Edison companies he remained with the General Electric Company for several years. When work was commenced upon the Metropolitan Elevated Railway of Chicago, he entered the employ of the West Side Construction Company, which concern built and equipped this road, and remained with the same company as engineer during the construction period and afterwards was superintendent of motive



power of the road, having in charge all power houses, shops and rolling stock. It will be recalled that the Metropolitan Elevated was the first elevated railroad in this country equipped electrically for regular service, and was from the first an entire success.

After leaving the Metropolitan road, Mr. Gerry was engaged for some time with the Northwest Engineering Company in designing water power and transmission plants. He went to Montana in 1898 to take charge of the engineering and construction for the Helena Water and Electric Power Company, at that time building a dam and power plant on the Missouri River, for the transmission of power to Helena. The Helena Water and Electric Power Company has since been reorganized as the Missouri River Power Company, of which company Mr. Gerry is at present chief engineer and general manager. This company owns and operates a large power plant, located on the Missouri River, about 18 miles from Helena, Mont., from which electrical power is supplied to the cities of Butte, Helena, and their environs. The distance from the power plant to Helena is 18 miles, and the transmission at 12,000 volts. The distance to Butte is 65 miles, and the transmission at 50,000 volts. The power at Helena is used for lighting, street railway and industrial purposes, including the operation of one of the smelters of the American Smelting and Refining Company, and of ore concentrating mills, etc. At Butte the power is used in connection with the operation of the mines, smelters and mills of the Anaconda Copper Mining Company, Boston and Montana Mining Company, Butte and Boston Mining Company, Colorado Smelting and Mining Company, Parrott Silver and Copper Company, Washoe Copper Company, etc.

Mr. Gerry is a member of the American Institute of Electrical Engineers, American Society of Civil Engineers, Western Railway Club, and several other engineering societies and clubs.

Electricity in Austria-Hungary.

BY FELIX HOSCHITZ.

THE application of electrical energy is always dependent upon two important factors—the demand of the industries for a cheap and easily distributed form of power and the presence of cheap sources of energy such as coal or water power.

Austria-Hungary is amply provided with both of these forms of energy. The coal mines in the north of Bohemia and in the north of Hungary can easily meet the demands of the home market, and besides export a considerable quantity of high-grade coal. The Alps and Carpathian mountains, which cover one-fourth of the monarchy, are rich in water powers. However, the same conditions prevail here as in other mountainous countries, *i. e.*, that these districts are poorly populated and devoid of industries; so that the latter cheap form of energy can be utilized only to the extent of furnishing light to the surrounding towns and villages. The large cities and industrial centers are forced to rely upon coal as the source of energy. It is true that in Austria the industries do not progress with such giant steps as in America, but they show a healthy and continual advance.

A great number of native firms have in the course of the last few years endeavored to increase the application of electricity for light and power purposes, and with great success, and a number of foreign (German and American) firms have established sister companies to compete with them. The consequence of this is that a large number of power plants have been erected, of which the most important and interesting will be here described.

Before entering upon a resumé of the results accomplished in Austria-Hungary in the field of electrical engineering, it may be of interest to call attention to the work of the two engineers, Pollak and Virág, of Budapest (the latter died in October, 1900, at the early age of 31). Their latest achievement is the writing telegraph, which is probably well known in America, and hence a brief description of the general principle will suffice here.

The transmitter consists of a metal drum revolved by a motor, and over which passes paper strips perforated with the required letters. The current impulses are transmitted over two circuits. The receiving instrument consists of a double telephone, the movement of whose diaphragm causes a small mirror to be deflected; a beam of light from an incandescent lamp falls upon this mirror, which, when reflected, registers the movement of the diaphragm upon a strip of sensitized paper which is rapidly unrolled from a drum and immediately developed and fixed. In the course of the last year the inventors have made an improvement, enabling them to produce hand-

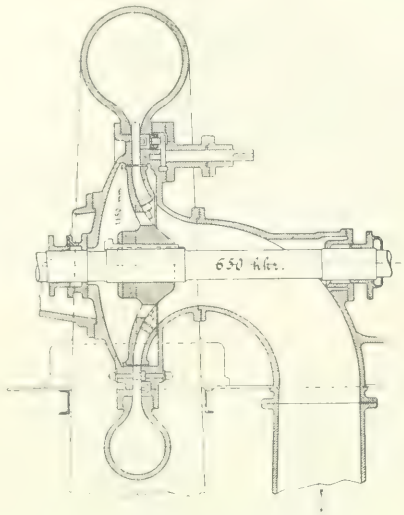


FIG. 1.—FRANCIS TURBINE.

writing. In trials made with this system over a distance of 360 miles (Budapest—Fiume) a speed of 70 letters per second was attained—that is, approximately 4,000 words per hour—which exceeds anything that has previously been attempted in this direction.

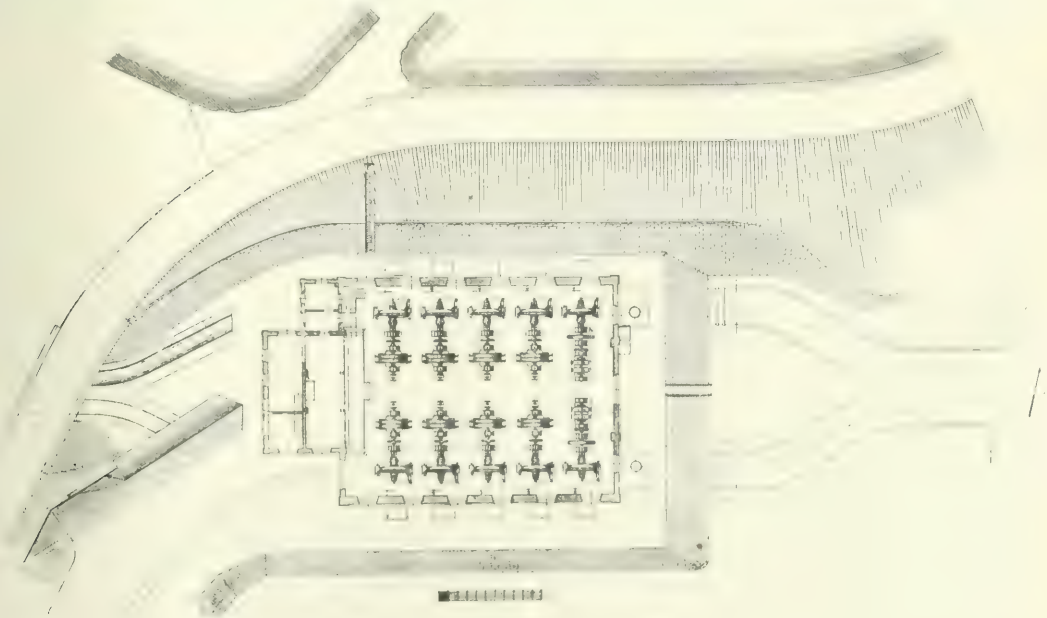


FIG. 2.—CAPITAL CASTLE GREAT AUSTRIA PARK.

Another Austrian achievement is accredited to Don Carlo von Auer-Welsbach, whose name is well known all the world over through his invention of the famous incandescent gas light mantle. He has lately succeeded in converting the rare metal osmium, pre-

viously known only as a powder, into thread form. This intractable and almost infusible metal Welsbach uses as a filament in his new osmium lamp. While the ordinary incandescent lamp consumes over three watts per Hefner candle and the new Nernst lamp, 1.7 watts, the osmium lamp is said to require 1.45 watts at the beginning and after burning 1,500 hours, 1.7 watts. A remarkable feature of this lamp is that if after long use the filament becomes defective, it can be restored to its original condition without either removing it or the bulb. As the resistance is low in these lamps, it is made for voltages from 20 to 50 volts.

Electric light and power plants have in the course of the last few years been erected in most of the towns of the monarchy, even in the small ones. Vienna, the capital, has had for a number of years



Map of Vienna Electric Railway System.

three central stations erected by private companies. As these were, however, unable to furnish sufficient power for the proposed electric tramway system—to replace the horse tramways—in addition to carrying their own lighting load, the city council decided to erect its own central station, which has recently begun operation.

There are two independent generating stations, one of which carries the railway load, the other the lighting and motor load. The engine room of the tramway plant has a floor space of 3,530 square meters and contains five 2,000-kw generators direct connected to 3,000-hp four-cylinder, triple-expansion engines and delivers three-phase currents at 5,000 volts. Steam is generated in twenty Babcock & Wilcox water-tube boilers. The whole steanf plant is equipped [illegible] operation.

The three-phase currents at 5,000 volts are distributed to five sub-[illegible] stations contains from 2 to 7 motor-generator sets. Each has a capacity of 800 hp, and consists of a synchronous motor direct-coupled to a 570-volt direct-current, shunt-wound generator. These operate in parallel with a storage battery and feed the many branched tramway circuits of which we shall come to speak later.

The power house which is to supply the current for lighting and for power purposes is approaching completion, and will be in operation by August of this year. The engine room has a floor space of 2,050 m². There are at present three 2,000-kw three-phase 5,000-volt generators. The current is distributed to the five substations and transformed by separate motor-generator sets into direct-current at 2 x 220 volts. The direct-current is distributed throughout the city by a three-wire net work. By special agreement a consumer can be supplied with three-phase currents at any desired voltage up to 5,000 volts. The output of this generating station can be increased to [illegible] kw.

It may be of interest to mention something of the charges for current, which have been made very low to compete with the existing companies. For lighting, the price per kilowatt-hour is 14 cents where the lamps will probably be used less than 600 hours per year. For a greater consumption the price is reduced to 9 cents per kilowatt-hour. For power purposes the charges are 8 cents per kilowatt-hour, a reduction of from 3 to 50 per cent. being made according as the number of operating hours exceed from 200 to 4,000 hours per year. The charges for meter rental are from $2.50 to $11 per year, according to the size of the meter.

The central station of the "Internationalen Elektricitätsgesellschaft," erected in 1890, has recently been enlarged, two 1,000-kw two-phase generators being added. The total capacity of this plant

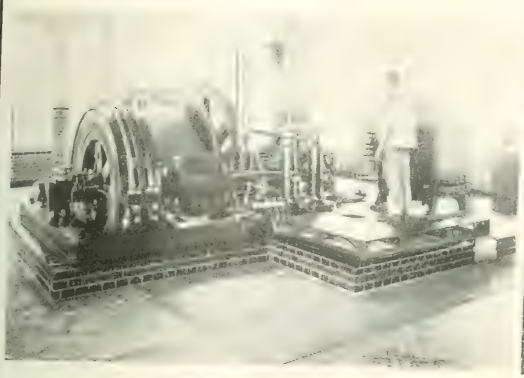


FIG. 4.—RICHARD SHAFT HOISTING PLANT.



FIG. 7.—MINING LOCOMOTIVE.



FIG. 5.—RICHARD SHAFT PUMPING PLANT.

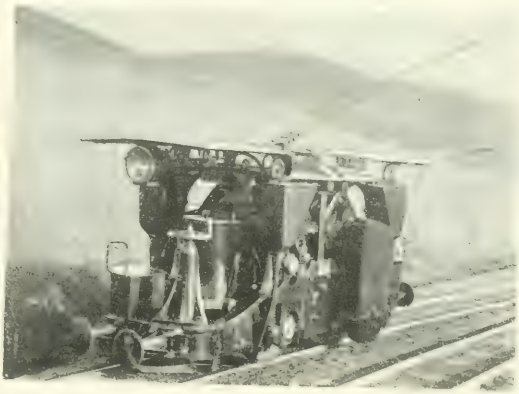


FIG. 8.—MINING LOCOMOTIVE.

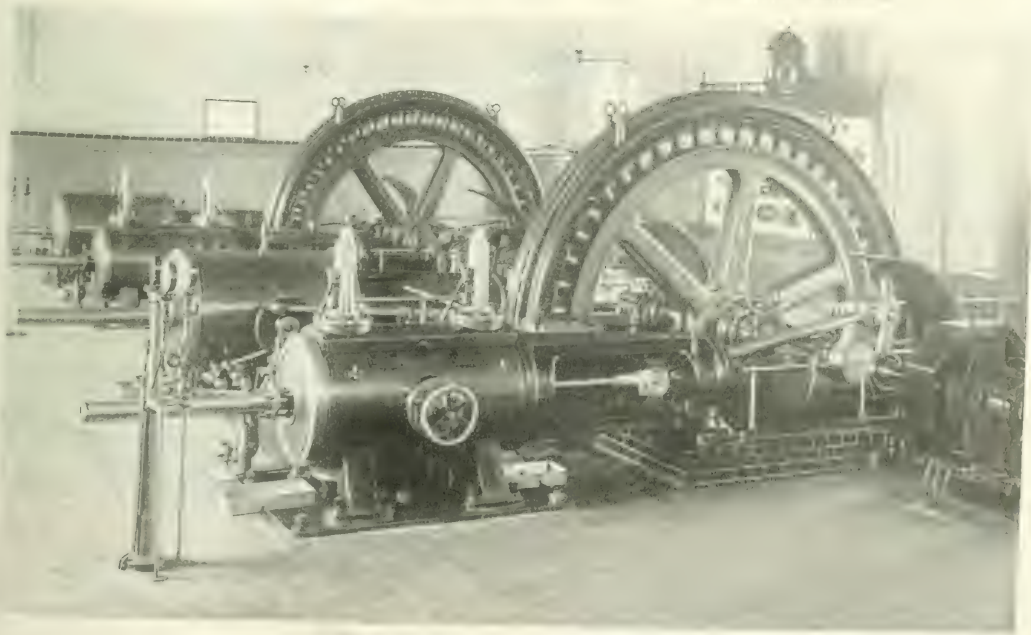


FIG. 6.—RICHARD SHAFT GENERATING PLANT.

is 15,200 hp. The two-phase generators were built by Ganz & Co., of Budapest and Leobersdorf, near Vienna.

Another large plant recently completed has been built in Jaice (Bosnia) by the Elektricitäts-Actien Gesellschaft Schuckert & Co., for the purposes of utilizing the water power of the river Pleva for the production of calcium carbide. The river forms a large lake, used as a reservoir, from which the water flows over a series of

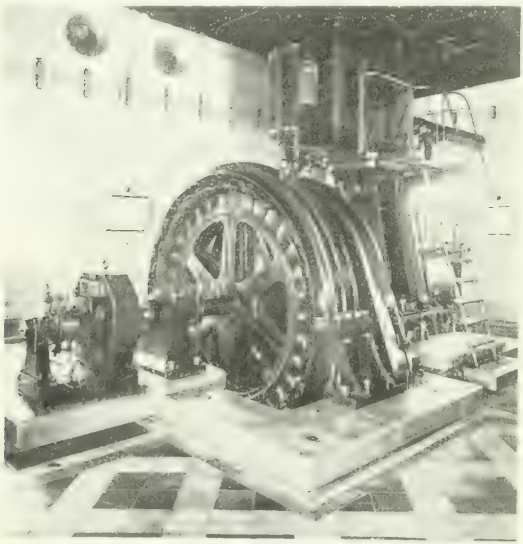


FIG. 9.—MARIA SHAFT GENERATING PLANT.

cascades into the river Vebas, some 250 feet below. From the upper lake the water is conducted partly through open channels and partly through tunnels for a distance of two miles, and with a 1 per cent. drop to two nearly vertical steel pressure tubes leading to the power house below. There are eight turbines, each of 1,000 hp, at 300 r. p. m. (see Fig. 1), and two turbines, each of 632 hp. All the turbines are reaction turbines of the Francis type. The smaller turbines are each connected to two direct-current generators, which supply the circuit for lighting the town and vicinity. Each of the 1,000-hp turbines drives a three-phase generator of 1,000 amperes' output at 155 volts. This current is directly transmitted to the carbide furnaces. Fig. 2 shows a plan of this plant.

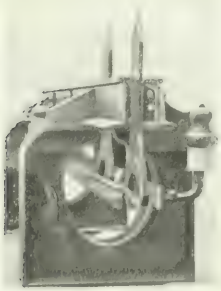


FIG. 10.—[illegible]

An interesting piece of engineering work recently completed deserves mentioning. It consists of a hoist to raise freight cars containing dutiable goods from the railroad tracks to the custom house, which is located on a considerably higher level. This hoist or elevator is capable of raising 15 tons a distance of 20 feet in 2 minutes. Daily 120 to 150 cars are handled by it. The two platforms are entirely independent of each other, each being operated by a 40-hp motor.

The above leads us to mention a number of electrical installations made in the mines o fthe monarchy to further their rational and economical operations. Figs. 6 and 9 give views of such plants, erected by the Austrian Schuckert Company, for the coal mines of north Bohemia—namely, for the Maria and Richard shafts. Special attention is directed to the method of driving the exciters. Fig. 4 and 5 show the hoisting and pumping engines of the Richard shaft.

Naturally the coal mines are also equipped with an underground system of electric tramways to facilitate and cheapen the handling of the coal. Figs. 7 and 8 show two mining locomotives, built by the previously mentioned firm of Ganz & Company, of Budapest, for the coal mines of north Hungary. Each locomotive weighs 8 tons, and is capable of drawing a train of 60 coal cars, each car holding 2,200 pounds, at a speed of 7 miles per hour. The locomotives have two motors and are mounted on movable trucks, enabling them to round the sharpest curves encountered on such underground roads.

In the following we shall summarize the development of the electric railway in the monarchy. The electric railway is by no means as extended as in the United States, but the number of roads operating with electricity is steadily increasing as the almost weekly concessions granted by the ministry for railways tend to show. The electric railways at present in operation are all street tramways, as the application of electricity to railroads has as yet found but little encouragement.

The latest statistics give Austria a total length of electric roads of 150 miles and Hungary 96 miles. Vienna's extensive tramway system, which was only completed and put in operation in February of this year, is not included in the above statistics. Fig. 3 shows this system with its many branch lines. Its total length is 105 miles. The greater portion, 90 miles, is operated with the overhead trolley.

In order to preserve the architectural beauty of some of the streets, an underground system of supply was resorted to. The system adopted is that of Siemens and Halske, as employed in 1897 in a very similar manner in connection with the Budapest tramways The general construction of the conduit and the arrangement of the conductors is seen in Fig. 10. At intervals of about 7 feet iron castings are set into the concrete wells of the conduit, and to these the slotted rail is bolted. The conductors are supported every 11 feet by insulators suspended from the rail. The construction is such as to facilitate the quick removal and replacement of an insulator from the street, hand holes being, of course, provided. The contact shoe



FIG. 11.—VIEW ALONG THE LINE, SHOWING THIRD RAIL.

is made of wood and sheathed with metal. It has two lateral wings which are pressed against the vertical contact surfaces by springs. The movement of the contact shoe is controlled by the motorman, who can easily insert it into the slot or withdraw it at will, thus enabling the same car to use either the underground or overhead systems.

Nine miles are now thus equipped, the results attained being satisfactory.

A local standard gauge steam road passes through Vienna over a road bed containing many curves and bends. The present service of trains hauled by steam locomotives has proved unable to meet the demands of the ever-increasing traffic on an economical basis. It was, therefore, decided to substitute electrically-operated trains. For this purpose an experimental road, 2.3 miles long and with a maximum grade of 1.8 per cent., was first built. A portion of this line is seen in Fig. 11, which also shows that the current is taken from a third rail. The trolley rail has a cross section of seven square inches, and rests without special fastening on insulators supported by the ties. Every car has a separate motor and controlling device. The multiple unit system, well known in America, is here used, the whole train being controlled from the forward car. Shunt motors were used so that in going down grade and in braking a portion of the power can be regained. There is also a short-circuit brake and a vacuum air brake.

The whole equipment of this experimental road and of the four heavy passenger coaches was carried out by Siemens and Halske. The success of these trials, which are still being continued, will probably lead to the reconstruction of the whole present steam road system.

In concluding, attention will be called to the street tramway system of Czernowik. Unusually unfavorable grade conditions were here met with. There is an average grade of 6.6 per cent. and on short stretches even as high as 10.4 per cent. A case of this kind is rarely met with in street railway work.

The Synchronous Converter as Voltage Controller—I.

By M. Seidner.

THE automatic voltage control of a combined alternating-continuous current-transmission system, using synchronous converters, is one of the most important problems in electrical engineering. The elegance with which this problem can be analyzed graphically, and the harmony existing between the theoretical results and practical application make its investigation interesting and worth the trouble.

The difficulties encountered in solving this problem are based upon the properties of the alternator and converter, either of which ought to control the voltage automatically. The voltage of the converter—the terminal link of the potential chain consisting of alternator voltage, voltage drop in transmission line and converter voltage—cannot be regulated from the generator-end on account of the kinetic independence of the different links, as will be shown. In the case of a continuous-current system, the voltage control is a simple problem, for the voltage components (generator voltage, voltage drop and receiver voltage) are unidirectional, and, therefore, either quantity is determined by the other two. But the capability of the alternating-current circuit for electromagnetic induction causes the voltage vectors to spread out into the shape of a triangle, and consequently we must know also the angle formed by the two sides (generator voltage and voltage drop) to determine the third (receiver voltage). In other words, the device for governing the voltage of such a system must be sensitive not only to the quantity, but also to the character of the load. This necessitates having the voltage controlled at the converter. The field of the synchronous converter, however, has no direct influence on the voltage of the continuous current. This voltage rather is dependent on the impressed e. m. f. The variation of the magnetic flux results only in change of phase relation.

This suggests the idea of employing this character of synchronous machines for indirectly regulating the voltage by changing the field of the converter; that is, by balancing with the idle current in such a manner that the receiver voltage can follow the prescribed path.

How this can be done I shall try to show in the following graphical treatment. (For a mathematical analysis of this problem see E. I. Berg, Power Transmission and Distribution for Railway Work, *Transactions* of A. I. E. E., 1898):

The converter as a synchronous machine operates according to the well-known diagram of such machines. In Fig. 1 the line OX represents the direction of the current vector, OY the direction of the e. m. f. necessary to overcome the reactance voltage—the vectors revolving clockwise. From the data of the machine the impedance line OZ is determined. Assuming the length $OP_1 = e$ to represent the e. m. f. between the collector rings of the synchronous converter, and OZ_1 the voltage drop in the armature, P_1Z_1 will be its counter e. m. f. By taking the length OZ_1 as the voltage drop caused by the so-called "synchronous reactance" of the machine, P_1Z_1 will be proportional to the exciting current. The rectangle $A\,B\,O\,C$ represents the power received by the converter. But the same power may be taken with the same e by changing the counter e. m. f. P_1Z_1 with different phase relations, thereby moving point A on an equilateral hyperbola $H - H$. With the counter e. m. f. Z_1P_2, the converter, for instance, takes the same power with the same amount of current from the line; but while the current lags in the former case it leads in the latter.

The synchronous converter, we see, is capable of taking a lagging or leading current from the line by changing its field excitation P_1Z_1. This property of synchronous machines is used in many instances to increase the power factor of a system.

Changing the diagram by taking $O\,P_1$ to represent the induced e. m. f. of the alternator and P_1Z_1 the terminal voltage of the converter, $O\,Z_1$ will be the voltage drop in the alternator and line. Obviously, the same voltage $O\,P_1$ with the same amount of current $O\,Z_1$ will produce a terminal voltage smaller or greater than the cophase voltage, as the current lags or leads. P_1Z_1 is the terminal voltage with a lagging, P_2Z_1 with a leading current, $P_2Z_1 > P_1Z_1$.

The conclusion from the foregoing is that by turning the lever of the field rheostat of the synchronous converter we are able to alter its terminal voltage at the alternating side; and at the continuous-current side indirectly by changing the phase relations. The converter is even capable of doing this work automatically, as will be shown later.

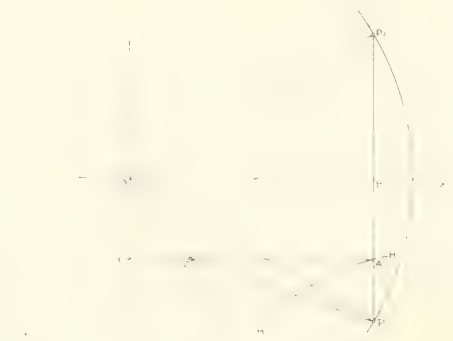


FIG. 1.

Regarding the voltage control, in practice a constant terminal converter voltage, or one increasing with the load, is mostly desired. The alternator is given a constant excitation, or by compensation it is made capable of keeping its voltage constant. The simplest problem for a theoretical treatment is that of a constant voltage at the converter terminals, and a constant alternator exciting current. Now, instead of separating the armature reaction into self-inductive, magnetizing and demagnetizing components, respectively, let us consider them as one or "synchronous reactance." Then the constant excitation at constant magnetic reluctance corresponds to the induced armature voltage completely. (See Steinmetz, "Alternating Current Phenomena.")

Let E = induced e. m. f. of alternator at open circuit.
e = terminal voltage of converter.
r = resistance of alternator armature and line
X = synchronous reactance of armature and line.
Z = synchronous impedance of armature and line.
Z_1 = synchronous impedance of converter.
a = energy taken by converter.
A = energy of alternator.
ϕ = phase angle at converter.
ψ = phase angle at alternator.
α = impedance angle [illegible]

In Fig. 2 the familiar diagram of power transmission is given. The horizontal line $O\,X$ shows the direction of the current vector, I, II, III are the impedance lines of the alternator, line and converter; $O\,Z$

is the resulting impedance line of the alternator and line. The constant alternator voltage, E, is represented by the circle $K-K$. This voltage appears at the converter terminals as $e = P Z_2$, after the voltage components $O Z_1$ and $Z_1 Z_2$ have been used for driving the current through the alternator and line. If $Z_2 Z_3$ is the voltage drop in the synchronous converter, then $P Z_3$ represents its counter e. m. f. and exciting current. The energy A transferred from the prime mover to the alternator is proportional to the rectangle $A B O C$. Of this



FIG. 2.

the converter receives $A B D Z_2$, and the rest, $D Z_2 C O$, is lost. The increasing current shifts the point Z_2 toward the outside on the line $O Z$, while the other terminal point, P, of the voltage-vector $Z_2 P$—which remains constant—travels along the circle $K-K$. For each current amplitude we can and must design a new diagram.

This diagram is a "snap-shot" of the power transmission; but the clearness and possibility of rapid construction—the most excellent points of graphical illustrations—vanish as soon as the different vector quantities are set in motion by the changing load. Every point of the diagram will then describe a different path, mostly of a higher order, and the mental eye tires in following them. But the engineer



FIG. 3.

requires a "moving picture" of power transmission, which not only refers to a momentary condition, but also illustrates the occurrences under a variable load.

By retaining the voltage-vector in the case of variable currents instead of the current-vector, the geometric path of point P will be a circle with $O_1 P = E$ as radius. The diagram arising from this is [illegible] The fixed vector is $O O_1$ [illegible] $P_1 Z_2$. By drawing a circle with a radius $O_1 P = O P_1 = E$ with O_1 as its center, and then $Z_2 P_1 \parallel O P$, the triangle $O_1 O P$ will be the reflected picture of the triangle $P_1 Z_2 O$; consequently, $O P = O Z_2$. But as $P_1 Z_2$ is parallel to $P O$, the angle $P O X$ represents the difference of phase between the current and e. By drawing $O Q$ parallel to $Z_2 Z_3$, and $\frac{O P}{Z_2 Z_3} = \frac{O Q}{Z_2 P}$, the triangle $O P Q$ will be the enlarged reflection of triangle

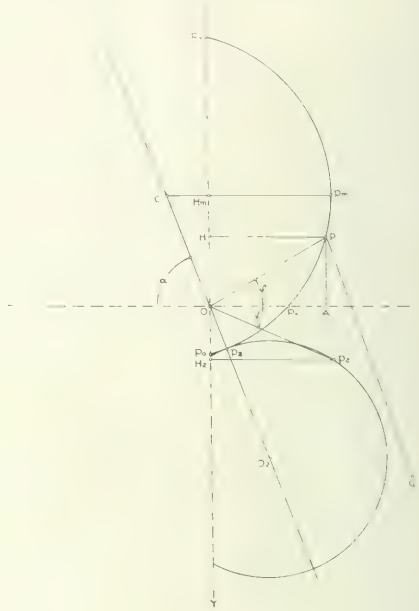


FIG. 4.

$Z_2 Z_3 P_1$, and, consequently, $P Q$ is proportional to $P_1 Z_3$; i. e., $P Q$ gives the excitation of the synchronous converter. The location of Q is determined only by Z, Z_1 and e, consequently is fixed in its position independent of the load.

The power delivered to the converter is $a = \frac{P O}{Z} \cos \zeta \, e$; but as e is constant, this power is represented by $H P$ in a corresponding scale.

In order to determine the output, A, of the alternator, the vector $E = O O_2$ is fixed and a circle struck with $O_2 P_2 = e$ as radius; then the triangle $O O_2 P_2$ is the reflected picture of triangle $O P_1 Z_2$; consequently, $O P_2 = O Z_2$, i. e., $O P_2$ represents the current, and ψ the difference of phase between E and the current. $P_2 H_2$ is the power delivered to the alternator. For measuring this energy vector with the scale of the converter energy vector, the transposing factor is $\frac{E}{e}$.

The new diagram of power transmission with constant induced e. m. f., and constant converter terminal voltage, without construction details, is shown in Fig. 4. As the load changes, P travels on the characteristic circle $K-K$. $P O$ thus gives the current with its working component $P H$ and idle component $P A$. The phase difference at receiving end is γ; $P H$ equals energy received by the converter, $P_2 H_2$ equals energy consumed by alternator, whereby $O P_2 = O P$; ψ is the phase difference at generator, $P Q$ equals corresponding excitation for converter.

The scale for the different quantities is as follows:

Current $= \frac{P O}{Z}$ ampere.

Energy $a = P H \frac{e}{Z}$ watt.

Energy $A = P_2 H_2 \frac{E}{Z}$ watt.

Counter e. m. f. of converter $= P Q \frac{e}{Z}$.

The current lagging 90 degs. is $O P_0$; for this current $a = o$, but A already has a certain value. As the current approaches the voltage,

it diminishes in quantity, yet a and A increase. The smallest value of the current is $O P_z$. Passing $O P_z$ the current increases. $O P_x$ is the co-phase current. Beyond this position the current leads. $P_y O$ is the current leading by 90 degs., and beyond P_y it reverses. The alternating side of the synchronous converter operates as a generator, and the converter draws current from the continuous-current side.

The excitation of the converter must be first continually diminished, until $O Q$ intersects the characteristic circle, beyond this it must be increased.

The maximum energy taken by the converter, $a_{max} = P_m H_m$; that consumed by the alternator $A_{max} = P'_m H'_m$. Evidently the stability of the converter reaches the indifferent position prior to the alternator.

The diagram given in Fig. 4 can also be used for determining the balancing power of synchronous machines running in connection. The angle $O O_1 P$ represents the phase difference between the generator or line voltage, and that of the receiver. Any deviation from the synchronous speed swings the vector $O_1 P$, altering the angle $O O_1 P$, thereby the load $P H$ changes, endeavoring to keep up the balance on the lower quarter of the characteristic circle, and making the system unstable on the upper quarter. If $\tau = o$, point O_1 will be located on the ordinate axis, and we get the fundamental formula $P H = E \cdot e \cdot \sin O O_1 P$.

The diagram given in Fig. 4 is correct only when the excitation of the synchronous converter is of a quantity corresponding to $P Q$.

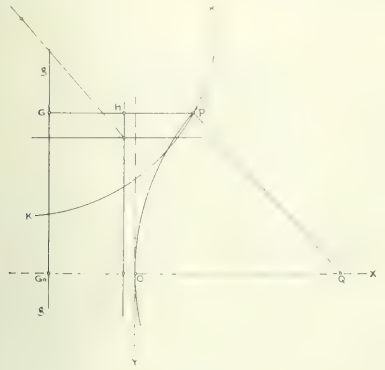


FIG. 5.

For loads changing slowly, as for lighting purposes, the regulation can be done very closely by hand. But for rapidly fluctuating loads—as those of electric railways—an automatic regulation of the field is desirable. The question is, Can this automatic regulation be done by compounding the converter?

The converted current is proportional to the watt component $P H$ of the alternating current. The m. m. f. of the series field varies as the length $P H$, while the m. m. f. of the shunt field is represented by the line g-g, which is parallel to the ordinate axis $Y Y$ and its distance $G_0 O = p$ (Fig. 5). The total m. m. f., therefore, is proportional to $G P$, and this again must be proportional to $P Q$ to obtain an absolutely constant voltage.

To find out the conditions under which these requirements are obtainable, let us attack the inverse problem first: What is the geometric location of point P, whose distance $P G$ from a fixed line $g-g$ is proportional to the distance $P Q$ from the fixed point Q? Let us take O as the origin of the rectangular co-ordinates $X X$ and $Y Y$, so that $O Q : O G_0 = P Q : G P = m$, in which case we get the polar equation of the line in question.

The equation of the line is:

$$(p + x)^2 m^2 = (m p - x)^2 + y^2, \text{ or expanded.}$$

$$m^2 p^2 + m^2 x^2 + 2 m^2 p x = m^2 p^2 + x^2 - 2 m p x + y^2,$$

$$x^2 (m^2 - 1) + 2 m p x (m + 1) = y^2.$$

This is the equation of a conical section, having the directrix $g-g$.

If $m^2 < 1$ = ellipse.

$m^2 = 1$ = parabola.

$m^2 > 1$ = hyperbola.

$m^2 = 0$ = circle.

Imagine the shunt current at equal m. m. f. reduced to the number of series turns; then m becomes the Z part of the number of series turns of the magnetic circuit. As such $m > 1$, and the curve will be a hyperbola. The axis of this hyperbola runs through point Q, and is vertical to the ordinate axis. In order to obtain an absolute voltage control, this hyperbola would have to cover the characteristic circle. Not only is this impossible, but a contact of higher order of the two curves is out of question, as the conic sections curve towards Q. We must, therefore, be satisfied with an intersection of the curves which is practically located, so that it corresponds to the normal load. The diagram, therefore, is approximately correct only within the enclosed section; beyond this it loses its value. Nevertheless, for practical purposes, this adaptation of the voltage is sufficient.

An absolutely constant voltage control is possible by using also the idle current component for field excitation. In this case the directrix $g-g$ contracts into a point Q and the hyperbola becomes a circle, which in certain cases can completely cover the characteristic circle. In the special exciter for compensating alternators—first suggested by Professor Andre Blondel—this principle is used by employing the whole current as armature reaction for excitation.

Melbourne, Australia, Municipal Plant.

THE municipality of Melbourne, Victoria, entered the electric lighting field in 1891 by the establishment of a street lighting plant, this being the first plant in the city. The area that had to be lighted by electricity was about 6,000 acres, and it was decided to install an arc lighting plant solely for this purpose. Twenty-four Thomson-Houston 50-light arc dynamos were installed, and were driven by four compound surface-condensing engines by the aid of countershafting. The main streets were illuminated by arc lamps, and the side streets by series incandescent lamps in circuit with the arcs. This system has been in operation ever since without the development of a single electrical fault in the arc machines.

In 1896 an Act gave authority to all municipal councils to establish electric lighting plants within their own area, and also gave power to these councils to purchase any electrical plant within their area at a valuation plus 10 per cent. within two years after the passing of the act. The Council of Melbourne availed itself of the opportunity of purchasing the three companies which had existed for several years in the city of Melbourne and in the same area. These negotiations having been concluded satisfactorily to all parties concerned, the council's engineer, Mr. Arnot, was instructed to proceed to England, America and the Continent to investigate the latest practices in electrical engineering, and to prepare specifications and call for tenders in London for the plant which he should consider necessary for the private and ultimate lighting of the whole of the city of



FIG. 1.—MELBOURNE MUNICIPAL ELECTRIC LIGHT PLANT.

Melbourne. The plant designed after this trip was commenced in 1900, and below we give a description of its principal features:

The new engine room, shown in Fig. 2, which is 96 ft 8 in. x 78 ft. 6 in., is in a substantial brick building. The roof is of double span and is supported in the center by wrought-iron columns. Under each span there is a 10-ton traveling crane with a span of 37 ft. The general arrangement is shown in the accompanying ground plan. The basement is utilized for the condensing plant, consisting

of surface condensers and steam-driven air circulating pumps. The exhaust steam pipes are also brought under the floor of the engine house and connected to a cast-iron common exhaust pipe 18 in. in diameter. The boiler house is 103 ft. x 62 ft., built of brick and well ventilated, and so arranged that a future extension will include the erection of coal bunkers above the stoke-hole, which will carry 500 tons of coal and feed into mechanical stokers in front of the boilers. The coal would then be elevated by a coal conveyor or electric hoist.

The boilers are of the well-known Babcock & Wilcox type, four in number, of an evaporative power of 12,000 lbs. of water per hour, and fitted with superheaters guaranteed to give a superheat of 150° F. The flue gases are taken away from the back of the boiler and passed through a Green economizer in two sections, each consisting of 240 tubes. The dampers are so arranged that either or both of the sections may be in use at one time, or the economizer cut out entirely by the use of a by-pass. The scrapers of the economizer are driven by an electric motor of 1 hp.

The engines are of the three-crank tandem vertical compound

diameter, driven by two electric motors direct-coupled, drive a strong current of air up the tower through the galvanized steel wire cloth, over which there is a constant volume of falling water. The water falls into a tank at the base of the tower, and returns to a large storage tank, already mentioned. This tower is of sufficient dimensions to cool the water required to condense 44,000 lb. of steam per hour. The condensers are situated immediately below the down-exhaust pipe from the engines, and between each condenser and main exhaust there is an automatic exhaust valve which will open to the atmosphere automatically should the pressure in the condenser exceed 3 lb. per square inch. The engine driving the circulating and air pumps is compound condensing, and is guaranteed by the makers not to use more than 28 lb. steam per indicated horse-power.

The steam pipes are all of steel, the main ring being 9 in. by 3/8 in. lap-welded steel, with steel flanges screwed and braized, made by Lloyds. The extension pieces are large steel U-shaped, one being midway between the four boilers on the main ring, and the other in the main ring in the engine room. The bends and T-pieces are also of steel, no copper being used throughout. At two places in the

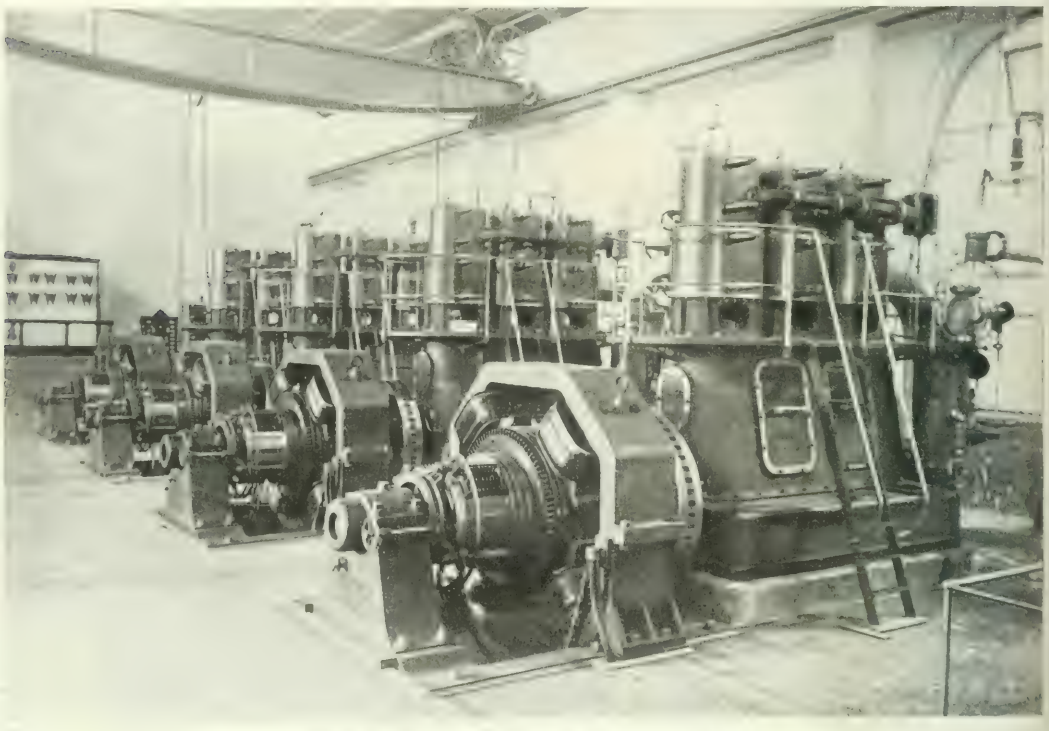


Fig. 2.—Generating Room, Melbourne Municipal Electric Light Plant.

Belliss type. Four are 550 hp and one of 350 hp, driving, by direct coupling, four 350-kw sets and one 200-kw set continuous-current four-pole generators with slotted cores and carbon brushes. The speed of the large size is 340, and that of the small 420 r. p. m. The steam consumption of the 550-hp engines does not exceed 19 lb. per electrical horse-power per hour, and for the small set 21 lb. per horse-power per hour, when working with a steam pressure of 145 lb. per square inch, and condensing with a vacuum equal to 25 in. of mercury.

The governors, which are driven directly from the crank shaft and operate on the throttle valve, are very satisfactory, the increase not being more than 5 per cent. between full and no load. A forced system of lubrication is used with these engines, an oil pump being operated from the crank shaft.

It has already been stated that surface condensers are employed, the water for condensing purposes being obtained from a tank holding 250,000 gallons of water. The circulating pumps deliver this water to the top of a cooling tower similar to the Barnard type. This tower is in two sections, and is 44 ft. high. Four fans, each of 10 ft.

engine room the steam pipe is anchored, so as to distribute the expansion. The feed pipes in the boiler house are all of copper, and are in duplicate, the boiler feed being supplied by either a compound duplex steam pump or a three-throw electrically-driven pump. A special bus-pipe arrangement permits of delivery through a filter and economizer, and from either the electric or steam pump or straight delivery to the boilers. The suction of both pumps is connected with a special storage tank of 50,000 gallons, with hot well, which is situated over the flue, or with the town supply water mains.

The switchboard is situated at the end of the engine room and raised on a special platform, is 36 ft. long and 8 ft. 9 in. high, and contains all the necessary switching apparatus for the new plant. The feeder panels are on the outside, the battery, booster and balancer switching arrangements being in the center. Maximum and minimum cut-outs are in circuit with each dynamo, as well as the usual ammeters and voltmeters of the Kelvin type. Six feeders are already laid and connected to the board, and accommodation exists for an additional four.

A motor-driven booster consisting of three separate machines coupled together on one bedplate, the center being the motor, is

used for charging the large battery of accumulators, each booster being capable of giving a current of 170 amperes at 160 volts and provided with resistance and multiple switch, so that they can be used at any voltage up to 275.

The balancing set consists of two complete machines coupled together end to end on one bedplate. Each armature is capable of carrying 150 amperes, and is worked on one side of the three-wire system with 230 to 260 volts each side; that is to say, the voltage at the bus-bars of each armature as connected varies from 230 at light load to 260 volts at heavy load on each side, when the system is balanced, and without a balance pressure may vary from 215 to 275 volts.

Immediately behind the switchboard is situated the battery room, containing two batteries, each of 140 Tudor cells, the normal capacity of each cell being 1,000 ampere-hours. The accumulator room is situated over the workshop, test room and stores, the floor consisting of heavy wrought-iron girders, hardwood, felt and asphaltum. The room is well ventilated and fairly cool, the roof being lined with sawdust, and no windows are exposed to the direct rays of the sun.

The test-room, which is situated behind the switchboard, is fitted up on one side with a slate table 24 ft. long, resting on isolated brick piers. On the other side a bank board is used for the testing of meters. In this room all the necessary apparatus and standard instruments have been fitted for the general use of the station.

The low-pressure three-wire system of distribution, which is carried out at a pressure of 460 volts across the outers, at present exists to a distance of about 1½ miles from the power house. The cables are all paper insulated, lead covered, single cables laid in wood troughing filled in with bitumen. The wool troughing, which is 1 in. thick, is made from the famous red gum of Australia, which has a very long life. The distributors are of 0.3 sq. in. section, with 0.15 sq. in. middle wire, and the feeders are 0.1 sq. in. and 0.5 sq. in. The arc mains are 7-16 S. W. G., and the presure wire which is brought back from each feeder point to the station is 3 7-20. Altogether, about 49 miles of cable have been laid in the streets, the work having been carried out by day labor under the supervision of the city council staff.

During the period, over three years, occupied by the council in

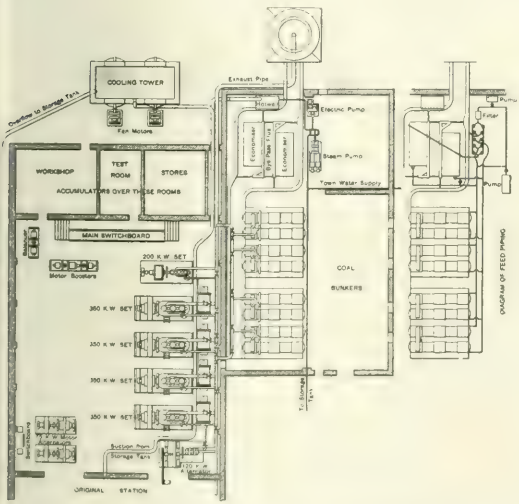


FIG. 3.—PLAN OF GENERATING STATION AND DIAGRAM OF PIPE CONNECTIONS.

negotiating for the purchase of the companies, four small alternators, each of 75-kw capacity, and one compound set of 120-kw capacity, were installed by the council to supply in the first place its own requirements in the municipal buildings, and also several other large consumers in the city. This alternating-current plant generated at 2,000 volts, and supplied, through transformers, 100 volts at consumers' terminals. The alternating-current system will be maintained for the present in the outlying area of the city, which is considerably scattered and principally residential, and extends in some cases a distance of three miles from the power house. Arrangements have, therefore, been made to drive two of those 75-kw alternators by two 100-hp motors, one of which will be of sufficient size to take charge of all the day lighting for several years to come. These motors will be driven by the large continuous-current generators. A steam alternator during hours of heavy load will be brought into requisition. These motor generators will principally do pioneer work in the suburbs, opening up payable work for the underground system which can be fed by a booster feeder.

The consumers who have been connected to the council's and the three companies 100-volt systems number about 900. They are rapidly

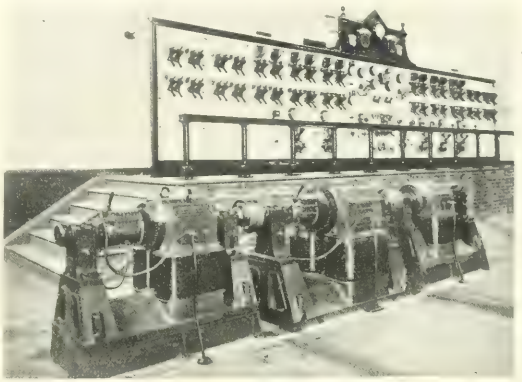


FIG. 4.—SWITCHBOARD AND BOOSTER.

being changed over to the 230-volt system, and in the meantime have been supplied by the Electric Lighting and Traction Company of Australia, which purchased the power house of the two original electric supply companies in Melbourne. For this assistance the council pays at the rate of 8 cents per kilowatt-hour at the boundary of the city, and recovers 10 cents per kilowatt-hour from the consumers after serious losses in distribution incidental to a house-to-house system of transformer distribution. The burden of the change of voltage has, of course, fallen on the city council, as the majority of the installations were not in a condition to stand the 230-volt pressure.

It is of interest to note, in connection with this new extension of the City Council plant, that the estimated cost was $620,000, and that it has practically been completed to within $500 of that estimate.

The Telephone on the "Burlington" Road.

The Chicago, Burlington & Quincy Railroad Company has in actual operation at the present time branch exchanges at Chicago, Kansas City, Rock Island, St. Louis and Omaha with an aggregate of 141 lines and 231 stations. Branch exchanges are now being installed at Aurora, St. Joe, Havelock, Hannibal and Lincoln, with a total of 161 lines and 220 stations. The company has just finished the stringing of a pair of copper wires between Chicago and Aurora, to connect the exchanges at these points, in addition to the composite iron wire circuit between the same points, which has been in operation for the past two years. Mr. W. W. Ryder, joint supervisor of telegraph for the road, informs us that he is getting one simple Morse circuit out of the new combination copper line. A pair of copper wires is now being strung between Lincoln and Havelock, to connect the branch exchanges now building at these points. It is the intention to eventually install branch exchanges at all division points and important terminals, and to have them all connected, making a system similar to those now in use on some of the principal Eastern railways.

No attempt has yet been made by the Burlington people to handle trains by telephone, other than at terminals and where "blind sidings" have been connected with the nearest regular telegraph office, and, when necessity arises, moving trains from those "blind sidings" by the telegraph operator telephoning the order to the conductor of the train to be moved. This is quite an important feature, as on some of the Western lines the regular telegraph offices are few and far between, while there are a good many "blind sidings," and by connecting them telephonically with the telegraph office, the necessity for operators at those points is very greatly lessened.

Bremer Arc Lamp.

The patent budget of April 15 added another to the list of Bremer arc patents, the claims of this latest covering a combination of elements claimed specifically in prior patents. As the specifications give a clear and concise description of the Bremer invention as a whole, they are reprinted below almost in full:

In electric-arc lamps many devices have been proposed to prolong the life of the electrodes, which, as is well known, is shortened by the air-currents flowing around the carbons. The most effective structure has been found in arranging a chamber or cylindrical body around the pencil ends, which prevents access of air to the said ends and in such a manner secures a longer life of the carbons. The use of such a chamber with ordinary carbon is objectionable owing to the fact that it decreases the light emission, and while it raises the temperature of the luminous arc no means are provided by which this increase of temperature is utilized. Even the arc will be less luminous the more the temperature around it rises.

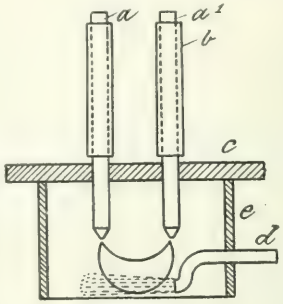
A great improvement has been realized in arc-lamps arranged as above by providing them with carbon pencils containing an addition of metallic salts or such substances as have a higher temperature of combustion or volatilization that carbon itself. Such carbon pencils will in any case cause a highly-luminous arc; but the temperature of incandescence and the power of emission of light possessed by the substances will be intensified in proportion to the heat generated by the combustion of carbon. Seeing now that such reflectors materially increase the temperature around the burning carbon points, it is just in the case of arc-lamps of this kind that a materially-improved effect is obtained by the application of the carbon pencils just referred to. Consequently while with ordinary carbon pencils the reflectors will cause a disadvantage as regards the yield of light, on account of the higher temperature or reduced luminosity of the arc, with the use of the aforesaid special carbon pencils the very cause thereof is utilized for realizing an improvement.

In arc-lamps described in the patent—that is, having carbon pencils containing an addition of metallic salts—said pencils are placed downwardly, pointing parallel or converging, and inclosed at their points by a chamber, above described. This combination presents the great advantage that the arc can be projected downward in a crescent-shaped or fan-like form, its color being rendered more uniform and homogeneous owing to the circumstance that the light, so to speak, is seething in metallic vapors. At the same time the temperature around the luminous points is increased, and consequently an extraordinarily intensified luminous effect is produced in the case of carbon pencils impregnated with metallic salt which are placed with their points directed downward. The crescent-shaped or fan-like formation of the arc, which of course entails an increase of its area, and consequently an increased luminous effect, can be obtained with ease and certainty by the arrangement of an electro-magnet energized by the current of the lamp and the magnetic field of which acts on the arc, either attracting or repelling it and projecting it outward, so as to impart to it the above-mentioned shape. On the other hand, in the case of arc-lamps in which a magnetic field or solenoid is arranged for the purpose of regulating the resistance in the arc itself in accordance with the requirements of steady burning or for the purpose of deflecting it in a certain direction, it is particularly advantageous to use carbon pencils containing an addition of metallic salts or such substances as will yield a luminous arc, because in this case the deflection of the arc involved by regulating or directing the arc causes an enlargement of the area of the arc which if the arc itself is luminous must at the same time entail an increased luminous effect.

The arrangement described above of carbon pencils impregnated with metallic salts may also be applied without further modification for alternating-current arc-lamps. It is a well-known fact that a great disadvantage of these lamps is that nearly one-half of the light emitted by the incandescent carbon points is projected upward and can only be thrown downward with a certain loss by means of a reflector. This is mainly due to the fact that 90 per cent. of the emitted light emanates from the crater-surfaces, and as the lower one of these emits just as much light as the upper one the above-mentioned effect results.

A modification of the direction in which the light is emitted in alternating-current lamps can be obtained by adding substances to the carbon pencils which will render the arc luminous, thus giving a less preponderant proportion to the light emitted by the crater-surfaces. A gain in the radiation of light is more especially realized in the horizontal direction, which is of particular value for some purposes, while, on the other hand, the radiation of light in an upward direction and with it the coefficient of loss is reduced. Experiments have also shown that it is thereby rendered possible to work alternating-current lamps with a higher voltage than is practicable in the case of ordinary electrodes. When applying a higher voltage and, accordingly, a greater distance between the carbon points, correspondingly more light is obtained, the arc being luminous; while if ordinary carbon pencils are used no increase of light is obtained notwithstanding the increased distance between the carbon points, as the arc is not luminous.

In the accompanying illustration, the letters *a a'* designate a pair of carbons being placed downwardly-pointing and parallel to each other. As described above, these pencils contain a high addition—for instance, 20 to 70 per cent.—of metallic salts, as calcium fluor and the like, which renders the voltaic arc very luminous and elastic; the carbons are fitted in tubes *b* or other suitable holders projecting through a plate *c*, and their points are surrounded by a hollow casing *e*. This casing, which may be of any form, forms a chamber around the points and prevents to a certain degree admission of air to the voltaic arc, so that the latter, which consists of the burning metal particles, is kept in its high illuminating state. A magnet *d* or a solenoid may be arranged in the casing, as shown, which produces its lines of force in such a manner that the arc becomes considerably enlarged, which may be easily done according to its elasticity. It has been found that the arc when being submitted to the lines of force of the magnetic field was also greatly enlarged, assuming the shape of a knife-blade, the matter contained in the arc and consisting of a large number of exploding particles being thus spread asunder and equally exposed to the influence of air, so that the color gets more homogeneous, and also the calm of the arc is considerably increased.



BREMER ARC LAMP.

It may be added that a deposit from the arc on the interior surfaces of the casing forms a highly reflecting surface.

Kelvin and Westinghouse on the Metric System.

Lord Kelvin appeared last week before the House Committee having in charge the metric bill, and supported that measure. He said that he had long hoped Great Britain would take the lead in this matter, but if it would not he thought the United States should lead off, believing his own country would follow suit. He commended the plan of the committee to allow time for the people to familiarize themselves with the system before adopting it as the standard of measurement. Mr. George Westinghouse, who accompanied Lord Kelvin, also spoke favorably of the metric system. He said, however, that he believed it would take the people at least ten years to learn to use it.

Electricity for the Long Island Railroad.

General Superintendent Potter of the Long Island Railroad Company appeared before Magistrate Connorton, at Flushing, Long Island, last week, to answer a complaint made by the Board of Health. Mr Potter was charged with violating Section 134 of the Sanitary Code, forbidding the use of soft coal. Edward J. Kiely, representing the Corporation Counsel's office, said that the company had been warned some time ago against the use of soft coal, but had paid no attention to the notice. He asked that the defendant be held for Special Sessions.

Mr. Potter said that his company proposed to do away with the use of steam, and had been making experiments looking to the adoption of electricity on the road. The company, he said, was anxious to do all in its power to satisfy its patrons and the general public. No action was taken by the court.

General Electric Report.

The tenth annual report of the General Electric Company, covering the year ending Jan. 31, 1902, consists, as usual, of reports by the president, first vice-president, third vice-president, and a financial report.

President Coffin in his report gives a resumé of the more important financial showings. The profits of the company for the past financial year (including a profit of $938,584.47, derived from the sale of securities), after deducting all general, patent and miscellaneous expenses, expenditures of $1,131,583.98 on factory plants and machinery, and allowances for depreciation and losses, were $8,598,241.34. Subtracting the dividends on preferred and common stock and interest on debentures, $1,997,966.40, there remained $6,600,274.94. The increase in the value of stocks and bonds owned by the company was $2,057,685.07, including a total addition to the surplus account of $8,657,960.01. After reducing the book values of certain items in the securities a net increase of $2,057,685.07 is shown in the aggregate book value thereof. Besides this increase in value the company has realized a net profit from sales of sundry stocks and bonds during the past four years an amount in excess of $2,500,000. Apart from these profits, it has collected in interest and dividends from said securities during said four years an additional amount of $1,140,000, or about 4 1-5 per cent. per annum, upon the book value thereof.

First Vice-President Eugene Griffen reports the total sales (amount billed to customers) at $32,338,036.64. The cost of sales was $25,254,122.00, leaving a profit on sales of $7,083,914.64.

The yearly orders for the past eight years as contrasted with the amounts billed to customers are as follows:

Year ending Jan. 31st.	*Amounts billed.*	*Orders received.*
1895	$12,540,395	$12,160,119
1896	12,730,058	13,235,019
1897	12,540,994	11,170,319
1898	12,396,093	14,382,342
1899	15,679,430	17,431,327
1900	22,379,463	26,323,626
1901	28,783,275	27,969,541
1902	32,338,036	34,350,840

Since Feb. 1, 1900, the orders received have not included the items of services of experts and labor, freight and transportation, supply material, boilers, engines, etc., of outside manufacture and bare copper wire, which items were included prior to 1900. These items amounted to $1,828,962 during the past year.

The orders received include generators and rotary converters of a capacity of about 250,000 kilowatts; railway motors of a capacity of over 600,000 horse power; other motors, capacity over 150,000 horse power; transformers, capacity over 200,000 kilowatts; incandescent lamps, over 15,000,000.

During the past year orders have been received for 55,000 horse power in generators (including three of 10,000 horse-power each) for the Niagara Falls Power Company, to be used by it both on the American and Canadian sides of the river. One thousand eight hundred railway motors (125 horse power each) for the complete motor equipment of the Manhattan Elevated Railway, New York City; also control equipments and air compressors therefor. The entire equipment of the tramways of Tokyo, Japan, including 3600 kilowatts in generators, 250 car equipments and all accessory apparatus. This will be the largest electric plant in Asia. The electrical equipment of several high speed interurban railways connecting important cities. In cluded in the amounts billed are: 5760 horse-power of generators and 4200 horse power of motors for the Mysore installation in India, which utilizes the water power of the streams from the Western Ghauts and transmits the power ninety miles to the Kolar gold fields; 3000 horse-power of generators, 4700 horse-power of rotary converters and 12,800 horse power of railway motors for an electric railway connecting Milan, Gallarate and Varese, Italy, this road now being operated by steam. More than 9000 motors of various sizes for the operation of machine tools, blast and ventilating blowers and fans, air pumps, air compressors, hoists, printing presses, linotypes and other typesetting machines, circulating and lifting pumps, refrigerating machinery, cash carrying systems, for controlling valves at a distance, for the operation of conveyors, motor generator sets, engine governors, large electric switches and rheostats, movable stairways and platforms and elevators, the training of heavy ordnance, etc., etc.

As further illustrating the various uses of electricity the following is a list of chemicals for the production of which electrical apparatus was sold during the past year: Aluminum, carborundum, calcium carbide, corundum, graphite, sponge lead, alkalies, ferro-titanium, sodium, potassium chlorate, barium hydrate, barium cyanide, phosphorus, ozone, chromium, ferro-silicon.

Following is a list of ships on which the company is now installing electrical equipment or which have been completed during the past year: Battleships Maine, Missouri, Georgia, Nebraska and Indiana; monitors Arkansas, Florida and Nevada; cruisers Prairie, Raleigh, Yankee, Rainbow, Detroit, Panther, Olympia, Denver, Chattanooga, Cleveland and Des Moines; gunboat Machias; torpedo-boat destroyer Stewart; torpedo-boat Wilkes; transport Crook; steamships Korea and Siberia for the Pacific Mail service, and a large number of merchant vessels.

The successful operation during the year of transformers at 80,000 volts renders practicable the use of hitherto unavailable water powers and the transmission of power therefrom over distances of 200 miles or more in competition with coal.

The company has received about one hundred and sixty thousand separate orders during the year (not including contracts), an average of 528 per day. Current orders have gradually increased from 380 per day in 1897, to 528 per day in 1901.

It has been the rule of the company to sell for cash, and the standard terms call for cash payments within sixty days of shipment. The actual record for the past five years is as follows:

Year ending Jan. 31st	*S/D Attached to B/L.*	*30 Days.*	*60 Days.*	*90 Days.*	*Over 90 Days.*	*Stocks, Bonds.*
	%	%	%	%	%	%
1898	20.9	41.9	22.8	4.6	9.8	0.0
1899	28.8	35.7	18.7	8.9	6.1	1.8
1900	12.9	61.6	12.5	10.0	3.0	0.0
1901	17.7	57.9	11.5	8.4	4.3	0.2
1902	12.3	65.6	11.4	6.3	4.3	0.1

Third Vice-President E. W. Rice, Jr., states in his report that the continued increase in the business has required further expenditures during the year for extensions to existing buildings, and the erection of new ones, and for additional machinery, aggregating about $1,500,000, exclusive of the cost of patterns, small tools, etc.

At the Schenectady Works, the pattern shop of 52,000 square feet and the additions of 70,000 square feet to the machine shops, mentioned in the last report, have been completed. Buildings are now being erected for the manufacture of wire and cable and insulating materials, of 180,000 square feet; a machine shop for large work of 117,000 square feet; a building of 60,000 square feet to increase the facilities for manufacturing switches, controllers and other small articles; and an addition of 13,000 square feet to the testing shop.

The building now used as general office at Schenectady was originally designed for manufacturing purposes, and is suitable for such purposes. The new office building, which has been under construction for the past year, will soon be completed and the present building utilized for manufacturing, adding about 40,000 square feet. An extension has already been begun to the shipping department, which will add 30,000 square feet, and a new power house which will add 6000 horse power to the present equipment.

At the Lynn Works the machine shop and testing facilities were increased by the addition of a building having 25,000 square feet of floor space; substantial additions were made to the power plant, and plans are now being prepared for a building of 55,000 square feet floor area for the manufacture of meters and instruments.

At the Harrison Works the fire-proof storage building of 68,000 square feet area, mentioned in a previous report, was completed during last summer, and plans are being prepared for further substantial additions to the manufacturing facilities to take care of the increased sales of incandescent lamps.

The floor area of all the factory buildings is approximately 2,500,000 square feet, which will be increased this year about 400,000 square feet by the buildings now under construction. The number of employees in all the works is about 15,000.

The erection by the British Thomson-Houston Company of large works at Rugby, England, will be of assistance to the manufactur-

ing facilities, as that company has hitherto been principally supplied by the works in this country.

During the past year there has been a continual increase in the size of electrical units and a great extension of the useful field for electrical apparatus. An order has been closed for several electric generators, each of a capacity of 10,000 horse power, which are 50% larger than any machines heretofore built. These mammoth generators are to be used in a new power house at Niagara Falls, and the large size was adopted because of the lower relative cost and the saving in hydraulic and other engineering work. The machines are of the same general type as those which have been standard with the company for several years.

An order has also been taken for five 5000 horse power generators for Niagara Falls, making a total of 11 machines of this size ordered for use at that point. These are interesting because they are of the design of General Electric engineers, whereas the first six mentioned in the last report follow the designs of outside engineers. The company's design was finally adopted because of lower cost and general excellence.

There has been a notable increase in the mileage and importance of electric railways due to the consolidation of adjoining systems and the development of high-speed interurban lines. Steam railroad managers are showing more interest in electric traction, and the company's engineers have carefully studied the problems presented by large terminals and heavy traffic conditions. The company has so perfected the methods of collecting current, controlling motors and transmitting the electric current that no serious engineering obstacle to the displacement of steam locomotives on many existing steam railroads remain where the conditions of traffic show the electric system to be economical. That electricity is thoroughly reliable and entirely able to handle heavy passenger traffic with success has been amply demonstrated by many installations in regular operation for several years.

The company secured the order for the electrical equipment of trains for the Manhattan Elevated Railroad of New York City which called for the construction of eighteen hundred 125-horse power motors. This contract was awarded after severe competitive trials of motors of other manufacturers. There is employed on this road the system of train control which was mentioned in a previous report, and has now been in operation for several years; it has been standardized and is highly successful. It simplifies the control of an electric train and permits of its ready subdivision into one or more units. The same method of motor control is being used in connection with the electrical operation of hoists, printing presses and similar work.

Over 100,000 horse-power of alternating-current generators have been designed and shipped during the past year for general power distribution. Electrical energy is now commonly transmitted over distances from 50 to 100 miles with commercial economy. There have been installed during the past year transformers to be operated at 80,000 volts, which is the highest pressure for which transformers have been commercially built; the highest previous was 60,000 volts.

There has been a great increase in the size and number of electric motors for power purposes. The company has now under construction a large number of motors of sizes ranging from 500 to 1000 horse power. The application of electric power to the operation of textile mills, machine shops, mining plants and all classes of machinery is rapidly increasing. Manufacturing plants covering large areas are rapidly adopting electricity for distributing power, because it is now a recognized fact that there is no other method of distributing power over large areas comparable in economy or effectiveness. Even in small plants, where efficiency of transmission is relatively unimportant, the use of electric motors is found profitable because of the increased output obtained.

The manufacture of electric locomotives has shown a satisfactory increase largely due to the excellence of the company's designs. This is also true of its work for the navy, merchant vessels, shipyards, dry docks and similar structures. The company's engineers have also been extremely successful in perfecting and developing the various small articles of manufacture, such as arc lamps, meters, instruments, switches and controllers.

In conclusion Mr. Rice says that although the company's engineers have always been liberally supplied with every facility for the development of new and original designs and improvement of existing standards, it has been deemed wise during the past year to establish a laboratory to be devoted exclusively to original research. It is hoped by this means that many profitable fields may be discovered.

The financial report, of which a resumé is given below, discusses in considerable detail the various operations of the year and the present status of the company's financial affairs.

ASSETS.

Patents, franchises and good will were carried in the last annual report at $2,000,000. During the year there were expended for acquiring sundry new patents, in patent expenses, patent litigation and royalties, $452,072.14, leaving the total patent account before closing the books at $2,452,072.14.

The bookkeeping profit of the difference between the par of $1,162,000 debentures and $959,400 (par) of common stock issued therefor, including $21,418.36 cash to purchase the fractions connected with such issue, all credited to patents and good will, was $181,281.24. Since the last annual report there have been realized from the liquidation of sundry patent owning sub-companies and credited to this account, $54,665.53. A balance now written off of $216,125.37 added to the above gives $452,072.14, leaving all the patents, franchises, good will, etc., of the company standing on its books at the date of this report, as per balance sheet, at $2,000,000.

All factory plants are free from mortgage or other lien. The company's constantly growing business necessitates continuous large expenditures on its plants, to increase its manufacturing capacity, by acquiring more land (one hundred and eighty-six acres having been purchased during the past year), enlarging old and erecting new buildings, installing new machinery and for general improvements.

On Jan. 31, 1893, the book value of all factory plants was $3,958,528.21. From that date to Jan. 31, 1902 (over and above all ordinary expenditures for the maintenance and repair of buildings and machinery), additions of lands, buildings, machinery, etc., have been made at a total cost of $7,859,352.90, making a total book cost of the plants of $11,817,881.11. To offset depreciation there have been written off during the above nine years $7,817,881.11, leaving their book value at Jan. 31, 1902, $4,000,000, divided as follows: Schenectady plant, 319 acres, $2,749,998.90; Lynn plant, 43 acres, $1,000,000.80; Harrison plant (lamp factory), four acres, $250,000.30.

Following is a summary of the changes in this account since the last annual report:

	Book value Jan. 31, 1891.	*Cost of additions during the year.*	*Written off at the end of the year.*	*Book value Jan. 31, 1902.*
Real estate.....	$1,858,044.65	$718,398.71	$378,398.71	$2,198,044.65
Machinery.....	1,541,955.35	774,954.55	514,956.55	1,801,953.35
Patterns.....	1.00	135,197.81	135,197.81	1.00
Sundries.....	1.00	103,030.91	103,030.91	1.00
Totals.....	$3,400,002.00	$1,731,581.98	$1,131,583.98	$4,000,000.00

The real estate account (other than factory plants), represents the investment in the Edison Building, 44 Broad street, New York City; also a four story brick building covering five lots on the corner of Avenue B and 17th street, New York City, and sundry parcels of land in various places, mostly improved and rented, which have been acquired at various times, chiefly in payment of debts. It is stated that all are free from mortgages and will be sold when opportunities offer.

Due to the rapid growth of electric enterprises in all parts of the country, the value of the company's investments in stocks and bonds of local lighting and railway companies has greatly increased, particularly during the past year. No substantial change having been made in the book value of these securities since January of 1897 (a period of five years) the directors have now made a careful valuation of all the separate items of stocks and bonds remaining on hand at Jan. 31, 1902. The result of this valuation is a net increase of $2,057,685.07 in the total book value thereof.

Such of these securities as are quoted on the market, or as to which there are recorded transactions, are, in accordance with the previous policy of the company, taken at prices lower than reported sales. All others are taken at values upon which it is hoped a future profit may be realized by the company.

Schedules annexed to the report contain lists of the most important of the company's holdings of stocks and bonds. Other than those carried at one dollar as below explained, the total par value of all stocks and bonds owned by the company is $14,306,593.94. They are carried at an aggregate book value of $9,825,007.93. Miscellaneous securities of many underlying, manufacturing, selling and patent-

owning corporations, and also of street railway and lighting companies, are carried at one dollar for each lot, in all, $113, making a total book value of all stocks and bonds of $9,825,120.93. The report states that it is believed the present aggregate realizable value of the foregoing described securities is fully equal to the total amount at which they stand on the books.

Pursuant to the established policy of selling securities which there is no special reason for holding permanently, various stocks and bonds have been sold for cash since the last annual report. Their total par value was $2,090,918; they were sold for $2,182,687.20, and had been carried on the books at $1,244,102.43, making a profit of $938,584.77. The money realized therefrom was used in part payment for miscellaneous stocks and bonds, acquired to protect and improve existing investments, at a cost of $2,769,024.39. Of this sum $1,544,810.76 has been invested in shares in the capital stock of the British Thomson-Houston Company, Limited. This investment gives the General Electric Company a controlling interest in this important company, which is just putting in operation large manufacturing shops at Rugby, England.

The notes and accounts receivable represent the total debts now due the company. They appear in the balance sheet at an estimated realizable value—*i. e.* from their face, $11,900,992.94 (which is less than the billed amount of goods shipped during the last four months of the year) has been deducted an allowance of $536,807.89 for possible losses.

The net amount of sales billed to customers during the year exceeded $32,000,000. Of some 13,300 regular customers on the accounts receivable ledgers, there were debit balances against 5400 at the close of the fiscal year.

A tabulation shows the balance of notes and accounts receivable to be $11,900,992.24. In addition to the above there are notes and accounts receivable (of several years standing) of one hundred sixty debtors, aggregating $1,237,950.48 (*face value*) which have been written off to profit and loss except the nominal book value of one dollar for each debtor. They stand on the books at a total of $160 and are being liquidated gradually. The total amount realized from this class of notes and accounts by settlements made during the past year was $24,126.37.

The allowance for possible losses, not including the "Dollar" class, is fixed at $536,807.89.

LIABILITIES.

The company has no note payable, nor is there under discount any paper bearing the company's indorsement or guaranty. Since January, 1895, the company has not borrowed any money; nor at any time since that date has its credit been used either by issuing notes, indorsing customers' paper for discount or lending its name in any way. By adhering to its established policy of maintaining sales on a basis of cash, or short credit to desirable customers, all purchases have been paid for in cash.

At Jan. 31, 1901, there were outstanding in debentures, $1,534,000. All the debentures are on their face exchangeable for stock at the option of their holders, at the rate of $100 of stock for $120 of debentures. During the year the holders of 1,162 debentures surrendered them and 9,594 shares of stock were issued therefor, $1,162,000, leaving debentures outstanding at the date of the annexed balance sheet, $372,000. On April 15, 1902, there were but $252,000 debentures outstanding, $120,000 having been exchanged for stock since Jan. 31.

Pursuant to the provisions of the stock corporation law, certificates for 25,508 shares of common stock were issued during the past

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1902.

Expenses.			Earnings.		
Cost of Sales		$25,254,122 00	Balance January 31, 1901 (Surplus)		$6,629,180 64
			Sales	$32,338,670 04	
			Royalties and Sundry Profits	141,841 33	
					32,479,427 97
			Dividends and Interest Received on Stocks and Bonds Owned	259,094 24	
			Interest and Discount	175,256 36	
					434,350 60
Interest on Debentures		42,309 89	Profit on Sales of Stocks and Bonds		938,584 77
Dividends Paid:			Enhancement of Book Values of Stocks and Bonds		2,057,685 07
On Common Stock	$1,871,968 00				
On Preferred Stock	83,688 51				
		1,955,656 51			
Surplus at commencement of year	6,629,180 64				
Undivided earnings now added to Surplus	8,657,960 01				
Balance January 31, 1902 (Surplus)		15,287,140 65			
		$42,539,229 05			$42,539,229 05

E. & O. E. HENRY W. DARLING, *Treasurer.*
EDWARD CLARK, *General Auditor.*

CONSOLIDATED BALANCE SHEET OF JANUARY 31, 1902.

Assets.			Liabilities		
			5% Gold Coupon Debentures	$372,000 00	
			Accrued Interest on Debentures	3,100 00	
			Accounts Payable	1,349,335 33	
			Unclaimed Dividends	4,775 79	
					$1,729,211 12
Cash		$4,058,448 00			
Stocks and Bonds	$9,825,120 93				
Real Estate (other than factory plants)	464,195 68				
Notes and Accounts Receivable	11,364,345 05				
Work in Progress	1,338,258 93				
	22,991,920 59				
Merchandise Inventories:					
At Factories	$7,742,605 55				
"General and Local Offices	1,037,968 16				
Consignments	96,309 47				
	8,876,883 18				
		31,868,803 77	Capital Stock (see page 23)		24,910,000 00
Factory Plants	4,000,000 00				
Patents, Franchises and Good-Will	2,000,000 00				
		6,000,000 00	Surplus		15,287,140 65
		$41,927,251 77			$41,927,251 77

E. & O. E. HENRY W. DARLING, *Treasurer.*
EDWARD CLARK, *General Auditor.*

fiscal year upon the surrender and cancellation of certificates covering a corresponding number of 7% cumulative preferred shares of the capital stock of the company. On April 15, 1902, there was but 4 shares of preferred stock outstanding, the remainder having been exchanged into common.

At Jan. 31, 1901, there were outstanding 239,515 shares of the capital stock of the company, par value, $23,951,500. During the past fiscal year there have been added 9,594 shares issued in exchange for debentures surrendered, $959,400, leaving capital stock outstanding, $24,910,900.

The capital stock issued Jan. 31, 1902, was $24,910,900; authorized against $372,000 debentures outstanding; authorized to be issued for $1,000 debenture purchased for cash in November, 1900, and for fractions purchased to Jan. 31, 1902, $21,300; or a total capital now authorized of $25,242,200. The accompanying tabulations give the balance sheet and profit and loss account of Jan. 31, 1902.

Fessenden System of Wireless Telegraphy.

Last week the Fessenden system of wireless telegraphy, as installed on the coasts of North and South Carolina, was tested in the presence of a large number of government officers, including General and Captain Russell, of the Army Signal Corps; Lieutenant Bucker and Lieutenant Hudgins, representing Rear Admiral Bradford, chief of the bureau of equipment of the Navy department; Professor Tittman, superintendent of the Coast Survey, and Professor Wainwright, of the same survey.

Testing stations are established at Wier Point, on the northwest shore of Roanoke Island, and at a point about five miles to the westward of Cape Hatteras, 50 statute miles from the Roanoke Island station. The space between the two points is nearly all Pamplico Sound, which at this season of the year is fresh and not so good for the transmission of wireless messages as salt water. Tests made by Professor Fessenden show that the energy required for successful transmission over such brackish water is about thirty six times greater than over salt water under similar conditions.

A mast about 140 feet high is erected at each of the sending stations for carrying the aerial wires. These consist of five copper wires at each station, strung about twelve inches apart and nearly vertical. The transmitting apparatus consists of the usual induction coils common with other systems of wireless telegraphy, but the receiving apparatus is different from that employed in any other system, and is, for the present, kept secret, although the working was thoroughly exhibited to the experts present at the test.

A telephonic receiver is employed, and it is a remarkable fact that messages can be sent and received as rapidly as by land wire lines, and much more rapidly than over a cable. Messages were sent and received at the rate of about twenty-five words a minute in this test. It is stated that with skilled operators, 50 or more words a minute may be transmitted. A telephone receiver was used in connection with a relay electric bell for calling up.

In a letter to the New York *Herald*, of Sunday, Prof. Fessenden, in discussing the international regulation of wireless telegraphy, gives some further details of the system. He criticises the Marconi receiver, and quotes from reports made concerning the new type of receiver used in the Weather Bureau experiments.

One report says: "The receiver is positive in its action and entirely and absolutely reliable. It is entirely different in nature and action from the coherer, and gives no false signals like the latter does. I could get every single dot and dash made at Hatteras with the utmost clearness, and can receive with it at the same rate of speed as over an ordinary telegraph line. It is possible for any expert telegrapher to receive by it as fast as the key can be handled. I have had no trouble in using the receiver, except that due to bad sending at the other end, and even then could make out every single dot and dash, but could not read them. The signals and messages were taken perfectly on the new receiver when, under the same conditions and connections, the coherer was tried and would not give a single dot."

Another report is as follows: "Taken as our standard coherer one working well, *i. e.*, giving good clear transmission of messages when attached to a single No. 18 wire five feet long, the sending wire being similar and of the same length, the spark gap being one-eighth inch between slightly rounded points and obtained from a coil capable of giving three-sixteenths inch spark between points when the distance between sending and receiving wires is 45 feet and both coherer and coil are resting on the surface of the ground—then the third message received by Mr. Dorman in the tests referred to in his report was received with one five hundred and seventy-sixth of the least amount of energy required to work the standard coherer over the same distance, and with the same vertical and receiving wires used in each case, and with the coherer worked with a transformer with a maximum efficiency ratio of transformation and circuits accurately tuned."

Prof. Fessenden adds, that as the distance between Hatteras and the Roanoke station is only 50 miles, the energy at the sending station was choked down to about one-thousandth of that available with the apparatus as installed, merely for the purpose of making the comparison. The coherer is, of course, capable of working that distance easily, if more power be used, and, as a matter of fact, in some tests made last year, in order to demonstrate some improvements in the sending apparatus, a coherer was worked between these two stations with a single No. 16 B. and S. gauge wire, 65 feet long, and no transformer. The receiver has been worked at speeds which correspond to more than 500 words per minute without the slightest fault in the receiving and with only about 25 per cent. increase of energy per signal. The method is entirely separate and distinct from Marconi's, the principle used having no relation whatever to that of the coherer, and neither sending nor receiving apparatus being similar to Marconi's.

In the Weather Bureau stations, which are tuned, it frequently becomes necessary to find the periodicity at which one of the stations is working, and it seldom takes as much as five minutes to find this and to cut in. But by the use of other methods tapping or cutting in is impossible, so that the last excuse for legislation is removed.

Referring to the charge of monopoly against the Marconi Company, Prof. Fessenden says that the real question is not whether the Marconi Company will obtain a monopoly, but whether it will be able to obtain any business. "Scientific men have been working on wireless telegraphy for twenty or more years, and the distance sent had gradually been increased from a few yards to a mile or more when Marconi took up the subject. By a most ingenious combination of apparatus he has succeeded in obtaining results over long distances. For this the very greatest credit is due to him, and when wireless methods are in general use his name will undoubtedly be remembered as that of one who did much to advance the subject. His method, however, labors under the fundamental disadvantage that it is based upon the use of the coherer, an instrument which is unreliable, slow in action, and requires a large amount of energy to work it as compared with that required by several other kinds of receivers. While Marconi has been developing wireless work in the direction of long-distance working, other experimenters have been turning their attention to what they esteem more vital questions; *i. e.*, the invention of better forms of receiver, and of making wireless telegraphy capable of competition with land lines and cables."

In concluding his letter Prof. Fessenden gives a history of the work done by the Weather Bureau. The work, he says, was taken up in January, 1900, at the instance of Professor Moore, chief of the Bureau, who foresaw the immense benefit which such a system would be in distributing weather predictions to shipping and in obtaining data for predicting the weather on land. With the aid and encouragement of the Secretary of Agriculture and the chief of the Weather Bureau, the work had advanced so far, in spite of many difficulties and delays, that nearly a year ago, in a test witnessed by Professor Moore and the chief of his instrument division, Professor Marvin, messages were received over a distance of 50 miles with a single No. 16 wire, 65 feet long, without transformers. The nature of the phenomena involved and their laws had been exactly determined, and as far back as the spring of 1901 it was found possible to make the following prediction before the Philosophical Society of Washington:

"The problem now before the cable companies is that of multiplex working. This is about to be forced upon them by developments in wireless telegraphy. The more complete study of the phenomena involved in this application of electricity and the quantitative experiments of the Weather Bureau lead us without any chance for mistake to the conclusion that there is no obstacle in the way of transmission over distances much longer than across the Atlantic, and this with the expenditure of an amount of capital quite negligible in comparison with the cost of a cable; and we must be prepared at any day to learn that that ingenious and indefatigable

inventor, Signor Marconi, has succeeded in accomplishing transatlantic communication, though even then the really great problem, that of selective signalling, will still have to be solved. Yet no doubt this will come in due time, and the only salvation for the cable companies will be in the discovery and utilization of multiplex methods."

Though such moderately long distances had even then been covered with very short wires, it was not until nearly a year later that the numerous other problems had developed themselves when it was attempted to actually work stations practically were in process of final solution. Prof. Fessenden considers that even now it can be said most definitely that any legislation which must necessarily be made without knowledge of the line of future developments will almost certainly be harmful.

American Institute of Electrical Engineers.

The 164th meeting of the Institute was held at 12 West Thirty-first Street, New York City, on Friday, April 25th, at 8:30 P. M., about 125 members and guests being present. The general subject before the meeting was Electric Elevators, Electric Hoists and Telpherage, and was introduced by President Steinmetz. Papers were presented by Mr. Charles M. Clark, on "Telpherage," and by Mr. George F. Sever, on "Power Consumption of Electric Elevators with Alternating and Direct Current Motors." In the absence of the author, Mr. Clark's paper was read by Mr. Douglas Burnett. The discussion was opened by Dr. Sheldon and was continued by Messrs. Abbott, Torchio, Mershon, Rosenblatt, See, Williams, Thompson, Henshaw, Stott, Burnett, Taylor and Wellman.

In opening his paper on Electric Elevators, Prof. Sever stated that in New York City there are now approximately 3,000 elevators operated by direct-current motors and 300 by alternating-current motors. The object of the paper is to give results of some investigations made as to the relative economy of these two types of elevators. Twenty tests were made, of which five relate to direct-current elevators and the others to alternating-current elevators. The results are stated to have been in favor of the direct-current elevator. The starting power factor of the elevator alternating-current motors varied from .79 to .97, according to the load on the motor, while in running, the power factor varied from .14 to .68, the average being .36. It is stated that this indicates that the alternating-current motor is much larger than the average conditions would call for, but it seems necessary to provide this capacity in order to accommodate any heavy loads anticipated. The inrush of current of the alternating-current motors is large as compared with the direct-current machines, especially in those cases where there is no control. In one test with a controlling system using resistance in the motor the inrush currents were maintained at a value comparable with those used in the direct-current motors.

A curve was given showing the average energy for all elevators through a rise of 50 feet, carrying two passengers. The areas of the alternating-current and the direct-current curves are as 1.509 is to 1, thus showing a comparison against the alternating-current elevators of 33 per cent. The curves referring to the descent of the elevators show a relation of 1.79 to 1, the consumption of the alternating-current machines in descent thus being greater by 8 per cent. than for the direct-current motors.

Prof. Sever concludes that with the cost of power at 10c. per horse-power-hour for both types of elevators, it would appear more economical to use direct-current elevators in those places where both direct and alternating current are available. If the controlling apparatus is more simple with the alternating-current system, and the absence of a commutator on a motor can be counted as an advantage, the extra expense of operating an alternating-current machine might be offset by the decrease in repairs and attendance. Apart from the last considerations, there seems to be every advantage in favor of the use of the direct-current motor.

The paper by Mr. Clark on "Telpherage" opens with a historical account of the art, and the remainder of the paper is devoted largely to the consideration of a commercial telpherage system and applications made of the same. The conclusions of the paper are that, in general, wherever material is to be carried to a distance, there is no power so flexible, so economical in the first cost of installation, costing so little for power, or for the expense of maintenance, and of such great capacity, as telpherage. "It may therefore be designated a material transportation by an immaterial fluid, and may well be called one of the most important of the many adaptations of electricity."

At the annual business meeting, May 20th, the following papers will be presented: "Some Notes on European Practice in Electric Traction with Three-Phase Alternating Currents," by Mr. Carl L. de Muralt, of Baden, Switzerland; "A Novel Combination of Polyphase Motors for Traction Purposes," by Mr. Ernst Danielson, of Westeras, Sweden.

An extra meeting will be held May 28th, devoted to "Electricity in the Army and Navy." Papers will be presented by Colonel Samuel Reber, Messrs. Townsend Wolcott, Caryl D. Haskins and others.

New Telephone Patents.

The issue of the Patent Office for April 22 shows a marked recrudescence of activity among telephone inventors and Patent Office examiners, as it contains no fewer than 11 telephone patents. Mr. William M. Davis, of Chicago, is responsible for five of these, all relating to switchboard circuits and systems, which are assigned by the patentee to the Stromberg-Carlson Telephone Manufacturing Company; this enterprising concern is also the assignee of three of the other six patents.

Mr. Davis's first patent is on a switchboard system employing a form of annunciator devised by Messrs. Gustavus E. Hoglund and Carl M. Hedman, on which an application for a patent is pending. This drop is provided with a single electromagnet and single armature, the usual shutter and retaining lever and a push-rod engaging with the armature and abutting against an extension of the shutter

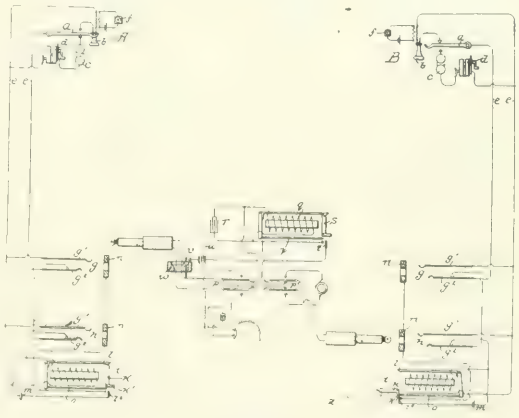


FIG. 1.—DAVIS'S TELEPHONE EXCHANGE SYSTEM.

when the latter is lowered; by means of this push-rod a second attraction of the armature restores the shutter. Mr. Davis's system provides for using this ingenious form of annunciator both for line and clearing-out drops. Referring to Fig. 1, the lines stations and jacks are of the usual arrangement; the line drop i has the push-rod o attached to the armature, the end of o abutting against the extension K^1 of the shutter K when K is down; in this position K^1 closes contact l^2 of the circuit of the restoring battery m, which circuit is also normally open between spring g^1 and thimble n of answering-jack h. When the plug is inserted g^1 and n are connected, the restoring circuit is closed, and the attraction of the armature causes o to throw up K, the contact l^2 being then broken and the restoring circuit opened.

The arrangement of the clearing-out drop q is practically the same, except that the restoring-circuit is controlled by the plug-seat switch w; the drop is connected in one side of the cord circuit and its inductance shunted by the condenser r, which also serves to intensify the effect of the ringing current over high resistance lines. This is rather an ingenious arrangement of electro-mechanical self-restoring drop. As indicated by the dotted lines at Z to the right

of the drawing, the drop may be used as a relay to close a local lamp circuit if lamp signals are desired.

An improvement in clearing-out signalling apparatus, patented by Mr. Davis, takes the form of an arrangement of circuits and the addition of a switch to the supervisory relay of the called subscriber, whereby when the latter has taken his telephone off the hook the two supervisory relays are thrown in parallel with each other and in bridge across the line so that both will be restored simultaneously only when both subscribers hang up. Referring to Fig. 2, the line-relay *n m* is of a form recently patented, having differential windings, one of which is shunted when the plug is inserted, allowing *o* to be attracted, thus breaking the circuit of the line signal *q*. The supervisory relays *i* are normally each in series with its respective line and common battery *l*; as soon as the called subscriber *B* answers his relay *i* is energized, extinguishing lamp *k* and closing switch *r* which throws the two relays *i* in parallel with each other and in bridge, including battery *c*, across the circuit. The relays will then be de-energized simultaneously when both subscribers hang up, but both will remain energized as long as the telephone at either substation is off the hook. This device should simplify matters in cases of "holding the line," as a signal is given only when both subscribers hang up and then it is a positive signal of both lamps at the same moment. Electrically the circuit has the advantage that the closing of the switch *r* shunts the supervisory relays out of the cord circuit, that is, form a series to a bridged relation.

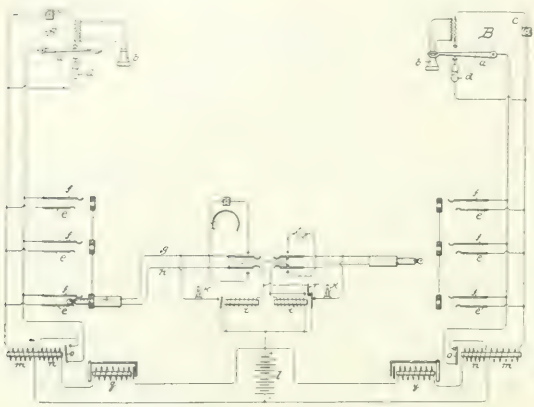


FIG. 2.—DAVIS'S CLEARING-OUT SIGNALING APPARATUS.

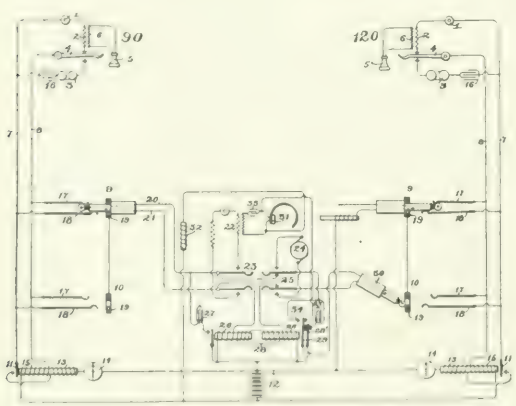


FIG. 3.—DAVIS'S MULTIPLE SWITCHBOARD AND TELEPHONE SYSTEM.

A switchboard system, due to Mr. Davis, has for its chief object the provision of means whereby test circuits may be completed by an operator testing a busy line without causing a diversion of current from the test battery over the telephone line of the calling subscriber. This object is effected by means of a switch contact, controlled by the called station's supervisory relay, which divides the tip-strand of the cord circuit into sections. Referring to Fig. 3, which shows a common battery system having line relays and indicators similar to those used in the previous patent, the switch 29 controlled by the called line supervisory relay 26 is the gist of the invention. When the relay is idle the tip strand of test plug 30 goes from spring 29 to the operator's circuit, the strand circuit being open at contact 34. When relay 26 is energized 29 is closed on 34, and the two sections of the tip-strand are then continuous. This device enables the operator to test a busy line without inflicting a click on the ears of the calling subscribers. While subscribers strongly object to clicks of the cracking sort, the noise of the busy test is hardly in that class, and, indeed, in very busy systems it is rather an advantage to have the subscriber hear it and learn to interpret it for himself. Modern practice tends rather to advise the subscriber automatically, at the time the operator is advised, that the line wanted is busy than to deprive him of the automatic signal.

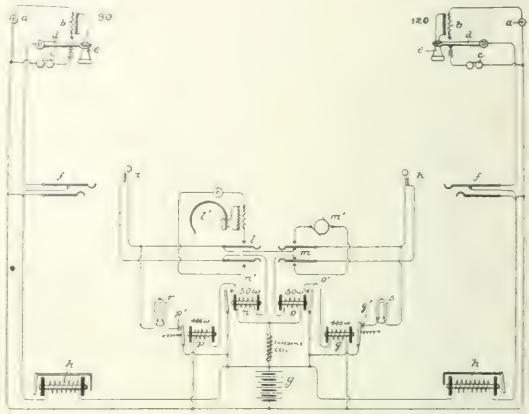


FIG. 4.—DAVIS'S TELEPHONE EXCHANGE SYSTEM.

Mr. Davis's fourth patent is on an arrangement of supervisory signals, which, it is claimed, is an improvement on present methods.

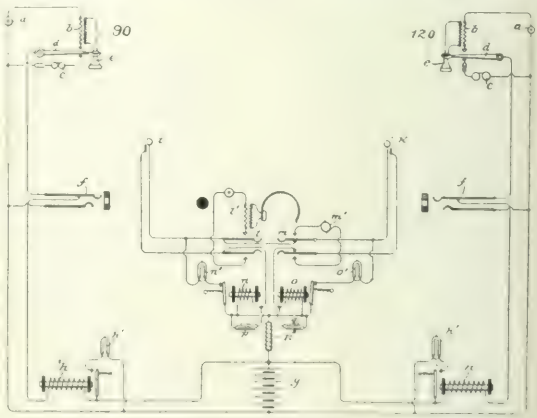


FIG. 5.—DAVIS'S TELEPHONE EXCHANGE SYSTEM.

One of the objections cited against the present style of supervisory relay is "the disagreeable clicking manifested in the receivers upon discharge of the condensers during the various manipulations and operations of the instrumentalities that enter into the system." It is difficult to see how much disagreeable clicking can arise from the operation of a supervisory relay that is energized and de-energized only at the moments of changing the relation between the receivers and the hook, when, of course, the receiver is not at the ear. For his improved clearing-out signal, Mr. Davis employs, as shown in Fig. 4, a low resistance relay, in series on one side of the line, con-

trolling a high resistance relay in a local circuit, which in turn controls the supervisory lamp. One pole of the common battery *g* is permanently connected to one side of the line, and the other through an impedance coil to the two supervisory relays *o* and *n*, included in the sleeve strands of the cord circuit. The armatures of *o* and *n* are normally withheld by gravity, and when attracted close contacts at o^1 n^1, thus energizing relays *p* and *q* and extinguishing lamps *r* and *s*. Whether the system shown in the diagram would get rid of all the clicks a common battery system is heir to is open to question. The fifth patent allowed to Mr. Davis is also on an improvement in clearing-out signals, designed both to obviate the clicking difficulty and "the objection arising upon the connection of long lines with short lines, which, where double supervision is employed, may in some systems create a shunt relation between the subscribers' lines, the short line constituting a shunt of low resistance, preventing the effective operation of the supervisory signals." In Mr. Davis's system the two objections mentioned are avoided by including the supervisory signals directly in the sides of the circuit, including the telephone lines, a source of current being bridged across the circuit, the bridge being located between the supervisory signals, each supervisory signal being provided with an individual shunt containing a condenser.

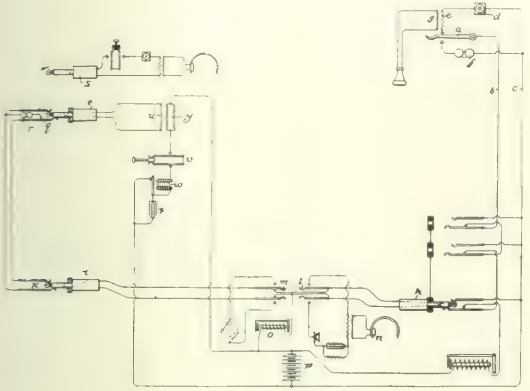
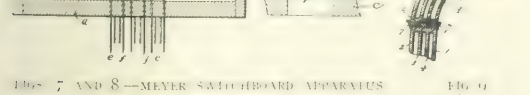


FIG. 6.—WEBSTER TELEPHONE EXCHANGE SYSTEM.

Fig. 5 shows the arrangement very clearly, the general arrangement of the circuits being the same as in the previous patent. The supervisory relays *n* and *o*, of high resistance (100 ohms) are in series with the sleeve strand of the cord circuit and in bridge with the battery across the line; they control the lamps n^1 and o^1 directly instead of by means of an intermediate relay, and each has its individual shunt containing condensers *p* and *q*, which aid talking and prevent a click from being communicated from one line to the other.



FIGS. 7 AND 8.—MEYER SWITCHBOARD APPARATUS.

FIG. 9. KIEFFER'S BOOTH.

Mr. Harry G. Webster, of Chicago, patents and assigns to the Stromberg-Carlson Telephone Manufacturing Company a switchboard system containing a device for attracting the attention of a subscriber who has failed to return his telephone to the hook after finishing a conversation. A simple supervisory signal (Fig. 6) is used, connected in bridge so that it is not de-energized until both stations have hung up. An operator failing to get the clearing-out signal would discover by listening in which station had left the receiver off the hook and connected that line by a trunk to a special operator's desk equipped with the signalling device. A signal *r* controlled by the jack *q* notifies the special operator that the services are required of the "howler," the name given to this device by the British Post Office some twenty years ago. The "howler" consists of the circuit breaker *w*, shunted by condenser *x* and the induction coil *y u*, the secondary of which is connected to the offending line by the plug *t*. In this way a note is delivered to the misplaced receiver to call attention to its wrong position. When the receiver is restored the clearing-out signal operates in the regular way.

Mr. William Meyer, of Chicago, patents and assigns to the Stromberg-Carlson Telephone Manufacturing Company an improved method of mounting lamp-caps or opals for switchboards employing lamp signals. Referring to Figs. 7 and 8, the caps *l* are mounted in a strip *m* bored with holes, having inclined or conical sides *o*; when pressed through the hole the lamp-cap fits firmly against the inclined sides and is held in place by the spring ring *r*, which is sprung into a circular groove in the holding strip. The complete strip of lamp-caps is attached to the face of the switchboard by the spring-catches *ss*, which fit into the socket clasps *t*; the strip is thus easily removed to effect lamp renewals.

No issue of a group of telephone patents is complete nowadays without a patent on a receiver detail and one or more on party-line systems. Mr. Harry M. Reeves supplies the first with a device for locking the casing of a receiver when the diaphragm is adjusted, a problem that so far has scarcely kept the telephone industry at a standstill. Mr. Georg Moller, of Copenhagen, Denmark, contributes to the art a party-line apparatus, the simplicity of which may be gauged when it is stated that each station requires a connecting-relay, a disconnecting-relay, a blocking-relay and an auxiliary blocking-relay. Those interested in relay puzzles are referred to patent No. 698,307. Albert K. Andriano, of San Francisco, patents a "secret service telephone system," the device consisting of apparatus for a selective interior system with arrangements to prevent a third station from cutting in on a line already connected to another. The day of the purely interior telephone system being practically over, such devices have little field of application. Telephone booths do not seem to offer much opportunity for the inventor's ingenuity, but Mr. Charles L. Kiefer, of Indianapolis, patents a booth with double-walls and doors, giving, as shown in Fig. 9, three separate air-spaces and four walls between the interior of the booth and the outer air.

Electrolytic Precipitation of Gold.

The following process for the recovery of gold from cyanide solutions is the subject of a recent patent to Edward D. Kendall, of Brooklyn: The dilute cyanide solution derived from the leaching of gold ores is permitted to filter slowly through a mass of hard fragmental carbon, packed around the porous cup of an electrolytic cell and connected as the cathode of a circuit of relatively high e. m. f. as 15 volts. A carbon plate, situated within the porous cup and immersed in a solution of caustic soda therein contained, constitutes the anode of this circuit. Upon passage of the current, the double cyanides are electrolyzed, the cyanogen being collected in the anode solution, and the precious metal deposited in pulverulent form in and through the mass of the cathode. After collection in this manner of a considerable quantity of the metal, the two compartments are emptied of their solutions, a carbon plate, silvered and rubbed with plumbago, substituted for the carbon plate anode, and the current connections are reversed. There is now permitted to flow through the cell a strong solution of cyanide of potassium, the flow occurring successively through the anode and cathode compartments, in the order named. Under these conditions the second step of the process—the recovery of the metal—is effected. The gold, which in the first step was distributed in divided form over the great area of the fragmental cathode, in the second step is redissolved from this cathode, which has now become the anode, and redeposited, this time in reguline form, on the metal cathode in the porous cell.

The method is a very suggestive one and loses nothing of interest from the fact that it is not, in its broad outlines at least, novel with the present patentee. Dr. Pfleger in 1895 first suggested that the coat of gold precipitated over an enormous cathode area from the dilute solutions of practice, be stripped and redeposited in a strong solution and thereby obtained in a smaller compass and more available form. The full and clear development of the idea is due, however, to Prof. S. B. Christy, of the University of California, who pointed out its advantages in the following figures:

A plant producing 600 Troy ounces of gold in thirty days would under normal conditions distribute this metal over 1,200 square feet

of cathode surface in a film approximately one three-thousandth (1-3000) of an inch in thickness; by the stripping process this gold may be collected upon an area not exceeding 10 square feet in a deposit 1-25th of an inch thick.

CURRENT NEWS AND NOTES.

SLABY SWIFTLY SUED.—A special cable despatch to the *New York Sun* of April 26 says: A despatch to the *Times* from Berlin says that the Braun-Siemens Company has brought an action against Prof. Slaby and Count Arco for infringing on its wireless telegraph patents. It is believed that the Braun-Siemens Company is co-operating with Marconi.

LONDON UNDERGROUND REGULATION.—A cable despatch from London of April 23 says: The Parliamentary Committee charged to consider Charles T. Yerkes's Railroad Bill, has approved the preamble thereto, subject to the insertion of a proviso that, in view of the "magnitude, novelty, and peculiar character of the enterprise," all the works should be subject to the supervision of the Board of Trade.

A VISIT TO NIAGARA was paid on Sunday last by Lord and Lady Kelvin, who were entertained by General Manager Rankine and Electrical Engineer Buck, at their respective residences. In addition to visiting the Niagara power plant, Lord and Lady Kelvin were received at the Ampere Company's works by Mr. C. S. Bradley, and shown the details of some of the electro-chemical processes there for producing nitrous oxide, barium hydrate, etc. Prof. F. B. Crocker and Mr. Calvin Rice were also members of the party.

WIRELESS POWER FOR LONDON.—We extract the following from a newspaper account of Lord Kelvin's recent visit to Niagara: "'Will we ever have wireless transmission of power?' asked a bystander. Lord Kelvin laughed. It was as far as his incredulity cared to go. 'Not more than a month ago Tesla told me,' said Professor Crocker, 'that he would within a short time be running tram cars in London by power generated on Long Island.' Lord Kelvin laughed again, but there was more incredulity than in his former laugh."

THE MORSE ESTATE.—The will of Mrs. Sarah Elizabeth Morse, widow of Prof. Samuel Finley Breese Morse, was filed for probate in New York this week. She left no real estate, and the value of the personalty is stated to be "upward of $8,000." The residuary estate is to be divided into three parts: one for her son, Edward Morse, of Washington, D. C.; another for her daughter, Leila Morse Rummel, of Washington, and the other for her granddaugher, Leila Livingston Morse. Another son, William G. Morse, of Port Washington, L. I., will not benefit under the will unless there is something for him in a sealed letter Mrs. Morse left, providing for the distribution of personal effects. She died at Berlin last November.

NEW POWER PROJECT IN CALIFORNIA.—The latest large electric power project in California is one in which E. T. Earl and his associates are interested. According to a statement of James D. Schuyler, the company's hydraulic engineer, it is proposed to install an electric transmission plant in Plumas County, when current will be transmitted a distance of 180 miles to San Francisco. Water appropriations of 120,000 miner's inches of the waters of Feather River and Butte Creek have been filed. The Big Meadows reservoir will have an extent of 8,000 acres, and the other in Butte Valley a few miles distant, will cover 2,000 acres. From the reservoir in Big Meadows it is expected to construct a canal about 10 miles in length to the Butte Valley reservoir, whence the water will be conducted along the edge of the Feather River canyon by a series of tunnels for a distance of five miles. At this point on Mosquito Creek water will have a vertical fall of 1,600 feet, giving an estimated total of 270,000 horse-power. The Western Power Company, with a capital stock of $5,000,000, has been organized in Los Angeles to handle these properties. Among those interested in the company are Edwin T. Earl, founder of the Earl Fruit Company, and Geo. F. Batchelder, vice-president of the banking firm of E. K. Rollins & Sons, of San Francisco and New York.

A METER BUREAU.—The New York State commission authorized by the last Legislature to determine the necessity for establishing a State electrical laboratory met in the State Engineer's office at Albany on April 28. The commission is composed of State Engineer Edward A. Bond, Charles P. Steinmetz, chief electrician of the General Electric Company, and Harold W. Buck, electrician of the Niagara Falls Power Company. The Legislature appropriated $2,500 for the preliminary expenses of the commission, which is to report to the next Legislature whether there should be established a State laboratory to pass on electrical currents and provide for official electric meters for the measurement of electricity as gas consumption is now measured. Each of the Commissioners decided to prepare a plan setting forth what he thinks should be done. These separate plans will be considered by the commission, as a body, at another meeting to be held on May 14.

ALTERNATING-CURRENT METERS.—The budget of patents of April 15 contained four on alternating-current meters, two of which were granted to Franz Schrottke, of Berlin, Germany, and two to Geo. Stern, of Charlottenburg, Germany. The last-mentioned patents relate to a new arrangement of actuating the windings of an alternating-current meter. As applied to an induction meter, there are two measuring systems, each consisting of two series and one shunt winding, the windings being arranged in co-operative relation to the usual short-circuited armature operating a counter. The current windings are so connected and arranged that the resultant of the current fluxes in the two systems are displaced in phase from one another by 150 degs.; and the shunt winding is connected and arranged to generate potential fluxes displaced in phase from one another by the same angle, the potential flux of the non-inductive load lagging in one system behind, and the other leading the current flux. The second patent covers connections such that the displacement of the current is 30 degs. from its impressed e.m.f. The Schrottke patents describe a meter of the induction type, consisting of a four-pole field surrounding a short-circuited armature, which latter actuates a counter. On two opposite poles is a winding in series, with one of the working conductors and also a short-circuited secondary winding. On the other two poles is a potential or shunt winding, in series with which is an inductance or a condenser.

CREHORE AND SQUIER SYSTEM OF TELEGRAPHY.—Two patents were granted April 22 to Messrs. Crehore and Squier on their system of telegraphy, which several years ago formed the subject of a paper read before the American Institute of Electrical Engineers. One of the patents relates to the system as a whole and the other to its application to submarine cable telegraphy. The object of the invention is to diminish the disturbances and mutilations of the signals hitherto experienced in telegraphy, and which are important factors in limiting the speed of transmission. The invention consists, briefly in impressing the characters of any desired code upon an alternating current, by systematically cutting out or suppressing definite semi-waves of said current in predetermined order of relation. This is done by opening and closing the circuit over which the current flows, at the instant when the current is naturally zero, and in making at the receiving end of the line a suitable visual record of the varying current, which may be read according to the selected code. In sending, a perforated tape is used, which causes the circuit to be opened and closed at times when the current is naturally zero. At the receiving end an electro-chemical receiver may be employed, or signals may be printed photographically on a sensitized tape in connection with an apparatus causing the plane of polarization of a ray of light to be rotated. The second patent relates to an application of this system to submarine telegraphy. With the method now in use the speed of cable transmission is very slow in cables as compared to the speed in land lines, due to the capacity of the cable and to the use of the "square top" signalling waves. The speed of transmission may be greatly increased by substituting for the square top wave of impressed e. m. f. an e. m f. which varies approximately as the sine law, and the patent describes an arrangement for accomplishing this result.

MILAN ENTERPRISE.—Reports have reached this country as to the formation at Milan, Italy, of a new company with $16,000,000 to consolidate light and power plants. It was thought this applied to local enterprises, but it is now stated that the intention is to acquire water power for electrical purposes throughout Europe.

25,000-VOLT DIRECT-CURRENT DYNAMO.—The Société Thury of Switzerland has recently constructed a 25,000-volt, 25-kw direct-current dynamo, the speed being 600 r. p. m. The revolving field is laminated, and the armature consists of 48 coils in slots. The fixed commutator has 98 segments with air insulation and the revolving brushes make contact on the interior surface. An air pump on the independent exciter furnishes a blast to extinguish sparks at the commutator, the voltage between segments being 500.

A CORRECTION.—In the article by Mr. Wm. A. Del Mar on the "Ratio of Transformation in Three-Phase Circuits," in the issue of April 19, the formula deduced should read:

$$\frac{\text{H. T. line P. D.}}{\text{L. T. line P. D.}} = \frac{n\sqrt{3}+D}{\sqrt{3}+d}$$

As printed, n, the sectional ratio, is omitted. This error was probably noticed by most readers, as the n is used in the example given after the formula.

A. A. A. S.—The coming meeting at Pittsburg of the American Association for the Advancement of Sciences promises to be one of the most successful in its history. Mr. George Westinghouse will be honorary president of the meeting, and the list of the honorary vice-presidents includes such names as Charles M. Schwab, W. N. Frew, of Carnegie Institute; Robert Pitcairn, of the P. R. R.; Prof. John A. Brashear and the presidents of a number of Pennsylvania and Ohio colleges. Mr. C. F. Scott, president-elect of the American Institute of Electrical Engineers, will act as chairman of the Excursion Committee. It is expected that the sittings of Section D, Mechanical Science, will have the largest attendance at the meeting. The sessions will begin June 28 and end July 3. Headquarters will be at the Carnegie Institute.

LIGHTNING DATA.—From 700 to 800 persons are killed annually in the United States, according to estimate made by Alfred J. Henry, of the United States Weather Bureau. In 1900 the bureau received reports of 713 cases of fatal lightning strokes. In the same year, according to the reports collected by the Weather Bureau, 973 persons were more or less seriously injured by lightning. The loss of life from lightning is greatest in the Ohio Valley and the Middle Atlantic States. If density of population only be considered, it is greatest in the upper Missouri Valley and in the middle Rocky Mountain region. Of the 713 fatal cases reported in 1900, 291 persons were killed in the open, 158 in houses, 57 under trees and 56 in barns. This seems to dispose of the old superstition that the safest place to be in during a thunderstorm is the open country and the most dangerous under a tree.

SUBWAY FOR MONTREAL.—It is stated that Montreal and the south shore will be connected by a subway in two years. The statement is attributed to H. A. Hodge, president of the Quebec Southern Railway Company, in which it is said Dr. Seward Webb and the Vanderbilt interest are deeply interested. The application of the subway company for power to construct, maintain and operate a subway under the St. Lawrence between the south shore and the city will come before the railway committee of the Privy Council this week. The plans, which are now at Ottawa, indicate that the tunnel will be the largest in the world. It will begin at the south shore, near Longmeuil, pass under St. Helen's Island, thence into the city to a central point of the east end, where the central station will be erected. The tunnel will not only be a medium for the Quebec Southern trains and for electric street cars and electric circuits, but for the interchanging of all business traffic and communication between the south shore, St. Helen's Island and Montreal. The subway will have two tubes, each 27 feet wide and 21 feet high. That for cars, passengers and freight will be double tracked. The second will be for teams and pedestrians, having drives and footways. The cost is estimated at from $4,000,000 to $6,000,000.

N. E. L. A. CINCINNATI TRAIN.—Mr. C. O. Baker, Jr., master of transportation of the National Electric Light Association, writes us as follows: "Arrangements have been made to run a special train to Cincinnati for the convenience of members of the National Electric Light Association and their friends to attend the twenty-fifth convention, to be held in Cincinnati May 20, 21, 22. This train will leave New York on Sunday, May 18, via the Baltimore & Ohio Railroad, foot of Liberty Street, 10 A. M., foot of Whitehall Street 9:55 A. M., arriving at Union Station, Cincinnati, directly opposite the Grand Hotel, headquarters of the Association, at 8 A. M. A rate of fare and a third, on the certificate plan, has been granted by the various passenger associations. Fare to Cincinnati on this train will be $16; sleeping-car fare, double berth, $4; section, $8, and drawing-room, $14. Return railroad fare, when the certificate is properly endorsed, will be $5.35. For particulars, apply to Mr. Lyman McCarty, Assistant General Passenger Agent, B. & O. R. R., 434 Broadway, New York City. Provided a sufficient number of passengers are secured for this train, a special dining-car and a club-car will be at the service of our people; it is, therefore, very important that those desiring accommodations on this train should make immediate application for space."

AMERICAN ELECTRIC AND AUTOMOBILE PATENTS.—We have received the first issue of the *American Electric and Automobile Patent Monthly*, published by the American Patent Publishing Company, Washington, D. C., which new publication forms a valuable addition to technical periodicals. The first issue contains 90 pages of drawings and 74 pages of descriptive matter. All the drawings accompanying patent specifications are reproduced quarter size. The descriptive matter consists of a brief description of the invention and its object, followed by all of the claims. A valuable feature consists in an appendix giving the number, name and date of references cited in the examination of applications, which information heretofore has not been accessible. As an example, in the case of two electric railway patents issued to the same inventor, there are no less than 25 citations of references made in the course of examination. The value of this feature to those interested in following closely an art is apparent. The publication will be issued monthly, at a subscription price of $5 per annum. The fact that it will be compiled by Mr. James T. Allen, of the United States Patent Office, is a guarantee of the completeness and reliability of the matter contained. Owing to the unsatisfactory present system of Patent Office classification and the apparent carelessness of the publication department in sending out patents when ordered by classes, the statement of the publisher that this publication will consider *all* patents within its scope should be noted. In addition to electrical and automobile patents, those on air and gas engines and acoustics are also included.

ANOTHER BELATED TRANSFORMER PATENT.—A patent was issued April 22 to Prof. Elihu Thomson on a transformer system, the application for which was filed almost 17 years ago—Nov. 2, 1885. As illustrated, a number of transformers are connected in parallel to a primary circuit, one secondary supplying a lamp and other secondaries supplying one or more incandescent lamps. The three claims accompanying the patent are as follows: "1. In a system of electric distribution, a series of secondary circuits of induction-coils supplying arc-lights or other devices, the primary coils of which induction-coils are multiple-arc branches of a single primary circuit, or set of mains *A, B* (supply mains), through which alternating or reversed currents are flowing, as described. 2. In a system of electric distribution, a set of mains *A, B* (supply mains), supplied by alternating currents, or alternating electrical impulses, rendering said mains alternately positive and negative with respect to each other, in combination with branch circuits taken from said mains at convenient points, and finally carried through the primary wires or coils of a set or series of induction-coils, the secondaries of which are connected to electric lamps, or other apparatus, for utilizing the impulses, generated in said secondaries by induction from the said primaries. 3. In a system of electric distribution, the combination with the high-potential mains through which the alternating or reversed currents are flowing, of electric converters or reducers connected in multiple between said mains, and incandescent lamps or other translating devices supplied from said reducers with currents of lower tension and greater quantity than those circulating in the main circuit-coil of the converter."

WIRELESS TELEGRAPHY IN PORTUGAL.—According to a despatch from London, Portugal has adopted the Slaby-Arco system of wireless telegraphy, and is erecting a station at the mouth of the Tagus and another at Lisbon.

THE MICROPHONOGRAPH IN FRANCE.—Consul-General Gowdy sends from Paris an account of a telephone for the deaf, known as the microphonograph. The instrument, which is a combination of the microphone and phonograph, was invented by M. Dussaud, professor of physics in the Ecole de Mécanique, Geneva, Switzerland, and afterwards perfected and brought to its present state by M. Jaubert and M. Berthon, the latter the manager of the Industrial Telephone Society, Paris. This instrument permits the indefinite repetition of a sound with the same intensity, tone, and degree of loudness, and, at the same time, the apparatus lends itself to the production of the most varied sounds, deep-toned or shrill, feeble or intense, so that the operator can by trial find the tone which will best impress the subject. The idea of the microphonograph is to increase the intensity of sound, while regulating and graduating it at will; in short, to do for sound what the microscope does for objects. The advantages which it has relative to the sounds created over those of the phonograph alone are: (1) They are considerably strengthened; (2) they are more distinct, with scarcely any nasal tone; (3) they can be regulated at will in their intensity, so that the instrument constitutes at the same time the most sensitive audiometer; (4) they can be heard by many persons at the same time; (5) they can be heard at great distances. The acoustic exercises by means of this instrument make the education of deaf mutes possible at a very early age. The exciting of the auditory nerve leads directly to the reviving of the sense of hearing and stimulates the utterance of words. Most encouraging results have already followed the use of the microphonograph. For scientific and commercial information regarding this instrument, address the Société des Industrielle des Téléphones, 25 rue du 4-Septembre, Paris, France.

COMPENSATION OF GENERATORS AND MOTORS.—Two patents issued April 22 to F. G. Baum relate to means for compensating both direct and alternating-current generators or motors. As applied to direct-current motors, two methods are described. In one, as illustrated, two generators in parallel are excited from an independent machine, the latter having a shunt winding in series with the line. In the other method the two generators have shunt fields; one side of the shunt is connected to one of the brushes of an independent exciter, the other brush being connected to the line. The exciter in this case has only one field coil, which is connected in series with the line. In either case the exciter runs at substantially constant speed. It is stated that this system of compensation simplifies the construction of generators, and, if two or more generators are installed, has very substantial advantages, since, by the simple addition of the compensator, the generators may be made with a single winding and the need of all equalizer connections done away with. Moreover, there is no adjustment of the low-resistance shunts and there is no drop in potential when new machines are added to one or more already running. As applied to alternating-current motors, in addition to an exciter a compensating apparatus is mounted on the shaft of the generator. Through the field of the latter the current of one phase of the line passes, in whole or in part. On a shaft of the compensator armature is a rectifying commutator and collecting ring. The rectifying commutator is in two parts, the segments of which alternate. One brush of the exciter is connected to the collecting ring and the other brush is connected to a double brush at the compensator, one of which bears on one side of the rectifier and the other on the other side. Each side of the rectifier is made up of alternate conducting and non-conducting segments, by means of which one-half of each wave period is removed. The segments of the compensator commutator are so arranged that when there is 90 degs. lag in the work circuit, they will coincide with the complete half period of the compensator e. m. f. so that the upper halves of each cycle are taken off and impressed upon the circuit of the exciter field coil. If, however, there is a lag of any less amount in the work current, the upper part of the cycle by that much does not coincide with the segments, and part of an upper half and part of a lower half is impressed upon the exciter circuit. In this way the exciter responds to any lag in the work circuit, and such lag is duly compensated for.

LETTERS TO THE EDITORS.

Burns from Arc Radiations.

To the Editors of Electrical World and Engineer:

Sirs.—I have just concluded a very exhaustive test of the electric arc mentioned by me in my letter in your issue of last week.

I find that the Röntgen ray effects are not in the arc itself, but in some substance fused in the material melted, and they only occur from time to time; but the burning effect is undoubtedly caused by the intense violet ray of the burning arc, which produces burns at a distance of 12 to 15 ft. from the arc. I used different currents and voltages, ranging from 1,200 amperes at 50 volts to 400 amperes at 500 volts. With the last-named current and voltage an intense roaring arc of dazzling brilliancy, and from 8 to 12 inches in length, was formed, and the rays from this arc were able to penetrate linoleum, asbestos canvas, etc., which substances I used as masks; burning took place rapidly, the skin reddening and blistering with from five to ten minutes' exposure. I also found that dark brown glass formed an effective shield to the burning effect of the rays, the skin so protected standing out from the rest of the surface exposed entirely uninjured.

I shall later have a chemical analysis made of the slag melted, and then test each substance found separately for the Röntgen ray effects.

Lorain, Ohio. C. H. Hines.

Control of Car Acceleration.

To the Editors of Electrical World and Engineer:

Sirs.—There appears to be an inaccurate statement in your issue of Feb. 15, 1902, page 312, in the description of a railway controller. It is there stated that if the current reaches more than a certain predetermined figure the upper cylinder is released, etc., and "this will prevent the motorman from accelerating the train beyond a certain predetermined rate."

This cannot be so, since the strength of the current has really no direct bearing on the rate of acceleration. On a down grade, for instance, a small current can cause great acceleration, and on an up grade perhaps a very strong current gives no acceleration at all. Since the device in question must be adjusted so as not to operate for the maximum permissible current, it is evident that it cannot operate for a smaller current, which under suitable conditions can cause very high rate of acceleration.

It is, however, desirable that the rate of acceleration should be regulated in some way, partly because too rapid acceleration causes discomfort to the passengers, and partly because it puts a greater demand than necessary on the source which supplies the current. A way to effect such regulation is to use in connection with the controller cylinder a device, adapted either to release the cylinder or to lock it, so as to prevent its further forward movement when the acceleration rate is too high. Said device is operated by an electromagnet, the circuit of which is normally open, but is closed if the acceleration is too rapid. The closure of said circuit at the proper time is effected by means of two contact pieces, one of which is carried on a little fly-wheel, possessing some inertia, and which is mechanically driven from the motor, a torsional spring being interposed in the transmission. The arrangement is such that when the acceleration of the motor exceeds a predetermined rate, the spring will deflect enough to let the fly-wheel lag behind and bring the contact pieces together, and thus energize the aforesaid magnet. While the acceleration is not greater than permissible, the spring will deflect to a smaller extent, so that the contact is open, and thus the magnet not operating.

This device is further described in a patent of May 16, 1899 which also mentions an arrangement for returning current to the line. In order to do this, the motor should be shunt wound, but since a pure shunt motor is not suitable for traction purposes, the motor is normally compound wound, and becomes a shunt motor only when acting as a generator for returning current, the series winding being in that case short-circuited.

The apparatus for this purpose consists of a magnet, energized by the main current of the motor, and acting on an armature polarized by a winding in which the current flows in constant

direction. If the current for the magnet changes from one direction to the other, it is evident that this polarized armature will tend to move in corresponding directions; and by connecting the armature to suitable means it can be caused to make or break a connection across the ends of the series winding of the motor, said making or breaking depending on the direction in which current flows in the armature of the motor. The arrangement is such that the said connection will always be open while the motor is driving the car, and it has thus all the benefit of the series winding; but when the car drives the motor, and the current in the armature is reversed, the series winding and any external resistance are automatically short-circuited.

Some appreciable amount of energy can in this manner be restored to the line, not only when the car is running down grade, but also when running on a level, through gradually increasing by the controller the strength of the shunt field before entirely stopping the car. This arrangement would appear to be of special value for an automobile, for the purpose of recharging the batteries while running.

New York. Gustaf Rennerfelt.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Commutation.—Boy de la Tour.—A long illustrated article. While he does not want to belittle the numerous former investigations of the theory of commutation, he remarks that in these theories the assumption is made that the brush rests on two consecutive segments, while in practice it rests generally on three or even more segments. He also thinks that in former theories, the introduction of the term of the self-induction of the coil at commutation has been unfortunate, as it has complicated the question. He first shows that the self-induction of the short circuited coils is practically zero. These coils move simply with a constant speed in a constant field, and, during the commutation, they are the seat of an invariable e. m. f. The intensity of the field does not change in the short distance which the coil passes during the commutation. Under these assumptions he develops a relatively very simple theory of the phenomena taking place during commutation. He first gives the formulas for the simple case that the brush does not touch at any instant more than two segments, and then the more complicated case that it may touch three segments at the same time. He then uses his formulas to show the different reasons to which sparking at the brushes may be due. If sparks occur, it is first necessary to find out whether this is due to defective commutation, or to a bad condition of the collector, or to vibrations, or to a fault of the winding, or to an incorrect construction of the brush holders. He gives exact rules showing how to investigate this, and gives numerical examples.—*L'Ind. Elec.*, Feb. 25, March 10.

Design of Direct Current Dynamos.—Kennedy.—An article in which he extends his explanations given in a former article, and answers to a criticism of Clayton. The dimensions of the armature are governed by the total flux through the armature, the number of turns of wire on armature, and the current at maximum output. The product of the number of turns of wire on the armature by the maximum current output should have a certain ratio to the total flux through the armature, to get sparkless collection. To get a specific rule, it would be good to base it upon experience by calculating the above ratio for a number of actually made first-class machines of various outputs. It is a practical fact that when that ratio is large the machine is bad, and when that ratio is small the machine is good, and what is wanted is to find just what that ratio should be. Of course, the question of cost enters and explains the persistence in high armature strength (presumably ampere-turns); it makes a cheaper machine, and that seems to be the chief consideration with some designers.—Lond. *Elec. Rev.*, March 28.

Properties of Collector Rings.—Girault.—An article referring to the experiments of Boucherot, described in the Digest, Dec. 14, in the abstract of Latour's article. He shows that the results of these experiments, concerning the variation of the impedance, can easily be explained, if the analysis is simplified by neglecting the phenomenon of commutation. It can also be shown that it is possible to obtain a variation of the impedance with the angular speed in the case of single-phase alternating currents under the condition that one suppresses one of the two fields revolving in opposite directions into which a single phase alternating field may be resolved. He gives the mathematical analysis of these cases.—*L'Ind. Elec.*, March 25.

REFERENCES.

Construction of Alternators.—Lasche.—A long and very well illustrated article on "rational construction of alternators." His article is based upon the experience of the General Electric Company, of Berlin, with three-phase alternators. He deals especially with the mechanical side of the construction and with the methods of manufacturing on a large scale.—*L'Eclairage Elec.*, March 22, 29.

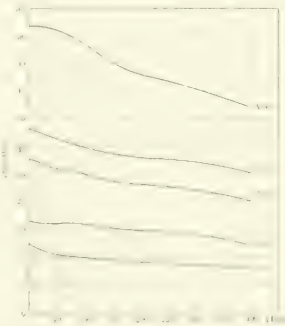
Characteristic Performance of the Induction Motor.—McAllister.—An article concerning the characteristic behavior of the induction motor of the present. The machine is discussed as an ordinary polyphase induction motor having a stationary primary wound with overlapping coils in slots, and a revolving secondary moving in the rotating field set up by the primary windings. The author also reviews the various starting devices used on induction motors.—*Am. Elec.*, April.

Alternators in Parallel.—Della Riccia.—A mathematical paper on the currents exchanged between two alternators working in parallel.—*L'Eclairage Elec.*, March 22.

Design of an Electric Motor Cycle.—Brocksmith.—An article, the second on this subject, with complete dimensional drawings and data for the construction of the motor and gearing for the electric motor cycle described in the previous issue.—*Am. Elec.*, April.

Lights and Lighting.

Tests of 220-Volt Incandescent Lamps.—Illustrated accounts of tests of 220-volt lamps. A large number of such lamps was obtained from four of the most prominent German lamp factories; photometric tests were made at the prescribed voltage by means of Bunsen photometer and Hefner-Alteneck standard lamp, and at the same time the current was measured. Of each make more than 150 lamps were investigated. From the results of these tests three lamps of each make, which appeared as normal, were chosen and used for the main tests. These lamps may be regarded as average lamps with respect to current, candle-power and energy consumption. The ad-



joining Fig. 1 gives the candle-power as a function of the time, for five lamps of 50, 32, 25, 16 and 10 cp respectively, the tests extending over 400 hours. Fig. 2 gives the watts per candle as a function of the time. The curves showing the amperes as a function of the time are nearly straight lines parallel to the axis of abscissas. It seems that the economical life of such lamps is scarcely more than 400 hours; the energy consumed per candle increases by about 30 per

cent. during the first 400 hours. The average consumption of energy is about 4.05 watts per Hefner candle, while it is about 3.35 watts per candle for 110-volt lamps. The remark is finally made that the 220-volt lamps are somewhat sensitive to vibrations on account of the double filaments, in so far as these vibrations occur during the

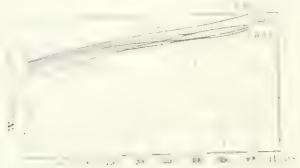


FIG. 2.—WATTS PER CANDLE.

burning of the lamps, as the two filaments may then come into contact and burn through. For this reason such a lamp should never be put into a socket, before the current has been switched off.—*Elek. Anz.*, March 30.

Nernst Lamp.—An editorial discussion of Hulse's paper, recently abstracted in the Digest. The average efficiency of a direct-current lamp during a life of 350 or 400 hours works out to about 2 watts per cp, the initial efficiency, if the first two or three hours be neglected, being about 1.7 watts per cp. This latter figure agrees with the efficiency given in the price list of the makers (General Electric Company, of Berlin), in which the initial efficiency of 200-volt to 240-volt lamps is also given at about 1.5 watts per candle. On the same basis the average efficiency of these higher voltage lamps would be 1.7 to 1.8 watts per cp, but actual life tests are required to show this. There will be a distinct economy in using Nernst lamps in place of the ordinary carbon filament for internal lighting where units of 50 cp are not too large, but the question of life and reliability and cost of lamp and renewals must also be considered. The cost of renewing the burner will be greater than that of the corresponding carbon filament lamp, and a proportion of the first cost must also be added. With cheaper electricity and higher efficiency shorter lived carbon lamps, the latter are by no means out of the run. As was described in the previous abstract in the Digest, the candle-power of the Nernst lamp drops considerably during the life, but so does the current, so that the consumption of watts per cp is maintained fairly constant; this is an advantage over the carbon filament lamp. It is suggested to replace the steadying iron resistance in the lamp by a smaller one, after about 150 hours; the lamp would then maintain a fairly high candle-power during the latter part of its life also, and the efficiency would not be materially impaired or the life greatly shortened.—Lond. *Elec.*, April 11.

Electric Lamp for Medical Use.—An illustrated description of a new type of ultra-violet radiation lamp, designed for the light cure of lupus and other skin diseases. A transformer charges a condenser which discharges across a spark-gap fitted with iron points about one-eighth of an inch apart. The oscillations are extremely rapid, with the result that an abundance of ultra violet rays is given off, in addition to a small amount of visible light.—Lond. *Elec.*, April 11.

POWER.

REFERENCES.

Electric Motors in Electrotyping Plants.—An illustrated article on electrically driven equipment of a modern electrotyping plant. The use of electric motors in connection with moulding presses, metal-shaving machines, routing machines and roughing or planing machines.—*Elec. Rev.*, April 12.

Piston, Corliss and Double Beat Valves.—An illustrated article on the relative merits of the piston, Corliss and double beat valves; with a description of the Van den Kerchove valve gear.—*Am. Elec.*, April.

The Sinclair Boiler.—Schmidt.—An illustrated article wherein the author indicates an improvement which might be added with advantage to the Sinclair water-tube boiler, recently brought out in England.—*Am. Elec.*, April.

Boiler Testing.—Hubbard.—An article on boiler testing, describing the various tests to be made, and the care to be exercised in accumulating data.—*Am. Elec.*, April.

Boiler Corrosion.—Lincoln.—An article on boiler corrosion, its causes and remedies.—*Amer. Elec.*, April.

TRACTION.

High-Speed Electric Railways.—G. W. Meyer.—An article on the electric operation of long-distance, high-speed railways. He believes the first railway of this kind will be built in the United States. He thinks only pure three-phase traction is to be considered. After some general discussions, he compares the relative advantages of the two following three-phase systems, the first with transformer substations distributed along the line, the second with transformers on the motor cars, the three-phase currents being supplied to the motor cars at full voltage. The second system requires heavier motor cars than the first. He assumes a motor car, with seats for 90 persons, to run at a normal speed of 180 km, and at a maximum speed of 200 km per hour. For the first system the weight of a car with 12 wheels is 110 tons, hence the pressure on a wheel, 9.2 tons. For the second system the weight of a car is 145 tons, the pressure on a wheel, 12 tons. The power required for a motor car in the first system is 1,420 km, in the second system 2,000 km. He refers to the experience gained in very high tension transmission in California, and believes that for traction also the tendency will be to use very high voltage, which could not well be transformed down by transformers placed on the train. For all these reasons he prefers the first system with transformer substations along the line to the second system with transformers on the trains. He then discusses a project of an electric high-speed railroad from New York to Chicago, the distance being about 1,600 km, the present trains taking 23 hours. For the electric road he assumes three stations—at Philadelphia, Pittsburg and Fort Wayne; he assumes a normal speed of 180 km and a maximum speed of 200 km; trains running at intervals of half an hour from both terminals, the total distance being passed through in nine hours. With the first system 100,000 hp are required, with the second 130,000 hp. The essential advantage of the first system is that only very few generating stations are required, two or even one being sufficient; the one power house he suggests placing at Niagara Falls with ten alternators, each of 10,000 hp, generating three-phase currents at 11,000 to 12,000 volts, which are transformed up to 75,000 volts; he suggests placing 40 transformer substations along the line each of a normal capacity of 2,400 kw and a maximum capacity of 4,000 kw; there the voltage is lowered to 6,000 volts; each substation has to supply distances of 40 km length. On the other hand with the second system in which the transmitted currents are directly supplied to the motor car and transformed in it by transformers, he thinks it would not be possible to run a higher transmission voltage than 20,000. This would require 10 generating stations distributed along the line, each supplying a portion of the line of 160 km. He thinks the first system is to be preferred.—*Zeit. f. Elek.*, April 6.

High-Speed Electric Railways.—Reymond-Schiller.—A fourth and fifth article of his serial. He discusses the air resistance in the best form of the front surface of the locomotive. If a speed of 200 km per hour is to be obtained, at least a three-meter gauge should be used. For the proposed Central European Railway a four and a half meter gauge should be used to obtain a speed of 250 km per hour. He gives data showing that the adhesion is greater for electric railways with the rail used as the return circuit, than for steam traction. He finds that for electric trains on a 1.435 meter gauge track, a regular service at a speed of 250 km per hour is impossible and that any considerable grades can only be overcome at a speed of less than 200 km per hour. On the other hand the influence of the grades is small for a gauge of 4.5 meters even at high speeds. He thinks that an electric locomotive of 20,000 hp is not an impossible thing.—*Zeit. f. Elek.*, Feb. 23, March 2.

Brockton & Plymouth Street Railway.—A description of this line which connects at one end with the extensive system of inter urban electric railways which intersect the eastern end of Massachusetts in all directions; 60-lb. T-rail are used throughout except in the city. The maximum grade is 8.8 per cent. The power station and equipment is very thoroughly described. The power station contains two 300-kw, three-phase alternators. The engines are provided with a speed changing or synchronous device and a safety stop, both of which are described and illustrated. There is also one 200-kw direct-current machine. There is one substation containing two three-phase 25-cycle 200-kw rotaries. The transmission voltage is 13,000, and aluminum feeders are used.—*St. R'y Jour.*, April 5, and *Int. Ed.*, April.

REFERENCES.

Feeders and Brakes.—Stillhenr.—A well illustrated paper, read

efore the Vienna Electrical Society. He first discussed the various orms of fenders and said that no inventor has yet succeeded in onstructing a device which meets the requirements of practice. A ood brake is the best means for preventing accidents. A greater etardation than 2 to 2.5 meter per second is not suitable on account f the safety of the passengers in the car. He discusses the various inds of brakes, and especially the electric brakes. Pure electric rakes are suitable for cars which have motors on each axle; otherise the braking current of the motors may be applied to an electroagnetic brake.—*Zeit. f. Elek.*, March 30.

Storage Battery Traction.—An article on storage battery traction ailures in Germany. Extensive tests have been made in several erman cities without success. Storage battery cars have been sed on a comprehensive scale in Hanover; the experience gained ere shows that "battery traction is too costly, that the heavy weight f the cars wears out the permanent way too quickly, that defects rise which militate against the cars affording an efficient service, nd that the danger of explosions is always present."—Lond. *Elec. ev.*, April 4.

Problems of Electric Railways.—Swinburne and Cooper.—The rst part of an illustrated reprint in full of their (Brit.) Inst. lec. Eng. paper, an abstract of which was recently noticed in the igest.—Lond. *Elect.*, April 4.

Railway Motors.—Siebert.—A well illustrated article on details construction and design of motors for urban and suburban roads. *Elek. Zeit.*, March 6.

Analysis of Street Railway Operations in Germany.—Mattersdorf. A graphical reproduction of some of the principal statistics of e operation of seven street railway lines in Germany and one in ustria, with attempts to deduce certain laws as to the ratio between r kilometers run, traffic density, gross receipts and operating penses. The roads selected are those in Berlin, Munich, Hamrg, Dresden, Breslau, Vienna and Cologne.—*St. R'y Jour.*, April and *Int. Ed.*, April.

Installations. Systems and Appliances.

Switchgear; Oil Switches.—Garrard.—An article giving "some servations on switchgear." The most necessary property which itchgear should possess is that, in performing the operations for nich it is intended, it should not cause rises or surges of potential the circuit. This is most important with high tension systems in nich the factor of safety of the insulation is necessarily lower than low tension systems. He thinks manufacturers have not given this subject the attention it deserves. He has made the experints to find out what would be the effect of allowing arcs to occur a circuit possessing capacity, that is to say, allowing the capacity a high tension cable to play across an air gap, forming an alterting current arc; in the circuit he had both an arcing horn switch d an oil switch; his experiments showed conclusively that under rtain conditions the arcing horn switch caused rises of p. d. in cable. He then refers to the marked difference between the action an oil brake switch on alternating end continuous current. Espence has shown that an oil break switch, which will act perfectly ll for breaking 400 to 500 kw at 6,000 volts alternating current, ll fail to act on 2,000 volts direct current, at loads from 100 to 200 . The oil break switch is, in fact, with alternating current, not uick-break in the true meaning of the word. An arc is drawn out a certain very short interval of time underneath the oil. This can be looked upon as a mechanically weak conductor, upon nich the oil presses and tends to rupture. Naturally the arc is chanically weakest at the instant when the current becomes zero; that moment the pressure of the oil overcomes the arc and exguishes it. The first time, therefore, the current crosses the zero e, the arc is put out. No rise of potential due to induction can cur at that moment. The maximum energy required to be abbed by the oil is that of half a complete cycle. Provided the mount of oil be kept above this minimum no danger of firing of oil is to be feared. As a matter of fact, all good oil-break itches have a large factor of safety in this respect, and the great vantages they possess, in every way, over open flare switches for gh tension alternating current systems are becoming generally cognized.—Lond. *Elec. Rev.*, April 4.

Wires, Wiring and Conduits.

Economical Cross-section of Conductors.—Teichmueller.—A long thematical article. Thomson (Lord Kelvin) first gave, in 1881, a formula for the calculation of the cross-section of a line so that the transmission is made under the most economical conditions. Beringer, in 1884, called attention to the fact that Thomson's formula is somewhat limited to a special case; he has given another formula. Ayrton and Perry came in 1886 to the same formula as Beringer. The author shows that it would be wrong to consider Thomson's and Beringer's formulas to be contradictory; on the contrary, one might say that both formulas state the same thing; or more correctly, the one makes up for the deficiency of the other. Besides this, the formula of Thomson's rule has been generalized later in such a complete manner and has been brought by Hochenegg into such a very simple and elegant form, that its application is indeed not more difficult than the simplest calculation of the conductor from the loss of voltage. Only the determination of the constants in this formula is more difficult, as they must be taken from wide experience. He shows that Thomson's formula is not limited to any special case, but is of general application, if it is supplemented by a term contained in the formula of Beringer (Ayrton and Perry). He discusses separately two cases: in the first case the power at the consumers' terminals, and in the second the power at the generating station has a given certain value. His results show the general and easy applicability of Thomson's rule in the form given by Hochenegg.—*Elek. Zeit.*, March 6.

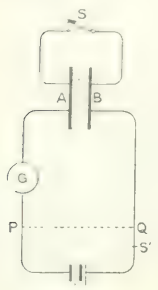
Conduit System of Wiring.—Bathurst.—A long article in which he points out that to introduce electric lighting to the middle classes and to compete with the gas people, a lower cost system of wiring is required. He thinks that superior mechanical protection is in the long run cheaper, more economical and permanent than to strive after high initial insulation resistance. The pioneers of concentric wiring have sufficiently proved the principle that good electric wiring construction can be effected by using only one insulated conductor, leaving the return conductor uninsulated; again, if the uninsulated conductor is arranged around it as an outer, other incidental advantages follow. He believes that "the standard method of wiring, which will ultimately be adopted, will consist of some suitable form of conduit enclosing and protecting a single inner conductor; it will, in fact, be an accessible concentric system." He now recommends a medium-grade conduit, which he calls "armorduct," as keeping a distinction between the cheap type conduit at present favored and the gas piping the electrical trade has to compete against. Armorduct is a special quality steel tube, having a medium thickness of wall, which is welded and treated under a special process by which it is possible to guarantee a perfectly smooth interior. The tube is enamelled inside and out with an insulating enamel which is moisture, acid and alkali proof. The enamel itself is flexible and applied in such a way that it must closely adhere to the surface of the steel for the purpose of preserving it from oxidation, rust or corrosion, which may arise from the nature of the plaster material or the building in which it may be installed. The pipes can be readily bent cold by hand labor on the job without splitting the tube or chipping the enamel. It is said that in price, armorduct can compete with gas-piping.—Lond. *Elec. Rev.*, April 11.

Electro-Physics and Magnetism

Ether, Matter, and Electricity.—Gilbert.—An illustrated account of some experiments upon the relations between ether, matter, and electricity, made at the suggestion of the late H. A. Rowland. The principal experiment related to the nature of electricity and its relation to matter. The experiment consisted in trying to detect a current generated in a wire wound on the periphery of a wheel in such a way that it would move in the direction of its length when the wheel was rotated. Connection was made to a delicate galvanometer by bringing out the ends of the coil of wire at the centre of the axis, one on either side of the wheel. The consideration which, above all others, has led him to look for such a current is the fact that it would give at once a simple explanation of the cause of the earth's magnetism. If one may assume that a moving body has generated in it, by virtue of its motion, an e. m. f., then a rotating body like the earth, which presents a closed circuit, will contain a current capable of producing a magnetic field identical with that which a constant current would produce in a stationary earth. His experiments were made with the greatest care, but the result of the entire research is purely negative. If any such cause for terrestrial magnetism exists, it has not been detected by his experiments.—*Phil. Mag.*, April.

Coherers and Induced Currents.—Muraoka and Tamura.—An ac-

count of experiments in which they made a further study of a phenomenon first detected by Sundorph. A metallic powder can be made conducting not only by the impact of electric waves, but also by means of an induced current; in the adjoining diagram *A* and *B* are two metallic rods lying side by side on a glass plate a few millimeters apart; the rods are connected with the poles of a battery. On sprinkling iron or nickel powder between *A* and *B*, the galvanometer *G* shows no deflection. But as soon as the circuit is closed through the key *S* the powder becomes a good conductor. Sundorph ascribed this phenomenon to the e. m. f. generated by the short circuit which produces sparks welding the particles together. The present authors thought that this phenomenon might be a magnetic one, and substituted brass powder for the iron or nickel, but found that it made no difference. Carbon powder showed a certain conductivity before pressing the key, and its resistance was sometimes increased and sometimes diminished. It was, however, always increased when the powder had been freshly dried. To see whether self-induction caused the phenomenon, they made the short circuit across *P Q* instead of *S*, and then found that the phenomenon did not happen. On introducing an inductance between *P* and *Q* and closing a circuit at *S'*, the brass powder acquired a distinct conductivity. But if a capacity was added to the inductance the reaction ceased. "This proves that the phenomenon is due to the inductance of the galvanometer." Sparks could be seen distinctly in the powder through a microscope, but only at break. They suppose that the sparks fuse the brass, but disintegrate the carbon. —*Ann. d. Phys.*, No. 3; abstracted in Lond. *Elec.*, April 4.



COHERER AND INDUCED CURRENTS.

Rectified Alternating Currents.—Gerschun.—A theoretical investigation which explains some peculiar experimental results which had formerly been obtained. He discusses the following problem: Given an e. m. f., consisting of half sine waves, all in the same direction, this e. m. f. may be impressed upon a circuit containing resistance and self-inductance. He shows that the average current then depends only upon the ohmic resistance; if the efficient of self-inductance is greater than zero, the instantaneous value of the current is never zero; the amplitude of the oscillations of the current on both sides of the constant average current is the smaller, the greater the time-constant of the circuit; the current curve is symmetrical in respect to its maxima and minima. He then gives numerical examples and finally determines the wave of the current in the secondary of a transformer when upon its primary an e. m. f. of the described form is impressed. The theoretical results are in good agreement with the experimental facts.—*Phys. Zeit.*, March 15.

Electro-Chemistry and Batteries.

Electric Furnaces.—Blount.—The conclusion of the full reprint of his illustrated (Brit.) Inst. Elec. Eng. paper. He describes several types of calcium carbide furnaces, the Acheson carborundum furnace, and phosphorus furnaces. In all such furnaces a high temperature is required. He then discusses the practicability of the electric furnace for lower temperatures. It frequently happens that an ore of paying richness occurs in a district where fuel is dear or hardly existent and the means of communication so bad that the cost of imported fuel becomes almost prohibitory. Such desolate regions are generally rich in water-power. An electro-chemical process of treating the ores is naturally used; such a process often needs some preliminary aid from older methods; frequently the ore has to be roasted. In such cases there are certainly possibilities in the electric roasting furnaces. He thinks that a fire-brick hearth in which grooves are chased so that iron rods of fairly large sections are embedded nearly flush with the level of the hearth would serve as well as more elaborate contrivances. He suggests using a low pressure and strong current, so that the iron rods might be stout enough to resist wear and loss by oxidation. They could be easily and cheaply renewed. Systematic roasting in a revolving calciner, instead of on a fixed hearth needing rabbles and much hand labor, would be accomplished at least as easily as any form of roasting by fuel in a similar apparatus. Roasting furnaces needing ploughs or rakes dragged over the hearth mechanically to stir the ore would be better suited to electric heating than to the usual roasting processes; the wear and tear of such form of mechanism is great, and largely due to their exposure to the fire gases which heat the or with an electric roaster this would be changed, the sole of the fu nace being the hottest part, the ore the next, and the plough stirrer remaining fairly cool. At the end of his paper he remar that in general two conditions decide in favor of the electric fu nace for a special operation: the need for a high temperature a the application of internal heating. The electric furnace is ind pensable for calcium carbide, carborundum, carbon boride, fus quartz in quantity, graphite, the diamond and the ruby. Substanc which may be prepared by other methods, but which are diffic to manufacture economically by any external method of heatir are zinc, phosphorus and carbon disulphide. He would also add ste for to heat this most delicate material in contact with ordinary fi and its products of combustion is to invite disaster.—Lond. *Ele* March 28.

German Electrochemical Society.—Ostwald.—A communicati in which he gives the reasons why he would like the name of tl society to be changed into the German Bunsen Society. He wa to extend the field of the society so that it comprises all the ap cations of physical chemistry in general in industrial chemist He refers to Knietsch's recent paper on the "contact process" making concentrated sulphuric acid; if industrial chemists had be better acquainted with the principles of physical chemistry, and pecially with the law of chemical mass action, the industrial develc ment of the contact process would have been much more rap "Who guarantees that in a few years for instance the catalytic pl nomena will not be so much in the front of industrial chemis that they will be much more discussed by the society than electi chemistry?"—*Zeit. f. Elektrochemie,* March 6.

Anodes of Irregular Form for Electroplating Work.—An illu trated note on a German patent of Kugel and Steinweg, for maki an anode of an irregular form so as to exactly correspond to t form of the cathode which is to be plated, in order that the distar between anode and cathode may be reduced to a minimum and in tl way the resistance of the bath be lessened. The anode is made follows: A hollow frame of glass, ebonite or other suitable mater is cast to the shape desired, with small perforations all over t surface. This hollow frame is suspended in the bath above the cat ode and is filled with waste cuttings or filings of the metal to be d posited at the cathode. Strips of the same metal are embedded the cuttings or filings to act as current connections; these bei placed in the center of the mass, are not quickly destroyed by t electrolytic action.—Lond. *Elec.*, April 11.

REFERENCES.

Electrometallurgical Industry of Germany.—L. Hoepfner.—So corrections of statements in Danneel's article, recently abstract in the Digest. The Papenburg plant produces copper and nickel the Hoepfner process.—*Zeit. f. Elektrochemie,* March 27.

Lead Storage Battery.—Pfaff.—An article on the development the manufacture of accumulators, especially of the mechanical man facture of the plates and grids.—*Centralbl. f. Acc.*, March 15.

Units. Measurements and Instruments.

REFERENCES.

Commercial Measurement of Electric Conductivity.—Addicks.—*I* illustrated article, in which, after a discussion of the units and stan ards, he discusses the following methods for measuring conductivit the Wheatstone bridge, the Thomson low resistance bridge, the sli wire bridge method, and the voltameter methods.—*Elec. Re* April 12.

Insulation Resistance of Trolley Wires.—Pomey.—A mathematic note on the measurement of the insulation resistance of trolley wir —*L'Eclairage Elec.*, April 5.

Telegraphy. Telephony and Signals.

Telephone Overhearing Indicator.—A note on a simple instrume which has been tried experimentally on the Government telepho exchange in Stockholm for about a year, to indicate to the su scriber whether the operator is listening to the conversation. Bridg across the subscriber's line and connected to it by a double po switch is a current detector whose middle point is earthed. Th center point of the operator's receiver at the exchange is earthe through the "engaged-test battery" in the ordinary manner. Thu

when the operator switches in her telephone through her listening key, a current is sent over both lines in parallel, through the above mentioned subscriber's indicator, and to earth, and the subscriber knows that the telephone operator is on the line. The indicator itself has two astatic needles, on whose common axis an aluminum disc is placed with red, black and white crosses painted upon it. This disc moves behind a black painted shutter. When any current is passing through the indicator the black cross is behind a cut of corresponding shape in the shutter, and when the operator is listening, the red or white cross shows. In this way, when the communication is through two exchanges, the connections can be so arranged that the white cross indicates that the operator at one exchange is listening, and the red cross that the operator at the other exchange is in circuit. This instrument is said to have worked well on the Stockholm system and to have been popular among subscribers.—Lond. *Elec.*, April 11.

Submarine Cables and the Coherer.—Guarini.—The conclusion of his illustrated article. Duplex transmission can be realized with a coherer in submarine cables, either by the differential system or by the Wheatstone bridge system. For the differential system a special coherer is to be used, a "magnetic coherer," the sensitiveness of which is varied by a magnet or electromagnet. Several diagrams are given showing the connections of the coherer in different systems. He finally discusses auto-decohering coherers; the decohering must be done with sufficient rapidity. He suggests making the coherer vibrate continuously; when an electric wave strikes it, it loses its resistance for a moment to regain it immediately by reason of the vibration.—Lond. *Elec. Rev.*, April 4.

Wireless Telegraphy.—An editorial on recent wireless telegraphic developments, from a "politico-international" point of view. The most salient feature is the inevitable spreading out of Hertzian waves in all directions from the originating center. An international agreement is necessary so that the natural and free intercommunication between the ships and coast stations of every maritime nation shall neither be prevented nor hindered. It is suggested to discuss this question at the International Telegraph Conference, to be held in London next year.—Lond. *Elec.*, April 4.

Miscellaneous.

Cutting Up Iron Tanks with the Electric Arc.—An illustrated description of the use of the electric arc in the removal of some large wrought-iron tanks in a building in Chicago. The tanks are 12 feet high and 24 feet in circumference, and to be removed they are cut down into small pieces. This is done by the electric arc; 75 to 80 amp. at 30 volts are used. One terminal of the circuit is attached to the tank and the other to an anthracite carbon, one inch in diameter and one foot long.—*West. Elec.*, April 12.

New Books.

Linear Drawing and Lettering. For Beginners. Accompanied by a blank book for lettering. By J. C. L. Fish. Palo Alta, Calif.: J. C. L. Fish. 65 pages, 46 illustrations. Price, $1.25.

The purpose of the author in the preparation of this book is to furnish directions and means for sufficient training in the use of drawing instruments to enable the student to construct accurate pencil drawings, make clean-cut ink lines, and do legible lettering. The directions regarding the use of instruments and for the construction of the various exercises are simple and clear, the work seems well arranged and the exercises well chosen for the purpose in view. The blank book contains 30 sheets ruled on one side horizontally and obliquely for lettering practice. These books seem well adapted for the purposes in view, and may be recommended to all who may be interested in drawing, either as a student or as a teacher.

The Principles and Practice of Linear Perspective. By Herman T. C. Kraus, C. E. New York: Norman W. Henley & Co. 53 pages, 11¼ by 15½ inches, and 14 plates of practical examples. Price, $2.50.

The engineer, whether he be electrical, mechanical or civil, is constantly compelled to have recourse to drawings in the design or construction of work. The ordinary shop drawing representing the object, as a rule in two or three views or projections, will probably never be superseded, but the frequent use of photographs to represent modern mechanical and engineering constructions, points strongly to the advisability and demand for showing objects in perspective. It is, therefore, highly advisable that the draughtsman himself should be able to produce a line-drawing, showing the object represented in perspective. Such drawings have decided advantages, and for certain purposes are, indeed, indispensable, especially where the object represented is not in a condition to be photographed, or indeed is only in the stage of planning.

The work before us is an excellent exposé of the principles of perspective drawing. By their aid, and with the assistance of numerous plates embodied in the work, the draughtsman has placed in his hands instructions which ought to enable him to represent effectively, almost any type of structure, whether mechanical, architectural, engineering, etc. We can heartily commend the conciseness and evident care with which the work has been prepared, while the illustrations are excellent for the purpose intended.

Dizionario Technico. Hoepli Manual. By E. Webber. Milan: Ulrico Hoepli. Second Edition. 553 pages. Price, 4 lire.

This is one of four volumes of a dictionary issued in the Hoepli Manual series, which excellent series now contains no less than 700 volumes. The dictionaries are in four languages, namely, Italian, German, French and English, and were prepared by Professor E. Webber, of Munich. On facing pages there are four columns, the first of which is arranged alphabetically and corresponds to the language which gives the name to that particular volume. The dictionary is rather a "word book" than dictionary in the ordinary sense, as the word in the first column is merely followed by the equivalent word in the columns under the head of the other three languages. The work is very comprehensive, comprising more than 20,000 words relating to all of the technical sciences. The arrangement is also excellent. For example, under the word "electricity" in heavy type (opposite to which are the equivalent words in the three languages with respect to its general meaning) are 20 lines of qualifying words, such as animal, contact, galvanic, static, voltaic, etc., the equivalents in the other languages being given of each of these.

Electrical Engineering Testing. A Practical Work for Second and Third Year Students, Engineers and Others. By G. D. Aspinwall Parr. Philadelphia: J. B. Lippincott Company. 474 pages, 218 illustrations, 31 tables. Price, $3.50.

If the author had stopped his sub-title at the word "students," and refrained from adding "engineers and others," and had omitted the word "practical," much of the critism to which the work is open would not apply. It is only as a student's laboratory manual that the work is of value. In fact, while the author does not so state, the reviewer strongly suspects that the work is simply a compilation of a series of instruction sheets of the kind issued to pupils to guide them in conducting various tests, and each of which is supposed to be complete in itself. Only on this ground can the useless reiteration in each test of such self-evident directions as "see that the instruments stand level and that their indexes are at zero," and "see that the oil cups are filled and feeding slowly before starting the machine," etc., etc., be accounted for.

We must take issue with the author's stereotyped direction for each test involving indicating instruments, *i. e.*, "adjust the pointer to zero if it requires it." If this direction were given only for such instruments as galvanometers and dynamometers, it would have some propriety. It is, however, given for tests on ordinary commercial instruments as well, and far from following the author's lead, the student should be impressed with the fact that a zero error should not be constantly adjusted by himself, but that such adjustment is only likely to aggravate matters, and that the proper course when such error exists is to note it and make proper correction by adding to or deducting from the number of degrees observed.

Another adverse criticism that applies to the book when looked at in the light of a reference volume is the fact that directions for the tests are in one section and the description of the apparatus in an entirely different one. This necessitates a continual reference back and forth that is anything but convenient.

It is not to be understood from the foregoing that the work is a failure; Mr. Parr's name would preclude such idea. The arrangement of the subject matter in each test is excellent, giving as it does the

chief advantages and disadvantages of the test, next a statement of the necessary apparatus, then the observations to be taken with outline diagrams of the connections, and, finally, ingenious and carefully worked out forms upon which the results of the tests should be recorded. After having filled out these blanks with the data obtained, the student will have but little excuse for not having grasped the full import and purpose of what he has been doing.

The inferences deducible from each test are also stated, and a few brief questions are inserted at the end of each section which are searching and pointed. College professors and instructors will find the volume of much assistance in systemmatically laying out their

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Production et Distribution le L'Energie Pour la Traction Electrique. By Henry Martin. Paris: Ch. Beranger. 760 pages, 870 illustrations. Price, 25 francs.

This large and well illustrated volume occupies a special place in the literature of the electric railway. It confines itself almost exclusively to a remarkably full discussion of the apparatus for the distribution and generation of current for railway use, dealing little with the concrete mechanisms used in the world's current practice. In this particular it is remarkably instructive, being especially rich in plans of stations and practical descriptions of their organizations.

The treatment of storage battery auxiliaries and of sub-station practice is, however, very meager, the former subject being dismissed in 13 pages, the latter in 12. The electrical design of feeder systems is likewise shuffled off in 8 pages, but the construction of a feeder system is quite fully discussed. By far the most complete portion of the work is that which deals with the arrangement and construction of the working conductors, both overhead and underground. This topic, occupying about three-fourths of the volume, is discussed in much detail, and with a richness of illustration that is particularly satisfactory, and the volume is a repository of a vast amount of useful information as to the world's practice in methods of construction and equipment.

The subject of conduit and surface-contact systems is treated with a fullness that is both unusual and highly important. The volume closes with a full report of the French requirements for the installation of central stations and conducting systems, as well as the laws relating to water powers. Altogether, we have here a very interesting record of electric railway design and construction in its mechanical details. Not a little of the apparatus described is, of course, American, but is much else that American engineers may well study to their profit. It is a volume which is a very useful addition to the library of every engineer who can read French—as every engineer should. There is so much of value in that language, and it is so singularly easy to acquire, so far as reading is concerned, that it should not be neglected.

Crane Motors.

With any shop possessing electric power an important claimant for its use is the traveling crane, which can be operated electrically with greater ease and precision than by any other method. The duties required of the motors are primarily three: the hoist, the

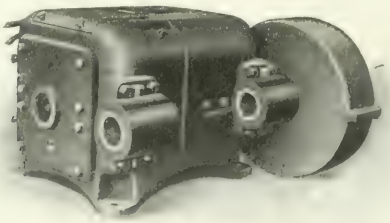


FIG 1.—CRANE MOTOR.

trolley travel and the bridge travel, with occasional extra duty, such as an auxiliary hoist, etc.

For accomplishing these various services, the Crocker-Wheeler Company now produces a line of machines of various sizes. The small size is for trolley travel alone and has normal ratings of [illegible] hp. It can be seen in the accompanying illustration between the tracks mounted on the front of the crane. Its own shaft is coupled to an extended one, which working in a spur gear gives motion to the trolley back and forth across the bridge. For any of the applications another size is built, rated at from 5 to 10 hp, and suitable for light hoist use or for operating a heavier trolley than the smaller size.

The motor shown in the illustration, mounted on an extended base above the trolley wheel, shows through spur gear to drive the drum of the hoist. The motor moving the entire bridge is

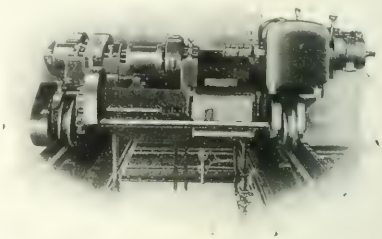


FIG. 2.—MOTOR ON TRAVELING CRANE.

mounted at the side of one of the main girders and cannot be distinguished in this view.

For heavier uses than this particular crane requires, other sizes are manufactured, giving a horse-power ranging from 25 to 60. The latter size is here shown and indicates the general character of this entire line of machines. They are all series wound with the fields wrapped in numerous windings of cambric, oiled muslin and rubber tape, the whole being painted and thus rendered impervious to moisture and dust to which the crane is exposed. The armatures are drum wound of iron clad type, the winding being thoroughly insulated before being placed in the slots. As will be seen, the frame is of very stout construction and appearance. The whole machine is made with the idea of withstanding heavy overloads and giving long extended satisfactory service.

Automatic Water Purifying Apparatus.

The accompanying illustrations represent a new type of water purifying and water softening apparatus which has been largely employed in Europe and is now being introduced in this country by the Automatic Water Purifying Company, 45 Broadway, New York. In Europe the method employed with this apparatus is known as the Reisert-Derveaux system, which has received awards at the principal European international expositions, from that of Frankfort, of 1881, to the recent Paris Exposition. Fig. 3 shows the apparatus as installed in the well-known works of Brown, Boveri & Co., Baden, Switzerland. Its main points of interest are the arrangements for continuously and automatically supplying the lime and soda reagents, and for automatically cleansing the filter.

Referring to Figs. 1 and 2, the apparatus consists essentially of an automatic lime saturator S, a soda chamber C, a water distributing tank R, with a lime slaking division J, a reaction chamber D, above which is an automatic filter F. The water to be filtered and purified enters the distributing tank R, whence it is conducted to the lime saturator, at the bottom of which it encounters a lime paste. Becoming thoroughly impregnated, the water and lime rise until the current diminishes so much, owing to the increasing cross section of the saturator that the undissolved lime particles no longer follow the saturated water; the water is thus clarified and leaves the top S through the pipe S_3 and is carried into the reaction chamber D. Hydrate of lime (slaked lime) possesses the property of dissolving and of entering into solution with water in definite proportions or until the latter is saturated; the water will not absorb more than a definite amount whatever quantity of lime may be present. This property renders it possible to keep up a uniform flow of lime-saturated water.

As stated before, the fully saturated lime water is conducted into the reaction chamber D, into which the small pipe C brings a certain definite amount of soda from the tank C. The carbonates of lime and other solid matter are here precipitated in consequence of the chemi-

cal reaction which takes place. The residuum is removed from time to time through a mud cock *W*. The water then rises through the annular passage *N* to the filter chamber *F*, where all remaining suspensions are removed; the purified and softened water is then drawn through the pipe *T*.

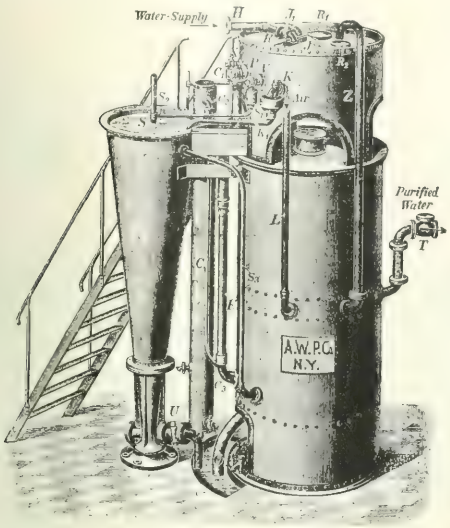


FIG. 1.—AUTOMATIC WATER PURIFIER.

In this apparatus the filtering material never needs renewal, owing to an ingenious arrangement whereby it is automatically cleaned when it becomes choked. As the quantity of sediment in the filter increases the material of the filter offers a continually increasing resistance to the flow of the water. Finally the water will rise to such

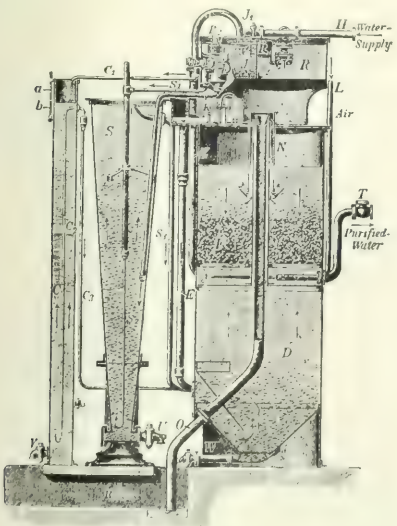


FIG. 2.—AUTOMATIC WATER PURIFIER.

a point that the air present will escape through the valve *Z* and a siphon, consisting of three pipes arranged concentrically, is automatically set in operation. At first air will be energetically drawn in through the pipe *L*, and rushing through the filtering material from the bottom upward, will thoroughly agitate it. When the influx of air ceases a definite quantity of water will enter below through the pipe *Z*; this will thoroughly cleanse the material, and the water containing sediment flowing off through the pipe *O*. After cleansing the siphoning arrangement will stop and the whole apparatus operate normally. The air and water working together cause a violent agitation, which the water alone would not accomplish, thereby separating the greater part of the impurities from the filtering material.

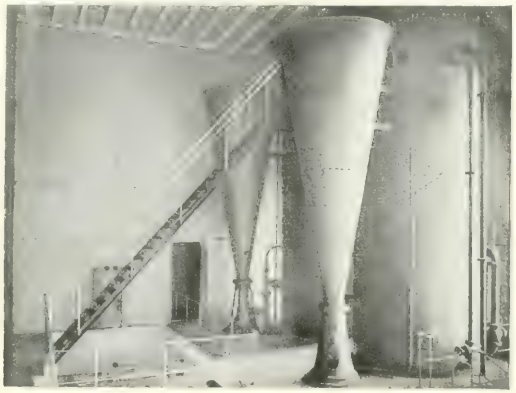


FIG. 3.—WATER PURIFIER INSTALLATION.

The attendance of the apparatus is confined to charging once a day with lime and soda, and opening the sediment cocks *U*, *W* and *Y* for a few minutes in order to remove the sediment and to test the water by means of an apparatus supplied with the filtering arrangement.

Hospital Electric Ambulance.

A few weeks ago an article appeared in this journal descriptive and illustrative of the new lying-in hospital given by Mr. J. P. Morgan. Additional to the many other interesting electrical features then noted is the ambulance, of which two views are given. It is of original and ingenious construction, the great aim being the comfort of the patient. As will be seen, it "loads" from the side, thus enabling a very easy transfer of the patient to be made. It was furnished by the Vehicle Equipment Co., of Brooklyn, and built on the Gibbs system. It is equipped with 2-hp Westinghouse motors, and with 44 cells of chloride accumulator. It can be speeded up to 20 miles an hour. It is electrically lighted with a cluster of three lamps inside, and with one lamp outside, and can also be electrically heated, a thermometer being carried to indicate temperature. The



FIG. 4.—ELECTRIC AMBULANCE.

weight is 5,400 pounds. The vehicle is charged at the power plant of the hospital, there being a special charging board for the purpose.

This new type of ambulance is proving very popular, and some five



FIG. 2.—ELECTRIC AMBULANCE WITH SIDE OPEN.

have since been ordered and built, including one for the Presbyterian Hospital, in New York; two for Paris and two for Boston.

Rieter's Electrical Brake Dynamometer.

The dynamometer illustrated herewith is the invention of Mr. E. H. Rieter-Bodmer, of Konstanz, Germany, and is manufactured in England by the Newton Electrical Works, Limited, Taunton.

In principle it is of the electrical absorption type. There is a magnetic system of two or more poles arranged so as to be capable of rotating through a small angle, and mounted on ball bearings to reduce the frictional resistance to a minimum. The magnetic system may be excited by a dynamo or accumulators, the latter, however, being preferable where great economy is required. The poles are surrounded by a cylinder of iron, which, when driven by the power to be measured, causes the generation of eddy or Foucault currents at the iron ring, these currents exerting a braking effort which tends to stop the rotation of the iron cylinder. By suitably varying the excitation the dynamometer may be made to absorb the exact power required. The mechanical work is transformed first into electric energy and thence into heat, this heat

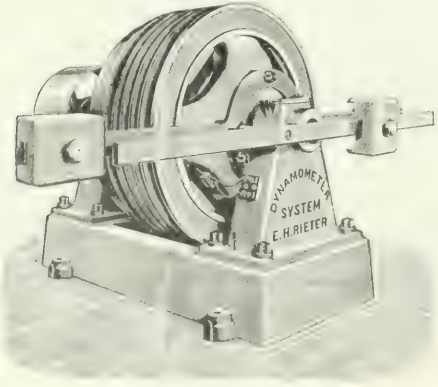


FIG. 1.—RIETER'S DYNAMOMETER.

being dissipated in the surrounding air by the rotation of the ring. In connection with the magnetic field are two levers carrying movable weights, which serve to measure the power absorbed after the manner of the Prony brake.

Among the advantages claimed for this form of brake is that, since the power is absorbed electrically, there is no frictional resistance, and consequently no possibility of "seizing," and no violent vibrations of the lever occur. Another advantage is that no artificial cooling is required. It is stated that a 35-hp dynamometer, tested by Prof. Weber, of Zurich, measured from 5 to 10 hp with a precision of 1 per cent.; from 10 to 20 hp with a precision of .06 to .03 per cent, and from 20 to 25 hp with a precision of from .03 to .02 per cent.

Development of Telpherage.

Note has been made from time to time in these pages of the development of telpherage, at the hands of the United Telpherage Company, of New York City. The range of work and opportunity for this form of transportation seems infinite, and each week witnesses some new application of the art to the distribution of material in small bulk.

We illustrate herewith some of the details of a plant just in-

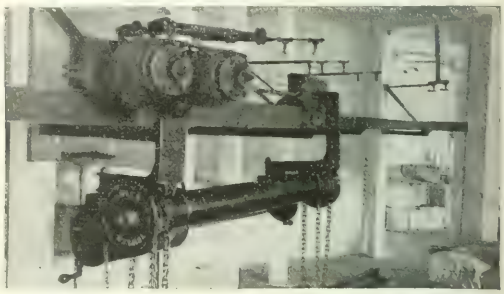


FIG. 1.—TELPHERAGE

stalled for handling light material of considerable bulk in a large factory. The installation presents many features of interest. In this case, with a view to the loads hauled, a girder rail is employed, with a double trolley, and with side bearing telphers to which a trailer is permanently attached. The telpher is controlled from either end by cylinder controllers, and there is a special hoist for elevating both sides of the car simultaneously. As will be seen, a telpher operator or a "telpherman" can be carried along, and his perch consists of folding steps at the car end. Leaving him out of consideration, the capac-

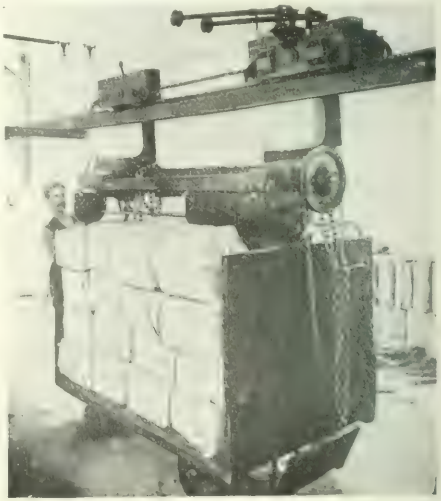


FIG. 2.—TELPHERAGE INSTALLATION.

ity of the system is 100 tons per day. The length of the line is 1,200 feet, in which there are four curves, one being an "S" with a grade of 12 per cent., which demonstrates strikingly the ability of the telpher to surmount steep grades. The total load on the solid rail track is 4,000 pounds, with which a speed on the level is made of ten miles an hour, while the speed on the grade attains five miles an hour.

About five horse power can be developed to do the work, showing that telpherage is already beginning to enter fields which at first were not supposed to be open to it.

"All-Wire" Rail Bond.

The accompanying illustrations show three different forms of the "All-Wire" rail bond manufactured by the Ohio Brass Company,



FIG. 1.—RAIL BOND.

Mansfield, Ohio. The bond shown in Fig. 1 is made entirely from one piece of flexible copper cable, and it is pointed out that there are thus no cast or welded joints to become loose or interpose additional resistance. It is stated that the conductivity of this bond, throughout its entire length, including the terminals, is equal to that of commercially pure copper. This bond is intended for use under the fish

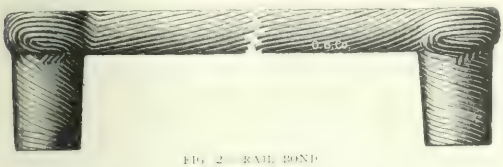


FIG. 2.—RAIL BOND.

plate, in which position it is protected from injury from outside causes as well as from theft.

The company manufactures a variety of styles for this particular use, and also furnishes special types for use around the fish plate or

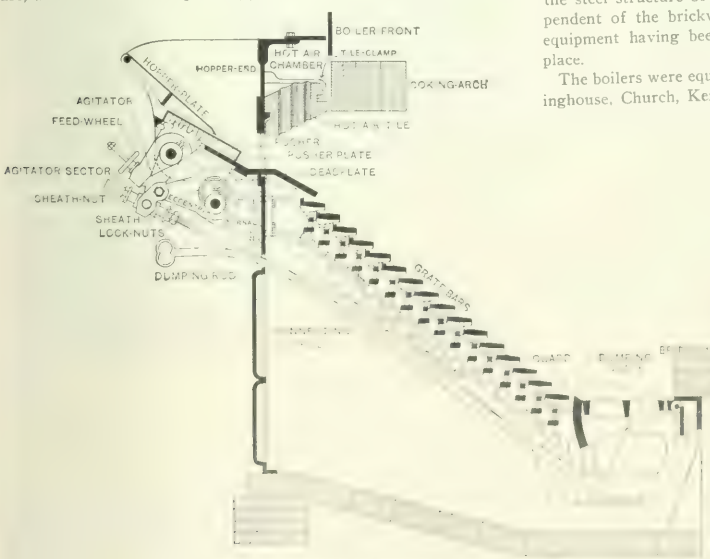


FIG. 1.—[illegible] MECHANISM.

under the base of the rail, as well as for cross connecting and underground bonding. In the manufacture of this bond the piece of flexible copper cable, which has been cut to length, is placed in a forming machine, in which the ends of the cable are cold pressed into shape for the terminals, as illustrated in Fig. 2. The size of the terminals, however, is considerably larger than in the finished bond. The ends are then heated almost to the melting point and forged accurately to size in a steel die. In this process the terminals are considerably reduced in size and the strands of wire are welded together, forming a solid mass of copper.

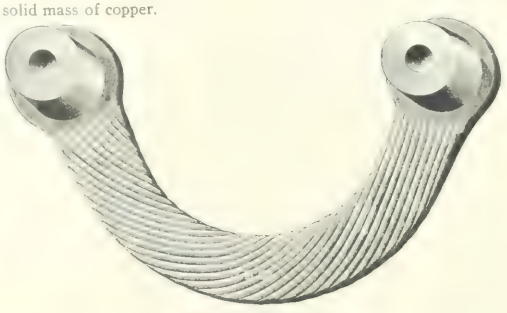


FIG. 3.—RAIL BOND.

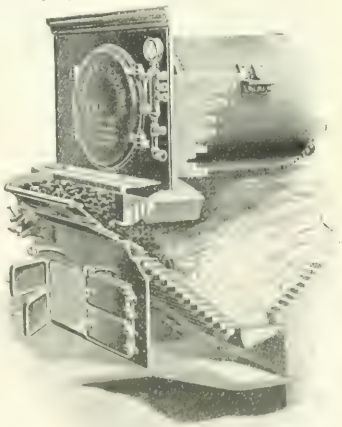
In Fig. 3 the manner in which the strands of the cable are gradually merged into the solid copper terminal is clearly shown.

Largest Mechanical Stoker Plant in the World.

The Ninety-sixth Street Station of the Metropolitan Street Railway Company of New York enjoys the distinction of being the largest electrical power plant in the world in actual operation at the present time. The general and electrical features of this plant have previously been described in these columns, and we now give a description of the steam generating plant with especial reference to the mechanical stoker equipment.

The steam plant contains 80 boilers, arranged in three tiers, 200 x 166 feet each. They are Babcock & Wilcox water-tube boilers, with 126 four-inch tubes, 18 ft. long and two 42-inch drums 9-16 of an inch thick and 23 ft. 3⅝ inches long. The boilers are built to carry 200 pounds, but, at the pressure adapted for the station, 160 pounds, they will have a rated capacity of 250 hp, although they can develop 400 hp. These boilers are supported by steel beams connected with the steel structure of the building, and they are thus entirely independent of the brickwork and of the floor itself, this part of the equipment having been installed before the brickwork was put in place.

The boilers were equipped with Roney mechanical stokers by Westinghouse, Church, Kerr & Company, and this plant has the distinc-



[illegible] OVER [illegible]

tion of being the largest installation of mechanical stokers in the world in actual operation to-day. There are other plants now in course of construction in New York, which, when completed, will have larger capacity, and these, too, are being equipped with Roney mechanical stokers—the Manhattan Railway, for instance, with its ultimate equipment of 384 stokers attached to 96 boilers of 50,400 hp; the New York Edison Waterside station, which will have 224 stokers under boilers developing 35,000 hp; and the Third Avenue Street

Railway plant of the Metropolitan Company with 240 stokers under 31,500 hp of boilers. But for some time the Ninety-sixth Street station of the Metropolitan Company with its 23,500 hp boiler capacity can rightly claim the distinction of leader in number and capacity of stokers as well as in character of equipment.

The details of construction of the latest form of Roney mechanical stoker are shown in the accompanying diagrammatic illustration, and the simplicity of the apparatus will be appreciated by an examination of this cut. The equipment consists of a hopper for receiving the coal, a set of rocking-stepped grate bars, inclined at an angle of 37 degrees from the horizontal, and a dumping grate at the bottom of the incline for receiving and discharging the ash and clinker. The dumping grate is divided into several parts for convenience in handling.

Coal is fed to the inclined grate from the hopper by a reciprocating pusher, which is actuated by the agitator and agitator-vector. The grate-bars rock through an arc of 15 degrees, assuming alternately the inclined position and the stepped position illustrated in the cuts, showing details of feed and grate movements. The grate-bars receive their motion from the rocker-bar and connecting-rod, and these, with the pusher, are also actuated by the agitator, which receives its motion through the eccentric from a shaft attached to the stoker front, under the hopper. The range of motion of the pusher is regulated by the feed-wheel from no stroke to full stroke, and the amount of coal pushed into the furnaces may, therefore, be adjusted according to the demand for steam. The motion of the grate-bars is similarly regulated and controlled by the position of the sheath-nut and lock-nuts on the connecting-rod. Each grate-bar is composed of two parts, a vertical web provided with trunnions at each end, which rests in seats in the side-bearers, and a fuel-plate, ribbed on its under side, which bolts to the web. These fuel-plates carry the bed of burning coal, and, being wearing parts, are made detachable, thus reducing the cost of repairs to a minimum. The webs are perforated with longitudinal slots to disclose the condition of the fire at all times without opening the doors; free access may be had to all parts of the grate to assist when necessary the removal of clinker. These slots also serve an important purpose in furnishing an abundant supply of air for combustion.

Anthracite coal is burned under half of the boilers in the Metropolitan plant. The stokers are fitted with what is termed a guard, which may be raised to prevent the small anthracite coal from sliding when the dumping grate is dropped to discharge the accumulated ash and clinker. On restoring the dumping grate to its normal position, the guard is dropped. The design and construction of the dumping grate and guard are clearly shown in the detailed illustration of this feature, and their operation will be readily understood.

An excellent view of one tier of the boilers equipped with Roney stokers in the Metropolitan Company's station is shown in the large half-tone reproduction. The experience of the company with these stokers has been very satisfactory. The saving in labor has been a considerable item, and the improvement in the service over the old standard of hand-firing is very noticeable. The efficiency of the entire plant has been raised while the coal bills are materially lessened. Another important advantage is the fact that hard or soft coal may be used, either separately or mixed. For this no alteration is required in the arrangement or construction of the stoker, merely a different adjustment of the feed and grate actuating mechanism. The supply of coal fed to the furnace is regulated by the feed wheel and the motion of the grate bars by the position of the lock nuts, and these adjustments are easily made by any fireman.

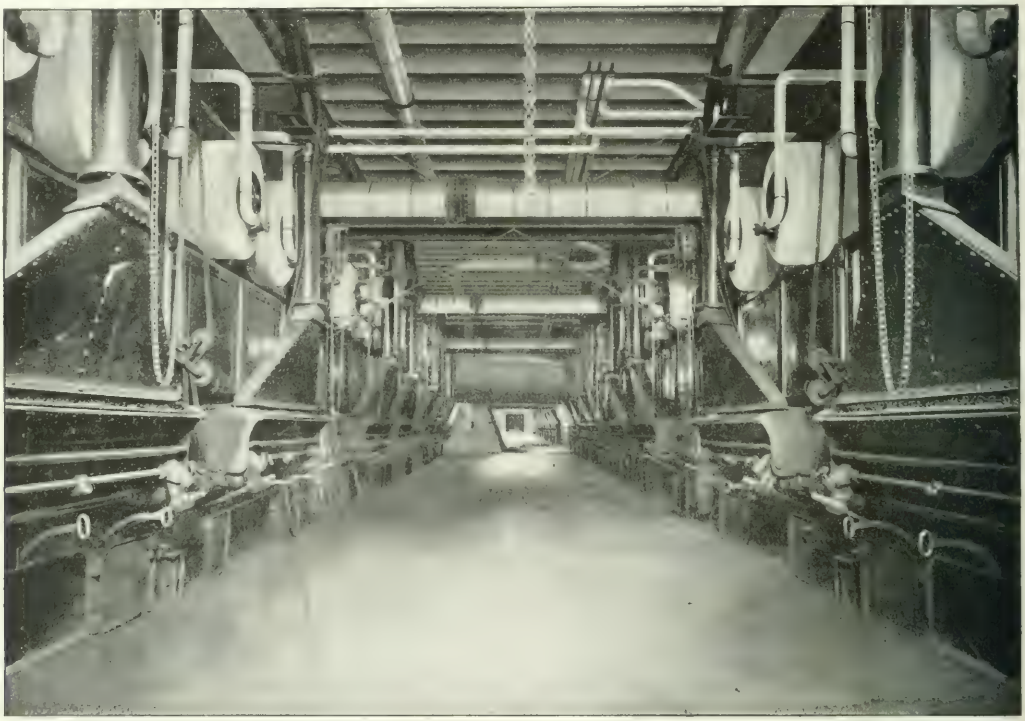


FIG. 3.—GENERAL VIEW OF METROPOLITAN STREET RAILWAY BOILER ROOM, SHOWING STOKERS.

These stokers are operated by small 4 x 4½-in. Westinghouse engines, made of special design for boiler house use, being of enclosed type with all moving parts entirely protected from dust and dirt. The engines run in a bath of oil; so do the worm and worm-gear, to which the engine, indirect-connected, and the worm-gear housing, which is completely enclosed, is attached direct to the engine frame and housing, making a complete and simple construction. The lubrication is entirely automatic, and this feature cuts down attendance to the minimum, so much so in fact that it is not a factor in the distribution of the power house labor. The operation and adjustment requires so little skill that they can be successfully taken care of by the ordinary fireman. In this particular plant each floor in the boiler house is divided into four sections. One engine is sufficient to run a section, but a relay is installed as a safeguard against possible accident to driving gear of shafting.

Although these engines are small in type they show a low water

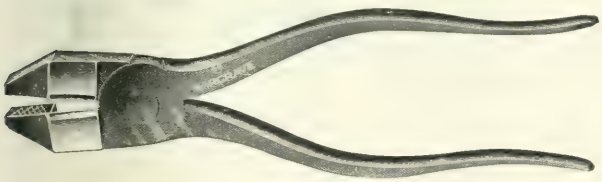
rate, giving, under good conditions, an economy of 42 pounds of water per horse-power. Taking the average results of several tests of the power required to drive Roney stokers under heavy loads, it is found that to operate stokers for 100 rated boiler horse-power about 0.1 indicated horse-power or 4.2 pounds of steam per hour are required. This amount of water is insignificant, as it represents only between 0.1 per cent. and 0.2 per cent. of the water evaporated by the boiler.

In operation the entire bed of fire is visible from the underside of the grate, as shown in the cut of the Roney stoker attached to a horizontal boiler. Clinkers can be seen as they form and may be dislodged without opening the doors. Then, too, if the fire should burn unevenly, it can be detected instantly and corrected without trouble.

The feature which commends this stoker particularly to the layman as well as the owners of a power plant, is that it insures complete combustion of fuel, and consequently eliminates the smoke nuisance. This is accomplished by furnishing sufficient air supply, mingling the air with volatile gases, maintaining a constant high temperature and a uniform supply of fuel carefully regulated to meet the demand. A coking-arch of fire-brick across the furnace covers the upper part of the grate and forms a reverberatory furnace and gas producer, the action of which is to coke the fresh fuel as it enters and releases its gases, and these, mingling with the heated air supplied in small streams through the perforated tile above the dead-plate, are quickly burned in the large combustion chamber above the bed of incandescent coke on the lower part of the grate. This method of supplying the coal at the front and coolest portion of the furnace, presents conditions most favorable for complete and economical combustion, and the stoker closely resembles a large Argand burner in the ease which which it is regulated and in its smokeless combustion of the hydrocarbons of the coal.

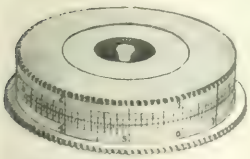
Linemen's Pliers.

The pliers illustrated in the accompanying cut are made by the Cincinnati Tool Company, Cincinnati, Ohio, of drop forged tool steel. They are 8 inches long and the side cutters have a sharp edge and high cutting power. The roughened surface of the nose of the instrument gives a powerful grip on the work, and altogether the tool has the appearance of being of massive construction. It is made in two styles, polished and black.



PLIERS.

Cylindrical Pocket Slide Rule.



CYLINDRICAL POCKET SLIDE RULE.

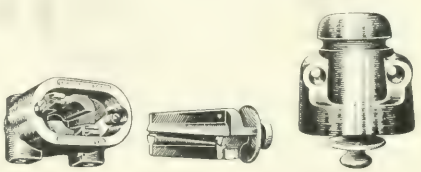
The instrument illustrated herewith was designed with the view to securing compactness and ease of use. The scales are of the same appearance as the upper scales on the ordinary 10-in. slide rule, the graduations, both in spacing and numbering, being exactly the same. This enables any one who is familiar with the use of the straight slide rule to use this instrument without further instruction.

The pocket calculator meets the objections to the use of the straight rule by its portability, which admits of more frequent use; and its scales being of the same character as those in ordinary use, practice with either helps in the use of the other. There are only two scales on the instrument, which is claimed to be an advantage, since there are fewer lines and graduations before the eye to distract attention from the proper lines; therefore, there is less liability to error in reading. The cylindrical form also aids in concentrating attention on a particular part of the scale. The two scales, it is stated, are sufficient for the operations for which the slide rule is commonly used.

This instrument is manufactured for Frost & Adams Company, 37 Cornhill, Boston, Mass.

Transformer Cutout.

A new primary switch and cutout manufactured by the General Electric Company is made of porcelain and is practically a pole line insulator combined with a transformer primary switch and single pole cutout; thus the wire may be brought directly from the line to the cutout and thence to the transformer without the use of an additional insulator. The cutout consists of stationary terminals with clips which make contact with a removable porcelain plug which carries the fuses. The construction is such that ordinary uncovered fuse wire may be used, although this is not recommended because of the possibility of improper fusing due to the increased length of wire over ordinary practice thus required, which of course materially affects the carrying capacity of the fuse. A line of fuses specially constructed for use in this cutout is manufactured. The plug when inserted in the cutout is held securely in position because of the peculiar design of the contact, and the construction of the handle is such as to protect the hand from danger of shock. The cutouts, which are illustrated below, are finished in black, thus corresponding to the general appearance of the transformers.



TRANSFORMER CUTOUT.

American Electrical Work in France.

We have had the pleasure of seeing during the past week the photograph of some work done in France recently by an old Edison man, Mr. Jos. Platky, the chief electrician of Ed. Beraud, the city contractor of Lyons. Mr. Platky for fifteen years has upheld the interests of the American electrical industry in France and on the European continent, and his big switchboard for a Lyons theatre is an excellent piece of work.

The switchboard is 2.80 meters in length by 1.70 meters in height, and the marble plate of 600 kilos is cut from one block of a thickness of 4 cm. In 1901 the city council directed the former wooden switchboard of the Grand Opera House to be changed to one of marble, and Mr. Augagneur, the mayor of the city, a well-known French electrician, requested the Beraud works to entrust this work to Mr. Platky, who had originally installed the old Edison board. The cost of drilling some fourteen hundred holes into the board, which was accomplished by hand-drills in about three weeks, and the rough part of the changing process amounted to 2,500 francs, and the change was accomplished without in any way interrupting the service.

The switchboard is mounted for general lighting with tri-phase current, furnished by the Compagnie de Jonage. Three bars on the right side of the board take the continuous current furnished by the Compagnie du Gas de Lyon, and light "security lamps," in case of a break-down of the general lighting current, provided by the Compagnie de Jonage. Every one of the 63 lines on this board are connected to the principal cut-outs. As the board was originally mounted with two bus-bars for a voltage of 110 volts another bar was added for the purpose of equalizing the current for three-phase. Each phase supplies 675 incandescent lamps of 16 cp.

Electrical Exhibits at the Charleston Exposition.

The only manufacturer of electrical apparatus having an extensive exhibit at the Charleston Exposition is the General Electric Company, whose exhibit occupies the center of Electricity and Machinery Building.

The operating part of this exhibit represents a typical modern rotary converter substation. It contains a 500-kw rotary converter, running on a 2,300-volt, 60-cycle circuit, and furnishing 500-volt current for motors used by the Exposition Company in different parts of the grounds. This installation consists of three 185-kw air blast transformers; the air being furnished by a standard blower operated by one of the company's induction motors. One of the company's standard railway switchboards is installed. It is of handsomely enameled slate and consists of six panels, four of them controlling feeder circuits. This converter is so connected that during the rush hours 500-volt current is supplied to the Charleston Consolidated Railway, Gas and Electric Company's feeders for the lines running to the Exposition. The company has aimed in its Charleston exhibit to show such apparatus as is particularly interesting to people of that section and to a certain extent typical of its business in the South. Two types of induction motors are shown, both representing the company's work in cotton mills. The Anderson Cotton Mills, at Anderson, S. C., use a peculiar design of induction motor, known as the water-cooled—a type which is of considerable interest to engineers visiting this exhibit. For general use, however, a standard type of induction motor, furnished with two pulleys at each end of the shaft, is preferred. A 65-hp motor of this type is shown mounted upon a frame. It is fitted with a hand-starting lever, and embodies all of the latest features recognized as essential to successful operation in the class of work for which it was designed. There are several small machines direct-connected to General Electric motors—notably a coffee grinder and a meat chopper of patterns extensively used. Two of the company's standard railway motors with one of the well-known type "K" controllers was exhibited, one of the motors being thrown open to facilitate inspection by visitors.

A complete line of the company's arc lamps is shown, most of them being in actual operation and provided with densely colored enclosing globes and glass casings, a combination which permits free examination of the mechanism and a close inspection of the arc without danger to the eyes. The Electricity and Machinery Building is lighted by means of General Electric series alternating system, as are also the grounds of the Exposition and the interior of the Auditorium and several other buildings. Transformers operating this system about the grounds are located in the Exposition sub-station in the Auditorium. A set of blue Vermont marble panels are shown with a full line of General Electric instruments, switches and other switchboard devices mounted on them.

One of the most interesting still exhibits of the Exposition is the company's well-known big model of its factories at Schenectady, N. Y., Lynn, Mass., and Harrison, N. J., which is placed directly opposite the main entrance on the company's space in the Electricity Building. It is surrounded by artistically grouped photographs and displays stands of the company's small wiring devices and supplies.

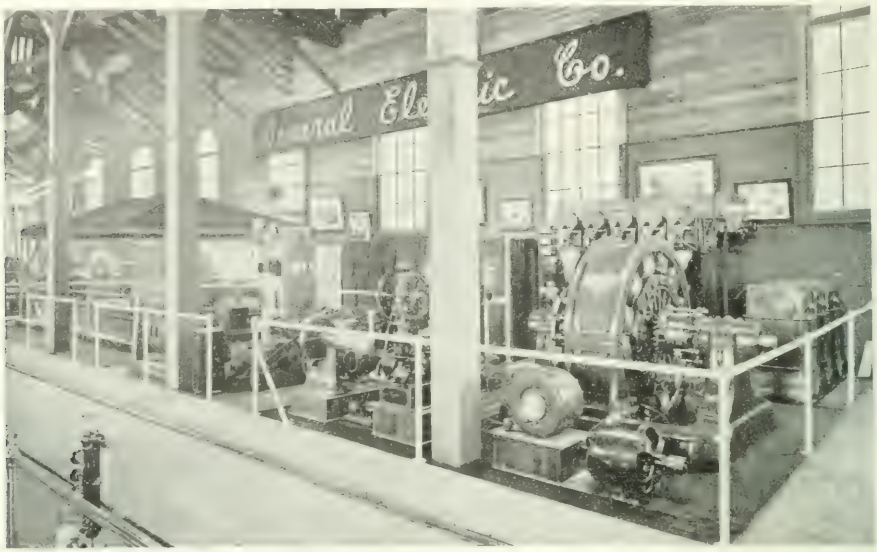
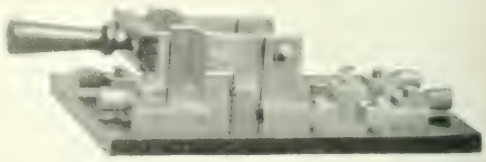


EXHIBIT AT CHARLESTON EXPOSITION.

Knife Switches.

The Reading Gas and Electric Fixture Company, of Reading, Pa., is placing on the market a line of knife switches, in the design of which the many troubles that have confronted manufacturers of high-grade switches, switchboards, panels and tablet boards have been dealt with, the result being an article which is claimed to be not only useful for first-class installations, but one which is also very pleasing and attractive to the eye.

Two of the points that may be mentioned with respect to construction are the method employed in fastening the blades and handle to the cross bar, so as to make them mechanically secure; and the perfect contact which is secured by guarding the blades into their respective contacts after the parts are all assembled.



KNIFE SWITCH.

The company has recently built and installed some very large switchboards, among them being a ten-panel power and lighting board for the Carpenter Steel Company, of Reading. The factory is under the personal supervision of Mr. Rudolph Miehling, who has had an extended experience in the manufacture and installation of switches, switchboards, panel and tablet boards.

Electrically-Driven Machine Tools.

We illustrate herewith two interesting large machine tools, built by the Niles-Bement-Pond Company at their Philadelphia shops. Fig. 1 shows a 72-in. engine lathe driven by a 15-hp Bullock motor. The motor in this case is a special one and is built around the regular cone shaft. By the use of the multi-voltage system it gives



FIG. 1.—72-IN. ENGINE LATHE.

seven speeds in each direction, and with back gearing to the face plate, there are 14 variations to the face plate ranging from three-quarters to 43 revolutions per minute. The changes of speed can be controlled from the carriage so that the workman does not have to leave his cutting tool in order to change the speed. The machine illustrated has been built for the Fore River Shipping and Engine Building Company's works, Quincy, Mass.

Fig. 2 shows a 79-in. double driving wheel lathe, driven by a 7½-hp Westinghouse motor. The motor speed is varied by field control and by means of clutched gears, the speed of the face plates varying

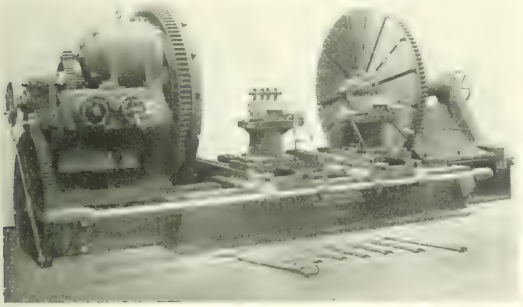


FIG. 2.—79-IN. DOUBLE DRIVING-WHEEL LATHE.

from 46/100 revolutions to 43 revolutions per minute. The feed mechanism on this machine is brought down in front of the bed so that everything is left clear overhead. The lathe was built for the Dunkirk shops of the American Locomotive Company. In the base of both machines a very large economy is effected over belt-driving by the use of electric power, and besides there is a great gain in convenience of operation.

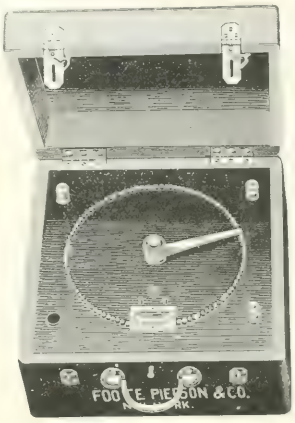
Cable Fault-Testing Instrument.

The instrument shown herewith is designed to be used by those not having the technical knowledge necessary to make galvanometer tests. With this instrument it is not necessary to know the resistance of the cables, the size of the wire, or the voltage of the battery used in testing, but simply the length of the cable in feet.

The fault tester consists of an accurately graded rheostat divided into 100 steps, and a sensitive portable D'Arsonval galvanometer with a suitable number of cells of dry battery all neatly mounted in one case. The whole apparatus is very compact, easily portable, and can be used in a man-hole for underground cables, or on a pole for aerial cables.

The method of use is simply one of ratio. An arm moves about a circle connecting the galvanometer to any one of the 100 points of the rheostat, and to determine the position of a fault it is only necessary to move the arm around the circle till it reaches a point where there is no deflection of the galvanometer, and then multiply such numbered point by the total length of the cable in feet. For example, say that the total length is two miles or 10,560 feet and there is a ground on the cable at some point. When a reading of the instrument is taken and the galvanometer balances at .58, we have $10560 \times .58 = 6124.8$ feet, showing that the fault is this distance from the end or point of observation.

The galvanometer used with this set is a "Delta" portable test-



TESTING INSTRUMENT.

ing galvanometer and can be used in connection with any Wheatstone Bridge set for the determination of high or low resistance, or such general work as is performed by high-class instruments of this kind. The instrument is manufactured by Foote, Pierson & Co., 82 Fulton Street, New York.

Solid Brass Desk Telephones.

The accompanying illustration represents a new common battery and magneto desk set, manufactured by the Eureka Electric Company, Chicago, Ill. In the construction of this instrument the base and upright are of solid brass and engine-turned. This solidity of construction is a protection to the instrument against damage in case of accidental fall from the desk or table on which it is placed. On this desk set there is mounted the Eureka Company's



DESK TELEPHONE.

regular special receiver with all hard rubber case and solid back, special diamond grained carbon transmitter, which latter instrument is especially adapted to use on long lines and for common battery work. The company furnishes these instruments for both common battery and magneto work, with the other usual parts to complete the sets, according to requirements.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Interest on money closed at 4 per cent. for 30 to 90 days and 4 to 4½ per cent. for four to six months. The hot wave caused a crop scare which was reflected on the stock marked, and this, added to the decision of the Supreme Court in favor of admitting the State of Washington as a contestant against the Northern Securities Company, caused a rush to sell stocks. The market, however, stood the deluge very well, and at the end of the week there was a much better feeling. United States Steel stocks exhibited considerable strength toward the close of the week, which had a good effect on the rest of the list. Amalgamated Copper also advanced, and activity prevailed in industrial stocks, with upward tendency. In the traction list, Metropolitan Street Railway is the only stock that showed any weakness, closing at 152¼, a net loss of ¼ point, after having reached 154¼. Brooklyn Rapid Transit closed with a net gain of 3¾ points on transactions of 247,200 shares, the closing price being 70¼. General Electric advanced to 331½ during the week, closing at 328—a net gain of 5 points. Westinghouse common made a net gain of 5 points, and the 1st preferred 4, closing at 227 and 230, respectively. Western Union was weak, closing at 92¼—a net loss of 2 points. Other closing prices were: American District Tel. 38½—a net gain of 5 points; American Tel. and Cable 93—a net gain of 1 point; American Telephone and Telegraph 183¾—a net gain of 4¾, and Com. Cable 158—a net gain of 6 points. Following are the closing quotations of April 29:

NEW YORK

	Apr. 22.	Apr. 29.		Apr. 22.	Apr. 29.
American [illegible]	[illegible]	[illegible]	General Electric	[illegible]	[illegible]
American [illegible]	[illegible]	[illegible]	General Carriage	[illegible]	[illegible]
American Dist. Tel.	—	38	Hudson River Tel.	—	100
Brooklyn Rapid Transit	[illegible]	[illegible]	Metropolitan Street Ry.	[illegible]	[illegible]
Commercial Cable	[illegible]	[illegible]	N. E. Elec. Vehicle Trans.	[illegible]	[illegible]
Lanston Monotype	[illegible]	[illegible]	N. Y. & N. J. Tel.	[illegible]	[illegible]
Manhattan Beach	[illegible]	[illegible]	Tel. & Tel. Co. of America	[illegible]	[illegible]
Manhattan Railway	[illegible]	[illegible]	Western Union Tel.	[illegible]	[illegible]
Electric Vehicle	3½	7	West. E. & M. Co.	227	224
Electric Vehicle 1st pf.	[illegible]	[illegible]	West. E. & M. Co. 1st pf.	[illegible]	[illegible]

BOSTON.

	Apr. 22.	Apr. 29.		Apr. 22.	Apr. 29.
American Tel. & Tel.	[illegible]	[illegible]	Mexican Telephone	[illegible]	[illegible]
Cumberland Telephone	—	129	New England Teleph.	149⅞	150*
Edison Elec. Illum.	—	—	Westinghouse Elec.	—	—
Edison Electric Ill.	—	—	Westinghouse Elec. 1st pf.	—	—
General Electric	[illegible]	[illegible]			

PHILADELPHIA.

	Apr. 22.	Apr. 29.		Apr. 22.	Apr. 29.
American Railways	47	47	Phila. Traction	[illegible]	[illegible]
Electric Storage Battery	[illegible]	[illegible]	Phila. Elec.	[illegible]	[illegible]
Lake Superior Corp.	—	—	Phila. Electric Vehicle	—	—
Lake Superior Corp. pf.	[illegible]	[illegible]	Phila. Rapid Transit	—	—

CHICAGO.

	Apr. 22.	Apr. 29.		Apr. 22.	Apr. 29.
Chicago Edison	[illegible]	[illegible]	National Carbon 1st pf.	[illegible]	[illegible]
Chicago Telephone	[illegible]	[illegible]	National Carbon 2d pf.	[illegible]	[illegible]
Commonwealth Edison	[illegible]	[illegible]	Union Traction	[illegible]	[illegible]
Diamond Match	[illegible]	[illegible]	Union Traction pf.	[illegible]	[illegible]
National Carbon	[illegible]	[illegible]			

* Asked.

CONSOLIDATING VIRGINIA TROLLEYS.—The Merchants' Trust Company of New York has entered into an agreement by which it has become the purchaser of the following Southern companies: Virginia Electrical Railway and Development Company, capital, $1,000,000; Richmond Traction Company, capital $1,000,000; West Hampton Park Railway Company, capital, $300,000. The purchasers of the properties already control the Richmond Passenger and Power Company, which has a capital of $1,000,000. The consolidation which will follow will embrace all the street railways of Richmond, Manchester and Petersburg, and the interurban connecting lines; all electric-light and power business in the same places; water rights of the James and Appomattox Rivers, and large holdings of real estate, including sites for manufactories. Edward Langdon, of New York, president of the Merchants' Trust Company; E. L. Bemiss, president of the three companies; R. Lancaster Williams, acting for the owners, and Randolph Williams, counsel for the three companies, were at the conference when the deal was closed. The different stocks are to be placed with the International Trust Company as depositary. Mr. Langdon said: "There will be a number of betterments, and Richmond and other territory served will be given facilities unexcelled. This applies not only to street railways, but electric-light and power service, which will be supplied economically and reliably." Mr. Langdon added that Fritz Sitterding, president of the Virginia Passenger and Power Company, would be the executive head of the consolidated properties. The Richmond Traction interests will be represented.

MARCONI WIRELESS TELEGRAPH.—E. Rollins Morse & Bro. are offering $1,200,000 of the $6,650,000 capital stock of the Marconi Wireless Telegraph Company of America at 65, par value 100. The circular states that the company has been organized to control the Marconi system of wireless telegraphy and all inventions and patents relating thereto in the United States of America and Cuba, Porto Rico, the Hawaiian Islands, the Philippine Islands, Alaska, the Aleutian Islands, and all ships under the American flag. It is the only public issue of stock that will be made. The directors of the company are: Wyllis Rossiter Betts, John W. Griggs, ex-Attorney General of the United States; Samuel Insull, president of the Chicago Edison Company; Commander J. D. J. Kelley, U. S. Navy; Eugene H. Lewis, of Eaton & Lewis, lawyer; H. H. McClure, of the S. S. McClure Company; Colonel John J. McCook, of Alexander & Green, lawyers; G. Marconi, E. Rollins Morse, Cyrus J. Sedgwick, treasurer of the Hall Signal Company; Loyal L. Smith, Spencer Trask. It is now announced that Dr. Pupin has also assigned to the company his "tuning" patents, and will take pay partly in cash and partly in stock.

NEW JERSEY TROLLEYS.—The State Board of Assessors report the 1901 business of the electric and street railway companies of New Jersey. The gross receipts of all the lines were $8,137,076, an increase of $398,688. The companies expended $4,464,513, which was a net increase of $84,288. The dividends paid last year were $486,640, a decrease of $131,300. The statement shows that the total mileage of these companies is 846. The capital stock issued was $81,607,189, and the capital stock of this authorization which has been paid in is $79,925,180. The total funded debt of these companies is $64,702,500, and the other debts amount to $3,079,597. The value of the roads is $152,401,800. There were eight companies that paid a dividend, the principal company being the Consolidated Traction, which is leased to the North Jersey Traction. The aggregate of the dividends was $300,000. The other companies paying dividends were Asbury Park & Sea Girt, $6,000; Bridgeton & Millville, $4,000; Camden Horse, $50,000; New Jersey & Hudson, $22,500; Rapid Transit of Newark, $59,220; Raritan Traction, $5,000, and Trenton Railway, $39,020.

BIRMINGHAM, ALA., ELECTRICS.—Mr. H. M. Atkinson, who engineered the deal by which the Birmingham Railway Light and Power Company became sole owner of the electric, power, gas and street railway properties at Birmingham, and, with the assistance of the Old Colony Trust Company, of Boston, organized the amalgamated company, and floated its bonds, has been elected president of the Birmingham Belt Railroad, with Louis P. Pairo, vice-president. The Birmingham Belt circles and courses through the city of Birmingham with side-tracks into practically every industry, acting as a local transfer for the trunk lines. Mr. Atkinson's election means the extension of these lines and their betterment. It is generally understood that the Birmingham Belt has a close connection with the Railway, Light and Power Company.

DIVIDENDS.—American Light and Traction has declared the regular quarterly dividend of 1½ per cent. on its preferred stock, payable May 15. National Carbon has declared a quarterly dividend of 1¾ per cent. on the preferred, payable May 15. At the regular quarterly meeting of the directors of the Allis-Chalmers Company, the usual quarterly dividend of 1¾ per cent. upon the preferred stock of the company was declared. The directors of Westinghouse Electric have declared the regular 1¾ per cent. quarterly dividend on the assenting stock, payable May 15, New York. Consolidated Gas directors have declared the regular quarterly dividend of 2 per cent., payable June 16. The American District Telegraph Company has declared a semi-annual dividend of 1 per cent., payable May 15.

MEMPHIS LIGHT AND POWER.—A special dispatch from Memphis, Tenn., says: Fifty-one per cent. of the stock of the Memphis Light and Power Company has been sold to Anthony N. Brady, of New York, and C. K. G. Billings, of Chicago. S. T. Carnes, president of the company, sold the stock.

UTICA LIGHT AND POWER.—A syndicate headed by Mr. A. N. Brady has acquired the Utica, N. Y., Electric Light and Power Company, and is consolidating the gas and electric interests in that busy city.

POTTSVILLE, PA., CONSOLIDATION.—It is stated that the gas electrical illuminating interests of Pottsville, Pa., are being consolidated with a capital stock of $3,000,000.

GENERAL CARRIAGE has been in bad odor and under a receivership for some time, but last week trading in the stock attracted much attention in Wall Street. Prices went from less than 1 up to 15, and stayed above 10. The company, it is stated, is to be immediately reorganized and put in active operation. C. S. Drummond, managing director of the British Electric Traction Company of London, it is announced, will become the president of the reorganized company. It is officially stated that the plan for the rehabilitation of the company will not require any assessment on the stock. The interests back of the company say that they have formed extensive plans for the operation of vehicles in this city and elsewhere, and have acquired much property and patent rights which are to be turned over to the General Carriage Company, which will at once re-establish its business. Contracts were signed last week for the transfer of the Hunter patents to the persons interested in the reorganization of the General Carriage Company. Joseph H. Hoadley, of the International Power Company, who controls the Carriage Company, gave out the following statement in regard to the purchase of these patents: "We have bought outright all the patents of Rudolph M. Hunter, of Philadelphia, a pioneer electrical inventor in electric motor power. These patents control the operation of electric motors and batteries on vehicles by the method known as the series parallel control, and no electric vehicles can be successfully operated without infringing one or more of these seventy patents. The importance of this purchase lies in the fact that every manufacturer of automobiles will have to pay tribute to the General Carriage Company, which will cease to be localized to New York State operations and become general in its influence. Mr. Hunter's inventions date back to the early days of electrical work, but his patents still have several years to run because, on account of the broad scope of his claims, the Patent Office withheld the issue of these patents for many years. Exclusive manufacturing rights have been entered into with the International Power Company, which will give the General Carriage Company unlimited manufacturing facilities."

NEW YORK TUNNEL ROAD.—Articles incorporating the Pennsylvania, New York & Long Island Railroad Company have just been filed at Albany. It is proposed to construct and operate a tunnel railroad, about five miles long, in New York City, to be connected with any roads hereafter built, and will thereby form a continuous line for the carriage of passengers and property between points within and without the city of New York. The road, which will be operated by electricity, is to have an approach to the surface at its eastern terminus. The western terminus will be under the waters of the Hudson River on the boundary line between the States of New York and New Jersey, at a point of connection with the railroad to be organized under the laws of New Jersey, and opposite that part of New York City lying between West Thirtieth and West Fifty-ninth Streets. The eastern terminus of the road will be at a point of connection with the lines of the Long Island Railroad Company in the Borough of Queens, at Thompson Avenue. The capital stock of the company is $20,000,000. Its directors are as follows: A. J. Cassatt, Thomas DeWitt Cuyler and C. A. Griscom, of Haverford, Pa.; John P. Green, of Rosemont; Charles E. Pugh, of Overbrook; S. M. Prevost and W. A. Barnes, of Philadelphia; Samuel Rea, of Bryn Mawr, and William H. Baldwin, Jr., of New York City.

INDIANAPOLIS TROLLEYS.—Articles of incorporation have been filed in the office of the Indiana Secretary of State by the Indianapolis Northern Traction Company, with a capital stock of $3,500,000. The directors named are Charles A. Baldwin, Henry Moore, William H. Bloss, Ellis C. Carpenter, Albert S. Richey, Arthur W. Brady and Charles Berry, all officers of the Union Traction Company. The new organization is a combination of the interests of the Central Traction Company, which has been absorbed by the Union Traction Company, of which George F. McCulloch is the head, and of other interests which have received franchises and rights of way through various cities north of Indianapolis. Roads will be built by the new company from Indianapolis to Logansport through Tipton, Kokomo and Peru, and connecting these towns with various surrounding cities. The entire system when built will be acquired and operated by the Union Traction Company. The amount of the securities for the new road has been underwritten by an Eastern banking syndicate, and the deal was arranged by President McCulloch, of the Union Traction Company. Work will be commenced on the road immediately, and the lines will be put in operation as soon as possible.

ELECTRIC COMPANY OF AMERICA.—The Electric Company of America's annual report shows for the fiscal year ended Dec. 31, 1901, net earnings from operation of plants $281,232, and profits from other sources $198,954; total income, $480,186. The surplus over the dividend of 50 cents per share was $174,148. At the annual meeting, held in Camden, N. J., the stockholders voted to reduce the capital stock from $25,000,000 to $5,000,000, and that the reduction be effected by reducing the par value of the shares from $50 to $10 per share, making the stock full-paid and non-assessable. To accomplish this purpose, the directors were authorized to use so much of the surplus as may be judged advisable. The amount standing to the credit of the surplus account on Dec. 31, 1901, was $916,194, and it is proposed to credit from this $1.50 per share on the amount paid in on the stock, when it is made full-paid 10. There will then remain a surplus to credit of profit and loss of about $300,000. The company at the close of the fiscal year had $200,000 cash in bank and the only current liabilities were $6,597 bills payable. The comparative net profits from operation of plants from January 1, 1902, up to March 31, shows an increase of 32 per cent.

WESTINGHOUSE ELECTRIC.—With regard to the splendid rise in this security, the following is credited by the *Wall Street Journal* to a well-informed inside authority: "There is no truth in the rumor that Westinghouse and General Electric are to consolidate, but there has been much inter-buying, if I may use the word, by stockholders in each company. Harmony is to be the by-word of the two companies in the future, and both will be immeasurably benefited by the absence of competition, especially in the foreign field. The fact is that the business of the Westinghouse Company has trebled in the last two years and this increase will be sustained. The company is now earning at least 40 per cent. on the stock, and has accumulated a surplus of over $10,000,000. The control of the company now lies in the hands of New York capitalists, and the best results are sure to be brought about by these controlling interests. Remarkable returns on the present capital, steadily increasing business and unequalled future prospects are the reasons for the recent interest in the stock, and the same considerations will hold the stock at the present valuation or bring about a further advance."

BRONX TROLLEY BONDS.—At White Plains, N. Y., last week there was filed with the County Register a mortgage given by the Westchester Traction Company to the New York Security and Trust Company for $1,500,000. The mortgage is given to secure bonds to the same amount, and covers all the trolley lines of the company in Westchester County. The money resulting from the bond issue is to be used to build new lines and extend existing ones. It is said the company will push its way into the Bronx at once to secure connections with the rapid transit subway and the Manhattan Elevated roads, and begin active competition with the Union Railway Company, which now has a virtual monopoly of transit facilities in the Bronx and Westchester County, as the Westchester Company's lines lack proper terminals.

SHAWINIGAN BONDS.—At a meeting of the Shawinigan Water & Power Company, held at Montreal on April 4th, it was decided to make an issue of $3,000,000 of 4½ per cent., thirty-year, first mortgage gold bonds. The purpose of the issue is to retire the present outstanding 5 per cent. bonds to the amount of $1,500,000, and to furnish funds for the extension of the company's operations to the city of Montreal. It is stated that the company has made satisfactory arrangements covering the disposal of the bonds, and that this move on the part of the company would bring in some of the largest financial interests in the United States.

AN OGDENSBURG DEAL.—Chester Snyder, as trustee for a syndicate of ten Pennsylvania capitalists, has purchased all the bonds of the Ogdensburg, N. Y., street railway, not held by the syndicate, at par value, and also paid all outstanding indebtedness, taking full control and ownership. G. C. G. Davis, of Easton, Penn., was placed in charge as manager. All the stock of the Ogdensburg Gas Company is arranged for by the Pennsylvanians, who already hold the entire stock of the Ogdensburg Power and Light Company. The bonds and indebtedness of these companies represent nearly $300,000.

THE JOSEPH DIXON CRUCIBLE COMPANY.—The annual meeting of the Joseph Dixon Crucible Company, of Jersey City, was held last week. The old board of directors was re-elected, and in turn re-elected these officers: President, E. F. C. Young; vice-president and treasurer, John A Walker; secretary, George E. Long; executive committee, John A. Walker, Joseph D. Bedle and William Murray. The financial statement shows that the company has a surplus of $1,300,000, with outstanding debts of about $37,000.

LOUISVILLE HOME TELEPHONE.—The Home Telephone Company has filed a mortgage for $2,500,000 on its plant in Louisville, of which $1,000,000 will be put upon the market at once. The company expects to begin operations about May 1, and claims to have 5,000 subscribers with three-year contracts. The field is already occupied by the Cumberland Company, a branch of the Bell Telephone system.

PHILADELPHIA BELL.—The stockholders of the Philadelphia Bell Telephone Company have voted to increase the capital stock from $8,000,000 to $12,000,000.

AMERICAN DISTRICT TELEGRAPH.—At the directors' meeting of the American District Telegraph Company last week, the resignations of Gen. Thos. T. Eckert, president, and Mr. C. A. Tinker, vice-president, were accepted, and Col. R. C. Clowry was elected president, and Mr. Wm. H. Taylor, vice-president.

Commercial Intelligence.

THE WEEK IN TRADE.—Dealings and speculation during the week are reported by the mercantile agencies as having been of a very full volume for this season of the year, despite the irregularities in weather conditions and extreme temperatures. The hot wave in a large part of the country relieved the retail demand of the retarding effect of the backward weather, while in the Northwest snow and rain checked retail trade distribution. Among the industries activity has remained as great as heretofore, and the labor situation is somewhat improved, particularly in the building and allied trades, which report great activity prevailing. The anxiety and desire to get supplies of crude material in iron and steel is almost as great as ever. Prices for pig are higher at all centers, and high premiums for prompt deliveries of Bessemer are still paid. Finished materials are in increased demand, and very heavy orders for structural material are being placed. Large shipments of Canadian steel billets are reported as arranged for. The market for copper was quiet, various transactions being reported but none of large volume. Prices are somewhat lower, the latest quotations being 11⅞@12c. for Lake, 11½@11⅝c. for electrolytic in cakes, wire bars and ingots, 11¼@11⅜c. in cathodes and 11¾@11½c. for casting stock. The business failures for the week, as reported by Bradstreet's, numbered 181, as against 193 the week previous, and 214 the same week last year.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended April 14: Antwerp—19 pkgs. material, $674; 3 pkgs. machinery, $665. British West Indies—63 pkgs. material, $415. Berlin—3 pkgs. material, $134. Bremen—2 pkgs. machinery, $90; 3 pkgs. material, $100. British Australasia—323 pkgs. material, $15,603; 13 pkgs. machinery, $808. British East Indies—4 pkgs. machinery, $300; 24 pkgs. material, $1,791; 64 pkgs. material, $1,875; 14 pkgs. machinery, $1,320. Brussels—2 pkgs. material, $87. Central America—3 pkgs. material, $642; 1 pkg. material, $33. Constantinople—1 pkg. material, $6. China—8 pkgs. material, $71. Cuba—2 pkgs. machinery, $51; 6 pkgs. material, $155. Egypt—1 pkg. machinery, $48. Glasgow—4 pkgs. material, $203. Hamburg—3 pkgs. machinery, $130; 36 pkgs. material, $1,484. Havre—20 pkgs. machinery, $2,100; 16 pkgs. material, $684. Hayti—6 pkgs. material, $85; 86 pkgs. material, $4,610. Liverpool—172 pkgs. machinery, $10,196; 67 pkgs. material, $2,612. London—80 pkgs. machinery, $15,155; 144 pkgs. material, $6,712. Marseilles—20 pkgs. material, $500; 605 pkgs. machinery, $58,902; 45 pkgs. material, $1,775. Mexico—37 pkgs. material, $1,110; 9 pkgs. machinery, $1,625. Malta—2 pkgs. machinery, $213. Portugese Possessions in Africa—1 pkg. goods, $75. Peru—71 pkgs. material, $4,955. Southampton—8 pkgs. material, $1,369; 248 pkgs. machinery, $2,915. St. Petersburg—12 pkgs. machinery, $1,310. U. S. Colombia—2 pkgs. material, $25; 5 pkgs. material, $109. The following are the exports of electrical material and machinery from the port of New York for the week ended April 22: Antwerp—30 pkgs. material, $1,280; 3 pkgs. machinery, $2,445. Argentine Republic—40 pkgs. material, $325. Athens—14 pkgs. material, $250; British East Indies—15 pkgs. machinery, $1,457; 51 pkgs. material, $2,490. British Guiana—23 pkgs. material, $228. Berlin—17 pkgs. machinery, $5,270; 2 pkgs. material, $43. Brazil—17 pkgs. machinery, $7,813; 57 pkgs. material, $4,932. British Possessions in Africa—1 pkg. machinery, $970; 236 pkgs. material, $12,117. British Australasia—82 pkgs. machinery, $5,025; 100 pkgs. material, $2,670. Bradford—16 pkgs. material, $750. Bale—16 pkgs. material, 537. Bergen—4 pkgs. machinery, $150; 3 pkgs. material, $150. Balboa—1 pkg. material, $20. Bremen—17 pkgs. material, $1,147. British West Indies—85 pkgs. material, $1,609. Cuba—164 pkgs. material, $2,196. Chili—54 pkgs. material, $1,324; 2 pkgs. machinery, $387. China—59 pkgs. material, $1,350. Copenhagen—1 pkg. machinery, $45. Central America—3 pkgs. material, $60; 4 pkgs. machinery, $121. Genoa—6 pkgs. material, $200. Gijon—3 pkgs. material, $70. Hamburg—5 pkgs. machinery, $5,000; 73 pkgs. material, $5,482. Havre—22 pkgs. machinery, $981; 39 pkgs. material, $841. Japan—11 pkgs. material, $2,552. London—76 pkgs. insulated cable, $25,165; 132 pkgs. machinery, $7,102; 93 pkgs. material, $3,123. Liverpool—105 pkgs. machinery, $10,685; 50 pkgs. material, $2,143; 4 pkgs. copper wire, $1,340; 54 pkgs. copper wire, $2,100; 77 pkgs. copper wire, $6,650. Marseilles—7 pkgs. material, $500. Manchester—254 pkgs. machinery, $27,575; 7 pkgs. material, $406. Mexico—104 pkgs. material, $464; 20 pkgs. machinery, $7,500. New Zealand—3 pkgs. material, $51; 20 pkgs. wire, $440. Naples—13 pkgs. machinery, $1,250. New Castle—2 pkgs. material, $35; 10 pkgs. machinery, $800. Philippines—69 pkgs. material, $3,147. Peru—53 pkgs. material, $2,309. Rotterdam—1 pkg. machinery, $200. St. Petersburg—31 pkgs. machinery, $9,220. San Domingo—6 pkgs. material, $30. Swansea— 5 pkgs. material, $340. Southampton—9 pkgs. material, $324. U. S. Colombia—11 pkgs. machinery, $225; 1 pkg. wire, $140; 59 pkgs. material, $1,731. Venezuela—36 pkgs. material, $687; 10 pkgs. machinery, $117. Vienna—1 pkg. machinery, $45.

THE HAINES & NOYES CO., through its private telephone department, closed up last week the following large contracts: Telephone system for A. B. Dick & Co., Chicago, manufacturers of the Edison Mimeograph; Inter-communicating telephone system for Mr. Royal C. Vilas' summer home on the St. Lawrence River; telephone system for the Central Union Life Insurance Company, Chicago; for Mr. Frank Hibbard's residence, Lake Front, Ill.; for the St. Anne's Hospital, Chicago; for the Oley Valley Electric Ry. Co., Reading, Pa. The Haines & Noyes Co. has also closed five contracts for large apartment house telephone systems in Evanston, Chicago, etc. Through its agents in Kansas City, W. T. Osborn & Co., it has just equipped the Wheeler apartment building in that city with 45 telephones and annunciator switchboard. The Haines & Noyes Co. has also closed a contract with the Board of Education, Chicago, for a number of telephones.

THE FIRST CEMENT PLANT IN CANADA to be operated by electric power is that of the National Portland Cement Company, at Durham, Ontario. All of the cement-making machinery in this plant will be driven by induction motors supplied with current by two Westinghouse 450-kw three-phase alternators. These machines are of the engine type with revolving fields, and run at 125 r. p. m., 3,000 alternations and 600 volts. Two exciting units are provided, one consisting of a 62½-kw, 125 volt, engine type, direct-connected generator, direct-connected to an automatic engine, and the other of a 56½-kw machine coupled to an induction motor. The output of the exciters will be used not only for exciting the fields of the alternating-current generators, but also for arc and incandescent lighting throughout the works and grounds. The Westinghouse Company also furnishes the 8-panel switchboard and instruments.

SALES OF ROTARY CONVERTERS.—Two rotary converters of 300 kw each have recently been purchased by the Manchester, N. H., Traction Light and Power Company from the Westinghouse Electric and Manufacturing Company. They will be located at Hooksett, N. H., and will deliver power for the operation of the Concord and Manchester branch of the Boston & Maine Railroad, this road having entered into a contract for power with the Manchester Traction Light and Power Company. The machines are to be supplied with three-phase alternating current, and will deliver direct current at 600 volts. The Westinghouse Company has also recently sold two rotary converters to the South Covington and Cincinnati Street Railway Company, one being of 200-kw capacity and the other of 400-kw capacity.

VALVES FOR CENTRAL STATIONS.—The Cleveland Electric Railway Company has awarded a contract to The Foster Engineering Company, of Newark, N. J., for four 8-in. non-return stop valves. In connection with the equipment of its new Riverside station, the New York Edison Company has placed orders with the same concern for one 8-in. and four 10-in. combination valves, and two 8-in. and one 10-in. non-return stop valve.

THE SALEM ELECTRIC LIGHTING COMPANY, Salem, Mass., has contracted with S. B. Condit, Jr., & Co., Boston, for a new alternating high-potential switchboard for its plant. This switchboard will have 20 panels and will be 56 feet 4 inches in length; it will be equipped throughout with Elden alternating, oil-type circuit breakers and switches. The company will build a fire-proof addition to its plant in which to erect this board.

PLANT FOR HONOLULU.—The Wagner-Bullock Electric Manufacturing Company's San Francisco agents have closed contracts for an electric power plant for the Von Hamm-Young Hotel Building in Honolulu, H. I. There will be two 100-kw generators and one 40-kw. Each of the machines will be direct-connected to a Union Iron Works engine.

LIGHTING PLANT FOR TOOELE, UTAH.—The Clark Electric Power Company, of Tooele, Utah, has closed contracts with the General Electric Company for a 400-hp electric light and power plant. It will be a water-power system, operated by impulse wheels supplied with water from two pipe lines.

STEAM TURBINES FOR LONDON RAILWAYS.—Steam turbines are, as already noted, to be adopted in the electric generating station to be built for the Metropolitan Railway Company of London, the contract having just been given to the British Westinghouse Electric and Manufacturing Company, of Manchester. The latter are now filling a similar contract for the Metropolitan District Electric Traction Company, and as there will be a general similarity in the two stations, it will be easy to arrange for connecting the two and making them interchangeable, as far as the supply of current is concerned, which feature was required by the terms of the franchise of the two roads. The Metropolitan power station will be located at Neasden, in the northwest of London, and will contain three sets of 3,500-kw capacity each. The Chelsea station of the Metropolitan District Railway will contain four sets of 5,000 kw each. The electrical machinery for both stations will also be supplied by the Westinghouse Company. The current will be three-phase alternating and of 10,000 volts, to be transformed in substations to direct-current for use in the car motors. It will be remembered that the matter of equipping the Metropolitan road electrically was the cause of a long and hard-fought battle before a court of arbitration between the Ganz polyphase and the American direct-current systems of working. The latter finally triumphed, being espoused by the District Railway under the leadership of Mr. Charles T. Yerkes. The steam for the immense steam turbines in the District and Metropolitan plants will be generated in water-tube boilers. The aggregate power of the two plants will be 30,500 kilowatts.

EXTENSION OF WESTINGHOUSE WORKS.—The Westinghouse Electric and Manufacturing Company will begin immediately the construction of new buildings at East Pittsburg, which will greatly increase the size of their works. The new buildings will be known as the "east extension," and the plans for them were made two years ago, when it was seen that the natural development of this company's business would, about this time, make the additions necessary. The plans also require the building of a river wall along the banks of the Turtle Creek, from a point near Turtle Creek Station, to Brinton Station, below the works of The Westinghouse Machine Company. Arrangements have also been entered into with the Pennsylvania Railroad whereby a special railroad line will be built from East Pittsburg to the new Westinghouse foundries, which are now being established at the town of Stewart, several miles to the east. This railroad will be built for the exclusive use of the Westinghouse companies. The construction of this large undertaking has been entrusted to James Stewart & Company, of Pittsburg, St. Louis and New Orleans, whose remarkable achievements in erecting, in record time, the new Westinghouse Electric works at Manchester, England, have for several months been the theme of general attention in the English and American press.

SALES OF IDEAL ENGINES.—Among the recent sales of Ideal engines by A. L. Ide & Sons, Springfield, Ill., are the following: one 15—22 x 16 d. c., City of Rochester, Minn.; one 13 x 14 d. c., Standard Brewery, Chicago; one 12 x 12 d. c., Grand Hotel, Yokohama; one 13—22 x 16 d. c., N. W. Malleable Iron Works, Milwaukee; one 16 x 14 d. c., Ill. Asylum for F. M. C., Lincoln; one 24 x 20 d. c., Springfield Electric Light & Power Co., Springfield, Ill.; one 18 x 16 d. c., Springfield Electric Light & Power Co., Springfield, Ill.; one 11 x 12 d. c., Ferguson-McKinney D. G. Co., St. Louis, Mo.; two 11—18 x 14 d. c., Ferguson-McKinney D. G. Co., St. Louis, Mo.; one 12 x 12 belted, Hamm Brewery, St. Paul; one 14 x 14 d. c., Hyde Park Hotel, Chicago; one 11—18 x 14 d. c., Wilson Bros., Chicago; one 15—22 x 16 d. c., Wilson Bros., Chicago; one 14 x 14 d. c., Carthage Electric Light Co., Carthage, Ill.; one 18—14 x 10 belted, L. F. Madison, Northwood, Ia.; one 16—24 x 18 d. c., Hall Building, Kansas City, Mo.; one 16 x 14 d. c., Farrand Organ Co., Detroit, Mich.; one 13 x 14 d. c., Ludlow-Saylor Wire Co., St. Louis, Mo.; one 17 x 16 d. c., Sattley Mfg. Co., Springfield, Ill.; three 15 x 14 d. c., Washington University, St. Louis, for Administration Buildings, World's Fair, 1903; one 14—22 x 16 belted, Postum Cereal Co., Battle Creek, Mich.; two 13 x 12 d. c., Wagner El. Mfg. Co., St. Louis, Mo.

NATIONAL ELECTRIC LAMP WORKS.—The famous old Brush Electric Works, in Cleveland, long disused for electrical purposes, have passed into the hands of the National Electric Lamp Company, the deed covering the entire property, machinery, etc. The new owners will begin improvements on May 1. Their possession is conditioned upon the different leases, and as fast as these can be arranged, the site will be vacated to the new owners to leave the way clear to occupancy for the manufacture of incandescent lamps on a large scale. The first improvements will be begun on May 1, when a large four-story office building will be erected to take the place of one of the present buildings and furnish quarters for the general offices of the company. Some of the buildings will be left standing, others will be remodeled, while still others will be torn down and replaced with structures suitable for the purposes of the company. It is proposed by the new owners to build one plant for the manufacture of glass globes for the incandescent lamps. The change is one of the largest single transactions of realty property to be made in Cleveland for some time.

ANOTHER LARGE MEXICAN WATER-POWER PROJECT.—F. S. Pearson, consulting engineer of the Metropolitan Street Railway, together with other prominent Americans or Canadians, is interested in a project to construct large water-power plants for the purpose of generating electricity for use in the City of Mexico. Plants having a capacity of 40,000 hp are to be built at the Falls of Necasca, near Huatchinango, about 90 miles from the Mexican capital. Power will be derived from two falls, each having a head of 1,200 feet. Construction will begin in July. Mr. Hugh L. Cooper, formerly of the Stilwell-Bierce & Smith-Vaile Company, who recently constructed the large hydraulic plant for the Sao Paulo Tramway, Light and Power Company, at Sao Paulo, Brazil, is now in Mexico on the project. It will be recalled that Mr. Pearson and his associates have also secured a franchise to supply the City of Puebla with electric power.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed contracts for the installation of chloride accumulators with the Edison Electric Illuminating Company, of Brooklyn; Detroit United Railway; Kansas City & Leavenworth Railroad Company; Wolvin Building, Duluth; Society for Crippled Children Hospital; residences of Alfred Gwynne Vanderbilt, Newport; C. Ledyard Blair, Far Hills, N. J.; Bayard Thayer, Lancaster, Mass., and R. B. Angus, Sinneville, Quebec. They have also contracted for an increase in the plants of the Peekskill Traction Company; Union Station, Brooklyn, and the residence plant of J. D. Rockefeller; and are also installing batteries in several yatch plants.

BUCKEYE ENGINES.—Among the recent orders received by the Buckeye Engine Company, Salem, O., through its New York office, are the following: The California & Arizona Mining Company has requisitioned for a 12x22x18-inch tandem engine to be direct-connected to a 125-kw capacity generator. The St. Louis Portland Cement Company, of St. Louis, Mo., is to be supplied with two 14½x25x21-inch for direct connection with generators of 150-kw capacity. The New Orleans Postoffice, now under construction, is to be installed with three simple engines, 11x14-inch, to be direct-connected to 60-kw generators, and theNantucket Malleable Iron Works, of Wallingford, Conn., are to be equipped with a 15¼x26½x27-inch cross compound condensing engine to be direct-connected to a 200-kw generator.

PROPOSALS FOR ELECTRIC PUMP AT MONTREAL.—U. S. Commercial Agent F. S. S. Johnson writes from Stanbridge, Can., April 7, 1902: An opportunity presents itself to our manufacturers to compete with Canadians in proposals for an electric power pump for the Montreal waterworks. Tenders for the electric pumping engine will be received up to noon on Tuesday, May 6th, at the office of the city clerk, City Hall, Montreal, for the erection at the high level station of a 5,000,000-imperial-gallon pumping engine, to be driven by electricity against a pressure of 26 pounds per square inch.

OMAHA-DES MOINES TROLLEY.—The Creston (Iowa) Electric Railway, Light, Heat and Power Company has begun work on the line from Creston to Winterset, Ia., a distance of 40 miles. It is the ultimate intention of the builders to extend from the eastern end to Des Moines, and from the western to Omaha, making a direct road between the two cities. The cars used will be the same size as ordinary railway coaches, and will run 45 miles per hour. The work will be completed before the end of the year. Bonds to construct the line have been sold in New York.

THE GOULD STORAGE BATTERY COMPANY reports the closing of the contract for the second battery for the Pittsburg, McKeesport & Connellsville Railroad, Pittsburg, Pa., to be installed at the Connellsville Station. This is a duplicate of the battery at the Uniontown Station of the same road, and has a capacity of 171 kw. It will be used for the present as a floating battery on the direct-current system. The contract calls for the increase up to 212-kw plate capacity and 318-kw tank capacity, when it will be used in connection with rotary converters.

ELECTRIC POWER IN RAILROAD SHOPS.—The Michigan Central Railway Company is introducing electric power into its shops at Jackson, Mich. Three engines, aggregating 800 hp, purchased from the Ball Engine Company, Erie, Pa., furnish the power. These engines will be direct-connected to alternating generators running in parallel, and will be supplied with synchronizing devices for changing speed while in operation.

General News.

THE TELEPHONE.

PUEBLO, COLO.—Extensive plans for improvements have been made by the Colorado Telephone Company, which practically means a rebuilding of the system here.

MT. CARROLL, ILL.—The Carroll County Telephone Company has placed a contract with the Kellogg Switchboard and Supply Company for a 300-line magneto, self-restoring, drop board.

LACON, ILL.—The Pekin Telephone Company has placed a contract with the Kellogg Switchboard and Supply Company for a 300-line magneto, self-registering drop board.

MACOMB, ILL.—R. D. Robinson and E. J. King have secured a franchise from the city council to establish a telephone exchange in this city.

WELDON, ILL.—A franchise has been asked by the Farm and City Telephone Company to build and operate an exchange in Weldon.

CHILLICOTHE, ILL.—The People's Telephone Company has increased its capital stock from $4,000 to $10,000.

INDIANAPOLIS, IND.—The Union Stock Yards firms recently took concerted action and appointed a committee to present grievances before the local management of the Central Union Telephone Company. The grievance asserted that the toll charges of the company should be reduced. Objection was also made to the practice of charging for overtime on long-distance calls, the patron firms contending that the amount of their monthly business was sufficiently large to warrant an occasional infraction of the time limit without extra pay. The demands, however, were turned down by the company. On receipt of this report by the committee the commission firms individually wrote notices to the company ordering it to take its instruments from their offices and are now awaiting developments. The order affects a hundred or more telephones.

NEW CASTLE, IND.—Mr. E. G. Matthews, of Cleveland, Ohio, sold to Mr. McDorman the plant of the New Castle Telephone Company. C. O. Phelps and E. H. Brubaker, joint owners with Matthews, objected to the sale of their interests, and before the situation was adjusted it is alleged that Matthews sold the plant again to Mr. Faulkner, of Dunkirk. McDorman now brings suit to enforce specific performance of contract in first sale, demanding that Faulkner turn the plant over to him, and that the work of construction cease until the matter is settled.

ALEXANDRIA, IND.—The Gas Belt Construction Company has placed a contract with the Kellogg Switchboard and Supply Company for a 1,200-line common battery switchboard with all necessary apparatus.

MUNCIE, IND.—The Gas Belt Construction Company has placed a contract with the Kellogg Switchboard and Supply Company for a 3,000-line common battery switchboard with all necessary apparatus.

ELMWOOD, IND.—The Gas Belt Construction Company has placed a contract with the Kellogg Switchboard and Supply Company for an 1,800-line common switchboard with all necessary apparatus.

PENDLETON, IND.—The Anderson Fall Creek Rural Telephone Company was recently incorporated and is negotiating with the Central Union and the Anderson companies for switch privileges.

INDIANAPOLIS, IND.—The Farmers' Telephone Company is now building its projected lines throughout the northern part of Indiana County, from Decker's Point to Rochester Mills, etc.

PHILADELPHIA, IND.—The Philadelphia Farmers' Telephone Company has filed articles of incorporation here. It has a capital stock of $5,000.

PLAINFIELD, IND.—The directors of the Plainfield Telephone Company will increase the capital stock from $10,000 to $25,000.

BLOUNTSVILLE, IND.—The Blountsville Telephone Company has been incorporated with a capital stock of $1,200.

CARLISLE, IND.—The Carlisle Co-operative Telephone Company has been incorporated with a capital stock of $10,000.

SHAMBAUGH, IOWA.—A telephone system has been organized to extend from Shambaugh to Braddyville, to be called the Norseman Valley line. Marion F. Nicholis is temporary president.

DAVENPORT, IOWA.—The American Telephone and Telegraph Company is about to make arrangements for the construction of a line from Davenport to Hannibal, Mo.

CLARION, IOWA.—It is reported that 75 miles of rural telephone lines will be built this season, connecting with the Clarion exchange.

DES MOINES, IOWA.—The Larchwood Telephone Company, with a capital of $1,500, has been incorporated by J. M. Hoggardt and others.

DES MOINES, IOWA.—The Kingsley Telephone Company has been incorporated by J. C. Cotrell and others. Capital, $2,500.

GRIMES, IOWA.—The Farm Mutual Telephone Company, capital $20,000, has been incorporated by B. S. Prunty and others.

GUTHRIE CENTER, IOWA.—The Mutual Telephone Company has been granted a franchise in this place.

PARKSTON, IOWA.—The Parkston Telephone Company has incorporated

ACKLEY, IOWA.—The Cedar Valley Telephone Company is inaugurating a local exchange here.

LORIMER, IOWA.—The Southern Iowa Telephone Company is putting in an exchange here.

WILTON, IOWA.—The Wilton Telephone Company will erect a new toll line to Muscatine.

PORTLAND, ME.—The Half-Moon Telephone Company has been incorporated with a capital of $10,000. E. J. Vose, of Knox, is president, and William Farwell, of Thorndike, treasurer.

DETROIT, MICH.—The Co-operative Telephone Company has decided to drop all further negotiations with the People's Company and to accept bids for putting in its proposed new plant.

DETROIT, MICH.—The city council of Ironwood has been asked for a franchise for an independent telephone exchange. It is likely that the application will be granted.

MARSHALL, MICH.—The Marshall Telephone Company has filed articles of incorporation, with $15,000 capital.

LAKEFIELD, MINN.—The Lakefield Telephone Company has filed articles of incorporation with a capital stock of $3,000.

FARIBAULT, MINN.—The Citizens' Telephone Company has been sold to the Northwestern Telephone Company.

McINTOSH, MINN.—Anton Jensen has been granted permission to install a local telephone system.

BILLINGS, MONT.—Another local telephone system will be constructed in Billings by the Montana and Wyoming Telephone Company, in accordance with the franchise granted it by the city council.

OMAHA, NEB.—The Independent Telephone Company will ask to incorporate the Omaha and Council Bluffs Telephone and Telegraph Company, for the construction of independent telephone systems.

LINCOLN, NEB.—The Beaver Valley Telephone Company has incorporated with a capital stock of $5,000.

OMAHA, NEB.—The Nebraska Telephone Company will spend $150,000 in bettering the service, including a new switchboard.

ROSELLE, N. J.—The New York and New Jersey Telephone Company is arranging for the installation of the telephone exchange in Roselle.

CANTON, OHIO.—The Everett-Moore syndicate has effected an agreement with the local stockholders of the Stark County Telephone Company, whereby the latter will furnish immediate funds to carry out needed extensions, which will be made at once. The directors of the company have announced that an additional board, giving accommodations for 1,700 new subscribers, has been ordered, and will be installed as soon as possible. From the manner in which subscriptions are coming in, it is expected there will be fully 3,000 subscribers in the city, besides several hundred who are awaiting the construction of long-promised country lines.

DAYTON, OHIO.—The Dayton Home Telephone Company, recently sold by the Federal Telephone Company, is now in the hands of Dayton and Columbus people. Work on the conduit system is to be pushed at once, and an exchange building is to be erected at Fourth and Jefferson Streets. The company has over 4,000 contracts for telephones.

BATAVIA, OHIO.—The Citizens' Telephone Company has made connection with the lines of the United States Telephone Company, thus securing long distance service for its subscribers. The company has nearly 600 subscribers in Clermont County, and the system is rapidly being extended to every portion of the county.

HICKSVILLE, OHIO.—The Hicksville Telephone Company has completed arrangements whereby its subscribers can talk, free of charge, with Fountain Chapel and Antwerp. A new line is to be built to McCormack's Corners, connecting a number of farmers. The exchange has 175 subscribers, and is making good gains.

TOLEDO, OHIO.—Representatives of the Putnam County Telephone Company, the Northwestern Telephone Company and the Napoleon Home Telephone Company held a conference with representatives of the Toledo Home Telephone Company, a few days ago, relative to toll lines and farmer line rates.

NAPOLEON, OHIO.—The mutual telephone companies of Henry County and the Napoleon Home Telephone Company held a meeting at Malinta, a few days ago, with a view to consolidating the systems. The matter is under consideration by the various interests.

MANSFIELD, OHIO.—The Star Telephone Company is building lines to Pleasant Valley and Germany, connecting up a number of farmers in these districts. The company has 600 telephones in Mansfield.

VENEDOCIA, OHIO.—The Jennings Telephone Company has placed a contract with the Kellogg Switchboard and Supply Company for a 100-line magneto self-restoring drop board.

WASHINGTON, PA.—E. B. Throckmorton has sold one-half interest in the Standard Telephone to James R. Throckmorton for $30,000. It will now be known as the Standard Telephone Company.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company is extending its line to Cadott, to connect with the Cadott Telephone Company's line, which reaches Boyd, Cadott and Stanley. The Badger State Telephone Company, which has a terminal at Thorp, will extend its line to Stanley this summer, and connect with the Cadott company's line. This will connect this city with Marshfield, Abbotsford, Greenwood and Neillsville.

BLOOMER, WIS.—The Bloomer Telephone Company, at its annual meeting, increased the capitalization from $2,000 to $8,000. New lines will be built to Cook's Valley, Sand Creek and Cartwright. Officers elected are: President, A. T. Newman; vice-president, Wm. Newton; secretary, H. Lebiles, Jr.; treasurer, W. E. Sketch; director, three years, Dr. C. B. Ackley.

OSHKOSH, WIS.—Application has been filed by the Oshkosh Telephone Company asking for a franchise for an independent telephone line in this city. An underground system is to be used. A. B. Ferdinand, of Milwaukee, is the promoter.

MADISON, WIS.—The Bangor Independent Telephone Company has filed articles of incorporation here. It has a capital stock of $5,000.

EAU CLAIRE, WIS.—The Wisconsin and Minnesota Telegraph and Telephone Company will install a new telephone system here.

CHIPPEWA FALLS, WIS.—The Wisconsin Telephone Company will rebuild its system in this city.

ORFORDVILLE, WIS.—The Orfordville Telephone Company has been incorporated with a capital of $10,000.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Warrior River Light and Power Company, capital $1,000,000, has been incorporated by R. R. Zell, John L. Burns and others. The purpose is to utilize the power of the Warrior River for the generation of electric power and the operation of a street car system connecting Birmingham with Ensley, Pratt City, Bessemer and other outlying industrial points.

SAN FRANCISCO, CALIF.—There is strong talk of the final construction of the McCloud River Electrical Power Company's proposed plant in Shasta County, Calif. The original project was promoted by A. F. Johns and turned out disastrously, work having been suspended nine months ago for lack of money to pay for the machinery that had been constructed for the plant. The water wheels are stored near the power site. Geo. H. Proctor and Lord Thurlow, who recently came West to exploit the proposed Eureka & Eastern Railroad, are associated with A. F. Johns in the company, which was recently incorporated. They claim to have money provided for paying some of the debts of the original concern and to construct a 5,000 horse power electric transmission plant and a 75-mile pole line. It is proposed to transmit electric power from the plant on the McCloud River to Red Bluff, taking in Bully Hill, Kennett, Copley, Keswick, Redding, Corning, and Willows. The projectors have spoken of encouraging new industries by furnishing free power for a time.

SAN FRANCISCO, CALIF.—The California Central Gas & Electric Company, which distributes the current from the Bay Counties Power Company's transmission line, is making propositions to the authorities of numerous towns to operate municipal water works plants by electric motors. The Marysville water works is operated on this plan. Woodland has closed a contract, and Napa and Chico are considering the question. The company has offered to install a 1,000,000-gallon pumping plant, driven by an electric motor and to furnish power for two years at a specified rate. At the end of that time the plant will become the property of the city.

SAN FRANCISCO, CALIF.—The plans for the proposed electric power plant at La Grange are being perfected by a company including Col. J. E. Doolittle and Alexander Brown. The La Grange Ditch and water rights to 2,000 in. of water have been bonded, and it is intended to begin construction of the plant this summer. The members of the company will dredge the Tuolumne River on a large scale for gold. Electric current will be transmitted for lighting and for power to the mines of Calaveras, Tuolumne and Mariposa counties.

SAN FRANCISCO, CALIF.—The Lytle Creek Power Company, which has been incorporated in San Bernardino County, Calif., with a capital stock of $200,000, will issue $150,000 in 30-year 5-per-cent gold bonds, for equipping the power plant. The power house will be located in the Lytle Creek canyon. A contract has been secured to furnish the city of Riverside with 300 horse power, at $75 per horse power per year. The officers of the company are: J. L. Campbell, president; H. T. Hays, cashier; Chas. L. Allison, secretary.

SAN FRANCISCO, CALIF.—The Suburban Electric Company, which distributes the current of the Standard Electric Company south of Oakland, will increase the equipment of the local electric light plant in Haywards. An additional three-phase generator and a new boiler will be installed. This powerhouse, which was purchased from the local electric company, will be kept up as a reserve station for use in case of interruption of the service over the main transmission line.

SAN FRANCISCO, CALIF.—The Northern California Power Company, successor to the Keswick Power Company, has received an additional 1,000-hp Westinghouse generator. The new apparatus will be installed at once in the 4,500-hp electric station on Mill Seat Creek. There is sufficient water for developing 12,000 hp. The transmission line will be extended from Palo Cedro to Red Bluff, Tehama and Corning.

SAN FRANCISCO, CALIF.—The Consolidated Light & Power Company, which has voted an issue of $250,000 in 30-year bonds at 5 per cent, will extend its distribution system considerably and build a $150,000-gas plant in Redwood City, Calif. The company will distribute the Standard Electric Company's current in San Mateo County and a large part of Santa Clara County.

SAN FRANCISCO, CALIF.—The Electric Improvement Company, of San José, Calif., recently purchased a franchise permitting it to erect electric power lines in Santa Clara County, and also to lay underground conduits. This company will distribute the current from the Standard Electric Company's transmission lines through a large part of the county.

SAN FRANCISCO, CALIF.—The West Oakland shops of the Southern Pacific Railroad Company, Oakland, Calif., will soon be lighted by electricity throughout. An electric train lighting system is also being installed on passenger trains of this road.

SAN FRANCISCO, CALIF.—An electric power plant of large capacity, on Sherman Creek, 25 miles from Republic, Wash., is projected by Patrick Walsh and brothers.

DENVER, COLO.—The city will build its own conduit system for underground wires. It will rent space to the corporations which have overhead wires. A bill will be presented at the next meeting of the City Council providing that all wires shall be placed underground within the next five years. Bonds will be voted for the construction of the conduit. The profits from rentals will pay the cost and leave the conduit clear for a profit.

INDIANAPOLIS, IND.—A meeting has been called in this city, to be held at once, for the purpose of organizing the officers of the Central Station Electric Companies of the State, with a view to control the prices charged for electricity. T. C. McReynolds, general manager of the Kokomo Electric Railway & Light Plant, and H. C. Kimbaugh, of the Muncie Electric Light Company, are the prime movers. They say that the price of electricity per kilowatt hour for lighting and power varies in this State from 5 cents to 20 cents, and that the flat rate for a 16-cp light is from 15 to 65 cents. The electric men desire to get for the enttire State an even scale which will be enforced. They propose to take into consideration the difference in the price of coal in the different districts and base their scale of prices on this.

ASHLEY, IND.—This city has purchased the local electric lighting plant belonging to W. H. McIntire for $4,000. The plant will be enlarged and improved and municipal lighting tried by the town officials.

EMINENCE, KY.—An electric plant in Eminence and an electric line to New Castle have been agitated, and it is stated that the City Council will advertise for bids on the franchises.

LAKE ODESSA, MICH.—The village is preparing to operate an electric light plant in connection with the municipal water works plant.

ONAWAY, MICH.—The Village Council has turned down the proposition of a local company to establish a lighting plant.

HELENA, MONT.—Judge Knowles, of the Federal Court, at Helena, has signed a decree of foreclosure in the action of the Central Trust Company, of New York, against the Helena Power and Light Company. The sum of $501,926 is found to be due the plaintiff company under a mortgage given. The plant of the power company will be offered for sale.

SYRACUSE, N. Y.—The Seneca River Power Company, of Syracuse, has been incorporated to supply electric light and power in Onondaga and Oswego counties. Capital, $100,000.

YOUNGSTOWN, OHIO.—The Pennsylvania Railway has purchased the old Kaercher electric lighting plant, which was absorbed about two years ago by the Youngstown Consolidated Gas & Electric Company. Much of the equipment has been sold.

MANSFIELD, OHIO.—Charles W. Upson, F. S. Ozier and Huntington Brown have secured a 25-year franchise to furnish electric light and power and steam heat for public and private purposes. A plant will be erected at once.

SPRINGFIELD, OHIO.—The Citizens' Heating & Power Company with a capital stock of $10,000 has been incorporated by Walter L. Weaver, John L. Zimmerman, Frank P. Torrence, William Keifer and Frank H. Clark.

COLUMBUS, OHIO.—The board of agriculture has sold the electric light plant at the state fair grounds to the Portsmouth Street Railway Company, of Portsmouth, Ohio, which is about to open a park on its line.

GALLIPOLIS, OHIO.—The Citizens' Light, Heat & Power Company has been granted a franchise to string wires and install a lighting system throughout the town.

ELYRIA, OHIO.—The Elyria Gas & Electric Light Company has secured a franchise for a heating system to be operated in connection with the lighting plant.

CINCINNATI, OHIO.—The Cincinnati Gas & Electric Light Company is having plans prepared for its new power station to be erected adjoining its present station at Charles and Plum streets. The building will be 350 x 100 feet.

ATHENS, OHIO.—A Council favoring a municipal lighting plant has been elected, and it is probable that the project will be carried out without delay.

COLUMBUS, OHIO.—The North Side Business Men's Association will place electric light arches on High Street from the viaduct to Buttles Avenue.

NEW BREMEN, OHIO.—On May 5 New Bremen will vote on a proposition to issue $15,000 worth of bonds for a municipal lighting plant.

BAKER CITY, ORE.—J. J. Henry, of Denver, Col., has purchased the controlling interest in the Baker City Gas and Electric Light Company. He has announced his intention of expending $100,000 in the way of improvements and secured an option on the water of Eagle Creek for power purposes.

SPARTANBURG, S. C.—The White Stone Lithia Water Company of South Carolina has purchased the electric light plant of Converse College, at Spartanburg, for $1,361.25. This plant will shortly be removed to White Stone Springs and installed in the handsome new hotel now in process of erection there.

SALT LAKE CITY, UTAH.—A few weeks ago every switchboard connected with the Colorado Springs Electric Light Company at Colorado Springs, Colo., was burned out. The damage is placed at $50,000. It is thought that snow weighed down upon the wires, causing them to cross the feed lines, thus forming a short-circuit.

CHASE CITY, VA.—The Chase City Mineral Springs Company, Chase City, Va., is installing an electric power plant. The engines, which are built by the Ball Engine Company, Erie, Pa., are direct connected to Fort Wayne generators.

MILWAUKEE, WIS.—Milwaukee is to have a municipal electric lighting plant, if it be within the power of Mayor Rose to secure the issuance of bonds for such a purpose. At the present time the Milwaukee Electric Railway & Light Company furnishes all the electric lighting for the city.

SOUTH MILWAUKEE, WIS.—The city has awarded a 50-year electric lighting franchise to L. McElroy. Arc lights will be furnished for 75 a year each, on all-night schedule.

WAUWATOSA, WIS.—This city is contemplating installing a municipal electric lighting plant, the mayor in his message having recommended this.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham and Steel Cities Railway and Power Company has been incorporated, capital $1,000,000. The projectors have planned to build a net-work of street railways, connecting Birmingham with Ensley and other suburban industrial points, and intend to develop the water power of the Warrior River. It is understood that arrangements have been made to float the necessary bonds.

SAN FRANCISCO, CAL.—The conductors and gripmen of the Market Street [illegible] the recognition of their union. The strike was settled and the men, 3,000 in number, returned to work on April 27. The men got the increase in pay, but the company refused to unionize its forces.

VENTURA, CALIF.—The promoters of the proposed electric railway from Bakersfield to Ventura have applied for an electric lighting franchise in Ventura, as well as an electric railway franchise. John Burson is interested.

ATLANTA, GA.—There will be no hitch in the consolidation of the Georgia Electric Light Company, the Atlanta Rapid Transit Company and the Atlanta Railway & Power Company. From information secured it may be stated that C. J. Simmons, now president of the Atlanta Rapid Transit Company, will retire from the street railway business in Atlanta and will have no hand in managing the affairs of the Georgia Railway & Electric Company.

INDIANAPOLIS, IND.—The Indianapolis Northern Traction Company, an outgrowth and a part of the Union Traction Company system, has filed articles of incorporation, with a capitalization of $3,500,000. The directors are Charles A. Baldwin, William H. Bloss, Ellis C. Carpenter, Henry Moore, Albert S. Richley, Arthur W. Brady and Charles Berry, all of whom are connected with the Union Traction Company. The object of the new organization is to build an electric railway connecting Logansport, Kokomo, Peru, Tipton, Elwood, Marion, Muncie, Anderson, Noblesville, Walton, Bunker Hill, Atlanta, Cicero, Frankton, Sheridan, Westfield, Carmel and Broad Ripple.

INDIANAPOLIS, IND.—Indianapolis citizens headed by Samuel Morss have organized a company to build an electric railway between South Indianapolis and Waverley. Work has already begun in Morgan County and a franchise asked through Marion County. The latter will be granted as soon as the $1,000 guarantee is deposited. The company has bought Waverley Park, and the farmers are doing volunteer work on the park and the line.

WABASH, IND.—The Wabash River Traction Company has completed the purchase of the city lines of Logansport, Ind. The price is said to have been $140,000. The company is now operating 18 miles of line between Wabash and Peru and will extend to Logansport, a distance of 14 miles.

DUNKIRK, IND.—The Dunkirk-Mobile Transit Company, which proposes to operate an automobile transfer line between this city and Red Key, has been incorporated with a capital stock of $10,000. The enterprise is backed by Dunkirk men.

WINCHESTER, KY.—The City Council has granted a franchise to the Blue Grass Consolidated Traction Company to build an electric railway through the city.

NEW ORLEANS, LA.—The New Orleans Railways Company has taken charge of the property, etc., of the New Orleans City Railroad Company. This is the first step in merging the City Railroad Company and the New Orleans Railroad Company, which were bought by H. H. Pearson for himself and associates.

SAGINAW, MICH.—George Silsby, promotor of the Saginaw Suburban Electric Railway, which is to extend from Bay City to Flint, is reported to have completed arrangements in New York for floating the $800,000 bond issue necessary to build the road.

DETROIT, MICH.—The Rochester & Geneva (N. Y.) electric railway has been purchased by the Comstock-Haigh-Walker syndicate of this city. The project will be financed and built as soon as possible.

NEW YORK, N. Y.—The New York State Board of Railroad Commissioners has granted the application of the New York and Port Chester Railroad Company for permission to construct a four-track railway from Willis avenue and One Hundred and Thirty-second street, New York City, northeasterly through Fordham, Williamsbridge, Mount Vernon and New Rochelle, to a point on the boundary line between New York and Connecticut, a distance of twenty-one miles. A branch two miles long is to be built to Classon's Point, Long Island Sound. The road is to be operated by the third-rail electric system. The entire cost of construction and equipment, including the right-of-way, real estate, terminals, engineering, interest and contingencies, is estimated at $9,850,516. Mr. C. O. Mailloux and Mr. W. C. Gotshall are deeply interested in this promising enterprise.

ONEONTA, N. Y.—The Oneonta, Cooperstown & Richfield Springs Railway Company has decided to extend its road to Mohawk.

CHARLOTTE, N. C.—A charter has been granted to the Graham, Burlington & River Falls Street Railway Company to build a line from Burlington, N. C., to River Falls. Capital, $100,000.

CLEVELAND, OHIO.—J. W. Holcomb and Jay E. Latimer, of the Electric Construction Company, have secured an option from the Everett-Moore syndicate on the project known as the Cleveland, Painesville & Ashtabula Railway, being a 30-mile extension to Ashtabula of the Cleveland, Painesville & Eastern Railway. The property includes a private right of way, partially graded. Contracts had been let by the syndicate for a power station at Geneva, to be used also as a lighting plant for the village, and for a $50,000 bridge near Painesville. The price is understood to be $60,000, and it is stated that construction work will be pushed as soon as possible.

COLUMBUS, OHIO.—It is stated that the Columbus, London & Springfield Railway, one of the properties of the Appleyard syndicate, is to be equipped experimentally with the third rail system, for a distance of 23 miles, with a view to ultimately equipping all of the roads controlled by the syndicate in this manner. The third rail will be used only in the country, for high speed work, and the trolley pole will be brought into service in passing through cities and towns.

TOLEDO, OHIO.—It has been practically settled that the Toledo & Monroe Railway Company will carry out its original intention of extending its line from Monroe to Toledo, but, as the line can not be built for some months, the owners are endeavoring to arrange a lease of the Detroit & Toledo Shore Line from Monroe to Detroit. If the lease can be secured, the through line can be prepared for operation at once.

CINCINNATI, OHIO.—Dr. S. F. George, president of the Ft. Wayne, Dayton & Cincinnati Traction Company announces that arrangements have been completed for financing the project and that contracts have been let to J. G. White & Co. for building the road, and to the General Electric Company for the electrical equipment. The enterprise involves the building of over 400 miles of road, and it is claimed that the entire private right of way has been secured.

CLEVELAND, OHIO.—The headquarters of the Lake Shore Electric Railway Company are being removed from the Electric Building, this city, to Toledo, where the affairs of the company will be under the supervision of Receiver Albion Lang. President Mahler will continue to make his headquarters in this city, and General Manager R. E. Danforth will also have an office here. General Superintendent Stout will continue his headquarters in Fremont.

TOLEDO, OHIO.—The Ohio & Indiana Air Line Railway Company is offering stock at par for the purpose of development. The company claims to control 157 miles of right of way from Toledo to Bryan, Ft. Wayne, Ind., and Marion, all surveyed, and 10 miles graded. It claims to hold private entrance to Toledo, with right of way through Ft. Wayne. The capital stock is $750,000, and no bonus stock has been issued and no bonds offered.

CLEVELAND, OHIO.—On May 7 at Hamilton, Ohio, the stockholders of the Southern Ohio Traction Company and the Cincinnati & Northwestern Railway will meet to ratify the action of the directors of the two companies, looking toward a consolidation of the properties. The new company will be known as the Cincinnati, Dayton & Toledo Traction Company, and it will have an authorized capital stock of $5,000,000.

TIFFIN, OHIO.—The Tiffin & Southwestern Railway Company has placed a contract for the construction of its road with the State Construction Company, of Pittsburg. Ties are being distributed and work will start as soon as the weather permits. The line will touch Upper Sandusky, Versailles and Kenton.

CLEVELAND, OHIO.—At a recent special meeting of stockholders of the Cleveland, Painesville & Eastern Railway Company the capital stock of the company was increased from $1,500,000 to $2,000,000. The company is planning to purchase new rolling stock and other equipment.

WAPAKONETA, OHIO.—The town has furnished a ten-acre site and agreed to give $10,000 to the Western Ohio Railway Company for the location in this place of its car barns and repair shops for the entire system of 111 miles of road. Four large buildings will be erected.

FINDLAY, OHIO.—Ex-Lieut. Gov. Asa W. Jones, chief promoter of the Findlay & Marion Railway Company, states that the project has been financed. He states that construction work will start at once and that the line will be completed this summer.

DEFIANCE, OHIO.—N. E. Mathews, one of the promoters of the Defiance, Ottawa, Kenton & Columbus Railway Company, states that there is now little doubt that the road will be built. It is claimed that nearly all right of way has been secured.

CLEVELAND, OHIO.—The Cleveland City Railway Company and the Cleveland Electric Railway Company are making reciprocal traffic arrangements which indicate clearly that the long-talked-of consolidation is not far distant.

COLUMBUS, OHIO.—Senator Archer has introduced a bill to place electric railways under the supervision of the State railroad commissioner, who would have the same authority over them that he now has over steam roads.

CLEVELAND, OHIO.—R. E. Danforth, general manager of the Lake Shore Electric Railway Company, has accepted a flattering offer from the Rochester Railway Company, of Rochester, N. Y.

MARION, OHIO.—Eastern capitalists have become interested in the proposed Tiffin-Marion line, O. C. Stutz, the promotor, having completed arrangements for financing the project.

DELAWARE, OHIO.—The Delaware County Commissioners have granted a franchise to the Delaware, Berkshire & Sunbury Railway Company, of which E. F. Gwynn is president.

LIMA, OHIO.—The Lima Electric Railway & Light Company contemplates increasing its capital stock from $500,000 to $850,000 for the purpose of constructing a power plant.

COLUMBUS, OHIO.—The Central Market Street Railway Company has been granted a 25-year franchise for a line to the north corporation line.

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company contemplates building a new line between Brier Hill and Spring Common.

JACKSON, TENN.—An acceptance was received here from St. Louis capitalists by which they will purchase the electric street car system, electric light and gas plants of this city. The deal involves an outlay of about $200,000.

PETERSBURG, VA.—The Virginia Passenger Power Company of Petersburg, which recently purchased the Richmond Passenger & Power Company, has contracted for machinery to be used in an additional power plant at the locks near the city.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company is rebuilding the old Barger illuminating plant, on Commerce Street, to provide power and light for immediate necessity, pending the completion of the new $4,000,000 power plant now in progress. The cost of this temporary plant will be about $400,000. The plant will consist of eight 1,500-kw railway and lighting units.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Co. has declared a dividend of 1½ per cent, payable May 1. This is the tenth regular dividend, and will be paid to all stock holders.

JANESVILLE, WIS.—The track laying and grading for the Beloit, Delavan Lake & Janesville Interurban Road is now progressing rapidly in this city, and south toward Beloit.

BELOIT, WIS.—Local capitalists joining with H. H. Clough, of the Interurban Railway, will ask the Council for a franchise to build a local street railway system.

LEGAL.

BERLINER PATENT.—At Boston the United States Circuit Court of Appeals has heard arguments in the case of the Bell Telephone Company against the National Telephone Manufacturing Company. Plaintiff seeks to have defendant restrained from infringing the Berliner patent. Judge Brown in the Circuit Court held that the patent was invalid and the Bell Company is fighting the case on appeal.

MAYO & ROHRER COMPANY.—An involuntary petition in bankruptcy has been filed against the Mayo & Rohrer Company, manufacturers of electrical goods at 220 Broadway, New York, by the following creditors: John Greenough, as receiver of the New York and Staten Island Electric Company, $2,911; General Electric Company, $1,242, and the Bullock Electric Manufacturing Company, $689. It was alleged that the company is insolvent, permitted a creditor, Joseph Leo, to obtain a preference by a judgment on January 13 for $1,334, under which the sheriff levied on the property of the company, also allowed a receiver to be appointed for the company, and transferred some office furniture and money to Willis B. Dowd, a creditor.

ELECTRIC VEHICLE COMPANY SUIT.—Vice Chancellor Pitney, of the New Jersey Chancery Court, has handed down a decision sustaining the demurrer of John Jacob Astor, George H. Day, Philip T. Dodge, Albert A. Pope, Isaac L. Rice and others, the officers and directors of the Electric Vehicle Company, to the complaint of Richard Siegman, a stockholder, who alleged that $380,000 of dividends had been unlawfully declared and paid, and that these directors should restore that sum to the treasury of the company out of their own pockets. Mr. Siegman said that these dividends had been paid out of the capital stock of the company and not out of its earnings, and that the directors were responsible. The defendants replied that no such suit could be maintained by a stockholder either in his own right or on behalf of his corporation. The Vice Chancellor took this view of the law, remarking in his decison that nothing could be "more unjust and inequitable" than to permit a stockholder to recover from directors "the very moneys which the stockholders have already themselves received." He said that the section of the law under which Mr. Siegman asked relief was intended for the benefit of creditors "where the assets of a corporation were insufficient to pay creditors."

OBITUARY.

MR. B. F. HOOPER.—We regret to note the death of Mr. Benjamin Franklin Hooper, president of the Colwell Lead Company, on April 20, after a lingering illness at his home, in New York City. He was the son of John Hooper, an old stockholder of The New York Tribune, who preceded him as president of the Colwell Lead Company and who died in 1889. Mr. Hooper was graduated from the College of the City of New York in the class of '78. In 1883 he married Edith May Walker, daughter of Alva S. Walker, vice president of the Colwell Lead Company. He was a member of the Colonial, Hardware, Fulton, New York Athletic, and City College Clubs, the Chamber of Commerce, New England Society, and St. John's Lodge, F. and A. M. He leaves a widow, two sons and [illegible] daughters.

PERSONAL.

MR. H. C. PAULDING is now associated with Sargent, Conant & Co., inc., electrical engineers and contractors, Equitable Buildings, Boston, Mass.

SENATOR TILLMAN, who has had a good many sharp things to say about monopolies and trusts, admits that he has a frank from the Western Union Telegraph Company.

MR. DANIEL KILLION has severed his connection with Rossiter, MacGovern & Co., of New York city, and has accepted the position of manager to the Charles E. Dustin Company.

MR. A. FREDERIC COLLINS delivered a lecture April 26 in the New York Board of Education course of free lectures, on "Wireless Telephony, Wireless Telegraphy and Color Photography."

MR. C. O. MAILLOUX has just returned to New York from a prolonged Western trip which has carried him into Arizona. He returns to find his Portchester electric traction enterprise well advanced.

PROF. HOWARD T. BARNES, of the physical department of McGill University, Montreal, has been in New York attending the sessions of the American Physical Society, before which he read a paper.

MR. FRANK HIX FAYANT has in the May "Success" a very interesting article on the way young men are made into electrical engineers and he employs the General Electric works at Schenectady as the basis of his data and descriptions.

MR. JOHN D. CURTIS, formerly superintendent of the Washburn & Moen department, has left the employ of the Washburn Wire Company of New York and Providence, of which company he was general manager from the time of organization, two years ago.

MR. GEORGE T. HANCHETT has removed his offices to the Morton Building, 116 Nassau Street, New York, where he will have increased facilities for conducting the business of consulting engineer. He has paid particular attention to the enlargement of his facilities for making electrical tests.

MR. OTTO W. UTHOFF, who for the past four years has represented the Columbia Incandescent Lamp Company in the Eastern states, has resigned to accept the management of the St. Louis office of the Ohio Brass Company, looking after the trade in the Southern and Western states.

LORD AND LADY KELVIN.—Lady Kelvin was the guest of honor at a luncheon given by Mrs. Hobson, sister of Marion Crawford, at her home in [illegible] afternoon in compliment to the American Society of Social Science, at which Lord Kelvin received much attention.

PROF. ELIHU THOMSON.—Wireless telegraphy was discussed last week at a meeting of the Commercial Club. Prof. Elihu Thomson stated that Marconi is to be given credit for pointing out the way in long distance work, and that he has proved that there is practically no limit or distance to which messages may not be sent, provided they only have power enough behind them.

LIEUT. JOHN M. HODGINS, of the Navy, sailed from New York on the St. Louis on April 30, accompanied by two enlisted men, to make an inspection of German and French wireless telegraph systems. Lieut. Hodgins's mission is preparatory to the tests of wireless telegraph systems to be held between Washington and Annapolis next summer under the direction of Rear Admiral R. B. Bradford.

MR. C. O. BAKER, JR., sails this week for Europe on important business. One of the regrets is that he will not be able to give personal attention to his work as Master of Transportation at the time of the annual meeting of the National Electric Light Association, but he has put things in good shape, and has spared no effort to secure the comfort and convenience of delegates going to Cincinnati.

PROF. R. B. OWENS, of the electrical engineering department of McGill University, Montreal, visited New York last week in order to attend the reception to Lord and Lady Kelvin, at Columbia University, of which he is a graduate. It is understood he conveyed the desire of McGill to see Lord Kelvin once again, but the stay of the distinguished scientist is altogether too short to permit of such an extension to his trip.

MR. WARD S. ARNOLD, for some years past with the General Electric Company's Chicago office, has accepted the position of sales engineer to the Chicago office of the Stanley Electric Manufacturing Company. Mr. Arnold is well known, particularly in the West, for his genial personality and business ability, and both he and the Stanley Electric Manufacturing Company are to be congratulated upon his accession to that concern's force.

MR. T. B. DOOLITTLE and Mr. Thomas Cotter, of the engineering department of the American Telephone and Telegraph Company, of Boston, Mass., accompanied by Mr. Frank B. Knight, special agent of the same company, with headquarters at Dallas, are making a tour of the States of Arkansas and Texas, at the request of the Southwestern Telegraph and Telephone Company, with a view of obtaining information as to the needs of the telephone business in these two States. Extensive developments and improvements are in contemplation, especially with regard to rural service.

MR. G. LAWRENCE BETTS, who has been for many years past connected with the engineering department of the long-distance service, in New York, of the American Telephone and Telegraph Company, has resigned in order to accept a very responsible position with the Bunnell Telegraphic and Electrical Company, of New York City. He is a young man of great intelligence, executive ability and industry, and has acquired a rare experience in the supply lines he will now push in the electrical trade. He leaves his former position with the heartiest good will of his chiefs and associates and begins the new career this week.

KELLOGG SMOKER.—An impromptu smoker was held at the Union Restaurant on Randolph street, Chicago, April 18. Among those present were the following: W. W. Dean, K. B. Miller, J. C. Belden, C. B. Belden, Wm. Kaisling, C. P. Platt, S. C. Platt, L. J. Herbison, C. S. Webster, F. J. Dommerque, G. L. Burlingame, J. D. Edwards, E. Kraus, J. C. Lewis, F. L. Martin, C. A. Simpson, R. H. Manson; also W. A. Willard, of Chicago; William Tiedemann, of Menominee, Mich., and E. H. Martin, of Webster City, Iowa, who chanced to be in the city on his way from New York to Iowa. After the smoker considerable amusement was furnished by the skill of E. H. Martin as an impersonator and whistler. At the close of the smoker speeches were made, after which it was decided to make this a permanent organization, meetings to be held every month or two. Mr. K. B. Miller was then elected chairman, W. W. Dean, J. C. Belden and S. C. Platt were appointed as executive committee. The fundamental object of this organization will be to enable the heads of the different Kellogg departments and the company's engineers to get together, thus continuing the good feeling existing between the different departments.

MESSRS. GEORGE WESTINGHOUSE and H. S. Loud sailed for England on Wednesday by the American liner St. Louis. It will be recalled that Mr. Loud has been appointed general manager of the Trafford Park works of the British Westinghouse Electric and Manufacturing Company, Limited. In course of an interview with a representative of the ELECTRICAL WORLD AND ENGINEER, Mr. Loud said, on the eve of his departure: "The pattern and carpenter shops at the Manchester works are already in active operation and give employment to over 300 men and by July, according to the present outlook, the whole plant will be in full working order. For the purpose of filling responsible positions in the various departments of the works, we have been particularly anxious to secure English experts who have been through an Americanizing process. With this end in view some 35 young Englishmen, mostly college bred and having served their five-year apprenticeships in prominent British electrical shops, have been at the Westinghouse shops in Pittsburg for the past two years studying the most modern American electrical methods. They have just returned to the other side. There will be about 25 Americans engaged. Thomas Smith, who was foreman of the street railway equipment shops of the Westinghouse shops at East Pittsburg, is one of them. Of course for some little time we shall not be able to build the very large machinery which the Pittsburg works turn out, but inside of twelve months the British plant will manufacture complete equipment from its own castings; in fact, we shall be absolutely independent of American sources of supply."

MR. SIDNEY B. PAINE.—At the spring meeting of the New England Cotton Manufacturers' Association, held in Boston, April 23, and 24, a medal was presented to Mr. Sidney B. Paine by Mr. Alfred E. Adams, on behalf of the board of government of the Association. The resolutions said that the board of government awarded the medal for Mr. Paine's paper on "The Electrical Driving of Textile Establishments," contained in Volume 58 of the Transactions, and

in the practical development of the electrical transmission of power." Mr. Paine has been associated with the Edison companies and their successor, the General Electric Company, in New England territory for over twenty-one years. He probably holds the record for representing continuously for such a period electric light and power apparatus and systems.

MR. CALVIN W. RICE, who has for a number of years been on the engineering staff of the New York Edison Company, resigned on May 1 to take the position of second vice president of the Nernst Lamp Company. Mr. Rice will be manager of sales of the Nernst lamp, which has already been so successful various installations. A large exhibit was at the Pan-American Exposition in the central tower of the Electricity Building, where, with its soft, white light, there was almost a reproduction of daylight. The members of the Meter Department of the New York Edison Company gathered at Mr. Rice's office the day before his departure, and presented him with a handsome silver loving cup. This department was the one to which Mr. Rice gave the most attention, and its members are trained men, most of them being college graduates from technical courses, so that not only is the work of the department of highest excellence, but also it is a credit to a man to be a member of it.

EDUCATIONAL.

CLARKSON SCHOOL OF TECHNOLOGY.—This school at Potsdam, N. Y., provides courses in civil, electrical and mechanical engineering, and in domestic engineering for women. While providing the essentials of a liberal and scientific education, its object is thoroughly to prepare them for teaching the technical branches of home science, as well as for the most efficient management and supervision of the home. It has been approved by the Regents of the University of the State of New York, under whose charter the institution is organized and degrees conferred. During the first two years the work is taken with, and is identical to, that prescribed for all of the other four-year engineering students, except in the substitution of practical work in chemistry and home science for the advanced shopwork and surveying. In the last two years of specialized instruction the work is similarly taken along with the other engineering students in the same respective classes, except that in the home sciences and arts. The Clarkson School was opened in 1896, and is a memorial to Thomas S. Clarkson.

Trade Notes.

O. K. DRY BATTERY.—The Non-Polarizing Dry Battery Company, manufacturer of the O. K. Battery, has removed its headquarters to 209 Sullivan street, New York.

THE NEW YORK INSULATED WIRE COMPANY announces that on and after April 28 its New York offices will be located in the Engineering Building, 118 Liberty street.

THE MASSACHUSETTS FAN COMPANY, manufacturers of blowers, fans, dry kilns, etc., announces the removal of its factory and principal office from Boston to Bedford street, Waltham, Mass. The city office will remain at 53 State Street, Boston, as heretofore.

CHANGE OF ADDRESS.—The advertising firm of W. S. Hill & Co., Pittsburg, Pa., has taken the entire third floor of the Holmes Bank Building in that city to accommodate its rapidly expanding business. Its staff and facilities have been increased also.

THE CARTER ELECTRIC COMPANY, Pittsburg, Pa., has recently moved into larger and more commodious quarters in the Arrott Power Building. This company devotes especial attention to wiring buildings and installing isolated plants. Mr. E. C. Carter is the manager of the company.

THE WORLD'S WORK for May has a fine portrait of Lord Kelvin, and a very interesting illustrated article on Mr. W. C. Whitney, dwelling quite largely on his work in creating the Metropolitan Street Railway system in New York City. There are many other features of interest to engineers.

THE CENTRAL ELECTRIC COMPANY of Chicago is in a position to ship from Chicago stock all orders for Westinghouse lightning arresters. Any one contemplating the purchase of lightning arresters is invited to get descriptive catalogue from the above company, together with its prices.

BATES ELECTRIC FANS.—In a recent folder Messrs. D. L. Bates & Bro., Dayton, Ohio, show their various styles of fan motors, accompanied by brief descriptions of the same. This firm makes several styles of ceiling fans, column fans and desk fans, all being wound for direct-current only.

LIGHTNING ARRESTERS.—The Westinghouse Electric and Manufacturing Company has recently issued to the trade an attractive folder on Westinghouse lightning arresters. It contains an excellent description of the new Westinghouse "low equivalent" arrester, which has been received with much general favor.

DRESES MACHINE TOOL COMPANY.—Mr. Oscar W. Mueller has withdrawn from the firm of Dreses, Mueller & Co., Cincinnati, Ohio, his interest in the business having been acquired by the former co-partners, Messrs. Henry Dreses, William Gilbert and Charles Lange. After May the business will be conducted under the firm name of Dreses Machine Tool Company.

GUY ANCHORS.—W. J. Nagel Electric Company, 520 Adams Street, Toledo, Ohio, in a leaflet gives some facts and illustrations about Stombaugh guy anchors for telephone, electric light or street railway poles, fences and smokestacks. These devices are in the form of an auger, and when screwed into the ground are left there permanently as the anchor. They are easy to install and hard to pull up.

MACHINISTS' TOOLS.—A very complete line of machinists' tools is illustrated in a 100-page catalogue and price-list just issued by the Billings & Spencer [illegible] department has steadily increased its facilities, and is now prepared to furnish drop forgings promptly and cheaply. Electrical forgings from pure copper and bronze are a specialty of this department.

THE PERFECTION RAIL BOND, manufactured by the Perfection Rail Bond Company, for which Messrs. F. B. Badt and G. M. Willis, Chicago, are the general sales agents, is very clearly described and illustrated in a pamphlet of recent issue. It is stated that this bond makes a perfect electrical connection between the railends. The construction of the bond and the manner of its application are very clearly illustrated by means of section and general views.

"ALL-WIRE" RAIL BONDS.—The Ohio Brass Company, Mansfield, Ohio, has just issued Bulletin No. 9 on the subject of all-wire rail bonds. These bonds, it is claimed, represent the highest development in rail-bond design and construction. They are made entirely from a single piece of flexible copper cable. These bonds are illustrated and described elsewhere in this issue. Every electric railway manager will find something of particular interest to him in this bulletin, a copy of which should be in his possession.

THE REYNOLDS ELECTRIC COMPANY, at 221-225 Fifth avenue, Chicago, has recently patented a new fork for its improved Reynolds flasher that dispenses with all liability of the knives sticking, and makes it practically impossible for the fork to burn out. This, with other improvements, make this unquestionably one of the simplest as well as most durable motor flashers on the market. Its new "Zeigler" flasher, that requires no motor to run it, is one of the latest novelties in the electrical line, and is attracting great attention.

THE HOLTZER-CABOT COMPANY, Boston, Mass., is sending out a couple of neat leaflets, one of which is on the subject of factory specialties, which include the Ness automatic intercommunicating telephone system, the "Acme" watchman's time detector, gas engine igniters and direct-current motors and dynamos ranging from 1-10 to 100 horse-power. The other leaflet is devoted to the subject of Holtzer-Cabot fan motors of the 1902 pattern. Various styles of these machines are illustrated and their principal points noted.

MESSRS. ROSSITER, MacGOVERN & CO., 141 Broadway, New York, announce that Mr. John A. Stewart, heretofore their Western representative, is no longer connected with the company. The announcement is also made that its Cincinnati office has been discontinued. It may be stated in this connection that the firm has recently enlarged its factory in Jersey City and is now better prepared than ever to do electrical work of all kinds, paying especial attention to railway and central station machinery, particularly to repairs upon large generators.

FAN MOTORS.—The Sprague Electric Company, New York, has just issued a handsome catalogue of its Lundell fan motors for the season of 1902. This year's models are said to have higher efficiency than those of former years. Two new types are introduced this season; one is the 12-in. and 16-in. bracket-type fan, and the other is the 12-in. and 16-in. swivel and trunnion desk type. The various styles and types are illustrated in an artistic manner. The catalogue contains a very complete telegraph code, and altogether is a very artistic production.

QUIMBY PUMPS.—William E. Quimby, Inc., 86 Liberty Street, New York, has recently issued two neatly gotten-up pamphlets on Quimby screw pumps and Quimby house service pumps. The construction of these pumps is briefly explained, and illustrated, and their advantages pointed out. The rotary pump direct-connected to an electric motor is stated to be an efficient combination, and both motor and pump being mounted on the same bedplate a small amount of floor space is taken up. Both catalogues are well-illustrated, the views showing special applications of the pump.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, general sale agent for the Peerless direct current fans, and the Emerson alternating current fans, report that the outlook for a very large business in fans this year is extremely flattering. It has closed a great number of contracts for both direct and alternating fans, and should the demand keep up as it is now, its entire stock will be gone in the very near future. These fans represent the very highest type of their kind on the market, and should certainly prove ready sellers. The company issues very attractive catalogues illustrating this line, which will be mailed on application.

THE SHELBY ELECTRIC COMPANY, Shelby, O., owing to increased business has removed its Chicago office to 79 Dearborn Street. It has installed at this address one of the most complete testing laboratories in the West. The photometer has illuminated dials and long scales, being a combination of the laboratory-switchboard type. A motor generator is used to step up the voltage, which is automatically regulated, from 110 to 260 volts, if necessary. Considerable other apparatus is used in connection with the above, all being especially designed by different well-known instrument makers.

BRISTOL RECORDING INSTRUMENTS.—The Bristol Company, Waterbury, Conn., has just issued a new descriptive catalogue of its recording electrical instruments. The list of electrical recorders covers complete lines of recording voltmeters, ammeters and wattmeters for both alternating and direct currents. The catalogue is illustrated with views of instruments complete, charts, mechanisms, etc., and much information is given on the general subject of recording instruments. The catalogue is gotten up in a very attractive manner, the sage-green cover being printed in two colors.

MR. R. R. CORBETT announces that he has acquired the business of the domestic machinery department of Frank Brothers, and has consolidated it with the A. G. Schoonmaker Company, 128 Liberty street, New York. Contemplated extensions and improvements of Frank Brothers, including a factory and yards at Newark, N. J., will be carried out. The new concern will carry a full line of first-class new and second-hand electrical machinery, cars, motors, engines, boilers and relaying rail, and will make a specialty of repairing dynamos, motors, machinery and also broken or cracked cylinders of all automatic, Corliss and high-speed engines and pumps, by a secret process of burning on.

CONVERSE TRANSFORMERS.—The Converse Transformer Company, Pittsburg, Pa., recently issued a very handsome souvenir catalogue of its trans-

formers, various sizes of which are artistically illustrated. A brief history of the company shows that its engineers designed 60,000-volt transformers as far back as 1895. This high pressure has been exceeded by later transformers built for a pressure of 80,000 volts. The company, however, does not confine its output to high voltage power work, but makes transformers in smaller sizes and for lower voltages for lighting, power and special uses. It reports that it has never had a transformer break down.

STANDARD TELEPHONE.—Early spring orders for apparatus received by the Standard Telephone and Electric Company, Madison, Wis., are much larger by comparison than during previous seasons, and indicate a largely increased business for the coming year. The export business of the "Standard" into Mexico and South American countries is also increasing over previous years. The new improved switchboard this company is getting out will be ready for the market about June 20. Designs have been prepared and adopted for a new mechanically-restoring tubular drop, jack, and ringing and listening key, and a new style of switchboard cabinet has also been selected.

INTERCOMMUNICATING TELEPHONES.—A full line of intercommunicating telephones, built by the Couch & Seeley Company, Boston, Mass., is illustrated, and each instrument briefly described, in a catalogue just issued by the company. The list includes 13 different styles of instruments, but these represent only a few of those manufactured by the company. The intercommunicating telephone instruments as manufactured by this company are especially adapted for mercantile and manufacturing establishments, and it is stated that over 3,000 of them are used in independent private plants, government buildings, by railroad companies and industrial establishments.

THE AUTOMATIC OIL FILTER, SEPARATOR AND PURIFIER, manufactured by the American Oil Filter Company, Philadelphia, Pa., has been thoroughly tested and has, it is stated, given entire satisfaction in every case. The devices are in use in all classes of manufactories, electric light and power plants. This filter, is is claimed, will separate the oil and water automatically and filter and purify the oil at the same time without any attention whatever, the dirty water being carried off automatically to the sewer and the filtered oil to the oil tank. In a pamphlet just issued by the company the operation of the apparatus is described and its advantages pointed out. The address of the American Oil Filter Company is 1210 Real Estate Trust Building, Philadelphia.

WESTERN ELECTRIC FAN MOTORS.—The Western Electric Company has just issued its 1902 catalogue of fan motors, and it is one of the most artistic productions of the season. Several improvements in the construction of these machines are noted, principally in details, however. The line includes fans for use on direct, alternating and battery circuits, and with the various sizes of desk, bracket and ceiling fan motors the company is enabled to supply the many different needs of its customers. The various styles of fans are very clearly illustrated. At the back is a list of parts, code work for each, price, etc. The front cover of the catalogue is very handsome, showing the design and letters in relief work, with strong lights and shades against a pleasing gray background. Half-tone illustrations of the New York and Chicago factories are shown on the inside of the covers.

JUNIPER POLES.—The Standard Pole and Tie Company, 44 Broad street, New York, is sending out a leaflet giving considerable information on the subject of juniper poles for telegraph, telephone and electric railway work. The Standard Company a few years ago introduced juniper poles as a substitute for cedar poles, which are becoming harder to obtain and getting higher in price on account of the rapidly increasing demand. It is stated that juniper is closer in texture, finer in grain and consequently stronger than cedar, although a member of the same family. It is also said to be free from butt rot, which is an important feature. The company states that it has delivered during the past year over 20,000 of these poles for trolley, electric light and telephone service, and that without exception the highest satisfaction with the material has been given. It has several storage yards in Southern white cedar territory, and its supply is claimed to be unlimited.

VENTILATORS.—A new 16-page ventilator catalogue of the Buffalo Forge Company of Buffalo, N. Y., fully illustrated with half-tone engravings, describing in detail the many different types and sizes of ventilators manufactured by this company, is now ready, and any readers of ELECTRICAL WORLD AND ENGINEER who are interested can secure a copy by writing for it. This company, with its quarter-century of experience in the heating and ventilating of buildings of all classes, has come thoroughly into touch with the conditions which make stationary ventilators an efficient and most desirable apparatus. While the requirements of a stationary ventilator are somewhat hard to fulfil, they have been met by the new Buffalo improved ventilators. Their value, when in use with the fan system, is too often underestimated. In certain cases they are alone amply sufficient for proper ventilation. These ventilators are built of heavy gauge iron, and will resist any strain of reasonable magnitude they may be subject to. Many special interesting types are shown in the catalogue.

THE STROBEL & WILKEN COMPANY, of 591 Broadway, New York City, is achieving great success with the novelties which it is placing upon the market in the line of small electrical supplies for gas lighting, etc. One of these specialties is the Aladdin electric gas lighter, which is neat in construction, moderate in price, and which, with but one cell in the holder, gives 6,000 ignitions, thus lasting for a great many months before renewals are required. A specialty which stands equal in popularity is the Yankee searchlight or portable bulls'-eye, which comprises battery, lens and reflector and which gives an excellent penetrating light at small cost. The apparatus is well devised and strongly built and is handy for a wide range of purposes. In connection with these specialties is the O. K. dry battery, which is one of the simplest and best cells and one of the most durable on the market. It is in use by the United States government and by numerous large concerns, such as railroad companies, automobile companies, etc. The company will be glad to hear from possible purchasers, and will send further data and literature upon application.

COUCH & SEELEY TELEPHONES.—It is much to say of a telephone transmitter to-day, that after five years' test, under every conceivable condition, there has not been made a single change in any detail of its construction. This is true, however, of the Couch & Seeley apparatus. While possessing every valuable feature of the "solid-back" type, packing is absolutely impossible, and it is adaptable to either high or low voltage systems. Its interior construction is entirely original, the carbon granules being kept constantly in circulation, instead of settling into the lower part of the carbon block, contact being made with the diaphragm through a rolled-gold disc affixed thereto. Every part is made with the accuracy of watch construction. In design and finish it is a beautiful piece of work, and is furnished with any of the standard mountings. The adjustable arms on which these are mounted for standard types of exchange apparatus are a much higher grade of casting and finish than is ordinarily employed for this purpose; and at the same time, they are sold at prevailing prices for what are generally considered first-class goods. Every exchange manager and operator appreciates the value of highest efficiency and durability, and both of these qualities are a demonstrated fact in the apparatus made by the Couch & Seeley Company, of Boston, Mass.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 22, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau st., New York.]

697,962. RAIL BOND; J. M. Anderson, Boston, Mass. App. filed Feb. 10, 1902. The lug in the end of the bond, which enters the hole in the rail, has a threaded opening, the threads of which are of unequal size, so that the threaded plug which enters the hole will spread the lug.

697,963. MAGNETO-ELECTRIC GENERATORS; V. G. Apple, Dayton, Ohio. App. filed May 2, 1901. Details.

697,984. ELECTRIC MOTOR; O. F. Conklin and J. L. Milton, Dayton, Ohio. App. filed Aug. 29, 1901. Relates to the construction of the field magnet frame and base with reference to the manner of securing them together.

697,986. CONTROLLER FOR ELECTRIC VEHICLES; H. H. Cutler, Chicago, Ill. App. filed Aug. 24, 1899. A single master solenoid serves to cut down the strength of current flowing through a number of solenoids after the same have performed their work of raising the cores to alter the circuit.

697,987. CONTROLLER FOR ELECTRIC VEHICLES; H. H. Cutler, Chicoga, Ill. App. filed Aug. 24, 1899. The controller barrel is arranged to control the circuits through a series of solenoids and the solenoids control the circuits through the elements of the power supply.

697,990. CLEARING OUT SIGNALING APPARATUS; William M. Davis, Chicago, Ill. App. filed Jan. 11, 1901. (See page 771.)

697,991. MULTIPLE SWITCHBOARD TELEPHONE EXCHANGE SYSTEM; Wm. M. Davis, Chicago, Ill. App. filed June 17, 1901. (See page 771.)

697,992. TELEPHONE EXCHANGE SYSTEM; William M. Davis, Chicago, Ill. App. filed Aug. 1, 1901. (See page 771.)

697,993. TELEPHONE EXCHANGE SYSTEM; William M. Davis, Chicago, Ill. App. filed Dec. 7, 1900. (See page 771.)

697,995. MEANS FOR ADJUSTING DYNAMOS OR MOTORS ON THEIR BED PLATES; F. B. Duncan, Akron, Ohio. App. filed Feb. 21, 1902. The bed plates have slots, and bolts with conical heads pass through the slots into the field frame and bind the latter in place.

697,999. SIGNALLING MECHANISM; A. P. Dwelly, Boston, Mass. App. filed May 31, 1901. The signal is operated once at regular intervals or two or more times in succession at regular intervals, as the case may require, by providing a suitablue switch operated by a clock-work.

698,018. ANNUNCIATOR; G. E. Hoglund and C. M. Hedman, Chicago, Ill. App. filed Nov. 27, 1900. The electro-magnet itself operates to restore the shutter.

698,022. ELECTRIC MASSAGE MACHINE; E. B. Jacobson, Boston, Mass. App. filed Sept. 12, 1899. An electro-mechanical vibrator is arranged so that an electrical discharge is effected from the vibrator at intervals.

698,025. TELEPHONE BOOTH; C. L. Kiefer, Indianapolis, Ind. App. filed Jan. 28, 1901. (See Current News and Notes.)

698,027. POLARIZED MAGNET; E. C. Knapp, Syracuse, N. Y. App. filed May 28, 1901. Each pole of a magnet is forked and so located with respect to the poles of another magnet playing between them that the system will be very sensitive to a change in either the amount or direction of a magnetizing current.

698,038. SWITCHBOARD APPARATUS. William Meyer, Chicago, Ill. App. filed Oct. [illegible], 1901. (See page 771.)

698,039. PROCESS OF MAKING PLATES FOR STORAGE BATTERIES; A. Maygret, Paris, France. App. filed Dec. 3, 1900. The active material is formed into tubes and the lead cast into and around them.

698,046. ELECTRIC ARC LAMP; M. S. Okun, New York, N. Y. App. filed Nov. 15, 1897. The invention consists in a carbon feeding mechanism comprising an abutment, a movable clutch member to coact therewith to grasp a carbon feeding rod, a presser to act upon the movable member to move the carbon or its rod, means for pressing it toward said abutment, and means to relieve the pressure of the presser upon the movable clutch member.

698,047. FIRE ALARM; J. A. Olson, Minneapolis, Minn. App. filed Jan. 15, 1901. A thermometer in which a pointer moves over a dial and closes a circuit at predetermined point.

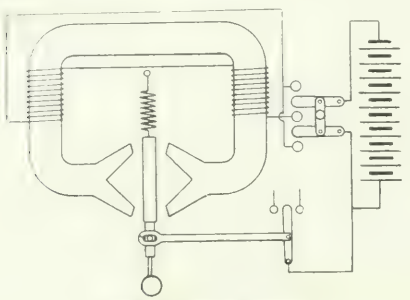
698,055. TELEPHONE INSTRUMENT; H. M. Reeves, Chicago, Ill. App. [illegible]

698,076. ADJUSTABLE TROLLEY SUPPORTER; T. E. Stucky, Indianapolis, Ind. App. filed Aug. 31, 1901. A horizontal arm extends from the top of the car and is adjustable to any distance towards the side of the track to bring the trolley wheel, which is carried at the outer end of the arm, into line with the suspended conductor.

698,087. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Feb. 25, 1901. (See page 771.)

698,096. CIRCUIT BREAKER; H. P. Ball, New York, N. Y. App. filed May 21, 1901. A construction by means of which the mechanism to make or break the circuit may be actuated independently of the automatic device from the front of the switchboard.

698,897. ELECTRICAL INSULATOR; H. P. Ball, New York, N. Y. App. filed Aug. 31, 1901. An insulator comprising a body portion having the shape of a long cylinder with parallel grooves in its surface and a supporting flange at the center.



[illegible] Polarized Magnet

[illegible],099. ELECTRICAL RAILROAD TRACTION APPARATUS; A. B. Boughan, Chicago, Ill. App. filed July 15, 1901. The slot is covered by jointed blocks of wood held in place and thrust aside by the plow.

698,124. CONTACT APPARATUS FOR ELECTRICAL RAILWAYS; A. Markle, Hazleton, Pa. App. filed Jan. 19, 1901. The contact shoe is connected with the end of the plow through springs and links.

698,127. WIRE COUPLING; G. L. Mitchell, Cincinnati, Ohio. App. filed June 12, 1901. The ends of the wire pass into a sleeve in which they are gripped by inclined washers through which they pass.

[illegible],133. INCANDESCENT LAMP SOCKET; W. H. Perkins, Waterbury, Conn. App. filed April 9, 1901. Details.

[illegible],136. SERIES MULTIPLE SWITCH; A. B. Porter, Evanston, Ill. App. filed Feb. 24, 1902. The improvement comprehends a plurality of connections for separate resistances or capacities by which all or any portion of them may be connected up either in series or in parallel.

[illegible],143. RAILWAY ELECTRIC SIGNAL AND SAFETY APPARATUS; W. H. Sauvage, Denver, Col. App. filed Oct. 12, 1900. An automatic system in which under abnormal conditions the air brakes are set and the steam cut off on a train automatically.

698,155. COUPLING FOR WIRES; R. Thompson, New York, N. Y. App. filed Feb. 1, 1902. The wires overlap each other in separate passages in a sleeve and locking screws pass through the wall between the passages and clamp the wire end.

[illegible],156. SYSTEM OF ELECTRIC DISTRIBUTION; Elihu Thomson, Lynn, Mass. App. filed Nov. 2, 1885. (See Current News and Notes.)

[illegible],158. ELECTRIC CLOCK-WINDING MECHANISM; A. Tuerk, Chicago, Ill. App. filed Jan. 31, 1901. Details.

698,179. RAIL BOND; F. H. Daniels and H. W. Wyman, Worcester, Mass. App. filed Dec. 28, 1901. The wire strands forming the body of the bond are secured in recesses in the end pieces by pressure.

698,180. RAIL BOND; T. J. Deviese, Crownhill, W. Va. App. filed Jan. 9, 1902. A conical split plug is formed on the end of the bond and is secured in the rail by a bolt which draws it through the opening in the rail.

[illegible],185. CABLE SUSPENDING HANGER; S. Du Perow, Cleveland, Ohio. App. filed March 15, 1902. A double hook, one end of which can be bent around the cable and locked while the other passes over the suspending wire.

[illegible],197. ADJUSTABLE TROLLEY SUPPORTER; T. E. Stucky and E. Hill, Indianapolis, Ind. App. filed July 8, 1901. A modification of the construction shown in patent No. 698,076.

698,200. VOLTMETER SWITCH; J. L. Hinds, Syracuse, N. Y. App. filed Jan. 11, 1902. Details.

698,214. PROCESS OF FLANGING METALLIC TUBES; N. McKechnie, Cleveland, Ohio. App. filed July 11, 1901. Two collars are fitted on the tube a slight distance apart and when the metal of the tube has been softened by a heating current, the collars are forced towards each other and throw up a flange on the outside of the tube.

698,218. ELECTRIC LAMP SOCKET; M. Norden, New York, N. Y. App. filed Jan. 16, 1902. A receptacle in which pointed screws carried by the socket terminals pierce the insulation on the respective conductors and make contact with the core.

698,233. ROSETTE; W. T. Thomas, Philadelphia, Pa. App. filed Dec. 26, 1901. Details.

[illegible],237. ELECTRIC VAPOR LIGHTER; B. E. Wilder, Chicago, Ill. App. filed Dec. 20, 1901. A portable device comprising a fuel reservoir, a wick and an electric sparking device.

[illegible],244. COMPENSATION OF GENERATORS OR MOTORS; F. G. Baum, Stanford University, California. App. filed Aug. 30, 1901. (See Current News and Notes.)

[illegible],245. MEANS OF COMPENSATING GENERATORS OR MOTORS; F. G. Baum, Stanford University, California. App. filed Sept. 5, 1901. (See Current News and Notes.)

698,250. RAIL BOND; G. B. Blanchard, Tacoma, Wash. App. filed Jan. 13, 1902. A laminated bond in which the outer layer at the end reaches around both sides and binds the ends together.

[illegible],251. CROSS BOND FOR RAILS; G. B. Blanchard, Tacoma, Wash. App. filed Jan. 30, 1902. The cross-wire has a flexible conductor at each end for attachment to the respective rails.

[illegible],256. ILLUMINATED SIGN; G. D. Chapman and C. R. Quine, Akron, Ohio. App. filed Jan. 30, 1902. A porcelain figure or letter is made complete with lamp sockets and adapted to be secured to the face of the sign by means of dove-tailed projections at the back.

698,260. ART OF TRANSMITTING INTELLIGENCE; A. C. Crehore, Hanover, N. H., and G. O. Squier, Fort Monroe, Va. App. filed Nov. 9, 1896. (See Current News and Notes.)

[illegible],261. SUBMARINE CABLE TELEGRAPHY; A. C. Crehore, Hanover, N. H., and G. O. Squier, United States Army. App. filed Oct. 25, 1898, renewed Oct. 5, 1901. (See Current News and Notes.)

[illegible],269. RAILWAY SIGNAL APPARATUS; L. Gachet, Paris, France. App. filed Nov. 3, 1900. Tripping devices are arranged at the side of a track to act upon circuit closers carried by a locomotive.

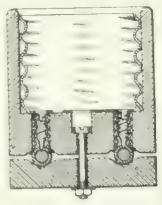
[illegible],278. LAMP HANGER; H. J. Harrison, Juneau, Alaska Territory. App. filed May 13, 1901. A shade roller, spring-drum arrangement to take up the flexible conductor of an incandescent lamp.

[illegible],292. PROCESS OF RECOVERING METALS; E. D. Kendall, New York, N. Y. App. filed July 9, 1900. The process consists in flowing through and over a mass of carbon presenting a large area of surface, a dilute solution of potassium cyanide containing gold or silver derived from the lixiviation of ores and at the same time subjecting the solution to the action of an electric current.

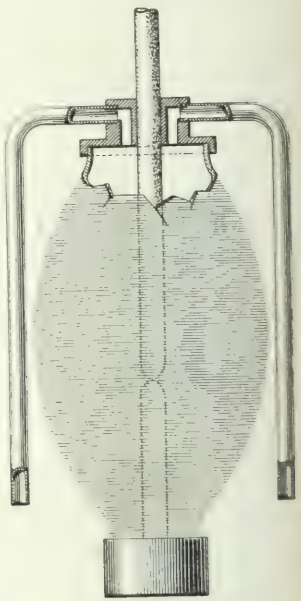
[illegible],305. GUIDING DEVICE FOR TROLLEYS; J. A. Miller, Omaha, Neb. App. filed Oct. 30, 1901. Details.

[illegible],307. PARTY LINE TELEPHONE APPARATUS; G. Moller, Copenhagen, Denmark. App. filed Sept. 20, 1901. (See Current News and Notes.)

[illegible],311. MAGNETIC SEPARATOR; J. H. A. McPhee, Dunedin, N. Z. App. filed Dec. 3, 1901. The ore passes on a belt over a magnetized pulley, the magnetic particles being retained by the belt until they reach a certain point, while the non-magnetic particles drop off earlier.



[illegible] Electric Lamp Socket



[illegible] Electric Arc Lamp

698,383. ELECTRIC CIRCUIT-CLOSING DEVICE; F. Wilke, Akron, Ohio. App. filed June 23, 1899. Details.

698,386. SECRET SERVICE TELEPHONE SYSTEM; A. K. Andriano, San Francisco, Cal. App. filed Jan. 23, 1901. (See Current News and Notes.)

698,388. ELECTRIC ARC LAMP; J. Auerbach and F. Gubing, New York, N. Y. App. filed May 17, 1901. The arc-inclosing globe is provided with an unrestricted escape passage for the gases developed by the arc, which passage is at the same time of such length as that the gas itself will prevent the entrance of air to the globe.

698,394. INCANDESCENT LAMP SOCKET; L. P. Dixon, Toledo, Ohio. App. filed May 9, 1901. Details.

698,417. ELECTRICAL KNIFE SWITCH; L. J. Smith, Leroy and W. F. Bossert, Utica, N. Y. App. filed Nov. 26, 1901. The clips and blades are made of ribbon copper, punched and bent into the desired form without being machined in any way.

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NATIONAL ELECTRIC LIGHT ASSOCIATION.

Last week we took occasion to commend to our readers the work of the National Electric Light Association and the approaching convention at Cincinnati. We are now able to give fuller details this issue as to the programme, and do not hesitate to commend it as one of the most useful and practical that the society has ever had submitted for its consideration. The topics range over a wide field of practice and experience, and the names connected with them are among those foremost in the art and industry. The renewed interest thus shown in the association, and this promise of a good meeting, are most encouraging; and we believe the result will be an attendance high in calibre and large in numbers. The business of electric light and power is still young, but has already overhauled that of gas as to income; and its future depends now on better work, higher efficiencies, closer economies, finer apparatus, abler men. At the Cincinnati convention, both men and methods can be improved by the public and confidential exchange of ideas, out of which will spring a more uniform and perfected art. There will not only be plenty of work done at Cincinnati, but the local committee has outlined pleasant opportunities for recreation that will be greatly appreciated by all who attend.

THE WESTERN UNION "SHAKE-UP."

Another Lochinvar has come out of the West, and to his hands have been committed the fortunes of the great Western Union Telegraph system. Such an event as a change in the presidency of our largest telegraph company would in itself be important, but when it is associated with many changes in the management, unusual attention is called to it. Not alone has Col. Clowry assumed the leadership, but with Gen. Eckert are beginning to go the heads of various departments with which they had been equally identified by many creditable years of hard work. It was, indeed, inevitable that these changes of personnel should come; in some cases because the moment was opportune to give up duties that had grown into a burden with advancing years; in others, because a new control must, of necessity, have its own chosen agencies and means of expression. In short, the new broom is "sweeping clean," and there is a "shake-up."

So far as we are aware, Col. Clowry has general sympathy and support from the electrical profession, because of the belief that the broad changes he is effecting are not made from a desire to enforce merely a personal policy for the sake of having one; but are due to a resolve to improve and rehabilitate the service. He has the reputation of being a forceful man; he now has the opportunity of showing himself a far-sighted, progressive one. The case might have been more hopeful with a younger president, like Mr. George Gould himself, but Col. Clowry brings with him from the West a notable snap and buoyancy. With something of the easy readiness to make betterments that goes with youth, these qualities are greatly needed in American telegraphy, which has sunk far below its proper level of efficiency and perfection. From this remark it is fair to exempt the Postal lines, but we are confident that, had the Western Union been more up to date, its rival would have gone even further, and both would be on a higher plane.

Dr. M. I. Pupin the other day complained bitterly of the antiquated telegraph methods, and said: "The Western Union does not spend ten cents a year for improvements so far as I can learn. A man who

offers them an improvement is treated like a book agent." This has been pretty near the truth. Only last week the greatest American inventor, whose telegraphic work is but part of his claim to fame, spoke to us in even stronger language of the deadness in telegraphy, and expressed the hope that a change impended. With an unprogressive art, there has inevitably been a stagnant industry, and telegraphy has stood still for years, although it ought to have been as prosperous and expansive as telephony. Much can be done to cheapen telegraphy, so that instead of sending one message a year, the average American will send ten. Automatic and machine telegraphic systems of the greatest promise, tried and approved, await liberal adoption, when a new crop of business at lower rates can be created, and telegraphy once more come again to its own. Col. Clowry has a splendid chance, and we shall be among those who are disappointed if he does not seize it at this critical juncture in his career and in the affairs of the vast property he has been called to administer and revivify.

American Enterprise Abroad.

To those who believe that successful American methods are usually correct methods intrinsically—that is, of general application and not necessarily dependent upon national conditions, material or human, as some of our foreign critics would have us believe—the recent applications of these methods abroad on a large scale must be a source of gratification. A notable example is furnished in the case of Mr. Yerkes and the London urban transportation problem. With a need for rapid transportation facilities that called for an electric railway development in advance even of most American cities and on the grandest scale, London is shockingly behind the times—indeed, has not yet reached the stage passed by most American cities ten years or more ago. Moreover, until recently the situation appeared to be hopelessly involved. Though the technical and newspaper press for years teemed with discussion on the subject, and schemes innumerable were proposed, realization at no time appeared nearer than when the subject was first broached.

Some months ago an American, Mr. Yerkes, appeared on the scene, and almost immediately the situation was cleared. The engineering problem was approached from the business standpoint, and after a thorough investigation a definite plan of development was fixed upon, which was closely followed by financial propositions which rendered the realization of the plan possible. At every stage opposition was encountered of the kind that had rendered all former endeavors nugatory, but the plans of Mr. Yerkes had the strength, both from the engineering and financial standpoint, to enable them to hold their own. Commenting upon the latest development—the consolidation of a number of railway schemes—our London contemporary, the *Electrician*, says that it really looks "as if in this magnificent project of the tireless Mr. Yerkes we have the one practicable solution of the problem of organizing a central authority to control London underground railways. As was characteristically said by that great man, Cecil Rhodes, 'there is no use of having big ideas unless you have the money to carry them out. Mr. Yerkes is not the only man who has big ideas on London traction; but Mr. Yerkes appears to differ from others in being able to find the millions necessary to carry them out." It ought have been added that the plans of Mr. Yerkes differed from the scores previously offered and academically advocated, in resting upon practical grounds that render their entire realization merely a financial question; and the needs of London and the solid nature of the investment make the matter of raising the funds a foregone conclusion. This willingness to adopt, to her own purposes and uses, men and material from outside her border is, after all, one of the real sources of England's greatness.

Modern Induction Coils.

The April number of the *Philosophical Magazine* contains a short paper by Prof. Trowbridge upon a recent development of the induction coil. The longest sparks yet obtained from any kind of induction coil are probably the high-frequency discharges of a Thomson-Tesla coil. Although these may possess enormous voltage, yet the total quantity of power usually obtained from a Thomson-Tesla coil is not very large. Of the primeval induction coils, the celebrated Apps inductorium is said to have given a 6-ft. spark; but if this was the limiting range attained, it is clear that only a small amount of power could be transformed in the apparatus. Prof. Trowbridge says he was unable to produce a spark more than seven feet long from an apparatus of the Planté type, in which condensers are discharged in series, but are charged in parallel. He believes, however, that suitably constructed induction coils may be capable of considerably exceeding this sparking distance.

The particularly noteworthy features of the coil he uses are the relatively short but powerful primary winding, consisting of a single layer of wire, and a special form of electrolytic interruptor on the Wehnelt principle. These two elements are connected in series across 110-volt mains. A small motor impresses a definite frequency upon the electrolytic interruptor. The current in the primary circuit, by ammeter, is described as varying between 5 and 10 amperes—representing, roughly, from half to one kilowatt of primary power—with a secondary sparking distance of thirty inches, at a frequency of from 5,000 to 60,000 interruptions per minute. The primary current is mentioned, however, as probably being much in excess of the indicated current at the commencement of each cycle of induction It seems possible that by suitable design, developing the electrolytic interruptor in the primary circuit, along with high insulation in the secondary circuit, that long sparks liberating many kilowatts of power may become available for the purposes of wireless telegraphy.

The Synchronous Converter as Voltage Controller.

Inductance plays a prominent part in alternating current circuits, and a particularly prominent part in the regulation of the pressure delivered by converters. In connection with these machines it has been recognized for some little time that inductance—or reactance—had a benecial influence upon the automatic regulation of compound-wound converters. Mr. Seidner's article on this subject, of which the concluding portion is printed elsewhere in this issue, contains a graphical treatment of the problem.

In the direct-current power circuit, the drop of pressure in the armature of a motor, or dynamotor at full load, is almost invariably a relatively small fraction, usually less than 5 per cent. of the pressure at motor terminals, and this is a necessity of economical transmission. In the synchronous alternating-current motor, or synchron ous converter, the drop of pressure in resistance at full load is similarly a small quantity, owing to similar considerations of economy. But the synchronous impedance of such a machine is much greater than its ohmic resistance. Consequently the total drop of pressure in the impedance of the machine is a very significant quantity. At full load this impedance drop is usually an appreciable fraction of the applied terminal pressure. One effect of this large drop of pressure is to throw the counter-electromotive force of the motor or converter out of phase with the applied e. m. f., and still further out of phase with the e. m. f. at generator terminals, if the applied e. m. f. and the c. e. m. f. are nearly equal in magnitude Another effect, however, is the possibility of adjusting the magnitude of the c. e. m. f. of the converter, and at the same time its e. m. f. on the direct-current side, by varying its excitation, within a con-

drop in the converter were very small, there would be practically but one c. e. m. f. which could be used, and that would be nearly equal to the terminal e. m. f. This would mean a falling off in pressure between the direct-current mains supplied by the converter, as the load increased, owing to the unchecked drop in both the alternating and direct-current sides of the system. The large impedance drop, while not necessarily diminishing the efficiency, enables a considerable range of c. e. m. f. to be generated by the machine, within the range of stable operation, the phase-angles of the e. m. f. triangle adjusting themselves automatically within this range.

The ordinary method of computing the regulative behavior of the converter is by the algebra of complex quantities. Mr. Seidner develops the application of the corresponding graphical processes. It is a curious fact that the loci of the curves traced graphically by the vectors of current, e. m. f., and power-rectangles, when any of these quantities undergo simple linear variation, is frequently a conic section; *i. e.*, a hyperbola, a parabola, or a circle (particular case of the ellipse). The skill of the draughtsman who develops the converter problem graphically, is manifested in so selecting the fundamental vectors that the variable curves directly considered are simple circles, thus eliminating the more graphically troublesome parabolas and hyperbolas. There can be no doubt that by plotting the various magnitudes vectorially, on a fairly large scale, the effect of load variations and their action on a compound-wound converter can be revealed to the eye with an accuracy that is sufficient for practical purposes. On the other hand, however, although the graphical method is swift and convenient, it requires to be checked occasionally by the algebraic method for confirmation, and whoever possesses the insight into the phenomena sufficient to draw the geometrical figures, should have no difficulty in making such corresponding numerical computations.

There are consequently two different kinds of alternating-current circuits in which the presence of judiciously inserted reactance may be beneficial. One of these is the automatically regulating compound-wound converter, above considered. The other is the case of a long-distance telephone circuit, in which additional artificially distributed reactance increases the strength of the received current. The modes of action of the extra reactance in the two cases are, however, quite distinct.

The Growth of Engineering Education.

It is a profoundly interesting thing to look back over the past twenty years and to contemplate the change that has taken place in the facilities for technical education, and what is of vastly more significance, in the public attitude toward professional training. The attitude of educators in the early eighties toward the modern education was for the most part a mixture of distrust and dislike. In a measure the persistent labors of leaders like Eliot, of Harvard, and Gilman, of John Hopkins, had brought the thinking public to a realization that Latin, Greek, and mathematics did not constitute the sum total of human knowledge, and that laboratories had their uses; nevertheless the general trend of the scholastic mind was against the innovations. It was right and proper that a clergyman, a lawyer or a physician should receive a full and adequate professional training, but the engineer should learn by hard knocks, in the field, in the workshop—anywhere and anyhow—provided he did not ask for resources that had been devoted since time immemorial to the digging of Greek roots. Far be it from us to cast aspersions on the classical education. It is in itself a good thing, worthy to be pursued as a preliminary to his professional education by anyone who can spare the time and money. But the attitude of quiet contempt taken by the old-timers toward any proposal looking toward a first-class scientific education was unmistakable. The chairs of science in the colleges and universities were then in great measure filled by men who had graduated in the sixties, had taught in high schools for a year or two, or perhaps attended a theological seminary and had then come back to the Alma Mater as instructors in classics or mathematics. A few years later a chair in science became vacant through the death of the venerable incumbent, and the instructor had pull enough with the trustees to drop comfortably into it.

Some of the men thus ensconced were big of brain and keen of perception, and grew with the growth of their science—others gradually fossilized. But to all alike, the requirements of the new education came with something of a shock. The old education could make scholars with a man, a book, and an unused barn—the new demanded apparatus and laboratories, workshops and machinery. Funds were short and the trustees quailed. To spend on a single piece of apparatus a sum sufficient to buy a complete set of the Greek and Latin Fathers was a bitter thing to contemplate. Fortunately, engineering science grew and prospered materially, and men came to the front—hard-headed business men who had touched the sources of American prospecrity and looked into the future. They reached into their pockets and began to endow. Money that if given at all ten years before would have gone to found a professorship of Aztec literature went to build an engineering laboratory. Within a decade the change was wrought, and without casting out the old the new had come. It came, too, with a rush that bore along even the most hide-bound institutions, until to-day there is hardly a college in the land where a student cannot get a solid grounding in science from well trained and progressive men. The technical schools have grown at a rate even more astonishing, and to-day if a young man wants a good technical training it is his own fault if he does not obtain it. The scientific school is clear of the ancient odium. Its graduates are neither looked down upon by the scholastic nor condemned by the practician. In fact, it is generally recognized that a man without technical training has a very hard row to hoe in modern engineering. It is a wonderful change, not only in material things but in point of view, and it is hard to overestimate its importance both to general educaton and to practical affairs.

There are some who pretend to despise education, technical or otherwise, for men of affairs and action, but their names shall be writ in water, while above the strand will loom the great figures of Carnegie and Rockefeller with their huge benefactions in the cause of education, and of Cecil Rhodes, struggling back to Oxford for his degree, laying the foundations of an empire, and leaving his fortune for training others to play well their parts in the world's work. The place which America has taken of late in the industrial sphere we believe is due in no small measure to the increasing number of men skilled in the engineering arts, the direct product of the new education, and this influence will year by year grow stronger. As times goes on we must look to it that the trend of education keeps on the line of progress. There will be no return to mediævalism; the danger, if there is any, lies in another direction—that the power of utilization will overrun that which reflects and originates. It was a keen appreciation of this that brought the Carnegie Instutition into being—a far-sighted realization that the theory of to-day is the practice of to-morrow, and that a big structure requires broad and deep foundations. If this country is to keep in the van it must find and take advantage of every short cut in sight that leads toward the goal. Otherwise there is waste of energy, a thing which the spirit of progress abhors. The growth of education must keep pace with the demands of the times, and when as now the opening century demands great things, it is no time to be self-complacent. Just now pure science is in a questioning tentative state, that state of unrest which preceds momentous advances, and the keener eyes are watching for the results. Practice can care for itself amply well for a while, and it is time to have a care lest we get out of sight of theory and miss the shortest trail.

Programme of the National Electric Light Convention.

Plans are now complete for the convention of the National Electric Light Association, at Cincinnati, May 20—22, at the Grand Hotel, and every indication promises a most interesting and successful meeting. It is the twenty-fifth convention, and President Doherty has resolved that it shall be a worthy starting point for the next period in the association's history. Secretary Porter has forwarded us the following preliminary programme:

"Rates," Henry L. Doherty, Denver; L. A. Ferguson, Chicago, Alex. Dow, Detroit; L. R. Wallis, Woburn, Mass.; Ralph J. Patterson, Waterville, Me.; Samuel Scovil, Cleveland, O.

"Signs and Decorative Lighting." Papers by Russell Spaulding, of New York, and E. J. McAllister, of Newark, N. J.

"Are Free Lamp Renewals Desirable?" James English, New Haven, Conn.; F. Ellwood Smith, Somerville, Mass.; F. W. Little, Peoria, Ill.; W. J. Greene, Cedar Rapids, Ia.

"What Efficiency Lamp Should be Used?" Henry L. Doherty; Samuel E. Doane, Marlborough, Mass.; L. G. Van Ness, Denver; Francis W. Willcox, Harrison, N. J.

"What Improvement is Desired in Meters?" Robert Ferris, Monmouth, Ill.; C. A. White, Somerville, Mass.; H. H. Scott, Lincoln, Neb.

"Are Loose-Leaf Ledgers Desirable for Electric Companies' Records?" G. E. Tripp, Boston; H. H. Fairbanks, Worcester, Mass.; Geo. W. Davenport, Boston; Charles R. Price, New Bedford, Mass.

"The Advantages of Gas Engines." Chas. H. Williams, Madison, Wis.

"What Changes Should Be Made in the Plan of Uniform Accounting?" J. P. Crowley, St. Paul, Minn.

"Caring for Consumers' Complaints." Irvin Butterworth, Denver.

"Boiler Firing with Oil." Jas. W. Warren, Los Angeles, Calif.; H. T. Edgar, El Paso, Tex.

"Three-Phase vs. Two-Phase for City Distribution." B. A. Behrend, Cincinnati; Chas. F. Scott, Pittsburg.

"Hot Water vs. Steam Heating." J. F. Porter, Alton, Ill.; P. H. Korst, Jamesville, Wis.; C. R. Maunsell, Topeka, Kan.

"Does It Pay to Treat Poles with Creosote, Oil or Other Compounds?" W. E. Moore, Augusta, Ga.

"Gas Explosions in Underground Systems." James Blake Cahoon, New York.

"Protection of Long-Distance Transmission Lines." F. C. A. Perrine, Pittsfield, Mass.; L. Denis, Quebec; P. N. Nunn, Provo, Utah; P. M. Lincoln, Niagara Falls, N. Y.; H. J. Gille, St. Paul.

"Present Performance of the 220-Volt Lamp." Fred. W. C. Bailey, Columbus, O.

"Report of Committee on Photometric Values of Arc Lamps." Henry L. Doherty, chairman.

There is also the "Question Box," which this year is literally buzzing with importunate queries of a most interrogative character.

Steps have been taken to provide entertainment, and the following gentlemen form the local reception and entertainment committee: H. C. Hutchison, chairman; Norman C. Kenan, A. C. Beattie, B. T. Price, J. B. Pevear, O. M. Hall, Thos. Ryan, Samuel Moyer, Samuel W. Glover, Alexander Lewis, H. J. Douds, John A. Devere, J. W. Bullock, Jesse Bindley, Edward Gillette, Wm. S. McCallum, C. B. Humphreys, Frank Lawrence, F. C. Colwell, Frank G. Bolles. This committee has arranged, among other entertainments, visits for the ladies to Rookwood Pottery and Cincinnati Museum of Fine Arts; a trolley ride through the city and suburbs to the Zoölogical Gardens, where luncheon will be served. The Bullock Electric Manufacturing Company has arranged for a trip to and through their works.

The Grand Hotel is headquarters, with rates of $3 per day, on the American plan, and $1 per day, and upward, on the European plan. Details as to transportation have already been published.

Electrical Engineers of the Day—XLV.

JOHN W. HOWELL.

John White Howell was born in New Brunswick, N. J., and received his education there and in New York and Hoboken, taking six years of college work—one at the College of the City of New York, two at Rutgers, and three at Stevens Institute of Technology with the class of 1881. Mr. Howell took no degree at any of these institutions, but in 1899 was given the honorary degree of Electrical Engineer by Stevens Institute. Mr. Howell's father was the means of starting him in his career. The Edison incandescent lamp had recently been invented, and Mr. Howell made his thesis on the subject, "Economy of Electric Lighting by Incandescence." This was one of the earliest contributions to the theory of the incandescent lamp, and attracted so much attention that it was reprinted in book form.

As a direct consequence of this thesis, Mr. Howell was soon after (1881) employed by the Edison Lamp Company, then at Menlo Park, N. J., on technical and experimental work, and has been employed in the Edison Lamp Works ever since. Mr. Howell developed the first successful electrical pressure indicator used on electric lighting circuits and also the system of indicating pressures at various feeder ends, which was generally used for some years. This system of indication made it possible to maintain the voltage at the lamps sufficiently close to operate high efficiency lamps with acceptable commercial life, and paved the way for experiments in burning lamps at 3.1 watts per candle-power, which were made by Mr. Howell and his brother, on the circuits of the Edison Electric Illuminating Company, of New Brunswick, and resulted in the adoption of lamps of that efficiency by lighting companies having good voltage regulations.

In the litigation over the Edison filament patent, it was Mr. Howell, who, after all others than Mr. Edison had failed, succeeded in making lamps as described in the patent specification, an achievement interesting on account of the primitive methods necessary to be observed in their manufacture. Tar and lampblack were rolled into filaments by hand as small as six-thousandths of an inch in diameter



and twelve inches long. The only tools used in making these filaments were a piece of plate glass, a stick, a garter clip, a pen-holder, some carbon rods, wire and a crucible. These lamps were burned on a life test six hundred hours, and justified the claims of the patent.

Mr. Howell has acted as an expert in most of the suits brought under the various Edison patents on lamps. In the litigation over the Novak lamp, Mr. Howell determined the amount of bromine in the lamp by a purely electrical method, his determination being afterward verified by the makers of the lamp. He has contributed numerous papers to electrical literature, several of which were read before the American Institute of Electrical Engineers, of which body and of the American Association for the Advancement of Science, he is a member. When the General Electric Company was organized, Mr. Howell was made engineer of the lamp works, which position he still holds.

Mr. Howell's patents and applications now pending on lamp and allied subjects are thirty in number. He has been largely instrumental in developing the art of lamp manufacture to its present degree of perfection, and in everything relating to the theory and practice of the art is recognized as the leading authority, both at home and abroad.

Mr. Howell has profited greatly by personal contact with Mr. Edison. In the early days of the incandescent lamp industry he received a deep insight into the master's conceptions of the art, which, together with Mr. Howell's natural ability, high character and fitness for the work, has placed him at the head of the world's lamp makers.

The Electric Elevated and Underground Road of Berlin.

A PLAN of Berlin clearly shows that a line of traffic running from east to west is sadly needed in the southern section of the city, in order to complete the belt line which was started many years ago. It was 20 years ago when Werner von Siemens first conceived the idea to supply Berlin with electric elevated and underground railways. One of these lines was planned to pass through the Friedrichstrasse, while another was to run through the Leipzigerstrasse. These suggestions were laid aside for various reasons, and it was not until 1891 that Siemens & Halske worked out a complete plan for an elevated road which would join the Warschauer Brücke railroad station with the Zoological Gardens. The traffic at that time already demanded the construction of such a road, which has now been completed with but a few slight alterations. The line now takes an east-westerly course with a branch to the north.

One of the most interesting features of the road is the connecting triangle, which lies to the east of the Potsdam freight depot. At this point three lines pass over and under each other, so there are no crossings at the same level. This removes three danger points and makes greater headway between trains possible, which is very desirable, as three lines of trains pass at this point.

At two points along the road the elevated and underground sections join, the grade at these junctions being 31.3 per cent. Fig. 1 shows a section of the subway and also the third-rail. The latter is situated outside of the two rails and 230 mm above them. On the elevated structure the third-rail is located between the other two rails and 180 mm above them. The reason for this difference of height is the necessity for the automatic shoe contact for the lighting of the cars in the subway.

The following circuits compose the system: 1. Operation of the trains. 2. Lighting of depots, signal houses, car-houses and workshops. 3. Signal apparatus. 4. Telephones. 5. Electrical operation of signals and switches at the triangle. The circuits for the operation of cars are located 1,096 mm from the center of the track. They consist of rails 3,600 sq. mm in section, and 12 meters in length. These rails also carry current for lighting and heating the cars. The rails are 180 mm above the rails on the elevated section, and 230 mm above in the subway.

The bare copper feeders are rectangular in shape and have an

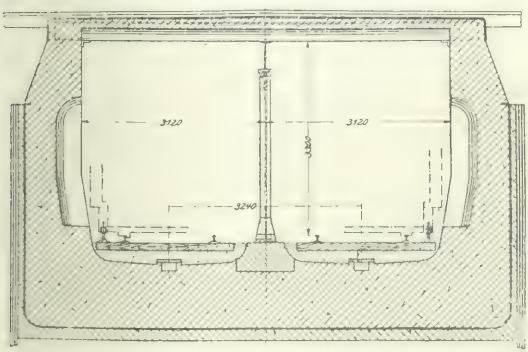


FIG. 1.—CROSS-SECTION OF UNDERGROUND ROAD.

area of from 1,000 to 1,500 sq. mm. The lighting wires for stations are also bare, and are situated next to the feeders.

As shown in Fig. 1, two longitudinal wooden beams are bolted to the transverse beams, 6 meters apart. These carry cast-iron brackets, within the hollow space of which the feeders and lighting wires are supported on insulators. The latter are fastened to a piece of flat iron, while the third-rail insulators are fastened directly to the wooden beams. To the top of the brackets guard beams are fastened, about 130 mm above the third-rail, which prevents anyone from stepping on the latter. Where telephone wires cross the elevated structure, 8 mm wires are fastened to the guard rail, and are connected to the return circuit, being, therefore, grounded, which gives ample protection to telephone apparatus in case a wire should break. All distances between track centers, etc., are altered at curves.

A somewhat different construction has been adopted at the Bulowstrasse Viaduct. The brackets are mounted on longitudinal sleepers, and the third-rail on transverse beams. At terminal stations and switches, the third-rail is not continuous, but the trains continually receive current, because the trains are provided with four contact shoes at each side, there being two on each side of each motor car, so that in case the front shoes should slide off the rear ones still collect the current. The several sections of the third-rail are connected together by means of cable.

In the car-houses the conducting rail is located to one side and



FIG. 2.—ONE OF THE OVERHEAD STATIONS.

above the tracks. It consists of an angle iron, which is covered by a ⌐¬ shaped wooden board, so as to protect it.

As indicated in Fig. 1, the contact rail in the tunnel is not located between the tracks but to one side of each set. It is only protected at the tunnel wall recesses. The rail is laid higher than on the elevated section so that automatic contact is made for lighting the car when the train passes from the overhead to the subway section. The insulators are attached to the extended sleepers, which are situated 6 in. apart.

The lighting wires are of such section that at the Warschauer Brücke depot, when the lamps at all depots are burning, there is a pressure of 660 volts, the pressure at the power station being 750 volts. At the intermediate depots the pressure is reduced to 660 volts by means of rheostats. This pressure is suitable for 12 arc lamps connected in series, each taking 55 volts, or three incandescent lamps, in series, each taking 220 volts. The cross-section of the lighting wires varies between 10 and 120 sq. mm. When some depot lamps are cut out, the pressure naturally tends to rise, but it is kept constant by a regulator which is operated at the central station by means of test wires. At several points the lighting wires are connected to the power circuits, so that the latter can be used for lighting purposes in case of accident to the former. These cross-connecting cables are 1,089 mm in diameter. The rails, used for returns, are connected together at the joints by copper bonds, and crosswise by copper rods.

Cables are used for signal and telephone purposes, and the current is returned through separate return circuits. Each depot is connected to the two adjoining ones by telephone, and may be connected in this way with any other depot at the central station. The number of wires in the telephone cables differs, therefore, at each depot, the number varying between 6 and 22, and the diameter of the cable between 20 and 28 mm. Cables are also used for carrying current to the signaling and switching apparatus at the junction triangle. These cables are also attached to the guard beams.

The insulators carrying the third-rail are covered by cast-iron caps, which are screwed to the central hard rubber portions. There is one insulator for each rail length, and a flange grasps the foot of the rail so as to prevent the latter from moving. Double insulators are used for feeders, the outer portion being of porcelain and the inner of hard rubber.

Each train consists of two motor cars with a trailer between them

The motor cars are provided with only one operator's platform, and the cars are so arranged that these platforms come on the two ends of the train.

The motors on each car are always connected in parallel. When the train starts in the forward direction the two sets of motors in the two cars are connected in series through a resistance. When going backward the motors in the leading car only are brought into action. The same for braking when one set of motors is cut out. The trucks and couplers of the motor cars and trailers are alike, the cars only differing in their interior arrangement. The two ends of the trailer are the same and do not differ from the ends of the motor cars, which they adjoin. The motor cars constitute the third-class and the trailers the second-class.

The exterior length of the car body is 12,000 mm. The width is 2,260 mm between sides of body. The height above rails is 3,180 mm. The wheel base is 1,800 mm. Distance between king-pins 7,500 mm. Weight of empty motor car 18,000 kg. Weight of loaded motor car 22,000 kg. Weight of empty trailer 13,000 kg. Weight of loaded trailer 17,000 kg.

The car bodies rest on a channel-iron beam frame, and are constructed entirely of wood. There are two slide doors 900 mm in width on each side at each end of every car, which lead to a sort of anteroom and not the actual car interior. One set of doors is intended for entering and the set at the other end for alighting passengers. There is, furthermore, an emergency door at each end of each car which connects with the adjoining car. This door is 1,700 mm in height and 750 mm wide, and can be closed by means of a bolt bar. Each

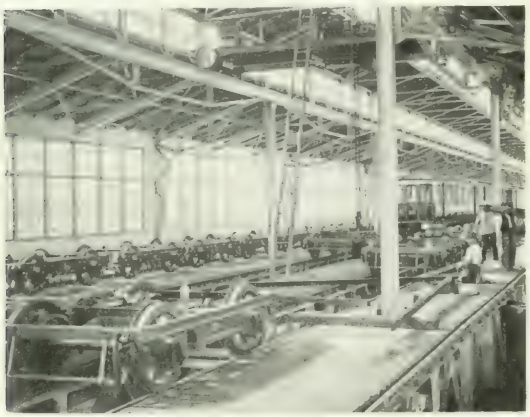


FIG. 3.—VIEW OF INTERIOR OF CAR SHOP.

trailer has 44 seats and each motor car 39 seats. They have standing room for an additional 30 and 27 persons, respectively.

The single buffer couplers are provided with evolute springs, which take up the pulling as well as pushing strains. The diameter of the buffer plates is 280 mm.

For ventilation 12 windows, 140 mm high and 700 mm long, are located at each side beneath the roof of the car. They can be so turned that the fresh air may enter through the front windows and the foul air escape through the rear ones.

The cars are heated by means of electric heaters placed beneath the seats and covered by a casing so that they cannot be touched. To prevent clothing of passengers from being overheated or burned, rods are fastened in front of this casing. Each car is lighted by 12 incandescent lamps. At the front and rear ends of the train two signal lamps are fastened. The lamps in the cars are fed by two circuits, so that in case one circuit is interrupted the car will not be in darkness. In addition, candles may be lighted in case of necessity. The contact shoes are attached to the sides of each motor car and trailer, so that at crossings the current is not interrupted.

A 30-mm wall divides the motorman's compartment from the rest of the car. In this compartment are the switches, switchboard, air-brake valves and manometer. A bell serves for giving ordinary signals, and a whistle for danger signals. The steel rims are sprung around the wrought-iron wheels of the trucks. The running surfaces are cylindrical, and the diameter of the wheels 850 mm.

Each truck is equipped with a four-shoe brake, which is operated by means of air pressure, or by hand from the motor car. The forward motor car of each train may be braked by the short-circuiting of its motors. The hand-brakes, which are only used when a single car is operated, are of the ordinary street-car type. The air brake is of the two-chamber Carpenter type. The braking cylinder, the air chambers and pipes as well as the pump are located beneath the car body. The pump is operated by an electric motor, the two machines being housed in one casing.

A part of the braking rods is attached to the frame and a part to the truck, which is provided with special iron fittings for catching the broken rods in case of accident. The braking apparatus has been so designed that the maximum braking pressure is 70 per cent. of the moving load, *i. e.*, 12.6 tons on the motor car and 9.1 on the trailer.

Each motor car is equipped with four direct-current motors in such a way that each axle is driven by one motor. The motors are the four-pole type and are of such capacity that the train can attain a maximum speed of 50 km per hour. The greater part of the weight of the motor is carried by a piece of flat iron fastened to the truck by means of springs, and a small part of the weight by the axle to which it is connected by means of clamps.

In case only one trailer is used on a train, each motor car is equipped with only three motors, and only when two trailers are used are four motors necessary. In the case of four motors, when running at full speed, all eight motors of the train are connected in parallel. Each controller contains two cylinders, one for the motor and one for the resistance. The former consists of two halves, each having its row of contact points. The resistance cylinder has a top and bottom contact for making connection with the resistances and a row of contact points making connection with the motor cylinders. The contact wheel can only be removed when the motor cylinder stands at zero, and in this position the motors are in circuit. In case the motor cylinder of the rear car is left at the zero point, which is necessary for taking off the hand-wheel, these motors are in a position to receive current when the same is sent through the cable joining the rear and forward motors. But if the motor cylinder of the forward car is also at zero, then the finger of the other car receives no current. In order to start, the current first enters at one contact finger, passes through the contact point of the motor cylinder to another contact finger, and from there to the spark-extinguishing coil to the first contact finger of the resistance cylinder, through the top and bottom contacts to the resistances which are connected in series; then through the motors of the first car, through its contact finger, through the junction box into the connecting cable to another contact finger on the rear car, through the zero contact point to another contact finger, through all the motors of the second car, and finally to earth. As the resistance cylinder is revolved, resistance is gradually cut out and the motors are connected in parallel in the well-known manner. In this way it is possible to control all motors from the forward platform, using only two connecting cables.

In tests of a train over an average distance of 800 m, between stations over a level section, the moving weight was 64 tons, the acceleration .695 m per second, and the maximum speed 11 m per second, which corresponds to an average speed of 30 km per hour. The retardation caused by braking is 1 m per second. The maximum speed may be increased to 12 m per second, which enables the train to make up for any loss of time. The transmisison ratio is 1:4.14 and the consumption 38.6 watts per ton-km.

The generating units are located in the basement, above which is the pipe gallery, and above this the boilers. The water is received from the Landwehr Canal.

There are a 15 and a 20-ton electric crane in the engine room. The chimney is 80 m in height, only 65 m of which is used, because the boilers are located in the top story. There are six water-tube boilers, working at a pressure of 10 atm, and each having a heating surface of 230 sq. m. Superheaters raise the steam temperature to 225 degrees C. By means of valves the superheaters may be filled with water and used for the generation of steam. Two steam pumps, each of 40-cu. m per hour capacity, feed the boilers. The steam pipes are arranged in ring fashion, and are of the Mannesman make. The joints are of cast-iron with wrought-iron flanges.

There are three internal pole, separately excited, Siemens & Halske generators, each of 800-kw capacity at 750 volts. The con-

nections of the machines at [illegible] driving. The current is led to the switchboard by iron-armored lead-covered cables. These are connected to the ordinary automatic circuit breakers and fuses. There is a separate switchboard for the boosters and the lighting and charging batteries, and this board is connected to the main board by cables.

The battery is capable of replacing one entire unit for one hour and furnish considerable more current for a shorter time. The battery is located under the three arches of the elevated railway viaduct.

The engines are coupled directly to the generators. They are compound condensing engines, having a 750-mm stroke and 800 and 1,270-mm cylinder diameters, and the engines have a normal capacity of 900 and maximum of 1,200 hp at 115 r. p. m., and a pressure of 9 atm. The high pressure cylinders are equipped with new Collman valve gear, while the low pressure cylinders are equipped with piston valves. The fly-wheels weigh 33,000 kg. Next to each fly-wheel is the starting device, which is operated by a 20-hp electric motor, which is common to all units. This device is cut out as soon as the speed of the engine exceeds that of the motor.

Air pumps and condensers are located in the basement, and are driven directly by their corresponding engines. The water pipe leading to the condenser is 750 mm in diameter, and connects two reservoirs in the basement with the canal. The water of condensation first flows into a well through a 800-mm pipe, and then into the Landwehr Canal.

The Electrical Equipment of the Experimental Model Basin at Washington Navy Yard.

BY J. ADGER MCCRARY.

SOON after the completion of the electrical equipment of the experimental model basin at the U. S. Navy Yard, Washington, D. C., there appeared in several of the leading magazines of the country an article describing the plant, but no effort was made to describe fully its electrical features. In this article it is proposed to give a more detailed description of the machinery and apparatus employed, and to deal more particularly with the electrical devices used.

The experimental model basin, which is 40 feet wide by 470 feet long, was built for the purpose of finding [illegible] different shaped and different sized models of vessels the actual resistance to be overcome for all speeds corresponding to those the vessel is likely to go, and from the results of these experiments the actual performance of a proposed design may be closely approximated.

Now, in order to do this it is essential that the model be towed through the water at the displacement corresponding to that of the vessel it is made to represent, and at a uniform speed; for unless the speed of towing be uniform or very nearly so the measurement of the resistance would be next to impossible. For the purpose of giving the models a uniform speed, a towing carriage spanning the basin and running on tracks on each side and driven by four electric motors is employed. The carriage has considerable weight (about 25 tons), hence it acts as a fly-wheel to an engine, viz., when it is once started and up to speed small variations of resistance such as is offered by the model being towed and any irregularities in the track have very little effect upon its speed.

The driving motors are coupled in pairs through gearing by a rigid shaft across the carriage. They were made by the General Electric Company, and are wound for slow speed and excessive overloads. For the control of the speed of these motors the Ward Leonard system is used, the principle of which is to vary the e. m. f. applied to the armature circuit, while the fields remain constantly excited from a separate source. To accomplish this is installed a generating plant consisting of three 125-kw General Electric generators—220 volts at 250 r. p. m.—direct-connected to McIntosh Seymour engines; and two General Electric marine-type generating sets—110 volts at 400 r. p. m.—of 15-kw and 40-kw capacity, respectively. The switchboard is so arranged that any one of the 125-kw generators may be run self-exciting at 220 volts, in this case to supply power to the construction shops of this department; or all three may be coupled in parallel for the same purpose when more power is needed; also, any pair may be coupled in series when it is desired to run the carriage at very high speeds.

The 15 kw and 40 kw generating sets are used for exciting the fields of the motors on the towing carriage and the fields of the 125-kw generators. The switchboard is so arranged that either one may do this work, keeping the other in reserve, or for other work.



FIG. 1. [illegible] AND MOTOR [illegible]

When running ordinarily only one of the 125-kw machines with one exciter is used, and from these machines to the experimental model basin building for transmission of power are three lines of cable. The one for the main armature circuit for the motors is carried to trolleys on each side of the basin. These trolleys con-

sist of 44-lb. rails bonded together at the ends and placed just above the tracks upon which the carriage runs, and contact is made with them by means of three large cast-iron shoes which are pressed up against and slide along the rails. The steel springs causing the pressure are not depended on for carrying the current, flexible copper strips being used for that purpose. The other two lines from the station go to trolleys of ordinary Figure 8 section copper, and contact is made by means of ordinary trolley wheels. One of these lines is used to transmit the 110-volt exciting current for the motor fields, while the other is used to connect the fields of the generator through rheostats to the 110-volt exciting source. There are two of these rheostats placed in easy reach of an operator on the carriage, and each has about 140 ohms resistance. One has five binding posts and is connected up to an ordinary reversible car controller with five notches in either direction and an off notch, while the other has 46 buttons and is connected in series with the first; thus, by the use of the two almost any resistance within the range of the rheostats can be obtained, and the voltage of the generator may be changed through a range from 0 to about 250 volts, according to the amount of resistance inserted—this voltage, of course, being reversed by a reversal of the controller handle. This reversal of e. m. f. applied to the armatures of the motor with separately excited fields gives rotation in either direction desired, and hence a travel of the towing carriage in either direction is obtained at will.

The towing carriage being very heavy it is necessary to give it a very great acceleration at starting when high speeds are to be obtained, in order to have the speed thereafter uniform. To get this acceleration the 125-kw generators are compounded, and the large current necessary for starting is made to go around the fields and help to bring up the voltage just when it is most needed, and while the current of the shunt fields has not yet had time to reach its full value. This series current, which is at first very large, gradually falls off as the carriage increases in speed, and the shunt fields which have now had time to reach their full value keep the e. m. f. practically constant and the carriage moves at a fairly uniform speed. To bring the carriage to rest when once under way it is only necessary to bring the controller handle to the off notch, provided the speed is not too great for the friction of all wheels, gearing, etc.; combined with the generator action of the motors this tends to bring the carriage to rest, but when the speed is greater it is found necessary not only to bring the controller to the off notch but immediately to reverse it and at once cause the generators to tend to drive the motors in the opposite direction. Of course, if the controller were then left in this position the carriage would immediately start in the opposite direction; this is avoided by putting the controller handle on the off notch just when rest is obtained. It will be seen then that by means of this controller a skilled operator can move the carriage in either direction at will with ease and exactness.

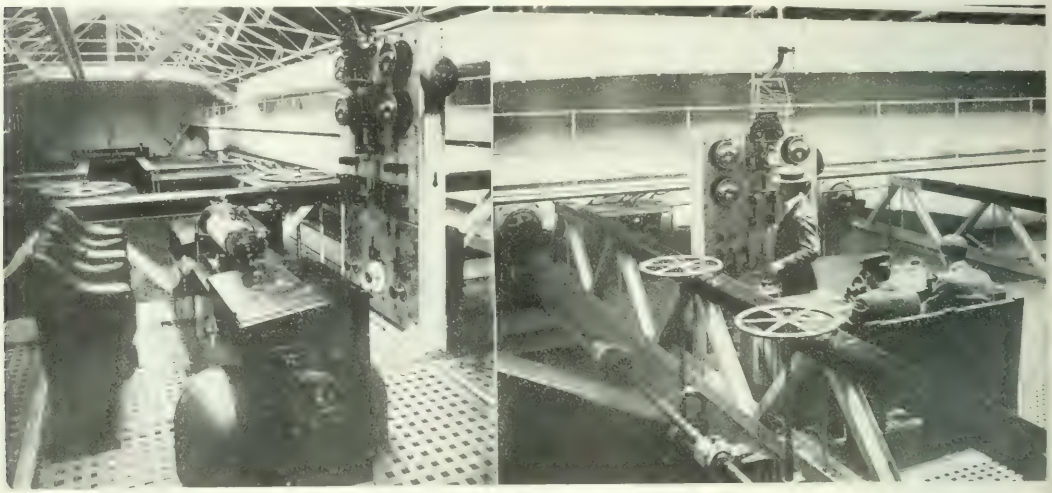


FIG. 2.—SWITCHBOARD, RECORDING APPARATUS, ETC., ON TOWING CARRIAGE.

per hour, the four motors are connected in series, but for higher speeds arrangement is made on the switchboard (Fig. 2) for connecting the four in series parallel; with this combination a speed of 18 knots per hour can be obtained, and even at this speed the generator action of the motors is used to bring the carriage to rest, although it has been found necessary to plug the circuit breakers both in the station and on the carriage, for the current is much greater than that for which the breakers are designed. This excessive current on stopping makes quite a flash at the commutator of the generator, but as it lasts only a short time (only about 3 seconds at most) it does very little damage. In fact, it has not been necessary to true the commutator on account of it, and one generator has been in almost constant use for three years.

On the carriage is seen (Fig. 1) two hoisting cranes for handling models about the building; these are operated by two 110-volt shunt motors fitted to winches, and have reversible controllers. For raising and lowering the central portion of the carriage is another small motor, and again hidden inside the desk (Fig. 2) is a 1-hp. 110-volt motor which operates the dynamometer. This is accomplished by means of two magnetic clutches, one on each end of the motor shaft, and by means of a multiple switch, either one of these clutches may be made to engage and put more or less tension on the dynamometer spring as desired, the motor always running in the same direction. The recording drum (Fig. 2), upon which a sheet of paper is fastened, and upon which time, distance and resistance are recorded, is also thrown into action by a magnetic clutch. These magnetic clutches are in reality friction clutches, for the power transmitted depends upon the friction between the magnet and its armature. They have three collector rings and are wound with two separate coils, one of the coils being only a few turns, through which a small current flows continuously in opposition to the magnetizing current. This demagnetizing current, with the help of small springs and a copper sheet between the magnet and its armature, causes the clutch to release almost instantly. The recording drum is connected through gearing to one of the cross shafts of the carriage, and the time record is made upon it by means of small pencils actuated by electromagnets, in the circuit of which is a break-circuit chronometer. The distance record is made by similar pencils, but in this case the circuit is broken as the carriage passes by small pegs located at definite intervals along the track. For these small time and distance magnets storage batteries are used as source of current.

It might be mentioned that in the model basin building there are several other motors. One 2½-hp. 110-volt is connected to a plunger pump which furnishes pressure for a hydraulic friction brake used to bring the carriage to rest when the electrical braking action is not brought about soon enough to accomplish its purpose. One 35-hp. 220-volt motor drives a large fan for forced heating and ventilation. For pumping the water out of the basin there are

three others, all 220 volts. The largest 25 hp. is direct-connected to a centrifugal pump, and the speed is controlled by the Ward Leonard system.

In connection with the model basin is a shop for the construction of models to be tested (Fig. 3), and here each machine is coupled to its individual motor, in some cases by belts, in others direct to



FIG. 3.—MODEL CUTTING MACHINE.

the machine. The power is delivered to the motors through a cable line under the floor near the center line of the building, from which branch lines lead off on each side to switches and starting boxes located on the wall. The switch, fuse-block and starting box for each motor is mounted on a neat wooden board which stands out from the wall, and the wires are brought up from behind through the board to their proper binding posts.

Message Rates in Independent Exchanges.

The Maryland Telephone and Telegraph Company, operating an extensive independent system in Baltimore, has found that flat rates for telephone service in a large city do not give satisfactory results. The company has introduced in the city council of Baltimore a bill to release the company from the provision of its franchise, which prohibits it from charging more than $48 a year for business service and $36 a year for residence service. In supporting this measure before a meeting of the council on April 28th, President Bouton, of the Maryland Telephone Company, said that experience had shown that the operating expenses per telephone increase with the number of telephones in use, by reason of the increased average use of the service by each station with the growth of the system. He stated that the operating expenses per subscriber in Baltimore were more than twice as much as the operating expenses per subscriber in the company's exchanges in smaller towns. His company furnishes many subscribers in Baltimore with service at a loss, as there are many large users paying a flat rate of $48 a year who send on an average as many as 15,000 calls in a year. Mr. Bouton pointed out very fully the limitations and disadvantages of the flat rate, and agreed that if the city council would withdraw the present restriction on the company's rates, he would institute a message rate schedule which would give low rates to the small users, and enable the company to charge all users a rate in proportion to the amount of service rendered.

This is the first instance, it is said, of an independent telephone company acknowledging the incorrectness of the flat rate principle and planning to adopt the message rate system, which for some years past has been so actively developed by the Bell Telephone companies as a result of their experience.

The Genesis of Wireless Telegraphy.

BY A. FREDERICK COLLINS.

SINCE wireless telegraphy has assumed a position in the front ranks of electrical arts and pursuits, the issue of priority of discovery and invention has developed a condition of affairs second only in its importance to the proposed measures which are to exterminate the menacing monopoly of it on the high seas.

The progress of all great things is necessarily slow, and a useful invention of any magnitude is not the accomplishment of one man but the combined result of the efforts of many minds.

Even the discovery of the Röntgen ray, so marked in its nature and wonderful in its operation, does not in its personified term offer an inkling of the laborious experimenting of Geissler, Crookes and the many other lesser known investigators who made the brilliant discovery a mere bagatelle for him who was destined to observe it.

A history of how each great invention and discovery has found its affinity in the name of a single worker, to the exclusion of all others, living or dead, would make interesting reading and doubly so if the narrative would give the Alpha and the Omega of the art with the names of everyone who helped to consummate it.

It is to record, if possible, the obscured efforts, the isolated facts which finally culminated in the combinations of ideas gathered from whatever source, that are responsible for the spark-gap and coherer system of wireless telegraphy, that I have essayed the rôle of historian in which accuracy and impartialism shall be paramount.

ELECTRIC OSCILLATIONS.

Without entering into the mass of cumulative data bearing on the discovery of the laws of direct, induced and alternating currents forming, primarily, the absolute basis of wireless telegraphy as well as all else of an electrical nature, let us begin with electric oscillations.

Electric oscillations, produced by a Leyden jar or the oscillator system of an induction coil, is the fundamental factor in the art of wireless transmission of the Morse code, and it is this surging of the electric charge which causes the propagation of the electromagnetic waves through space. Following closely the discovery of this phenomenon is the action of electric waves on metal filings, and finally the details of the system.

It is almost universally ceded by scientific authorities that Joseph Henry and Hermann Von Helmholtz were the first to discover and define the nature of the restoration of equilibrium of an electrified body discharging through a disruptive spark, as in the case of a Leyden jar.

As early in the last century as 1806, the phenomenon of a "backstroke" of lighting had been observed and recorded in *Gilbert's Annalen*. The sequence of events in the history of investigation of the oscillatory discharge is as follows: In 1827 Felix Savary advanced the hypothesis of electric oscillations, having been the first to put his observations on record, based on the experimental evidence of the irregularity of the magnetization of needles by a spark from a Leyden jar.

It was not until 1842 that Henry communicated to the *American Philosophical Society* a discourse on the "Oscillations of Electrical



FIG. 1.—OSCILLATING CIRCUIT.

Discharge," advancing as a solution for the anomalies of electrical induction as exhibited in the changes of polarity in fine needles the "existence of a principle discharge in one direction and then several reflex actions backward and forward, each more feeble than the preceding, until the equilibrium is obtained." Fig. 1 shows

in rectangular co-ordinates the oscillation of a disruptive discharge from the maximum potential until its reaches zero.

Hermann Von Helmholtz, in his *Erhalting der Kraft*, published in Berlin, describes some conclusions in 1847, in which he says it is "easy to explain this law if we assume that the discharge of a Leyden jar is not a simple motion of electricity in one direction but a backward and forward motion becoming continually smaller until the entire *vis viva* is destroyed by the sum of the resistance." This conclusion was reached after Wollaston had observed that both gases were present at both electrodes in decomposing water by the disruptive discharge.

Five years later, in 1852, Sir William Thomson, now Lord Kelvin, contributed to the *Philosophical Magazine* a mathematical paper tending to prove that the disruptive discharge was oscillatory, basing his deductions on the experiment of Faraday, showing "that the electro-chemical equivalent of the whole electricity that passes appears in oxygen and hydrogen; and rising mixed from each pole, is probably due to electrical oscillations in the discharges consequent on the successive sparks."

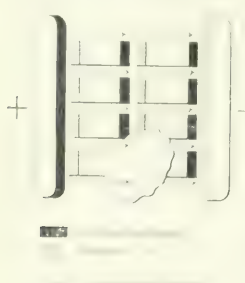
In 1859, or thirty-two years after the report of Savary was published, Feddersen was enabled to analyze the spark by means of a rotating plane mirror (devised by Sir William Thomson and constructed by Wheatstone), breaking up the principle discharge into a series of minute sparks, and the hypothesis of Savary, experimental evidence of Henry and the mathematical deductions of Thomson, were all verified by a physical process, and electrical oscillations were placed in the category of absolute knowledge.

ELECTRIC WAVES.

The relation between the oscillations of an electrically-charged body and the waves propagated through space as a result of the dissipation of the energy of the charge is now as well known as are the laws of light waves and the atomic vibrations which produce them. However, prior to 1888 the gulf separating the mathematically predicted electric waves from the physical production of them was "wide and deep, and dark as well."

It is remarkable how often the most brilliant, learned and scientific investigator will have within his very grasp a great truth, a mighty law, a gigantic fundamental principle only to let it slip away unrealized. Electric waves until 1888 were as elusive to those who sought them as a globule of mercury to the finger's touch. But at last they were discovered and the laws governing their action determined. Without this knowledge wireless telegraphy by the present method would not be possible. The work evolving their solution is more nearly individual, and the honor belongs more clearly to one man than is usually the case in electrical arts.

But to give credit where it is due, it will not be necessary to revert further than to Faraday's discovery of the relation of light waves and the magnetic field in 1855. This he did by passing a pencil of light through the field of a powerful electromagnet with the line of wave propagation parallel to the lines of magnetic force. A cube of very dense glass placed between the poles of the magnet with an analyzer was arranged to cut off all light waves before the magnet was excited. When the magnetic lines of force were created, Faraday observed an illumination of the previously darkened field, proving that light and magnetism possessed definite relations.



This phenomenon led James Clerk-Maxwell, in 1865, to evolve his electromagnetic theory of light. Without reciting his theory in its complex mathematical phases or analyzing his deductions of the co-efficients of the ether, it will suffice the purpose of this paper to state simply that all forms of transverse vibrations of the ether or polarizations are the resultant of electric force separate and distinct from atomic matter. (Fig. 2.)

OF THE ETHER.

Primarily these polarizations are produced by changes of electric potential, and the more rapid the change or oscillation the shorter will be the wave length emitted and propagated, and the greater will be the dissipation of force in developing the electromagnetic waves.

Having determined the relative values of the period of oscillation and the emission of waves propagated by it and that the velocity of light and electromagnetic waves practically agree, it was not difficult to find justification in the belief that other and longer waves existed could they but be demonstrated.

A series of facts in triplicate, showing how a discovery "so easy seemed, once found, yet which unfound most would have thought impossible," is shown in the efforts of Hughes, Fitzgerald and Lodge.

Prof. D. E. Hughes, the discoverer of the electrical phenomenon associated with the loose contact or microphone, made a series of experiments in 1879, and ascertained that the discharge from a Leyden jar affected at a distance the loose contact or microphonic joint, causing it to cohere. Hughes opined that this result was due to electric waves capable of penetrating to considerable distances; but all his efforts, his discoveries, his ambition, which would have doubtless culminated in the honor of his having been known as the inventor of wireless telegraphy, was swept away at a single stroke by Sir George Stokes, who maintained that all the phenomena exhibited could be explained by the well-known laws of magnetic induction. This so discouraged Hughes that he made no further attempt toward the elucidation of the electric wave hypothesis, not even to the extent of placing his views on record, until at least twenty-five years after. *Hughes discovered the spark-gap and coherer system of wireless transmission, yet could not prove the existence of the waves.*

In 1883 Prof. G. F. Fitzgerald described "a method of producing electromagnetic waves by utilizing the alternating currents set up when an accumulator is discharged through a small resistance." This method was the one by which Hughes, a few years before, obtained electric waves, and it is the only method we know of to-day by which a sufficiently high frequency of oscillation may be set in motion. *Theoretically Fitzgerald knew the requirements for the production of electric waves, but was unable to construct a physical apparatus to fulfill the conditions.*

When Principal Oliver J. Lodge was engaged in the investigation of lighting rods in 1884, he likewise trod the very threshold of discovery of the electric waves; he obtained many interesting results due to electric oscillations in metal conductors, thus *producing the mechanical action of Maxwell's electromagnetic waves in neighboring wires, but Lodge did not grasp the fundamental action of these waves in space.*

It was then left for Henrich Hertz to elucidate experimentally Maxwell's theory, as modified by Helmholtz, and his own conceptions of it, and to verify it with such an abundance of physical tests that wireless telegraphy in the hands of an assiduous mechanician was made a proposition of comparative simplicity. The concise enumeration of Hertz's work relating to wireless transmission is this: (1) A method of producing electric waves by the oscillatory discharge; (2) a physical means for measuring the finite velocity of electromagnetic waves, or, as they have been termed by Hertz, electric waves; (3) the discovery of stationary waves in space, or electric radiation; (4) the experimental proof of the identity of light and electric waves by means of physical apparatus, showing all the phenomena of optics, including refraction, reflection, polarization, diffusion, absorption and wave interference; and (5) a method of detecting and measuring the electric waves. (Fig. 3.)

These were the real stepping stones to wireless telegraphy, a

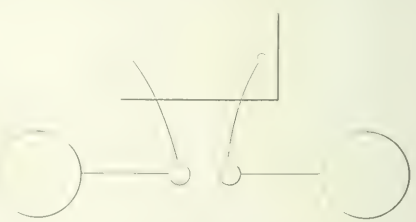


FIG. 3.—HERTZ OSCILLATOR.

greater stride toward its realization than had been made at any prior time, since his apparatus for emitting the waves, that is the induction coil, is the one in practice to-day, as are many of Hertz's electro-optical effects, which are utilized in the details of both transmitter and receiver.

To Sarrasin and de la Rive, Poincaré, Bjerknes, Righi, and the many others who have improved upon Hertz's apparatus, or who have offered additional information, wireless telegraphy does not owe much if anything at least in its present state. Lord

Kelvin, Lodge and their mathematical and theoretical followers must needs wait a little while until the perfected system is given a commercial value before their services to the art will be recognized, and those who are first may be last and the last first.

The detector Hertz employed was merely a circle of wire with a small air-gap between its approaching terminals, and these were tipped with small brass balls; it was a device, simple and very effective in the hands of the brilliant Hertz, but as a receiver of electric waves to any commercial distance it was far too imperfect. A more sensitive instrument was needed, and it is in the evolution of the coherer, or radio-conductor, that France and England has been stirred to their very scientific depths in the desire to establish the priority of discovery for their favored sons.

ELECTRIC WAVE DETECTORS.

In a paper read before the British Association in 1870, Mr. S. A. Varley described his observations "on the opposition of a loose mass of dust composed of conducting matter to electric currents of moderate tension." Varley made a large number of experiments with lightning bridges, based on the principle of a loose contact between the terminals of the instrument to be detected, but he did not venture an explanation to account for the phenomenon.

As I stated before, in 1879 Hughes operated a wireless signal apparatus by electric waves at a distance of a mile, and there is no other substance known so sensitive to feeble electric waves or self-restoring to the degree as that possessed by powdered carbon. But he, unfortunately, did not make known this branch of experimental physics at the time. But Hughes, nevertheless, occupies the unique position in the history of wireless telegraphy by being the first to operate an emitter of electric waves and receive them by means of loose contact.

Prof. Calzecchi-Onesti, in his researches conducted in 1884, found that metal filings placed between discs of copper cohered upon the break of a primary circuit, but attributed the effect to induction. With these preliminary essays in the art we now come to the last great scientific discovery that was to make the new wireless telegraphy possible.

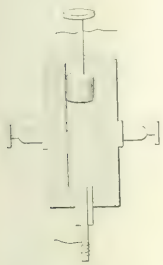


FIG. 4.—BRANLY. RADIO-CONDUCTOR.



FIG. 5.—LODGE COHERER, ¼-SIZE.

Prof. Edouard Branly published in 1890 a complete detailed account of the "variations of conductivity under electrical influence." In this paper he describes the "effects of electric sparks on a circuit comprising a single cell, a galvanometer and some powdered metal enclosed in an ebonite tube one square centimeter in cross-section and a few centimeters in length." (Fig. 4.)

This constituted the first device designed expressly for the purpose of receiving and indicating the presence of electric waves by means of metal filings. To it Branly gave the name of radio-conductor; with it he determined within a fair degree of accuracy the relative influence of electric waves on various metals and substances. He also stated that by tapping, the tube is returned to its original resistance.

It was not until 1894 that Lodge read a paper before the Electrical Congress, pointing out the possibility of transmitting signals with the Hertz radiator and employing a modified form of the Branly radio-conductor, shown in Fig. 5. This consisted of a glass tube, having a bore of 1 cm and a length of 18 cm, the ends having conductor plugs so arranged that the pressure upon the filings could be made variable with a screw adjustment.

In his researches of the phenomena discovered by Hertz and Branly, Lodge found that the particles of metal were drawn into contact with each other, or cohered, and so he gave to the tube the name of coherer, which, though not as euphonious as the terminology of Branly, struck the keynote of popularity ,and with its new name and in its new form Lodge's name came to be inseparably linked with it. The writer has gone over all the available sources of information at his command, but has not been able to find a single reference to the Lodge coherer antedating that of the Branly radio-conductor.

Lodge was, however, the first to adopt the electro-mechanical vibrator as a means for automatically tapping the tube to effect decohesion of the filings, and this arrangement is universally in use to-day in wireless telegraphy.

ANTENNÆ AND GROUNDS.

The vertical wires, or antennæ, and the earthed connections of both receiver and transmitter for the spark-gap and coherer system of wireless telegraphy are up to the present time indispensable features for long-distance transmission. There seems to be no record of the antennæ, or ground wire, used on a receiving device prior to that of Prof. Popoff, the details of which he communicated to the Physico-Chemical Society in 1895 at St. Petersburg. The apparatus was not employed by him as a wireless telegraph receiver—though it could have been used as such—but to graphically plot the differences of atmospheric potential.

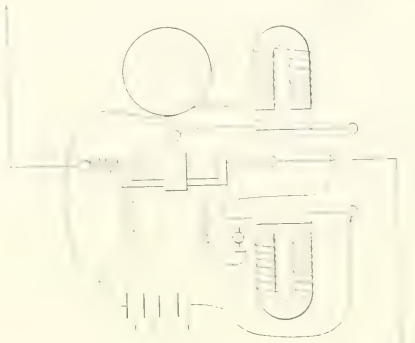


FIG. 6.—POPOFF RECEIVER.

Popoff's reason for applying the antennæ is clear, since it follows logically that if the electrical tension of the upper strata of air is to be observed a vertical wire, or exploring rod, as Popoff termed it, must needs be extended upward into that region. The earthed wire attached to the coherer also followed in logical sequence, for a knowledge of high potentials would at once suggest the necessity for carrying away and dissipating the excessive charges by this means. Fig. 6 shows the complete arrangement of the Popoff apparatus having all the important essentials for receiving wireless messages, including the relay and an automatic (Richard's) register.

This brings the state of the art up to 1896, when William Marconi applied for his first patent in England and immediately thereafter submitted his drawings and specifications to Sir Wm. Preece, of the Postal Telegraph Service. The specifications of this patent calls for a vertical wire and an earthed plate connected with the coherer. The absolute value of the antenna does not appear to have been impressed upon its patentee until nearly a year afterward, when his long-distance experiments practically failed for want of it, and he subsequently found by the addition of a greater length of vertical wire, that the successful results depended largely upon this important factor.

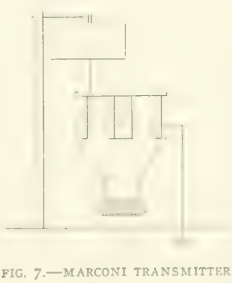


FIG. 7.—MARCONI TRANSMITTER.

The earthed wire is indispensable as well, but there is yet to be offered a satisfactory solution for its use. Different from the result attained by Popoff, the use of the vertical wire and the ground connection were, evidently not due to logical conclusions deduced from self-evident propositions by Marconi, but to his persistency of research. It would be indeed interesting to know the source of the suggestions that led him to the extenuation of the antenna and the use of the earth wire on his transmitter. (Fig. 7.)

Marconi is also entitled to the credit of having been the first to

employ the Hertz oscillator and Branly coherer in a practical working wireless telegraph apparatus. Lodge operated the system to obtain signals before Marconi, from a purely scientific standpoint, but offered no information that has influenced the present situation, excepting, perhaps, that given by his automatic decoherer.

The third distinctive claim to which Marconi is entitled is his improvement in the coherer. This, however, cannot be classed as either an invention or discovery, in the true sense of these words, but is, nevertheless, responsible, to a very great extent, for the present status of the art. A summation of the genesis of wireless telegraphy up to 1897, when Marconi produced a working system from a chaos of uncollected data, may be thus briefly stated: To those who ascertained the laws and constructed physical apparatus such as the Ruhmkorff coil, the voltaic cell and the electro-mechanical devices required for the new telegraphy, the measure of their services is already known.

To Hertz, Branly, and, finally, Marconi, the laurel wreath of success should be bestowed without fear, without favor, for to their genius are we indebted for the marvelous instruments capable of emitting and propagating electric waves through space, and a receiver of such super-sensitiveness that the feeblest wave impinging upon it would be registered and automatically translated into an intelligible code.

To Sir William Preece belongs a unique place in the development of the art, or for that matter in the history of invention. Himself an inventor of the electromagnetic induction system of space tele-

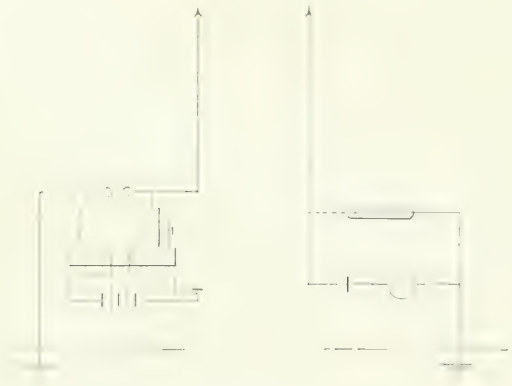


FIG. 8.—THE EVOLVED WIRELESS TELEGRAPH.

graphy, he was broad enough to recognize in Marconi's experiments a system superior to his own.

Lodge, Slaby and a host of other investigators in the etheric vineyard have little title in the present system that has carried an electric wave over a distance of 2,000 miles. But wireless telegraphy is, even yet, in a certain state of crudity, for without syntonization it must always remain limited in its application. It is in this especial field that the mathematical elucidation of the phenomena of the ether, the element of time for each oscillation, the values of resistance, capacity and inductance—all these determine the wave length—and syntonization has been shown to be capable of solution along these lines.

When syntonic wireless telegraphy is really accomplished a large portion of the present history will have to be interpolated with the excellent work of those referred to, and a new name chosen to "lead all the rest."

The genesis of wireless transmission is the prototype of all human progress that finds its climax in invention and discovery. The question is whose name should stand as a symbol of the art it represents. He who made the first obscured effort, he who worked out the greatest principle, or he who picked the brains of the world and produced a work that would withstand the time-stamp of commercialism? It is usually the latter, and justly, that reaps the dual reward of finance and fame. All who have contributed their mite, however, are entitled to their proper places in this royal coronation procession, and precedence should be given to those accounted best.

The Application of Electricity in Steel and Iron Mills.

By C. H. Hines.

AMONG the notable instances of the growth of the electrical industry is its application to the operation of the great steel and iron works of to-day, and its rapid increase and varied uses in such works.

Taking one plant that I have in mind which started with a 20-hp bipolar T. H. generator operating one crane a little over seven years ago, the same plant now uses 2,000 kw of power, which does almost the entire work of the plant, save operating the main rolls. Cranes, strippers, tables, blowers, charging cranes, pig casting machines, coal crushers, hoists and the pumps for supplying to the boshes of the furnaces are all operated by electric motors, while the ore, coke and limestone with which they are charged are handled by the same means. Among the minor applications are included telephone clocks, time detectors, automatic indicators, magnetic separators; electricity is even in the laboratory for chemical analysis and other operations, while for burning out chilled iron the skill of the electrician is sometimes called into play. And all these appliances are called on to do their work day and night, under the most adverse conditions in many cases; handled largely by unskilled labor, and doing work that would cause the average central station man to groan in spirit. Yet with all this they do their work so unfailingly that it is only when an important piece of mechanism stops for a brief period that the necessity of the electrical department is recognized. Moreover, the cost of repairs is far below that which would be required by a steam plant doing the same work.

In the plant that I have mentioned the 2,000 kw of power consists of 10 units, and the 5,000 hp of motors are in 200 units ranging from ½ to 150 hp. Two armature winders keep up all the necessary repairs to the armatures, as well as making up nearly all the coils required for repairs and re-winding.

One important factor which has not yet entered into the operation of these plants is the storage battery, and where the load is always fluctuating, as it is in these cases, they could be most profitably employed. As spare generators are not as frequent as in central stations, their value in the case of a temporary breakdown of a generating unit would more than compensate for their cost. .

A crying need also for these plants is a controller that will stand the constant abuse and reversals to which they are subjected. While many improvements have been made along this line the desired end has not yet been attained, but is, I hope, very near. Another need is a good brush holder adapted to stand the same treatment; for of all the many forms that are now used none is quite satisfactory.

I have found in estimating on the size of motors in connection with this class of work that it is always wise to figure on at least 25 per cent. greater capacity than is actually required, except in the most favorable locations. While by this method the greatest economy is not secured, yet the loss in efficiency is more than compensated for by the decreased danger of burn-outs and delays; for in steel works the entire ten commandments of operation are comprised in the words, "Thou shalt not break down or delay production."

A shut down of but an hour or so, if it affects the production, such as a deranged crane in the bottom house, means a loss in dollars far in excess of any economy of operation.

In most of the mills of the present day direct current at a voltage of 250 is commonly used. Most of these plants were started in a small way electrically and have constantly been added to, but in the most modern ones that are now building the alternating current has entered the field, and has come to stay. It does all that direct current can do, without the annoyance of commutator trouble, while its flexibility adapts it to all uses. As almost all the works of a steel plant are bunched in a comparatively small area, a low voltage can be used and the bugaboo of greater danger thus removed.

Alternators of a low frequency of about 25 cycles and ranging from 400 to 600 volts are best adapted to this class of work, as this permits the use of induction motors without the expense and losses of a cumbersome transformer system; while for the non-inductive load or lighting load, which rarely exceeds 15 per cent. of the total load, motor generators take care of and supply series arc lamps for the lighting.

Another point to be considered is the possibility of utilizing the gases from the furnaces direct in gas engines driving the generators. With the low frequency mentioned there is no reason why with the

present gas engine this cost [illegible] with a consequent increase of economy of operation.

There are many other lines that might be followed out with profit. Many cranes employed in the handling of sheets of steel and iron and other heavy material could be equipped with portative magnets, thereby saving time and labor. All these things are bound to come in due time; indeed many of them are even now here, or in the projected plans of new structures, and the day is not far distant when the electrical department of the steel mill will be recognized as its most important feature.

In conclusion, it will not be amiss to say a few words regarding the man whose skill and knowledge is looked to to direct these operations. The position of the chief electrician in steel plants is vastly different from the central station man, or a similar position in other branches of the electrical industry. He must not only understand his routine work thoroughly and have a well grounded technical knowledge, but must also be of an inventive turn of mind, as he is constantly called upon to devise some new method of harnessing the power he controls and must meet the demand promptly, be prepared for any emergency that may arise day or night. In addition to his resourcefulness he must have infinite tact and patience, since the major part of his working force is recruited from unskilled material.

Nickel Steel and Magnetic Observation.

BY CRITTENDEN MARRIOTT.

IN the opinion of officers of the United States Coast and Geodetic Survey, the discovery, by C. E. Guillaume, of the International Bureau of Standards, of the very peculiar magnetic properties possessed by nickel steel alloys containing from 15 to 25 per cent. of nickel, is likely to simplify amazingly all measurements of terrestrial magnetism, as well as all comparative galvanometric observations in which extreme accuracy is required. The use of these alloys will, it is believed, prevent changes of temperature from causing changes in the moment of the magnet itself, and thus do away with the immense amount of calculation now required to eliminate the error due to this cause.

Comparatively little is known in this country regarding high percentage nickel steels, only low percentage ones having been used to any extent here, and even these not as often as their good qualities would seem to justify. In France, however, investigators have been working on them for some years and have attained surprising results, discovering that alloys with less than 25 per cent. of nickel possess two curves of magnetic transformation, between which their state depends solely on which curve they have last cut and the place at which they cut it. According as this may be, they are either permanently non-magnetic, or possess a degree of magnetism which is not alterable by any change of temperature not great enough to cause them to cut one of the curves.

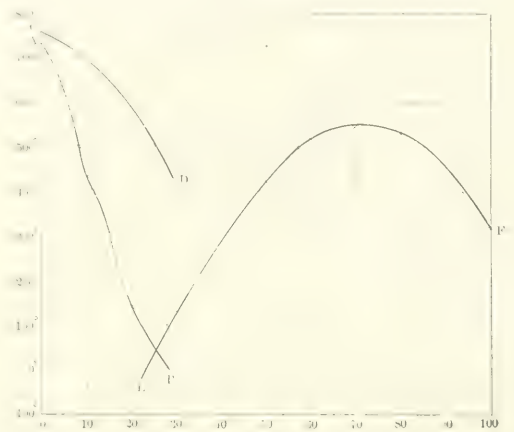
Alloys of more than 25 per cent., on the other hand, follow the usual law, becoming increasingly magnetic as their temperature drops and decreasingly so as it rises, the point where all magnetism is lost depending on the percentage of nickel they contain. These alloys M. Guillaume has christened "alterables"; the former class he calls "unalterables." In the accompanying figure, *AB* is the lower limiting curve of an unalterable alloy; *CD* the upper limiting curve, and *EF* the point of change of alterable alloys.

The very peculiar qualities of the unalterable alloys are best explained by an example. One with 24 per cent. of nickel, for instance, may be either non-magnetic, or may possess a degree of magnetism which is unalterable for any change of temperature between 0° and + 450° Centigrade. Hot from the crucible, it is non-magnetic, and so remains until its temperature has dropped to —, when it begins to gain magnetism, attaining a maximum at about —200°. If heated again, it retains its full magnetism until raised to + 450°, when it begins to lose and becomes altogether destitute at about + 650°, so remaining until again reduced to 0°. If the heating or cooling is stopped at any intermediate point (say at —100° or + 500°) and then reversed, the alloy retains the exact degree of magnetism which it possessed when the reversal took place.

For 24 per cent. of nickel the limits are 0° and + 450°; as the percentage is decreased, both limits rise, the upper slowly, the lower one rapidly, moving up about 30° C. for each 1 per cent. of nickel reduction. At 12½ per cent. the limits are about + 400° and + 650°, both far beyond any ordinary temperature. Therefore, a 12½ per cent. alloy is always below the lower limit, and consequently seems always magnetic. Nevertheless, there is a range of 250° of temperature (from + 400° to + 650°), where it may be magnetic or non-magnetic according to whether it was heated or cooled in order to reach it.

The limits as given are those at which magnetization begins to appear or disappear; the points at which it has fully appeared or disappeared are removed about 200° further apart at each end. If a fully magnetized alloy is required that shall remain unalterable at all ordinary temperatures, one whose point of change is about —230° would seem to be indicated. This would be attained with about 16 per cent. of nickel, a proportion which is supposed to be about that required for nickel steel to be used in magnetic measurement. Further experiments will be required to definitely settle this point.

These figures are strictly applicable only when no other elements than nickel and steel are present. If a small amount of chrome is added, the effect is to reduce the lower limits of the unalterable



MAGNETIZATION CURVES OF NICKEL-STEEL ALLOYS.

area. Thus 3 per cent. of chrome added to a 22 per cent. nickel alloy so reduces the lower limit that even liquid air is not cold enough to cause the shift to the magnetic state, and the alloy (which of course came non-magnetic from the crucible) can never be magnetized. If 3 per cent. of nickel had been added instead of 3 per cent. of chrome, the alloy would have become an "alterable," and would have been magnetized at about 0°. Lower percentages than 25 can thus be kept non-magnetic at ordinary temperatures by the addition of varying amounts of chrome. In other words, by proper additions the range of temperature within which the alloy is unalterable can be shifted almost at will, and the point at which any desired degree of magnetism is conferred can be brought to any convenient point.

Edison and Norway.

A special cable dispatch from London to a New York newspaper, dated May 4, says: It is many months now since it was reported that a body of British ironmasters had been attempting in Norway, with the co-operation of Mr. Edison, to meet the deterioration in Bilbao ores, and in a measure to combat the situation created by the establishment of the United States Steel Corporation. The result is now announced in the prospectus of the Dunderland Iron Ore Company, which has been formed, with a capital of £2,000,000, to work extensive deposits of iron ore in Norway by means of Mr. Edison's process. The enterprise is placed before the British public, backed by names of power and influence. The chairman is Sir David Dale, managing director of the great Pease firm, whose word is as readily acceptable in the North of England as a note of the Bank of England. The technical advisers of the company include Mr. Edison and Lord Kelvin.

The Synchronous Converter as Voltage Controller.—II.

So far, I have developed how a projected power transmission system operates under varying loads. In the following is to be shown how the different quantities are to be selected, so as to give the system certain desirable properties.

One of the most important quantities is the proportion of the alternator and converter voltage. The determination of the absolute value of the voltages and the other quantities does not come within the scope of this article. The changing of this proportion by the variation of the voltage e causes a shifting of point O on the impedance line $O Z$ in a circuit with fixed E, resistances and reactances (Fig. 6). All points on the characteristic circle travel with the same velocity and in the same direction. The maximum power transmitted under these conditions with a certain

P_m is

$$\frac{E H_m}{Z} \quad \frac{P_m O_x \cdot H_m}{Z} \quad \frac{E \cdot e}{Z}.$$

This power becomes a maximum for the voltage e, which annuls the first differential quotient:

$$\frac{dA}{de} = \frac{E}{Z} \; 2e \cdot \cos\alpha - \frac{E}{Z},$$

$$e = \frac{E}{2\cos\alpha}, \text{ and}$$

$$A_{max} = \frac{E^2}{Z}\left(\frac{1}{2\cos\alpha} - \frac{1}{2}\right).$$

The phase difference for this maximum power is

$$\frac{H_m O}{H_m P_m} = \frac{E}{2} \cdot \frac{1}{e} = \cos\alpha.$$

The co-phase current $\frac{O P_x}{Z}$ is determined by the equation,

$$\frac{E}{Z}\cos\alpha - \frac{O P_x}{Z},$$

and the current $\frac{O P_o}{Z}$, lagging by a quarter period,

$$\frac{E}{Z}\sin\alpha = \frac{O P_o}{Z}.$$

With the ruler and compasses we can substitute plain diagrams for these complicated equations. By varying the voltage e, Pm travels on the line $O Z$, and, therefore, $O P_x$ and $O P_o$ vary, and are functions of the impedance angle (Fig. 6). The maximum power transmitted with a certain $e = O_x P_m$ is

$$\frac{P_m H_m}{Z} \cdot \frac{E}{2\cos\alpha} \quad \frac{E H_m H_m O}{Z \cdot 2\cos\alpha} \quad \frac{P_m H_m O B}{Z \cdot 2\cos\alpha}.$$

In other words, the maximum value of a for a certain $e = O_x P_m$ and a is proportional to the rectangle $P_m H_m O B$. The current corresponding to this, its energy and wattless components, can be taken from the diagram. Drawing a circle with the radius $O_x O = E$ and O_x its center, it can be seen at a glance that $P_m C = O P_x$ = co-phase current, and $P_m D = O P_o$ = current lagging by a quarter period. The following is an explanation of the quantities of Fig. 6:

$O O_x = E$ = constant.

$P_m O_x = e$ = variable.

α = impedance angle = constant.

$\frac{E}{Z}$ = current for maximum output at a certain $e = O_x P_m$.

$\frac{P_m H_m}{Z}$ = energy component of current.

$\frac{O_x H_m}{Z}$ = wattless component of current.

$P_m O O_x$ = phase difference at receiver end.

$\frac{P_m C}{Z}$ = co-phase current.

$\frac{O P_o}{Z}$ = current lagging 90 degs.

$\frac{P_m H_m O B}{Z \cdot 2\cos\alpha}$ = maximum output for $e = O_x P_m$.

$\frac{A B P_m C}{Z \cdot 2\cos\alpha}$ = co-phase output for $e = O_x P_m$.

$\frac{E^2}{Z \sin\alpha}$ = overload capacity.

The diagram relating to the influence of the converter voltage e is readily understood. We endeavor to keep e as high as possible, to



FIG. 6.

operate with small currents. But increasing it to the alternator voltage reacts as detrimental to the system, as well as decreasing it below certain limits. If $e = 0$, P_m coincides with O_x, C with O and D with F. The alternator energy is consumed in the line. In this case the theoretical maximum energy is transmitted to the converter by a co-phase current. The system now can operate only with lagging currents, the leading currents cause it to become unstable. Increasing the voltage e, the maximum output taken by the converter increases,



FIG. 7.

but the power factor for this maximum output decreases rapidly. The possible maximum output is reached when $e = \frac{E}{2\cos\alpha}$. In this case the rectangle $P_m H_m O B$ has its maximum area. For this $\alpha = 0$. If $e = E$, P_m will coincide with C at D; the co-phase current and that lagging 90 degs. disappear, and the system is capable to operate only with leading currents.

Increasing the voltage has a great influence on the no-load current. $Tan\ P_m C D = \frac{\text{wattless current}}{\text{co-phase current}}$ corresponds for $e = 0$ to 45

degs. and varies with e, if r [illegible] attains the limit value $(90 - \alpha)$. Therefore, as $\alpha \lessgtr 45$ degs., the no-load current increases, remains constant, or decreases with increasing e. There we see the decisive influence of the impedance angle α on the no-load current; by increasing α this current can be decreased as one desires.

The impedance angle α can be altered in three different ways. First, at constant impedance; second, at constant reactance, and, third, at constant resistance.

If the voltage e is kept constant, P_m of the characteristic circle travels on circle $K - K_1$ as α varies (Fig. 7). Then $O O_x = E$, and $O_x K = e$. The maximum energy for a certain α is

$$\frac{P_m H_m}{Z} e \quad \text{If } Z = \text{constant} \quad = P_m H_m \frac{e}{Z}$$

or, in other words, the maximum energy transmitted to the synchronous converter is proportional to the length $P_m H_m$. If the reactance x remains unaltered,

$$Z = \frac{x}{\sin \alpha}, \text{ and } a = \frac{P_m H_m}{x} e \sin \alpha = \frac{P_m H_m P_m D}{x},$$

i. e., the maximum power is proportional to the rectangle $O B P_m H_m$. If the resistance r is kept constant,

$$Z = \frac{r}{\cos \alpha}, \text{ and } a = \frac{P_m H_m}{r} e \cos \alpha = \frac{P_m H_m P_m A}{r}$$

By drawing a circle with a radius $O O_x = E$, and O_x as center, we get $\frac{P_m C}{Z}$ = co-phase current; $\frac{P_m D}{Z}$ = current lagging 90 degs.

For Z = constant, $P_m C$, and, therefore, $P_m D$ is proportional to the corresponding currents,

for x = constant they are equal to $\frac{P_m C}{x} \times \frac{P_m A}{r}$ or to $\frac{P_m D}{x} \times \frac{P_m A}{r}$

for r = constant they are equal to $\frac{P_m C}{r} \times \frac{P_m B}{x}$ or to $\frac{P_m D}{r} \times \frac{P_m B}{x}$

The influence of the impedance angle α is explained according to the diagram, as follows: If α varies from O to 90 degs., the maximum power with constant z grows from $\frac{O K}{Z}$ to $\frac{E K_1}{Z}$,

with constant X grows from 0 to $\frac{O F K_1 O_x}{x}$, and

with constant r grows from $\frac{O K \times O_x K}{r}$

to a maximum, and decreases to 0. This maximum is reached when $\alpha = P_m P_m$ [illegible]

The relation of the co-phase current to that lagging 90 degs., varying the angle α from 0 deg. to 90 degs., increases in the three instances to the reciprocal value. If $e = E$, this relation increases from 0 to α.

The phase difference ϕ of the current corresponding to the maximum output increases from 0 to a limit, for which $(\phi + \alpha) = 90$. Beyond this value the phase difference diminishes, but the power taken may be increasing. The semi-circle $O O_x$ is the geometrical path of these points, which determine the maximum phase difference for all α from 0 to E. Increasing the impedance angle, therefore, has a similar effect as increasing e. But while the increase of e results in a steady increase of phase difference, the increase of α may diminish it.

The valuable influence of the impedance angle on the elasticity of the system, on the no-load current and on the power factor, explains the tendency to make the system highly reactive by inserting additional reactances. But while a heavy reactance from this point of view appears advantageous to the system, by inserting such additional reactances we must not ignore other directive phenomena, as the requirements of parallel running of synchronous machines, and the danger which arises from the electromagnetic inertia of a system heavily loaded with reactance.

Being familiar with the influence of the different quantities upon the diagram, after careful observation of the special conditions, it is a matter of experimental combination to decide upon the location of the characteristic circle in each particular case. It is generally preferable to give the characteristic circle such a position that it expresses the normal load with minimum current, that is, the converter runs non-inductively at normal load; consequently, the point P_m, indicating the maximum output, should be so located that the output is flexible enough with leading, as well as with lagging currents, without seriously disturbing the limits of the normal capacity with low-power factors. Care should be taken also to release the system from heavy no-load currents. By substituting the alternator terminal voltage for the induced e. m. f. in the foregoing graphical treatment, we get the solution of the other problem, that of constant alternator terminal voltage at constant receiver voltage, without further means. Moreover, the above graphical solution can also be adapted to the similar problem of compensating alternators.

The Economic Design and Management of Telephone Exchanges—XI.

By Arthur V. Abbott, C. E.

THE RELATION BETWEEN THE NUMBER OF OFFICES AND THE MILEAGE OF THE TRUNK LINE PLANT.

WHEN any territory is served by a single office, each sub-station may be immediately placed in talking relations with any other one in the whole group by the simple process of interconnecting the two sub-station lines by a flexible cord; for on the single office multiple switchboard system, every subscriber's line is within the reach of any operator. But when a given territory is subdivided, and has more than one office, it is no longer possible to interconnect all sub-stations, for the lines of some will converge to, and terminate in, one of the offices, while others will end in some other office. It is therefore necessary to provide some means, whereby stations tributary to one office that desire communication with those ending in any other office, may be accommodated. This is accomplished by providing between all of the various offices taken in pairs a set of special wires called *trunk lines*.

It has been shown that the total sub-station mileage for any territory decreases rapidly as the group is subdivided into smaller and smaller portions; but it is evident that this very endeavor to minimize sub-station mileage will be accomplished with a multiplication of trunk lines, for with each additional subdivision another office is added, from which, to all other offices, trunk lines must be provided. Further, the smaller the portion of any territory that is served by any one office the larger will be the portion of the exchange foreign to it, and the greater will be the probability that sub-stations will desire to talk outside, and not inside, of the boundaries of the office in which they terminate. So as sub-station mileage is decreased, by subdividing any territory, trunk line mileage is increased, and it is easily imaginable that the process of subdivision could be carried to such an excess as to cause the increments of trunk mileage to overbalance and exceed the decrements of sub-station mileage. Evidently the true minimum total wire mileage in any case is secured by making the sum of all sub-station mileage, plus that of all trunk line mileage a minimum, and the method of discovering this condition must now be described.

The total trunk-line mileage in any territory, will be proportional to the number of trunk lines needed, and to their length. The number of lines required will depend upon the volume of business to be carried, and a factor that might be termed the *Specific Trunking Capacity*, or, in other words, the number of messages per unit of time that it is practical for a trunk line to transmit. The volume of business will depend upon the number of sub-stations; the number of messages originated per unit of time, per station, and the ratio of the number of messages sent outside of the office under consideration to the total number originated. The length of the trunk lines will depend on the size of the exchange, and the number of offices into which it is split. Let S represent the number of sub-stations in any exchange, and T the average number of originating messages per day, then TS will be the total number of messages originated; this quantity is usually called the *Originating Traffic*. Let S' and T', and S'' and T'', etc., represent respectively the number of sub-stations, and their daily average originating messages, in the various offices into which the exchange may be sub-divided, then $S'\ T'$ and $S''\ T''$, etc., will denote the originating traffic of each of the individual offices. Let R' and R'', etc., represent the ratio of the messages sent out of offices S', S'', etc., to their originating traffics, then $R'\ S'\ T'$ and $R''\ S''\ T''$, etc., will denote the daily business sent out of the offices S', S'', etc. For brevity it is convenient to call this quantity the *Out Trunk Traffic*. If Q stands for the Specific Trunking capacity per line per day $\frac{R' S' T'}{Q}$, $\frac{R'' S'' T''}{Q}$ etc., will be the number of trunk lines needed for the offices S', S'', etc., to all the rest of the exchange

and $\frac{R' S' T' L'}{Q}$, $\frac{R'' S'' T'' L''}{Q}$, etc., will be the number of trunk lines per sub-station in the several offices. For brevity call these quantities respectively the *Office Trunkage and the Subscribers' Trunkage.* If L' and L'', etc., denote the average length in miles of the trunk lines from the offices S', S'', etc., to all other offices, then $\frac{R' S' T' L'}{Q}$ $\frac{R'' S'' T'' L''}{Q}$, etc., is the trunk line mileage from offices S', S'', etc., to all other offices, call this quantity the "*Trunk lineage*" then $\frac{R' T' L'}{Q}$ and $\frac{R'' T'' L''}{Q}$ etc., is the *Trunk lineage per sub-station.* For every exchange the proceeding quantities S T, S' T', etc., R Q and L will have certain specific and definite values which must be ascertained and used in order to secure the best design. But average values derived from extended experience will best exemplify the method of calculation, and will yield probable average results, that may be taken as general guides.

The values of S and T will vary with the size of the city under consideration. From present indications it seems quite certain that cities of 500,000 population and over will soon have at least 40,000 to 50,000 subscribers. Those of 200,000 to 300,000 inhabitants from 20,000 to 30,000 telephones, while towns of 75,000 to 100,000 people should be credited with not less than 10,000 stations. It is difficult and somewhat hazardous to assign a value to T on account of the rapidly changing character of the telephone business. As an exchange grows in size the increasing number of subscribers give greater and greater opportunities for conversation, and if all parties equally availed themselves of this possibility, the traffic would vary with the square of the number of sub-stations. But this is never the case; on the contrary, increase in traffic rarely keeps pace with the increase in sub-stations. The depression in the traffic rate is partly due to the fact that people having the greatest amount of telephone business are the first ones to subscribe, while those less telephonically busy come in afterward; and partly owing to the recent introduction of the coin box, slot machine and nickle telephone, or other forms of measured service which are rapidly creating a very large telephonic population who wish to "pay as they go," and are strongly averse to the contract, and flat rate system. With the flat rate method there is no incentive to any economy in traffic; and the subscriber, his friends, acquaintances and employes use the instrument *ad libitum.* But with any form of measured service, where the rental is at least in some degree proportional to the traffic, there is a strong motive for economy in the use of the instrument, a most powerful factor to depress the call rate. Taking all things into consideration, it seems probable that even the busy offices in the center of the largest cities will not average over twenty originating messages per day, while those in the residence districts, or on the outskirts should be credited with ten. For offices similarly located in medium sized cities a message rate respectively of sixteen and eight will be assumed, while for towns from 75,000 to 100,000 ten messages per station per day seems fair.

As any district is repeatedly sub-divided into a constantly increasing number of offices the size of each office and the number of sub-stations it contains constantly diminishes. Therefore S, or the number of sub-stations, etc., is the independent variable in both the trunk line and sub-station line problem, and will, for this part of the discussion, be assumed to vary from 500 to 7000, as it seems that smaller offices than 500 would never be considered, and that the economy of those larger than 7000 is certainly doubtful, as there is no American experience with central stations even of this magnitude.

The value of R represents the proportion of the originating messages that any office will send beyond its boundary lines. If it should be assumed that each subscriber in all of the various offices into which any territory may be divided originates an equal number of messages, and further, that each subscriber transacts an equal amount of business with every other subscriber, the messages trunked out of any one of the separate offices will bear the same ratio to the total messages originated by all the subscribers in the office under consideration, that the sum of the subscribers in the given office bears to the sum of all the subscribers in all the offices. So if S be the total number of sub-stations in the entire territory, and S' the number in any [illegible] under the proceeding hypothesis, the percentage of messages trunked out of the particular office will be $\frac{S - S'}{S}$

This is a ratio, but if T' be the average number of originating messages in the office in question S' T' will be the total number of messages originated by the office, and then $\frac{(S - S')\ S'\ T'}{S}$ will be the out-trunk traffic. This formula assumes an equality in traffic over the whole exchange, but if the average traffic T' of the office S' differs from the average traffic T of the whole territory this discrepancy must be recognized by introducing the factor T' as follows:

$$\frac{S\ T - S\ T'}{S\ T} \quad \frac{S\ T - S\ T''}{S\ T} \quad \frac{S\ T - S\ T'''}{S\ T}$$

which gives the out-trunk traffic of the office under consideration.

The preceding formula is based on the assumption that each person will always send an equal number of messages to all others. Such an hypothesis could only be true in a case where every individual was acquainted with, and equally interested in every other one in the whole community. In small villages the condition of equality of traffic is sometimes approximately realized, for in such cases every one is apt to know, and likely to have some dealing with all others. But in cities, particularly the larger ones, groups are formed, each one gathering around him a particular circle of friends, acquaintances and business associates, and ignoring all others, thus the telephonic business of each individual flows in certain well defined channels from which it rarely and only spasmodically departs. But owing to the complexness of society there is a constant overlapping of the acquaintance circles. Thus A and B are mutual acquaintances, and each knows a hundred other people. Of the hundred in A's circle B is acquainted with fifty, and of the hundred in B's circle A knows fifty. A and B talk together, B talks to fifty people outside A's circle, and A talks to fifty outside of B's circle; each talks to a hundred mutual acquaintances; and neither A or B send any amount of business to the great mass of sub-stations outside the limits of their particular coteries. To recognize this condition it is necessary to introduce in the preceding expression, a coefficient that may be denominated the "*Acquaintance factor.*" If q represents this factor the actual out-trunk traffic will be ascertained by the formula

$$\frac{q\ S\ T - S\ T + S\ T}{S\ T}$$

The value of q varies between quite wide limits. In cases where there are two or three offices of nearly equal size and serving similar districts about 68 per cent will hold true. When there are several small offices on the outskirts working into larger ones near the center 85 per cent to 95 per cent will represent q for the smaller offices, and 60 to 65 per cent for the large ones. In the cases of a number of medium-sized offices 70 per cent to 80 per cent is a fair average. While in the extreme of one large office and one small one 40 per cent to 50 per cent will indicate the factor for the large one and 92 per cent to 98 per cent for the small one.

The preceding expression will give such a value for the trunk traffic as would exist if the incoming and outgoing messages were always numerically equal in each office, and here a misconception often arises. Take, for example, an exchange of two offices. One, A, in the center, and the other, B, in the outskirts of a large town. Suppose A send B ten messages, and B send A one hundred; there will be a total one one hundred and ten outgoing trunk messages and one hundred and ten incoming trunk messages, but the incoming trunk messages *in A* will be ten times as great as the incoming messages *in B*. In the formula the only known quantities are the number of stations in the whole exchange and average message rate; also the number of stations and average call rate in the particular office under consideration. Therefore the formula gives the mean value between the numbers the numbers representing the incoming and outgoing trunk messages. Usually the difference is very slight, not more than three or four per cent, and it is only in case of a very large office and a very small one that any practical difference would exist. If there *is* a sensible difference between the incoming and outgoing messages it is possible to more closely approximate to the true value by adding or subtracting from the result given by the formula, such a quantity as will recognize this difference. The total number of originating messages is the only known quantity, hence the desired correction must be expressed as a percentage thereof. Let p be the percentage then $\frac{p\ S\ T}{100}$ will be a quantity either to be added to or subtracted from the mean value in order to ascertain the desired true number

of out-trunk messages. This correction must be additive in cases where the outgoing work is in excess of the average and subtractive where it is deficient.

The complete expression for the out-trunk traffic is therefore:

$$q\,\frac{S\,I}{S\,I} - S \qquad p\,\frac{S\,I}{100}$$

but usually sufficient accuracy is obtained by using the abbreviated form,

$$\frac{q\,S}{S} \qquad S'T'$$

in which q has a value ranging from .65 to .85, depending upon the relative sizes of the offices S and S', and from these expressions the following values for R are immediately deducted.

$$R = \frac{q\,S\,I}{S\,I} \qquad \frac{I}{I} \quad \text{or} \quad R \qquad q\,S \qquad S$$

The Isolated Plant versus the Central Station—Discussion at the Chicago Electrical Association.

The evening of May 2 was given over to a discussion of the isolated plant versus the central station, at the Chicago Electrical Association. The meeting proved to be a very interesting one, and the discussion was at all times animated and full of good points.

To start the discussion, Mr. C. A. Dresser presented some figures on the probable cost of installation and operation of a certain size of isolated plant. Mr. Dresser introduced these figures by saying that there was nothing positive in his own conviction regarding the advisability of the isolated plant where central station service could be obtained. There were undoubtedly places where isolated plants could furnish current cheaper, and also cases where it could be better supplied by central station. No one case either way proves anything as to the general proposition. In order to discuss the matter some hypothetical case must be assumed, and he assumed a plant which would have a load of 80 hp for 10 hours per day, 300 days a year.

For this plant he assumed it would be necessary to put in a capacity of 100 hp in a single unit. The cost of soft coal suitable for the Chicago isolated plant is $2.50 per ton. In a plant of this kind an evaporation of 6 pounds of water per pound of coal is a safe estimate as to commercial possibilities. The cost of water in Chicago is 10 cents per 1,000 gallons. He assumed that one man could operate this plant and that a licensed engineer for this purpose could be obtained for $75 per month. The load he assumed to be 80 indicated hp for 300 days in the year, 10 hours per day, or 240,000 indicated hp-hours per year. He assumed that the simple high-speed engine used in such a plant would require 40 pounds of water per indicated hp hour, which with an evaporation of 6 pounds of water per pound of coal would call for 6⅔ pounds of coal per indicated hp-hour, or 750 tons per year, or say, 800 tons including everything, which, at $2.50 per ton, would cost $2,000. Water consumption on the same basis would be 1,152,000 gallons per year, or $115. Oil, waste and supplies he figured at $300 per year. The engineer would cost $900 per year. The cost of such an isolated plant of 100 hp capacity with one engine and one boiler, he assumed at $6,000. Ten per cent. depreciation on this would be $600 per year, and interest at 6 per cent., $360 per year. Cost of rent and insurance were assumed at $100 a year, making the total operating expenses and fixed charges $4,375 per year. Figuring a load of 80 hp, 10 hours per day for 300 days, the cost per indicated hp-hour would be $0.0182. He assumed that since the efficiency would not be very high in a small plant of this kind, 1 kw would require 1.8 indicated hp for its development. This would make the cost 3.27 cents per kw-hour.

As to the matter of exhaust steam heating, which could be done from this plant, he said, it is customary to estimate that the exhaust from 1 hp would heat 100 sq. ft. of radiating surface and 8,000 sq. ft. would, therefore, be available from 80 hp. One sq. ft. of radiating surface will heat 100 cubic feet of space in a factory such as this plant would be installed in, and the amount of space which could be heated from the 80 hp would be very nearly the capacity of a general factory building, which would install an isolated plant of this kind. If the factory was heated by direct steam, one-third pound of coal per sq. ft. of radiating surface per day would be required. He figured that the cost of coal for heating would amount to at least $100 per year on this basis, and the fireman during the heating season would cost $300. The cost of the boilers for heat would be $800, upon which the depreciation at 10 per cent. would be $80. Figuring in incidentals connected with heating, the cost would be $1,028 per year for heating alone, if there were no isolated plant. Deducting this from the cost of operating, the isolated plant would bring the cost of power down to $0.0014 per indicated hp-hour, or $0.025 per kw-hour. However, Mr. Dresser considered this to be rather of an extreme case, for the average load is too high in proportion to the maximum capacity of the plant. In order to provide against breakdowns it would probably be necessary to put in a plant of 125-kw capacity, consisting of two boilers and two generating units of 75 and 40 kilowatts, respectively. The cost of this plant would be $10,000, depreciation at 10 per cent, $1,000 per year, and interest $600 per year. It would require two men and an engineer, at $1,000, and a fireman at $600 per year. As better evaporation could be secured with a plant so arranged than in a plant with a single boiler, he figured an evaporation of 7 pounds of water per pound of coal, which with the same output as before amounted to $1,712 for coal bill for the year. Figuring in all items, the cost of power would be $4.559 per year, of $0.0285 per kw-hour, deducting the cost of direct steam heating as before.

One other type of isolated plant considered was the small gas engine plant. He figured on one having a continuous load of 20 hp, making an output, if operated 10 hours per day for 300 days in a year, of 60,000 hp-hours. He found the lowest guarantee made by gas engine manufacturers to be 14 cubic feet of gas per brake hp-hour, using Chicago gas. At $0.50 per 1,000 cubic feet, this would make the cost $420 per year. The labor he figured in with the janitor service of the building and made no charge against the isolated plant. Supplies were estimated at $0.50 a day, or $150 a year. Cooling water required would be only about $3 a year. Estimating the cost of such a plant to be $3,500, depreciation would be $350 at 10 per cent., and interest $210, making the total cost $1,133 per year, $0.019 per hp-hour, or $0.0332 per kw-hour.

Mr. S. M. Bushnell, of the Chicago Edison Company, then read a very carefully prepared argument in favor of the central station as against isolated plant supply of current. By way of introduction he stated that the central station was an outgrowth of the present-day conditions, and that the tendency of the times was towards concentration and consolidation. This is an age of combination. The central station is but one example of this. In order not to make the discussion too general to be of any value, he confined his remarks to a few Chicago conditions. Here, he stated, that two companies allied to each other, the Chicago Edison Company and the Commonwealth Electric Company had acquired all the small inefficient central stations in the city, and by consolidating into large generating plants were able to materially reduce the cost of operation. The policy of these two companies was to reduce the cost to the consumer to the lowest possible figure consistent with a fair return on the actual money invested, and stability of business and permancy of investment were sought rather than extraordinary profits.

These companies had paid interest at 6.47 per cent. on the actual investment for some time. The present investment is $16,598,000. The franchises under which they operate allow a charge of $0.20 per kw-hour. Eight years ago a sliding scale was adopted for power, with 10 cents per kw-hour as maximum, and as further adjustment of rates seemed to be necessary a department was started in the company which devotes its entire time to an analysis of the cost of producing and distributing electrical energy, in order to arrive at the proper rates for all conditions. The old rates, while providing for the actual consumption of current neglected the question of idle investment necessary in order to be prepared to furnish certain classes of customers. A new system of charging was, therefore, begun, based on the Wright maximum demand meter. By this the continuous user of light or power who has a low maximum load obtains the best rate, since the investment required to supply him is lowest in proportion to the amount of energy he consumes.

By this system, with the present scales, the cost to customers for power is from $0.04 to $0.15 per kw-hour. As showing that consumers are as a matter of fact finding it profitable to abandon isolated plants in favor of central station supply, Mr. Bushnell referred to some statistics taken from Chicago. Thirty consumers have, in the past year, abandoned isolated plants to get central station supply. According to the city electrician's report, there was a net decrease of an equivalent of 50,000 16-cp incandescent lamps on isolated plants as compared to central station service in 1901. Among the reasons tending to make it possible for central stations to give service

cheaper than isolated plants may be mentioned, that the average load on the central station, owing to the great number of its consumers, is more nearly steady, and hence its load factor is better than an isolated plant; then, too, the central station has both down-town and residence districts to supply, and when the down-town district is quiet after business hours the same generating equipment is supplying current to outlying residence districts. The coal consumption of a large generating station, such as that of the Chicago Edison Company, is about one-third of that of an isolated plant per kw-hour; the large plant also has all the advantages of labor-saving appliances in coal and ash handling and the small attendnce per kw of output required for very large engines. For convenience, he classified those customers likely to consider isolated plants versus central station supply under six heads.

1. Churches and public halls, if supplied from an isolated plant, would require a large investment in proportion to the actual quantity of energy used in lighting. This investment would lie idle a greater portion of the time, hence the advisability of a supply from central station in this case is apparent. Freedom from noise and the vibration of an isolated plant is important in a church or public building, as is also availability at all hours without special preparation, and in these places space is often valuable.

2. Office buildings and apartment house owners object to the isolated plant principally on the ground of the annoyance of taking care of such a plant and of having it in the building and the friction which arises in the supplying of current to tenants. As far as the owners of these buildings are concerned, it is more convenient and agreeable to them to let tenants purchase of central stations than to attempt lighting themselves and maintain the plant.

3. Retail stores have a good load factor, and hence in this respect conditions are favorable for the isolated plant. However, the Wright demand system of charging makes possible a very low rate for central station supply to this class of customers. Space is so valuable in many retail stores at present that it can be ill spared for a plant. The question of reliability is also to be considered. The space available for coal storage in a retail store is very small, and the plant is liable to interruptions on account of the blockades and strikes shutting off the coal supply or by the breakage of water mains. Central stations supply is more to be depended on. The use of electric elevators in these stores make possible the supply of all power from the central station mains, leaving only the heating plant in the store.

4. In wholesale houses the extensive use of electric elevators gives an extremely variable load for an isolated plant, and in such a case central station supply is more desirable.

5. Newspaper and printing offices desire, above all else, absolute reliability that nothing may delay publication. This reliability can better be secured from central station than from isolated plant service, as previously explained. The three-wire system of direct current supply from the Edison mains offers a handy means of getting two speeds on a printing press motor.

6. Hotels and restaurants. In this the question of valuable basement room is one of the most important factors in deciding in favor of central station supply.

In conclusion, Mr. Bushnell said that while it was difficult to secure the adoption of central station supply where isolated plants had been already installed, it became an easier matter when the isolated plant was worn out. While it had been at some times considered that the development of the isolated plant was in the interest of the electrical manufacturer and consulting engineer, he felt that the central station was the best ally to the consulting engineer and the electrical business because of the stimulating effect it had on the use of electrical apparatus and electrical power transmission in large and small factories and shops.

Mr. Charles F. Hart, chief engineer of the Chicago *Record-Herald*, said that it was a difficult matter to get an honest discussion on the question of isolated plant versus the central station, because everyone sufficiently interested to discuss it was prejudiced by his pocketbook one way or the other. The central station men were, of course, in favor of that kind of supply, while the consulting engineers and the chief engineers of large isolated plants and the manufacturers of small electrical apparatus would naturally be in favor of isolated plants because it meant money in their pockets. He thought there never would be a disinterested discussion of the question. For his part, he could not discuss it honestly, and he did not believe anybody else could. He said if any Edison Company employe could be found who had given a customer a receipted bill for power and light at a rate of $0.04 per kw-hour, that man would lose his job immediately. (Laughter.) That $0.04 rate, mentioned by Mr. Bushnell, looked very well but applied only to power, and when one came to pay for light at $0.08 per kw-hour, central station figures did not come so near isolated plant figures as Mr. Bushnell had made them appear.

He admitted, as is true, that the large generating stations could evaporate water cheaply, but the loss between switchboard and consumer amounted to 50 per cent. He did not believe it possible for a central station company with its distribution losses and other carrying charges to deliver current as cheaply as the isolated plant could furnish it. A great deal had been said about the importance of the electric elevator in a consideration of this problem. From his observation the electric elevator had not been a howling success in more than six large stores in Chicago. One feature of central station supply, which he thought might be more fully emphasized, and which, as chief engineer of a newspaper plant, he appreciated very much, was the function of a central station supply as an insurance against interruption. He got a great deal of satisfaction out of the throw-over switch which enables his concern to be supplied from the Edison mains at any time his isolated plant may fail. He had never used it, but he was very glad to have it there, and thought that as an insurance company the central station company was very valuable, and that a charge might legitimately be made for this insurance feature, even if the central station supply was never used.

Mr. Scheible questioned the statement that the losses in distribution amounted to 50 per cent.; he thought they came nearer 25 per cent.

Professor Woodworth, chairman of the meeting, skilfully analyzed the discussion and made it clear that there were certain conditions under which it was unquestionably better to put in an isolated plant, and there were certain other conditions where central station supply was unquestionably the best, the latter being in the case of small users. The discussion hinged, he said, over the great middle ground where there was some question between the two methods. Each case must be considered by itself. He mentioned the solution of the problem that he had decided upon at the Lewis Institute plant. For a portion of the year, when the load is heavy and much steam heat is required, the isolated plant was run; for the balance of the year, when no steam heat was used and the load was light, the central station current was taken. In this way the high maximum demand charges of the central station were avoided and the high operating costs of running an isolated plant very much underloaded were also avoided.

Mr. John Mabbs, chief engineer of the Board of Trade, said that a few years ago his employers were confronted with the necessity of either installing an entirely new plant in the building or arranging for central station supply. The matter had been gone into very thoroughly by competent engineers, and the result of the decision was that $50,000 was invested in an isolated plant for the Board of Trade Building. The cost of power at the Board of Trade is now one-half what it would be with central station supply. They practically had heat free for seven months of the year. The maximum capacity of this plant is 250 kw, but the demand rarely reaches over 150 kw. Current is sold by meter to the tenants of the building on the basis of $0.10 per kw-hour, with a sliding scale which gives a customer of 1,000 kw-hours per month a rate of $0.05 per kw-hour.

Mr. Peter Junkersfeld thought that the figures given by Mr. Dresser at the beginning of the discussion assumed too high a load factor, and that the actual average load of most isolated plants would be lower in proportion to the machinery installed than under his assumption. He also thought that the $100 per year estimated for rent and insurance was entirely too low, and that the space occupied by the isolated plant would rent for much more than that amount. Such a plant would require 15 to 20 sq. ft. per kw of capacity. The Chicago Edison Company, with large consumers having a high load factor, made a rate which came within 3 per cent. of the $0.0285 per kw-hour figured by Mr. Dresser. He cited the increase in the number of central station customers taken from isolated plants as taken from the Chicago city report, and said that it was unlikely that all these new customers which had taken central station service had not gone into the matter very thoroughly, and the fact that they had decided in favor of central station supply went far towards proving the central station side of the case.

Mr. George D. Van Tassel, chief engineer of the Anglo-American Provision Company, thought that if the same grade of talent was

employed to supervise isolated plants and to convince owners as to their economy as is employed by central station companies in convincing owners of the economy of central station supply, there would be more isolated plants than there are.

In regard to the isolated plants in large office buildings, Mr. Hart made the point that where hydraulic elevators were used the exhaust steam from them is sufficient for most of the heating, and that this argument in favor of the isolated plant was not very strong.

These are but the main points of the discussion, which was extended and lively, but at all times good natured. The evident impossibility of getting unbiased testimony as to the cost of central station or isolated plant supply, caused considerable amusement at times, and was realized by none better than by the speakers themselves.

Recent Developments in Electrochemistry.

By Clinton Paul Townsend.

Electrochemistry is fairly represented in the great patent issue of April 29th—an issue comprising seven hundred mechanical patents, and far surpassing all previous records of the office.

ELECTROLYTIC PREPARATION OF PARIS-GREEN.

Mr. Richard Franchot, of Niagara Falls, proposes the following interesting and simple method for the preparation on a commercial scale of paris-green, the aceto-arsenite of copper. A copper anode is dissolved in a mixed solution of calcium acetate and arsenious acid, whereupon the separation of the insoluble double salt occurs directly. The reaction is strictly anodic, and in order to maintain the separation of the cathode products, the cathode, a sheet of copper, is enclosed in a linen bag which performs the function of a diaphragm. It is essential that this separation be complete, since either the hydrate or the hydrogen formed at the cathode would destroy the regular course of the reaction, the former by the precipitation of the corresponding copper compound, and the latter by the reduction of arsenious oxid with liberation of the highly poisonous gas, arsine.

Prior investigators have not, it would seem, touched upon this field, though Mr. Franchot's work recalls the method whereby Scheele's green has been produced by the electrolysis of an eight per cent. solution of sodium sulfate with copper electrodes in the presence of suspended arsenious oxid; in this case the copper is dissolved as a sulfate and the arsenic as sodium arsenite, an interchange resulting in the precipitation of copper arsenite and the regeneration of the sodium sulfate. Mitis green has also been produced in an analogous manner, the arsenious oxid being replaced by a solution of the pentoxid which trickles slowly into the bath around the cathode.

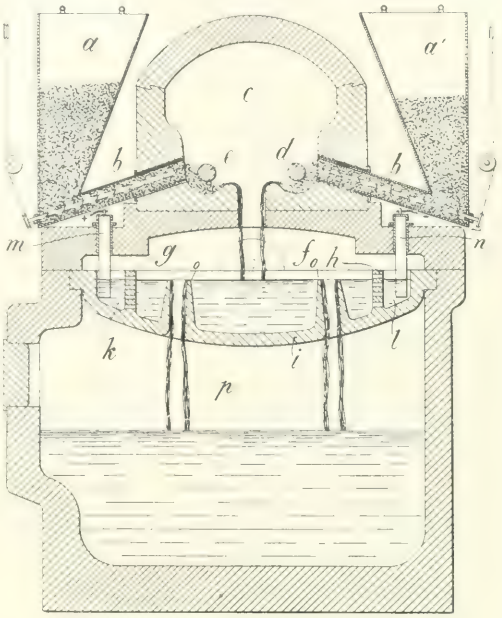
ELECTROLYTIC TREATMENT OF TIN-SCRAP.

A somewhat vague description of a method for the electrolytic recovery of tin from scrap metal occurs in the specification of Ernest Quintaine, of Argenteuil, France. The essential feature seems to be the composition of the bath, which is formed by gradually adding ammonium chloride and a chloride of tin to an acid solution of the nitrate of the latter metal, the addition being continued until the bath becomes clear. With a scrap tin anode, a lead cathode, and a very weak current, the tin is dissolved and redeposited in the usual spongy form upon the cathode.

GLASS MAKING IN THE ELECTRIC FURNACE.

Two patents to German inventors represent progress in the utilization of the electric current for the manufacture of glass. This is one of the most promising of the newer applications, and is of particular interest because glass at a sufficient temperature becomes a conductor of the second class; in other words, an electrolyte, and these later methods for its treatment represent to some extent developments of the Nernst principle.

August Voelker, of Ehrenfeld, in the device herewith diagramatically shown, both melts the raw material and refines the glass, applying to the former operation the arc and to the latter the resistance principle. The electric furnace-chamber *c*, of Chamotte, surmounted by the reflecting dome, carries electrodes *d*, *e*, beneath which the raw material is fed from hoppers *a*, *a*¹, by screws *b*. The molten mass overflows into the refining pot *f*, likewise of Chamotte, and constructed with integral perforated partitions *g*, *h*. Into the lateral chambers *k*, *l*, formed by these partitions, dip carbon electrodes *m*, *n*, between which the circuit is closed by the molten glass. Under the influence of the heat developed the glass becomes fluid and is rapidly cleared from gas bubbles, while the perforated partitions prevent its contamination by fragments from the electrodes. With reference to the current used, this astonishing statement is made: "It may,



APPARATUS FOR MANUFACTURE OF GLASS.

however, be assumed that five amperes for each square millimeter of electrode-surface is a fair maximum."

Johann Lühne, of Aachen, describes a rather complicated structure operating on analogous principles. The raw material is melted by passing through a series of arcs, developed between a horizontal prismatic bar of carbon, and a series of horizontal electrodes ranged along either side. The central bar is hollow and laterally perforated for the injection of hydrogen to raise the temperature of the belt of arcs. The raw material thus fused flows through a run-way in the base of which are imbedded any of the usual Nernst conductors, by the heat of which it is brought into a highly fluid state before it is discharged into the refining pots. This furnace is said to be applicable to the highest grades of optical glass, colorless and absolutely uniform in structure.

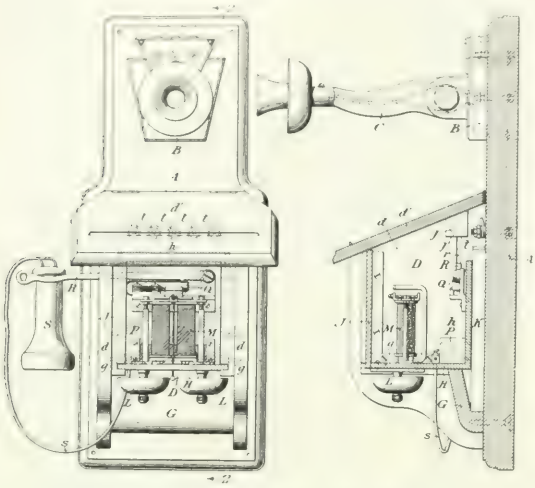
Since this particular art is so little developed, it may be of interest to refer briefly to the work done therein by prior inventors. S. Reich & Company patented in Germany, in 1882, a resistance furnace comprising substantially an open-bottomed crucible, of a carbon composition, into which the raw material was fed, being retained therein by a net of platinum wire; heat developed in the walls of the crucible fused the material into glass which dripped directly into the refining pots. More recently, Becker & Co., of Paris, have patented a number of forms of furnace, in all of which the raw material passes successively under or through a series of arcs, being thereby melted. Reference may be made also to the work of Sudre and Thierry, of Paris, who have been producing for industrial purposes compounds of refractory oxids in the electric furnace; while not strictly glass, in the ordinary acceptance of the term, these products are vitreous, transparent and homogenous, and far more refractory than ordinary glass.

Wireless Telegraphy to the North Pole.

It is stated that Capt. Bernier, the Arctic explorer, who will head the Canadian expedition to the North Pole, will take with him wireless telegraph instruments, by means of which he will endeavor to keep the world informed as to his progress. Capt. Bernier states that he has arranged with the Marconi Company for the instruments, and will take with him a gasoline engine and dynamo plant.

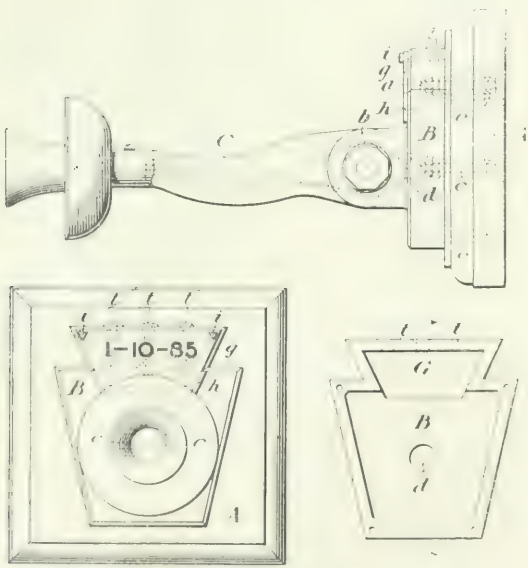
New Telephone Patents.

After a burst of activity resulting in the issue of a dozen or so patents relating to telephony, the issue of April 29th yields but a couple of inventions, both relating to details of telephone sets. Mr. Charles E. Wilson, of Philadelphia, is the inventor of both these devices and assigns them both to the Keystone Telephone Company, of that city. The first patent is on a telephonic wall set, in which all the working parts except the transmitter are mounted on a base-plate, so that the whole organization may easily be withdrawn for repairs or renewals. This is to enable the inspector to substitute a duplicate set, in the event of difficult repairs being necessary, without removing the whole instrument, and the arrangement also makes the parts more accessible for ordinary repairs. Referring to Figs. 1 and 2, *D* is the bell-box, having sides *d d* fixed to the backboard *A*, and top d^1 hinged to *A* in the ordinary manner. At the bottom of the box is the inclined tray or trough *G*, which supports the condenser *K*. On the inside of each side *d* of the box is a grooved trip *g*, in which slides the metal plate *H*, forming the bottom of the box; *H* is turned up at the back, forming a bracket *h*. The glass plate *J*, sliding in vertical grooves, forms the front of the box, overlapping *H* and held in place by the lid d^1. The lid is locked by a screw *j* passing through the side of the box and engaging in a lug j^1 on the under side of d^1. This screw *j* has a triangular head so that the box can be unlocked only by a special key carried by the inspector. The various parts of the mechanism are fixed to the plate *H* or its rear extension or bracket *h*, so that by opening the lid d^1, lifting the receiver hook out of its slot and sliding up the glass plate *J* the entire set of instruments can be withdrawn from the box for inspection or repairs. The connections are made by the binding posts *t t*. This is a neat and effective arrangement of the mechanism of a telephone set and ought to be of considerable help toward good maintenance.



FIGS. 1 AND 2.—WILSON WALL SET.

Mr. Wilson's second patent is on a base-plate for transmitter-arms, the object of which is to provide a concealed cavity for the line-terminals to prevent the public from tampering with them, while the covering of the recess is of such construction as to be readily accessible to the telephone employes. As shown in the drawings, Mr. Wilson makes his base-plate in the form of a keystone, which is patriotic, affords an attractive design, and especially lends itself to the effectual concealment of the aperture by which access is to be had to the terminal binding posts. The plate is a hollow casting, affixed to the back-board *A*; *a a a* are the binding posts, the wires entering by the apertures *t t t*, the wiring from the posts to the different parts of the instrument being done in the regulation manner. Covering the aperture *G* in the base-plate over the binding posts is a metal plate *g*, of similar shape, which is used to carry the number card. This is attached by screws *i i*, having triangular heads so that they can only be unscrewed by a special key. By unscrewing one screw and using the other as a pivot the cover or card can be revolved away, uncovering the aperture and revealing the binding posts. Several alternative methods are suggested of affixing the card plate used as a cover. This strikes one as a neat little improvement in the construction of exchange transmitters.



FIGS. 3 AND 4.—BASE PLATE FOR TRANSMITTER ARMS.

San Antonio Meeting of the Southwestern Gas, Electric and Street Railway Association.

At the meeting of the Southwesten Gas, Electric and Street Railway Association, held at San Antonio last month, Mr. E. H. Jenkins, of San Antonio, Tex., was elected president; Thos. D. Miller, of Dallas, treasurer, and H. A. Evans, of San Antonio, secretary. Other officers were elected as follows: Vice-president, C. F. Yaeger, of La Rede, Tex.; E. Dysterud, of Monterey, Mex., and A. E. Judge, of Tyler, Tex. Directors: H. F. MacGregor, of Houston, Tex.; Thos. D. Miller, of Dallas, Tex.; T. H. Steuart, of Waco, Tex.; S. A. Spencer, of Jennings, La.; H. T. Edgar, of El Paso, Tex.; W. A. Guthrie, of San Antonio, Tex., and J. R. Ward, of Beaumont, Tex. Dallas, Tex., was selected as the next place of meeting.

In a paper, entitled "The Flat-Rate Nuisance," Mr. Thos. D. Miller, of Dallas, Tex., attacked the flat-rate system of charging, setting forth the usual arguments against this system and in favor of the meter system. He considers that any electric light plant doing an exclusive flat-rate business could furnish on the meter basis current to from 25 to 75 per cent. more lamps at the same cost for operating expenses, or have the gross receipts proportionately increased by quoting a fair price for the service rendered to each customer, and no more than a fair price from anyone. Many electric light companies have gotten on a paying basis by an introduction of the meter system.

Mr. W. E. Judge read a paper on "How to Increase the Income," in which he advocated efficient methods of watching, testing, recording, accounting and canvassing. He considers that the method of charging on the Wright demand system would lead to very satisfactory results.

National Contractors.

The National Electrical Contractors' Association of the United States will be held at Philadelphia, July 13 and 14. Mr. W. Morton, of Utica, is secretary.

A Degree to Lord Kelvin.

At New Haven, Conn., on May 5, Lord Kelvin received from Yale University the honorary Degree of Doctor of Laws. The ceremony took place in Battell Chapel. It was the first time in over 100 years that a special assembly has been held at Yale for the conferring of an honorary degree. The distinguished scientist was ushered into the church by President Arthur T. Hadley, to the strains of music by a great symphony orchestra, followed by the most eminent members of the university corporation and faculties. The ceremonies were short. After the preliminaries Lord Kelvin was presented for the degree by Prof. Russell Henry Chittenden, Ph. D., Director of the Sheffield Scientific School. President Hadley conferred the degree, and said: "You have joined the different regions of the earth by your investigations of the submarine telegraph; you have joined the different realms of human thought by your contributions to physical theory. We confer upon you the degree of Doctor of Laws and admit you to all its rights and privileges." As the hood of the degree was slipped over the shoulders of the eminent scholar there was great applause. Lord Kelvin responded with thanks for the honor conferred, and after a tribute to Yale, reviewed briefly the development of the teaching of science in universities.

Lord Kelvin has been putting in a busy week on his return to New York City on Tuesday. The morning of that day he visited the laboratory of Mr. Peter Cooper Hewitt to see his mercury vapor lamps. After that he visited the Westinghouse lamp factory on Twenty-third Street with Mr. C. A. Terry and Mr. C. W. Rice, second vice-president of the Nernst Lamp Company. Late in the afternoon, escorted by President Cutler and Chief Engineer Carty, of the New York Telephone Company, Lord and Lady Kelvin inspected the new Cortlandt Street exchange, talked over the line to Chicago, and saw some of the Pupin "distributed inductances." They were received by President Fish and Vice-President Hall, of the American Telephone and Telegraph Company; President Clowry and Vice-President Clark, of the Western Union Telegraph Company, and by Messrs. Bethell, Sargent, Reilly, Wilson, Cahill, Webb, Thurber, Renouard, Schultz, and others of the telephone service of Greater New York; Mr. Thayer, of the Western Electric Company, and others. About an hour was spent at the exchange. On Thursday, Lord Kelvin was scheduled to visit the big Edison Riverside station, and to dine with Mr. Anthony N. Brady and officers of the New York Edison Company, at Delmonico's, to meet the leaders of the electrical industry in New York. On Friday Lord Kelvin is to visit Mr. Edison at the Orange laboratory, and on Saturday he sails for England.

CURRENT NEWS AND NOTES.

THE ST. LOUIS WORLD'S FAIR will, it is now determined, be put off for one year, as it is evident that it could not be ready by 1903.

THE CINCINNATI CONVENTION.—It appears that in connection with the approaching convention of the National Electric Light Association, at Cincinnati, a number of eastern delegates propose to leave on the preceding Sunday, over the lines of the Pennsylvania system. The Chesapeake & Ohio Company has also an excellent service for reaching the convention city, and has the well-known "F. F. V." Limited, which, leaving New York at 5 P. M. daily, reaches Cincinnati just 24 hours later. This is a solid, vestibuled train, lighted by electricity, with through dining car service, observation cars, and a most picturesque route. It seems likely that many will avail themselves of this train on Sunday evening, May 18, and, if necessary, extra sleeping cars will be added. Reservations of space should be made immediately in accordance with the announcement in our pages elsewhere.

CAP AND GOWN.—A telegram from Ithaca, N. Y., of May 3, says: The action of President Jacob Gould Schurman yesterday in introducing Lord Kelvin, attired in cap and gown, is causing no end of comment among Cornell professors, and it is thought that it means that Cornell will break away from the old traditions and will adopt the academic garb on all university occasions. The gown in question was procured in April while President Schurman was in Scotland, and was worn by him when he received the degree of LL. D. from the University of Edinburgh. It is a gorgeous affair, and will be worn by him at the important exercises hereafter. Hitherto there has been a strong feeling against this academic insignia and many professors are now pronounced in their opposition, but it is thought that the Faculty at its next meeting will follow the precedent set by the president.

OBSCURANTISM IN ELECTRO-CHEMICAL INDUSTRY.—In a discussion of a paper by Rhodin on "The Electrical Manufacture of Caustic Soda and Bleaching Powder," at Sault Ste. Marie, Ont., before the Canadian section of the (British) Society of Chemical Industry, it was reported that the hearty support which the manufacturers had given to the American Electrochemical Society, indicated that the policy of obscurantism in the electro-chemical industry was about to be abandoned. This also shows that such a society was needed to bring out papers from the industrial interests, and that those who are at the head of these industries probably appreciate the fact that their gain is probably greater than any supposed loss. A short time after the recent meeting of that society, at which an inventor of a process called attention to difficulties which he was having, he was enabled to improve his process very greatly, and admitted frankly that he was led to this improvement by the discussion which took place when he described before the society the difficulties which he had encountered. This is a good illustration of the great gain to the industries due to the frank discussion of their processes.

EFFECT OF LIGHTNING DISCHARGE ON BIRDS.—Mr. Leonard Joseph, in a communication to the British Institution of Electrical Engineers, reports that on Dec. 9, of last year, during a heavy storm, accompanied by thunder and lightning, a wild goose fell through the air and with a thud buried itself fairly deep in the sand. On the abatement of the storm, at a distance of approximately a kilometer from the point at which the bird above referred to was picked up, another dead wild goose was found. On a careful examination of the two birds, it was found that the only wounds upon them were " a narrow but direct opening about 3 cm long" on the back of the neck of the first found bird, and a small puncture "at a point where the neck joins the body" on the second bird. Excepting in the immediate neighborhood of these wounds the bodies and feathers of the birds were uninjured. The feathers at these points appeared and smelt singed. Both birds proved perfectly fit for the table. During the storm five flashes of lightning only were observed. Judged by the position in which the birds were found, Mr. Joseph is of opinion their flight was in opposite directions, the wounds in each instance being instantaneously fatal.

MR. YERKES IN LONDON.—A special cable dispatch from London, of May 3, has the following: There have been some interesting developments in the battle between the American millionaires for control of London's rapid transit system. One feature that stands out more than any other is Charles T. Yerkes's ability to beat English lawyers at their own game. Counsel for the Morgans' projected "tube" line had Mr. Yerkes on the stand before the House of Lords Committee for an hour or so one day this week. Mr. Yerkes sat passive, ingenuously answering or dodging questions relating to the financial plans of his own syndicate. Finally he calmly remarked to counsel: "I have been listening to your explanations of this matter," at which counsel hurriedly corrected the witness by declaring he had only been asking questions. But Mr. Yerkes, imperturbable and hugely amusing the committee, continued: "And it seems to me that you have certain information which I myself do not at this moment possess." With a smile, Mr. Yerkes next admitted that he was largely interested in the financial and operating departments of the new road, but, without a trace of apparent malice, he added: "I do not care to teach kindergarten schools here." The Morgans had questioned the correctness of the figures upon which Mr. Yerkes based the returns of his system, and Mr. Yerkes blandly waved aside such details, saying that he had not his notes, but would be delighted to solve the sums in arithmetic submitted to him by opposing counsel if they would allow him to bring notes referring to such abstruse matters from his office. Finally the Chicagoan was dismissed somewhat disgustedly, with the remark: "As you do not want to be sent back to school, I will not ask you any more questions," and Mr. Yerkes went out, smiling grimly.

article on some experiments on wireless telegraphy by a local electrician, says that "As near as can be determined the system is based on the principle brought out by Dr. Hertz, professor of physics, in a large Simian university, in 1888."

OHIO ELECTRICAL CONVENTION.—The Ohio Society of Mechanical, Electrical and Steam Engineers will hold its convention at Mansfield, on May 10. The wide scope of the society's activities promises a meeting of much interest to its members. Papers of interest to all three branches of engineering will be read and discussed.

NEW MEMBERS OF THE INSTITUTE.—At the meeting of the directors of the Am. Inst. of Electrical Engineers, held April 25, the following associates were elected: Anderson, Edward H., designing engineer, General Electric Company, Schenectady, N. Y.; Anthony, James Stowell, General Electric Company, 44 Broad Street, New York City; Badeau, Charles Cushing, switchboard engineer, Wagner Electric Manufacturing Company, St. Louis, Mo.; Bailey, Theo. P., assistant manager, Chicago office, General Electric Company, 1047 Monadnock Building, Chicago, Ill.; Brisley, Edward Betts, student, Stevens Institute, Hoboken, N. J.; Clark, Wallace S., engineer, wire, cable and tube department, General Electric Company, Schenectady, N. Y.; Cole, William Weeden, vice-president and general manager, Elmira Water, Light and R. R. Co., Elmira, N. Y.; Cutler, James Elmer, manager Philadelphia office, Stanley Electric Manufacturing Company; Edmondston, Edgar Davis, electrical engineer, The Lackawanna Iron and Steel Company, 401 Delaware Avenue, Buffalo, N. Y.; Ekstrand, Charles, superintending engineer, Brooklyn Cooperage Company, Brooklyn, N. Y.; Ellinger, Edgar, electrical engineer, George A. Fuller Company, New York City; Gray, Clyde D., assistant in electrical department, J. G. White & Co., 29 Broadway, New York City; Hellebuck, Gustave J., electrical engineer, Mediterranean Thomson-Houston Company, 5 Piazza Castello, Milan, Italy; Hines, Charles Henry, superintendent electrical department, Lorain Steel Company, Lorain, Ohio; Holman, George Ulysses Grant, general manager, The Canadian Electric Light Company, Limited, 12 Laporte Street, Quebec, P. Q.; Hough, Benjamin Kent, sales engineer, Stanley Electric Manufacturing Company, 1601 Empire Building, New York City; Humphrey, Calvin B., office manager, Westinghouse Electric and Manufacturing Company, 711 Neave Building, Cincinnati, Ohio; Hunt, Charles Wallace, president, C. W. Hunt Company, Stapleton, N. Y.; Judson, Hanford Chase, assistant engineer, General Electric Company, Dobbs Ferry, N. Y.; Leblanc, Maurice, consulting electrical engineer, Westinghouse Electric and Manufacturing Company, Villa Montmorency, Paris, France; McNary, Charles Herbert, superintendent of Provo Station, Telluride Power Company, Provo, residence, Nunn's, Utah; Miles, J. Walter, electrical engineer, Westinghouse Electric and Manufacturing Company, Irwin, Pa.; Miller, Dwight Dana, salesman, Westinghouse Electric and Manufacturing Company, 120 Broadway, New York City; Murphy, George R., engineer, operating department, The Electric Storage Battery Company, New York City; O'Donovan, Leo J., student, Columbia University, 302 West Seventy-second Street, New York City; Sheldon, Edward Ellis, electrical engineer, Hudson River State Hospital, Poughkeepsie, N. Y.; Short, Sidney Howe, technical director, The English Electric Manufacturing Company, 112 Cannon Street, London, E. C., England; Stoker, Simon Brewster, engineer, Westinghouse Electric and Manufacturing Company, Syracuse, N. Y.; Stovel, Russell Wellesley, electrical engineer, Pittsburg and Lake Erie Railway, Coraopolis, Pa.; Waddell, Charles Edward, electrician in charge electrical department, Biltmore Estate, Biltmore, N. C., Wellman, Harold Robinson, electrical engineer, motor department, General Incandescent Arc Light Company, 572 First Avenue, New York City; West, Erastus Lovette, assistant to electrical engineer, J. G. White Company, 29 Broadway, New York City; White, Francis Joseph, student, Columbia University, 53 St. John's Place, Brooklyn, N. Y.; Wilson, Norman James, electrical engineer, British Westinghouse Electric and Manufacturing Company, Limited, Trafford Park Works, Manchester, England; Woodbury, Daniel Coryton, student, Stevens Institute of Technology, Hoboken, N. J.; Yorke, George Marshall, assistant electrician, American Telephone and Telegraph Company, 15 Dey Street, New York City.

LETTERS TO THE EDITORS.

The Wright Demand System.

To the Editors of Electrical World and Engineer:

Sirs.—In your editorial of April 26th, on the system of charging customers at Woburn, you say, "If the capacity or investment charge were carried to its legitimate conclusion the price to certain classes of customers would become quite prohibitive—a condition which the authorities would not tolerate."

I am interested in the system of charging used at Woburn, because it is on exactly the same principles as those which form the basis of the Wright demand system, the only difference being that at Woburn they use (or rather propose to use if they can make one) an instrument which limits the maximum demand, instead of the Wright indicator, which merely measures the maximum demand.

In regard to the paragraph in your editorial quoted above, I disagree entirely. In the first place, the fact that the price of electricity is prohibitive to certain classes of customers is no ground for the authorities to interfere. The price of electricity for heating is prohibitive in almost all cases. It is prohibitive to the large majority of the class of small customers who use kerosene light. It is prohibitive to any customer who is at a distance from a central station. In fact, since less electricity is used than gas and kerosene, etc., it is safe to say that the price of electricity is to-day prohibitive in the majority of cases.

The Wright demand system, including the modification of it used at Woburn, and referred to in your editorial, is based on the principle that the charges to each customer should be based on the cost of supplying such a customer. If carrying this principle to its legitimate conclusion makes the price prohibitive to such a customer, it follows that that customer belongs in that large class who (at present costs of production of electricity) cannot afford to use it. The authorities would not interfere to require the central station to supply such a customer at a loss, since the central station would have to recoup itself for this loss by charging its other customers too much. The authorities would rather interfere to forbid supplying such a customer at a loss.

You yourself, on the same page, refer to such a case as occurring at Waltham, where the electric lighting company had been supplying current at a loss to a particular customer, and, so far from prohibiting the raise of price, the commissioners in effect required the company either to raise the price to this customer or to stop supplying him.

Of course, in practice rates must be adjusted to local conditions to a certain extent, and it would be easy to carry the principle of the investment charge to an extreme. Take the case, for instance, of a circus visiting a town for one night only. It would not be right to charge the circus the whole first cost of the engines and dynamos necessary to supply it with light, as well as the cost of the coal and labor.

Possibly I am overhasty in criticism, and you refer in your editorial to cases similar to the circus. The point I want to bring out is one which your editorial does not leave clear, and that is that no company should or can be required to supply a customer at a loss, and that the Wright system, even as used at Woburn, without the Wright indicator, comes nearer this ideal than any other possible system, except the Wright system with the Wright indicator.

BOSTON, MASS. R. S. HALE.

Synchronous Reactance.

To the Editors of Electrical World and Engineer:

Sirs.—Mr. F. G. Baum's article on "Synchronous Reactance," in your issue of April 26th, recalls to my mind the warfare I waged for years in the electrical papers against too strict a belief in the applicability of the short-circuit current for determining the potential drop in alternators.

When, in 1894, Dr. Behn Eschenburg, of Oerlikon, suggested the use of the short-circuit current for the purpose of calculating the synchronous reactance, this idea marked a great step in advance in the rational calculation of alternating current machines. While correct within the range of proportionality between magnetizing force and induction, it was only very approximately correct for high saturations. Time and again I pointed out this fact, backing up my argument by a series of experimental investigations. I will here re-

fer only to my letters on this subject in 1896 in *Elektrotechnische Zeitschrift*, Berlin, and to my papers on "The Factors which Determine the Design of Single-phase and Multi-phase Alternators," ELECTRICAL WORLD AND ENGINEER, 1900, Jan. 20, 27 and Feb. 3, where I showed that in alternators in which the field and armature leakage had been made small, the drop is considerably smaller at higher saturations than would follow from the synchronous reactance calculated from the short-circuit curve.

The regulation curves of Fig. 1 in my article in the Berlin paper, 1899, number 48, very strikingly illustrate the error introduced by using the short-circuit curve, and I particularly refer Mr. Baum to this paper for a critical estimate of the method.

Prof. Alexandre Potier bases on these experiments of mine his method of predetermining the drop in alternators. I must refer to his paper, "Sur la réaction d'induit des alternateurs," in *L'Eclairage Electrique*, 1900, p. 133, where he elaborates a very useful method identical with Mr. Baum's, given in your issue of April 26, 1902; and while I am in agreement with Mr. Baum's paper, I cannot forbear from remarking that it seems surprising that at this late season novelty can be claimed by Mr. Baum for discovering the discrepancy between calculation and observation in using the short-curcit current for determining the drop in alternators. So far as proposing a method is concerned for avoiding the error above alluded to, the credit is due to Prof. Alexandre Potier, whose paper was duly given in extract in the Digest of the ELECTRICAL WORLD AND ENGINEER.

CINCINNATI, OHIO. B. A. BEHREND.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Armatures Supplied with Alternating Current.—FLEISCHMANN AND ORGLER.—A well illustrated article referring to Latour's paper (noticed before in the Digest) on the properties of ring armatures which are supplied with single or polyphase currents through the commutator by means of stationary brushes. They give a simple explanation of the processes in such armatures. They first consider a ring armature which receives single-phase alternating current from two diametrically opposite brushes, the armature being fixed and the brushes revolving synchronously (*i. e.*, with the same speed as the vector of the current). They show that the e. m. f. induced in the windings, and, therefore, also the reactance of the ring, is entirely independent of the speed of rotation of the brushes. The magnetic flux varies at all points of the ring with the double frequency of the applied alternating current, the flux waves being pulsating waves; the variation of the flux all over the armature during a complete period is given in a series of diagrams. They then consider the same ring armature when it is supplied with two-phase alternating currents through two pairs of brushes, displaced in space by 90 degrees. When the brushes rotate synchronously, the flux has a constant value at each point of the ring, and the reactance of the ring is zero. If the brushes are fixed and the armature rotates synchronously, while being supplied with two-phase alternating currents, then we have a field fixed in the iron and revolving in the space with the speed of the armature. It is thus seen that to supply two-phase currents through a commutator here has the same effect as is obtained with the rotating field of a synchronous motor when direct current is applied by means of slip rings. If such an armature is brought to synchronism in a bipolar revolving field produced by two-phase alternating currents, the armature will run as a synchronous motor, after the alternating current excitation has been started. By moving the brushes it is possible to vary the relative positions of the stator and rotor poles. If, according to Heyland's method, the commutator segments are connected together by larger non-inductive resistances, the armature will revolve in a revolving field by itself. But it is doubtful whether especially when loaded—it will approximate synchronism sufficiently to reach synchronism and run as synchronous motor when the excitation has been started.—*Elek. Zeit.*, March 27.

Phase Displacement of Alternators and Parallel Running.—LEAKE.—An illustrated article in which he arrives at the following conclusions: The present practice of designing the rotating parts of direct-coupled generating sets for parallel running, so that the phase displacement on a load offering a constant torque shall not exceed a certain limit, is not justified by theory. A more rational method of designing the rotating parts is to proportion them so that the characteristic fluctuation of output shall not exceed a certain limit. The present state of the theory of parallel running does not justify the statement that parallel running is facilitated by low frequency.—*Lond. Elec. Rev.*, April 4, 18.

REFERENCE.

Polyphase Machinery.—EBORALL.—The first part of an illustrated reprint in full of a paper read before the (Brit.) Inst. Elec. Eng., giving "some notes on polyphase machinery." He discusses standard polyphase generators and first describes the construction of the field system, details of construction being given.—Lond. *Elec. Rev.*, April 18.

LIGHTS AND LIGHTING.

Electric Lighting and Illumination.—A collection of well illustrated trade notes, comprising 16 full pages, showing the several systems of illumination now on the market in England; also new fittings and accessories, with special references to the illumination at the coming coronation. Also an article, by Cash, on "the art of design for electric illumination, domestic and public"; and a paper by Sachs, on "artistic electrical illuminations."—Lond. *Elec. Rev.*, April 11.

REFERENCE.

The Lighting of Diversey Boulevard.—CRAVATH.—An illustrated article describing the system of lighting now in use on Diversey Boulevard, Chicago, with a description of the posts, lamps, cut-outs, etc.—*Am. Elec.*, April.

POWER.

Water Tube Boilers.—BOOTH.—An article on the circulation in water tube boilers. He concludes that the small tube, nearly vertical type, is distinctly and decidedly superior, and that large tubes of flat inclination, especially when long and with many bends, are absolutely dangerous and unscientific, unless provided with very certain and positive mechanically propelled circulation—a complication perhaps justified only when applied to existing boilers.—Lond. *Elec. Rev.*, April 4.

REFERENCE.

Water Power in Ireland.—TATLOW.—A long abstract of a paper read before the Dublin section of the (Brit.) Inst. Elec. Eng., giving "notes on Irish water power and its electrical development." After general statistical notes, he describes a few places where he believes water power could be developed at reasonable cost, where it is not used at present.—Lond. *Elec.*, April 4.

TRACTION.

German Electric Railway Statistics.—The annual statistical tables, comprising 18 full pages with a large amount of information, and showing the state of the public electric railways and tramways interests of Germany up to October 1, 1901; also an editorial summary. Private roads are not included, with the only exception of the Berlin-Zossen high-speed experimental road. The trials on the latter road have shown that when a sufficiently strong roadbed is provided, higher speeds than 160 km per hour are promising for the future. On October 1, 1901, 113 German cities (against 99 in 1900) had electric traction, with a total length of roads of 3,100 km, equal to 4,550 km single track. The total capacity of the generating electric machinery in use for traction was 108,021 kw (against 75,608 kw in 1900), excluding storage batteries. The increase in the use of storage batteries was still greater; their power was 25,531 kw (against 16,890 in 1900). The total capacity of generating machines

and batteries, together, for traction was, therefore, 133,552 kw. For light and traction together, the total capacity of generating machines and storage batteries was 486,120 kw. Regardless the relation between kw and km track, as an average of 85 roads, is given 20.8 kw per km track (against 19.9, 20.5, 20.7 in 1900 1899, 1898). The average number of kilowatts per motor car was 15.7 (against 15.1 and 14.3 in 1900 and 1899). These averages have, therefore, remained nearly constant, although the values of single roads differ greatly from these averages. Of the total 4,550 km single track, only 713 km are owned by municipalities, but even this is in part rented to private companies.—*Elek Zeit,* March 27.

Electric Traction on Railways.—The conclusion of the reprint in full of Swinburne and Cooper's (Brit.) Inst. Elec. Eng. paper, and of the discussion which followed; also an editorial on the subject. In the latter it is said that the electrical engineer has at his disposal at least two systems which are suitable for the electrical equipment of railways, the continuous current constant pressure system and the high-pressure, three-phase system. There is, however, a reason not to precipitate the application of electric traction on railways: this is that a certain amount of standardization is essential for efficient traffic. Attention is called to the remarks of Carus-Wilson and McMahon on the desgin of series direct-current motors. The former thinks that the American engineers have been running off the correct lines in designing their traction motors. He points out that the great advantage in the series motor originally was held to be the possibility of obtaining in it a torque per ampere of current with a wide range of from 2 to 1. The more recent motors, however, in order to reduce weight, have enormously diminished this range, and the advisability of this step is questioned.—Lond. *Elec.,* April 18.

Electric Railway Operation.—Some notes on statements made in the Prussian Parliament by the Minister on Railways Thielen. The experiments on the Wannsee Railway with passenger trains, at a distance of 10 miles from Berlin, proved unsatisfactory, and have been abandoned; a subsequent comparison with steam had shown the economy in favor of steam, besides the greater reliability in operation. Negotiations are, nevertheless, in progress with an electrical company, for the working of freight and passenger trains by electricity from Gross-Lichterfelde to Berlin, a distance of six miles. Referring to the Berlin-Zossen high-speed experiments, he said that a speed of 100 miles per hour had been attained, but as soon as a heavier road-bed will be constructed higher speeds will be possible. The question whether such trains can be operated at a profit is still unsettled, and he considers their use limited to the conveyance of passengers. The experiments had been made with a single car, capable of accommodating about 100 persons.—Lond. *Elec.,* April 18.

Negative Boosters.—Kapp.—An illustrated translation of his German paper on inserting negative boosters in the track, which has been abstracted recently at some length in the Digest. The proposition is discussed in an editorial note. It is first asked what will be the effect of a difference of potential of 12 volts—the full load voltage of his suggested boosters—between the ends of two rails a few feet apart? Secondly, his curves apparently assume that the negative terminal of the dynamo is not earthed, as is customary in Great Britain. It suggests that, failing a return feeder, Kapp would be safer in earthing his dynamo negative and leaving his bonding continuous, than in making experiments with 12-volt boosters on the track.—Lond. *Elec.,* April 11.

REFERENCES.

Operating Cost of Tramways.—Gueroult.—A continuation of his mathematical article (Digest, Feb. 1). He first gives the general calculation of the cost of operation and the receipts and then discusses several special points, like the influence of the number of cars, etc.—*L'Eclairage Elec.,* March 22.

Car House.—A description of the Elmwood car house of the Rhode Island Suburban Railway Company.—*St. R'y Jour.,* April 5, and *Int. Ed.,* April.

Multiple Unit System.—Blakstone.—An illustrated article in which, after a discussion of the principles and distinctive features of the Sprague and of the Thomson-Houston systems of multiple unit control, he describes the Sprague system.—*L'Eclairage Elec.,* March 29.

INSTALLATIONS, SYSTEMS, AND APPLIANCES.

British Central Station Statistics.—An editorial summary of statistical tables on electricity supply in the United Kingdom, published in former issues of this Journal. Besides 15 companies which distribute electricity over large areas, there are 282 central stations, of which 96 are company undertakings and 186 municipal. The whole capacity amounts to 400,000 kw, exclusive of batteries. In the provinces there are 250 plants with 300,000 kw, in London 32 plants with 100,000 kw. An account is given of the relative proportions of company and municipal undertakings: "while the provincial municipalities utterly swamp the companies, the Metropolitan companies go far to restore the balance, and the average sizes of their undertakings are, on the whole, not very dissimilar." The vertical high-speed engine is far ahead of all others; but in several instances vertical low-speed engines have been adopted for the larger units, and the high-speed steam turbine is making steady progress, at least 22 stations being equipped with steam turbines. There are 191 direct-current stations against 91 alternating-current stations; and of the latter 24 supply also direct current, mostly for traction. Of the alternating current stations, there are eight supplying two-phase current and three supplying three-phase, the latter being used only for transmission. In no case is three-phase current distributed to consumers, though two-phase current is used freely. Fifty-six stations supply power for traction as well as for lighting and motive power. The frequency shows a marked tendency towards a standard of 50 cycles per second. Only 76 stations are entirely without a battery of more or less importance.—Lond. *Elec. Rev.,* April 11.

WIRES, WIRING AND CONDUITS.

Consumers' Installations.—Ruddle.—An abstract of a paper read before the Dublin section of the (Brit.) Inst. Elec. Eng. He urges that the Institute rules for electric installations should be adopted by general agreement. A system of official registration should be established before any person should be entitled to act as a contractor with respect to premises supplied from public distributing mains, and that such license to practice should be conditional upon the loyal observance of the officially recognized rules. He also makes a number of special suggestions, among which are the following: The supply authority's fuse box should be regarded as being essential for the protection of both the consumer and the general system against accidental disturbance or misuse, and should never be interfered with by other than the station officials. The consumer's main fuses should be of lower carrying power than those provided by the supply authority. The consumer's main switch should be fixed next to the supply authority's fuse box, followed by the consumer's main fuses. In the selection of the insulating covering of the wires and cables more attention is to be paid to securing a lasting quality of material than an abnormally high insulating test. Under no circumstances should combination gas and electric light fittings be used, even with the so-called "insulating socket." No wood casing should be used under flooring, or anywhere, except for surface work, and no fuses should be concealed or placed where they cannot be easily inspected. He recommends that the maximum drop should not exceed 1 volt under ordinary circumstances, where the lighting is fairly dense. Where long, narrow rooms have to be wired, and the supply terminals are brought in at one end, a better average pressure results if the main cables are carried to the center of the room, and the lamps fed backward and forward from this point. Leads for arc lamps, motors, and other variable current consuming devices, should be enclosed in iron tubing, or other non-inflammable conduits. Motors of over ½-hp must be provided with properly designed and effective starting mechanism. The paper is concluded by some remarks favorable to the maximum demand system of charging—Lond. *Elec. Rev.,* April 11

ELECTRO-PHYSICS AND MAGNETISM

Form Factor and Peak Factor.—Benischke.—An illustrated mathematical article. Measuring instruments give the effective value of the alternating current or the e. m. f. On the other hand, the hysteresis depends on the maximum value of the magnetic field. For sine waves the ratio of the maximum value to the effective value is the square root of two; for other waves forms this ratio has a different numerical value; this ratio is called by him the peak factor (Scheitel Factor). He shows that the use of it gives in general more correct formulas than the use of the form factor (ratio of the effective value to the arithmetical average value). The form factor is, therefore, superfluous, and the way in which it has heretofore been applied in calculation is only correct in special cases, but is wrong in general. Moreover, the peak factor is more suitable for characterizing a wave form than the form factor, because for those wave forms which occur most generally in practice, the differences between the peak factors are greater than the differences between the corresponding form

factors. Finally the calculation of the peak factor is simpler than that of the form factor.—*Zeit. f. Elek.*, March 30.

Inductive Circuits.—Brew.—An abstract of a paper read before the Dublin section of the (Brit.) Inst. Elec. Eng., in which he gives "notes on inductive circuits." He first discusses "ferric" circuits (*i. e.*, circuits containing iron); the shunt winding of a large direct-current dynamo represents an inductive circuit. He then discusses non-ferric circuits and notices the following phenomenon: In some substations in Dublin the low pressure bus-bars on the transformer boards are coupled by rows of parallel cables to similar bus-bars on the feeder boards; it has been found that those cables which are towards the center of the group become hot at times of heavy load, while those at the edges remain cool, although the cables are all of the same section, and very approximately of the same length; by calculation of the self-inductance, it was found that for a frequency of 83, the impedance of the outermost pair is nearly 0.006 ohm, while that of the central pair is only 0.0037 ohm; for the same p. d., therefore, a larger current will pass through the central pair than through the outermost pair. He then discusses polyphase ferric and non-ferric circuits, and gives some mathematical calculations.—Lond. *Elec. Rev.*, April 4.

Electrostatic Rotary Field.—Von Lang.—An abstract of a paper read before the Electrical Society of Vienna, in which he gave the "demonstration of an electrostatic rotary field." He showed experiments in which dielectric bodies, such as cylinders of paraffine, discs of paper, glass, etc., were set into rotation in the rotary field. If the rotary field is separated by a glass cylinder from the rotating body, this does not prevent the rotation; but the rotation is prevented by enclosing the body in a metallic case or by a metallic screen. The method of production of the rotary field is not described.—*Elek. Zeit.*, March 13.

Evaporation of Charged Liquids.—Beggerow.—All experimental data, except those obtained by Pellat, go to show that the evaporation of a charged liquid does not convey away the charge. He repeated Pellat's experiments with additional precautions, and has studied water, alcohol, ether, mercury and various solutions. Positive and negative charges were used in each case, but no influence of evaporation upon the dissipation of the charge could be detected.—*Ann. d. Phys.*, No. 3, abstracted in Lond. *Elec.*, April 4.

Induced Radio-Activity.—Henning.—An investigation of radio-activity induced from thorium oxide in brass plates and wires of different sizes, mounted in the axis of a closed and positively charged brass tube and receiving a negative charge. The thickness of the wire only makes a difference when the difference of potential is small, since the ions do not readily reach the cathode, and a thick wire facilitates their transfer. When the difference of potential is great, the electric field is powerful enough to bring practically all the ions into the immediate neighborhood of the wire whatever may be its diameter.—*Ann. d. Phys.*, No. 3, abstracted in Lond. *Elec.*, April 4.

Solar Corona and Comets.—Nordmann.—An article in which he considers the sun as the source of all kinds of electromagnetic waves, although many of those are absorbed by the atmosphere of the earth. Hertzian waves should be chiefly produced in the zone of sun spots and faculæ and at the maximum of solar activity. The incandescence of the upper portions of the sun's atmosphere he believes to be due to Hertzian waves. The spectra of comets show that the incandescent gases of comets have a low temperature, something like that which obtains in discharge tubes. This fact identifies them with the incandescent gases produced artificially by means of Hertzian waves. As a comet approaches the sun, its spectrum is changed in the same way as that of a gas when the current is increased.—*Comptes Rendus*, March 3; abstracted in Lond. *Elec.*, April 4.

Hertzian Waves from the Sun.—Deslandres and Decombe.—An article in which they point out that while Nordmann could not find that the sun emits electric waves of Hertzian dimensions, his results are not conclusive. The complete solution of the problem requires a much larger apparatus. The protuberances of the sun atmosphere ought to send out waves of great length. They propose the systematic study of these waves by means of three antennæ normal to each other. —*Comptes Rendus*, March 10; abstracted in Lond. *Elec.*, April 4.

Magnetic Action of Cathode Rays.—Von Geitler.—He formerly described experiments which he believed to show that cathode rays exert an action on a magnetic needle. Recent researches have, however, convinced him that this effect was simulated by a thermo-electric effect which he had not suspected. He is therefore driven to the conclusion that his former results are untenable quantitatively, and possibly also qualitatively.—*Phys. Zeit.*, March 15; abstracted in Lond. *Elec.*, April 4.

REFERENCES.

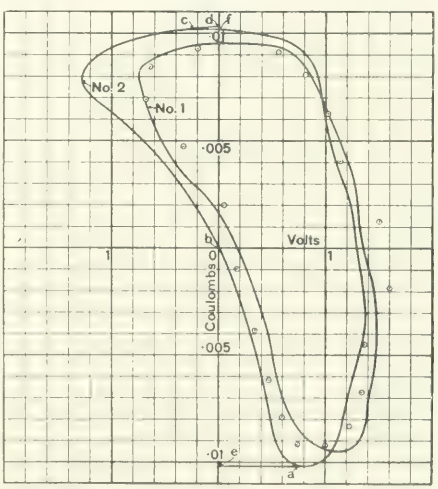
Selenium Cell.—Ruhmer.—An illustrated description of a new selenium cell which is said to give good results for wireless telegraphy when used in conjunction with parabolic mirrors. Its chief feature is that it is enclosed in an exhausted tube, which renders the cell more constant and reliable than previous patterns. The cell is cylindrical, and a lamp socket is provided at the bottom of the tube, convenient for connection.—*Mechaniker*; abstracted in Lond. *Elec.*, April 18.

Choking Coils.—An illustrated article giving the rules and formulas required for the construction of choking coils.—Lond. *Elec. Eng.*, Feb. 1; *Jour. of Elec.*, March.

Magnetic Induction of Electromotive Force.—A didactic article, explaining the pull on a conductor in a magnetic field. The article is illustrated by diagrams.—*Am. Elec.*, April.

Electro-Chemistry and Batteries.

Alternating Current Electrolysis.—Wilson.—An account of an experimental investigation of this subject, which is of practical interest at present, as alternating currents are used in rail returns for traction purposes. An alternating current is passed between electrodes in an electrolyte, and the curve of p. d. between the electrolyte (by means of an auxiliary electrode, which in the compiler's opinion may involve serious errors) and one electrode and the curve of current are observed; the current curve is integrated, giving the quantity in coulombs. If the coulombs be plotted in terms of the volts the area of the resulting curve gives the total dissipation of energy per period. Energy is dissipated by what may be termed electrolytic hysteresis. In his first experiments he sent an alternating current of 0.024 ampere per square centimeter of active surface between two plates of commercial lead in dilute sulphuric acid for seven hours at a frequency of 89 periods per second. The opposing surfaces of the two plates were ⅛-inch apart and parallel. The back of each of the plates was covered by a closely fitting piece of wood. In the adjoining diagram curve No. 1 is the cyclical curve at the beginning of the test,



and the points marked indicate the result at 89 periods per second at the end of the test. Curve No. 2 is the cyclical curve obtained at the end of the test at the frequency 22.3 and a current density of 0.007 ampere per square centimeter. At frequencies 89 and 23, respectively, the ratio of the maximum coulombs is 0.926, and the ratio of the areas of the cyclical curves is 0.854. The areas may be taken to represent work spent in electrolytic hysteresis. In the diagram, the current changes sign at the point *a* and the lead plate begins to be an anode; the work represented by the area *a b c* is negative. The plate continues to be an anode, "via *b*," until the point *c* is reached, when the current again changes sign. The work represented by the

area *b c d* is positive. At the point *c* the plate begins to be a cathode; the work represented by the area *c d f* is negative. From the point *f* to the point *a* the plate continues to be a cathode; the area *f a e* represents positive work. Taken as a whole, the area *a b c f* represents work spent upon "electrolytic hysteresis." In these experiments a considerable quantity of lead sulphate was formed and fell to the bottom of the cell. He also made experiments with pure lead electrodes and with aluminum electrodes.—Lond. *Elec.*, April 18.

Electrolytic Manufacture of Metallic Wall Paper.—A note on a German patent of Endruweit for an apparatus for producing thin films by electro-deposition. An endless metal band is first coated with potassium sulphide, and, after washing, is passed through a nickel bath. The thin film of nickel obtained in this way is backed by copper—by passing through a similar bath containing a copper salt in solution—and by tough paper, before being stripped from its support. A strong sheet or roll of paper, faced with bright metallic nickel can be obtained in this way, and the use of this material after relief-stamping and coloring, for wall papers and for advertisement show-cards is said to offer many advantages; it is also useful for packing the stuffing boxes of high pressure steam engines.—Lond. *Elec.*, April 18.

Production of Aluminum.—ASKENAY.—An abstract of a paper read before the Electrical Society of Vienna. He refers to the work of Haber and Seipert who found that the manufacture of aluminum on a large scale requires chemically pure materials, namely artificial cryolite free of silicum, alumina free of silicium and iron, and carbon electrodes of greatest purity. It is important to have the right temperature of the bath, which should be only slightly above the melting point of the metal. It is believed that considerable improvement may be obtained, as Bayer has succeeded in producing chemically pure alumina at low cost from bauxite.—*Elek. Zeit.*, March 13.

Direct Combination of Chlorine with Carbon.—BOLTON.—An illustrated account of experiments in which the electric arc between two carbon electrodes in an atmosphere of chlorine produced a direct combination of chlorine with carbon.—*Zeit. f. Elektrochemie*, March 20.

Rotation of Electrolytes in Magnetic Fields.—URBASCH.—A reply to the recent criticism of Drude.—*Zeit. f. Elektrochemie*, March 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Cathode Rays for Alternating Current Measurements.—MORRIS.—An abstract of a (Brit.) Phys. Soc. paper, in which he describes an experiment illustrating the use of the cathode rays in alternating-current work. The usual form of Braun tube is used, the rays falling upon a luminescent screen and forming a blue spot. A solenoid conveying an alternating current is placed near the tube. The varying magnetic field caused the spot to oscillate about its mean position. To determine the maximum value of the current a switch is arranged to rapidly replace the alternating current by a continuous one. The continuous current is then adjusted until the maximum excursion of th spot is the same as before, and the value of the current is read off from an ammeter in the circuit. For accurate work the frequency of the discharge from the induction coil exciting the tube, should be adjusted until it is almost in synchronism with the alternating current. The unsteadiness of the spot of light in the zero position limits the accuracy of the measurements. He has tried to reduce the vibrations by using an earthed aluminum diaphragm instead of a glass one.—Lond. *Elec.*, April 18.

Growth of Electric Currents in an Inductive Circuit.—MORRIS.—An abstract of a (Brit.) Phys. Soc. paper. An e. m. f. of 0.8 volt was applied to a coil wound on a ring-shaped laminated iron core. When the current had attained its steady value, the e. m. f. was reversed, and the variations of the current strength shown by an ammeter. About 20 seconds were required for the current to attain its maximum value in the opposite direction. A secondary coil was also wound upon the same core, and the effect which was produced upon the growing current by the closing of this secondary circuit, was shown. He determined curves of growth for different currents. Similar curves can be used to determine experimentally the hysteresis loss of transformers. Glazebrook drew attention to the fact that this method had been applied, with some slight modifications, to the determination of the hysteresis loss in some 3,000-hp transformers.—Lond. *Elec.*, April 18.

Electric Heater.—LEUFELDT.—An abstract of a (Brit.) Phys. Soc. paper, in which he describes an apparatus consisting of a vacuum-jacketed glass tube containing water which is boiled by passing an electric current through a platinum spiral immersed in the liquid. Tap water is preferable to distilled, because the small electrolytic action in the former case causes the boiling to proceed quietly. Different temperatures can be obtained by using other liquids. It seems to be intended for obtaining a constant temperature in physical research.—Lond. *Elec.*, April 18.

REFERENCE.

American Meter Practice.—REED.—Another article on this subject by the same author, dealing with the relation between meter losses and income, and dilating on the importance of meter maintenance and operation.—*Am. Elec.*, April.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—LECHER.—A discussion of the question why the transmission of wireless signals over distances is affected by the curvature of the earth. He thinks there is some analogy between the way in which the conducting surface of the earth affects the waves and the way in which a wire affects the same waves. As Sommerfeld has shown, a wire placed in the direction of propagation of an electric wave, produces peculiar effects. The electric oscillations are always at right angles to the surface of the wire, and a portion of the wave energy penetrates into the surface layer of the wire. It may be supposed that in a somewhat similar way the waves of wireless telegraphy run along the surface of the earth and especially of the sea, and a portion of the energy enters the earth's surface. Sea water is known to be a "good conductor" for waves of the Hertzian type. A crucial experiment would consist in sending wireless signals between two balloons of the same height, by means of vertical antennæ. Communication should be the easier the smaller their elevation. It would be interesting also to attempt to send signals up a precipice, with horizontal and vertical antennæ, respectively.—*Phys. Zeit.*, April 1; abstracted in Lond. *Elec.*, April 18.

REFERENCES.

Wireless Telegraphy in Spain.—GUARINI.—An illustrated description of experiments made in Spain by Cervera, and of his apparatus, which differs in some points from the usual wireless telegraph instruments.—Lond. *Elec.*, April 18.

Wireless Telegraph in Germany.—An illustrated review of the "German wireless telegraphy systems"; that of Slaby and Arco, used by the General Electric Company, of Berlin, and that of Braun, used by Siemens and Halske.—*Elek. Anz.*, March 13, 16, 20.

Wireless Telegraphy in Germany.—GUARINI.—Brief illustrated descriptions of the connections used in the transmitting and receiving apparatus in the Braun system and in the Slaby-Arco system.—Lond. *Elec. Rev.*, April 18.

Speaking Arc.—GUTHE.—An illustrated paper on the use of the speaking arc in wireless telephony. He describes the experiments and arrangements of Simon, Duddell and of his own.—*West. Elec.*, April 12.

A Modern Central Energy Bell Telephone Exchange.—An illustrated article describing the new common battery exchange of the New York Telephone Company at Mt. Vernon, N. Y. The board is equipped at present for 1,000 subscribers and 170 trunk lines, but provision has been made for an ultimate increase to 3,500 subscriber lines and 340 trunk lines.—*Am. Elec.*, April.

An Independent Central Energy and Toll Line Office.—An illustrated description of the independent telephone exchange at Alton, Ill. The exchange has a capacity of 3,000 lines, and was built chiefly as a link in the long-distance system of the Kinloch Long-Distance Telephone Company, of Missouri. The system used is the common battery relay system.—*Am. Elec.*, April.

Common Battery Multiple Telephone Switchboard System.—EVANS.—An article, with diagrams, describing the common battery telephone switchboard system devised by F. W. Dunbar.—*Am. Elec.*, April.

Telephone Engineering.—DOMMERQUE.—Another of the series of articles on this subject by the same author, this one dealing specifically with the laying out of trunk lines.—*Am. Elec.*, April.

Statistical.—Articles on the effects of the telephone tariff of 1899, on the development of telephone service in Germany; on telegraphy and telephony in Germany in 1900; also in Australia; comparative notes on the extension and the importance of the telegraph service in Portugal and the Azores; on telegraphy and telephony in Belgium

New Books.

Methode Pratique pour Calculer les Moteurs Asynchrones Polyphase. By Boy de la Tour. Paris: Ch. Beranger. 216 pages, 70 illustrations. Price, 12.50 francs.

The author of this book will be remembered by many American engineers as one of the delegates of the Société Internationale d'Electricité to the Pan-American Exposition at Buffalo, and they will doubtless be interested in the able work before us. Simple and lucid, with the elegance and ease characteristic of the literature of his nation, M. de la Tour presents in eight chapters the most essential points of the theory and calculation of the induction motor.

The book is divided into eight chapters, which treat successively of the rotating field in general, of the electromotive and counter-electromotive forces induced by it, of the torque exerted by this field, of the influence of the number of slots on the shape of the rotating field, of the resistance of the squirrel cage armature, of the diagrammatic representation of the phenomena in polyphase induction motors, and finally of the practical application of the theory to concrete cases.

The book is clearly written and well illustrated. In the vector diagrams, representing the phenomena in induction motors, the author follows the methods of Blondel, Behrend and Heyland. He says, on pages 141, 142: "There exists, fortunately, a graphical method which permits with the aid of a single figure to predetermine with exactness and rapidity all the conditions of running between starting and synchronism, taking into consideration with all the accuracy desirable, the important effect of the magnetic leakage.

"This method, which is certainly one of the most beautiful applications of graphical processes for the solution of electrical problems, is due to the labors of Messrs. A. Blondel, B. Behrend and Heyland. Although M. A. Blondel did not notice that a certain point in the diagram is constrained to move in a circle, he has yet contributed much to this discovery, made separately and almost at the same moment, by Messrs. B. Behrend and Heyland. Mr. Blondel gave before any other author an analytical study of the working of polyphase motors based on a very simple diagram which forms the point of departure for the circle-diagrams of the two last-named engineers."

In thus giving Prof. Blondel credit for laying the foundation for a rational treatment of the theory of induction motors, M. de la Tour merely states a fact known to all those who are familiar with the literature of alternating-current theory .

As the theoretic treatment prevalent in this book is essentially based on graphical methods by whose aid the necessary formulas have been derived in a simple and clear manner, the book is bound to arouse severe criticism in the camps of those to whom the very words "graphical treatment" have become a war-cry. But let these critics learn from the history of science that the greatest progress in new ideas has always been made by the use and aid of mental pictures, from which the formulas have been derived. So we see that Sir Isaac Newton in his Principia developed his theorems, we see Fresnel in optics build up his wave theory in this way, and, finally, we see Faraday lay the foundation of the theory of electricity entirely and completely by these mental pictures.

Clerk Maxwell has put himself on record in regard to the value of a theoretical analysis which is based primarily on graphical processes. The dynamic phenomena of rotation are doubtless among the most complex phenomena of nature. Poinsôt introduced momentum by vectors, and this is what Maxwell says about it: "We find Euler and D'Alembert devoting their talent and their patience to the establishment of the laws of the rotation of solid bodies. Lagrange has incorporated his own analysis of the problem with his general treatment of mechanics, and since his time M. Poinsôt has brought the subject under the power of a more searching analysis than that of the calculus, in which ideas take the place of symbols, and intelligence propositions supersede equations.

"If any further progress is to be made in simplifying and arranging the theory, it must be by the method which Poinsôt has repeatedly pointed out as the only one which can lead to a true knowledge of the subject—that of proceeding from one distinct idea to another, instead of trusting to symbols and equations."

Both in the theory of rotation and in that of alternating-current phenomena the use of vectors, as introduced into the theory of rotation by Poinsôt, has proved extremely advantageous, because, in the words of Maxwell, it means "proceeding from one distinct idea to another, instead of trusting to symbols and equations."

The persistent misapprehension by some men who should know better of the realisms of graphical methods is, indeed, astonishing. In alternating-current phenomena the value of the diagram consists in giving a geometrical skeleton, in which the magnitude of the vectors used can easily be expressed trigonometrically, as preferable, in vector algebra by means of complex imaginary numbers. But the superficial critics of any work in which graphical processes are used to some extent, raise a hue and cry against its author, accusing him of a contempt for mathematics or worse. If they will only take the pains to familiarize themselves with the combination of geometrical and analytical methods, they will, to again cite Maxwell, "Find themselves very much enlightened during the process, and will even be doubtful whether the ideas as expressed in symbols had ever quite found their way out of the equations into their minds."

The Laws of Radiation and Absorption. Harper's Scientific Memoirs. Edited by D. B. Brace, Ph. D. New York: American Book Company. 131 pages, illustrated. Price, $1.00.

A new volume of the series of *Scientific Memoirs* is always a welcome arrival, putting as it does before the reader a group of allied papers dealing with some important topic of physical science, and gathered often from sources quite inaccessible to the ordinary student.

The present book takes up the development of the theory of radiation and absorption, beginning with the classical papers of Prévost, from which sprang the "Theory of Exchanges," and following through the telling researches of Stewart to the culmination of the work in the great papers of Kirchhoff and Bunsen, that form the basis of spectrum analysis.

Prévost's two memoirs make particularly interesting reading, forming as they do almost the beginning of thermal science. They are based, like the fundamental work of Carnot, on heat as a form of matter. The scientific gentlemen of the present day who are busy investigating the properties of electrons may find in Prévost's opening paragraphs some hints worthy their attention. In fact, Prévost's work gives a beautiful demonstration of the independence of fluent quantities from particular conceptions of their physical nature.

To the ordinary reader the most interesting part of the volume is the translation of the epoch-making research of Kirchhoff and Bunsen. It is hard to realize at this day the profound sensation which it produced in the scientific world, but it is even now vastly instructive and forms the best possible introduction to the study of spectrum analysis.

The editor has furnished brief biographical sketches of the various authors, and has also added a very useful bibliography of the subject, including the most important papers which have been published up to date. It is a pity that the observations of Foucault, on the reversal of the D lines, were not translated in full instead of merely mentioned in a foot-note, since the original is not easily obtained, and fruitless as the observation was at the time, it was very important.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass, June 18—21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Engine Builders' Association of the United States. Next meeting, Pittsburg, Pa., May 22 and 23, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

National Electric Light Association. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902. (See programme on page 804.)

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Ohio Street Railway Association. Next meeting June, 1902.

Wireless Telegraph Bids.

At Washington, on May 6, Gen. Greely, chief signal officer, opened bids for wireless telegraph service in Alaska, where the ordinary cables fail in important points, owing to climatic conditions. The principal connection wanted was across the waters of Norton Sound, connecting Fort Davis, Cape Nome, with St. Michael, either by one circuit or by a relay on Stuart Island. In the latter case, or "A" route, the greatest uninterrupted distance would be ninety miles; in the first or "B" case, the stretch would be about 108 miles. The department also called for bids for systems between Rampart City and Winter Houses, a distance of 136 miles, or preferably between Fort Gibbons and Bates Rapids, a distance of 165 miles from the seacoast inland. Five bids were received, and another bid is on the way from the Arco-Slaby Company, of Germany. Foote, Pierson & Co., of New York, offered to supply four sets of instruments in guaranteed working order for $28,800. Queen & Co., of Philadelphia, who are the makers of the apparatus of Prof. R. A. Fessenden, with which the Weather Bureau has been experimenting, offered to put in the system on Route "A" for $6,000, and Route "B" for $7,000. Masts would be supplied for $4,000 extra, and a speed of from twenty-five to thirty words a minute would be guaranteed. This company did not regard it as feasible to communicate overland in Alaska, but proposed a system from St. Michaels to the nearest coast point opposite Rampart City, and a land wire leading in.

The Marconi Company complicated its bid by a provision for royalties, and division of commercial business. It offered to put in the "B" route for $9,919, and the "D" route for $11,005. In addition the company wanted a royalty of $250 per annum for each station, and one-half the receipts from commercial business.

A Belgian Invasion of America.

Mr. Ernest Solvay, of Brussels, has recently organized what is known as the Institute for Sociology, under the direction of Professor Waxweiler, who was formerly the head of the Labor Bureau at the Ministry of Labor, and a professor in the University. The institute is to be installed in Leopold Park, the city of Brussels cooperating by giving the necessary land. Monsieur Solvay has provided for the operating expenses, and at the end of 25 years the building, with its contents, will revert to the state. The museum contains a large central hall with small rooms suitable for research and class instruction, a library with special departments devoted to statistics, commercial geography, the economics of history, and a technical department, which will contain photographs, charts, diagrams and documents explaining industrial processes, and, in general, the interpretation of technical processes in their application to modern business. Methods of invention and organization will receive particular attention.

M. Waxweiler, the director of the Institute, has commended to the Industrial Betterment Department of the New York League for Social Service most warmly, M. de Leener, civil engineer and scientific assistant at the Institute, his representative, who is now in this country, studying our industrial problems. The Solvay Institute of Sociology will interest itself with the same subjects as the League for Social Service, but its methods will be somewhat different. The Institute has been founded for the purpose of giving every one desirous of studying social questions suitable facilities. It will not concern itself with questions of politics or religion or industrial conflicts, as between capital and labor. Its purpose will be scientific exclusively. The Institute will not give general information to the public, but, of course, it will help in every possible way foreign students or scientists coming to Belgium. In short, it is a laboratory for the study of social questions.

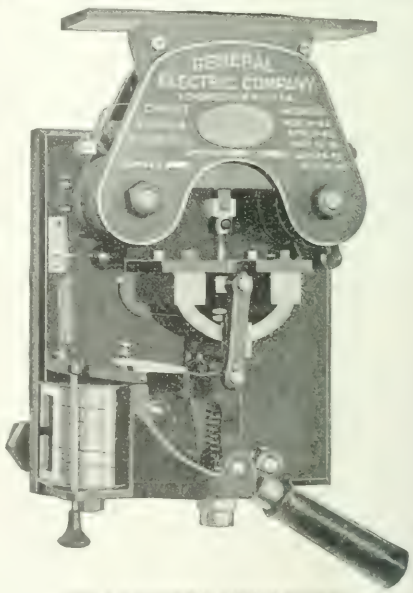
The League has placed its New York offices at the disposal of Mr. de Leener, who is especially desirous of securing photographs of shops, mills and factories, particularly the installation of machinery and the operation of automatic machines and labor-saving devices, such as electric motors, etc. Catalogues, special circulars, and whatever will interpret the use of the machine or device in department. All illustrative material will be fully credited to the individual or firm sending it, making special mention of the industry in question. It will be labeled with the name of the donor, and will be publicly acknowledged in the bulletins and in the review published by the Institute. All material for the Institute may be sent to the League, for M. de Leener, who will forward it to Brussels. Its receipt in New York will also be acknowledged.

If Americans will send the Institute photographs of their machines or of finished products, this material will come directly under the notice of those who are fitting themselves for positions as superintendents, managers and owners, where they will need just such machines and goods as they are making. Then, too, when they or their representatives are in Brussels, the facilities of the Institute will be at their disposal, so that they will be able to observe what other countries are doing along their own lines. Mr. de Leener's headquarters in New York are the offices of the League for Social Service, 287 Fourth Avenue.

Automatic Circuit-Breakers.

We illustrate herewith four types of magnetic blow-out automatic circuit-breakers for 500-volt direct-current circuits, made by the General Electric Company. The blow-out feature has been introduced for the reason, it is stated, that the only commercially practicable way of breaking direct currents at 400 volts and above is by the use of the magnetic field, which destroys the arc the instant of its formation, and, therefore, promptly and positively opens the circuit and prevents injury to the contacts. In these circuit-breakers the tripping point is adjustable to any desired current from 50 below to 50 per cent above the rated capacity, by adjustment of the calibrating spring of the tripping armature.

Fig. 1 shows a circuit-breaker having a capacity of from 150 to



2,000 amperes, and Fig. 2 one having a capacity of 3,000 to 10,000 amperes. These forms are especially intended for severe service, such as on generator and feeder panels, where the circuit is subjected to repeated and violent overloads. Destructive arcing is prevented by the use of supplementary contacts placed in a strong magnetic field, and arranged so as to break the circuit a moment after the current contact. The latter contact, which is built up of leaf springs, bears upon the main contact blocks when the breaker is closed. The coils of the blow-out magnet, and the secondary or plug contacts, are in multiple with the main contact. Owing to the comparatively higher resistance of the secondary contacts, practically no [illegible] when the main contact opens; then the

whole current passes through the magnet coils, and the strong magnetic field extinguishes the arc as soon as it is formed on the plug contact. The plug is not withdrawn until after the leaf contacts have left the contact blocks.

The circuit-breaker of Fig. 2 differs from that of Fig. 1 in the main brush, the manner of tripping, the arrangement of the secondary contacts, and in the dash-pot. The necessary power for tripping is obtained from a magnet, which is made in the form of a strap, encircling one of the main studs at the rear of the panel. Studs are carried through the panel to support the armature and form the necessary magnetic circuit; the armature spring and scale plate are, therefore, in front of the panel in an accessible position. The secondary contacts are held in place by a hinged clamp, and are so arranged as to be easily removed upon taking off the plate piece. The dash-pot has an adjustment by means of which the speed of tripping

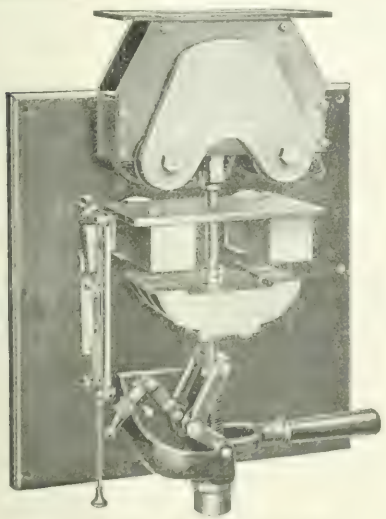


FIG. 2.

spring [illegible] the shock.

Figs. 3 and 4 show a circuit-breaker for use in small power plants where the conditions are not severe. Fig. 3 shows the instrument front connected, and Fig. 4 shows it back connected. This circuit-breaker is made for 100 to 500 amperes for front or back connection, and 200 to 800 amperes for back connection only. This, as well as the first two mentioned circuit-breakers, is supplied with an automatic locking handle. When the circuit-breaker is open, it is locked by removing the handle; and, when closed, the handle cannot be removed.

Fig. 5 shows a circuit-breaker which is made only up to 170 amperes, and is designed especially for protecting power circuits and stationary motors. As will be seen, in general principles it is somewhat similar to those shown in Figs. 3 and 4, but it has no secondary contact; it is, however, provided with arcing tips to protect the main contacts. The current is broken on a segmental contact similar to those used in railway trolleys. There is but one coil for both the tripping magnet and the magnetic blow-out, and the magnetic circuit is so arranged that the arc is ruptured in its field.

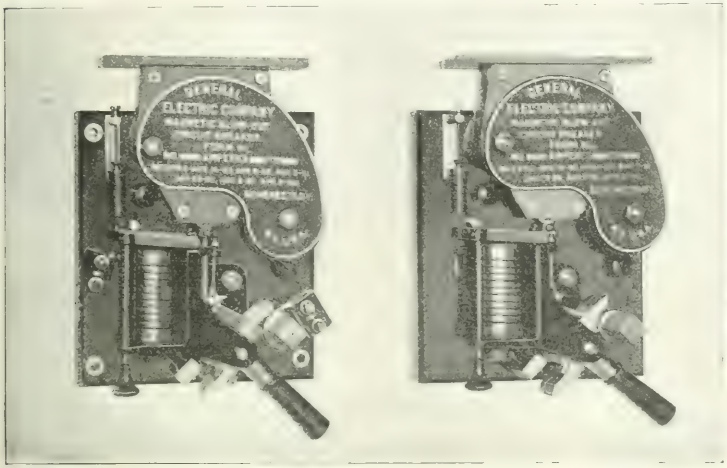


FIG. 3. FRONT CONNECTED CIRCUIT [illegible]

FIG. 4.—BACK CONNECTED CIRCUIT BREAKER.

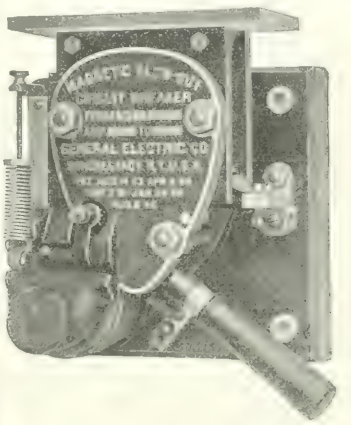
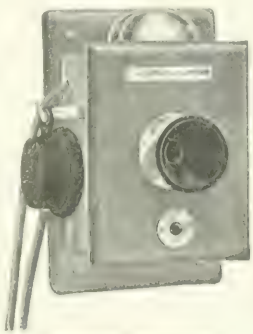


FIG. 5.—AUTOMATIC CIRCUIT BREAKER.

A New Telephone.

Owing to the rapid increase of private line telephones there is a growing demand for a first-class inexpensive telephone—that is, an instrument which "talks" perfectly, rings perfectly, which will not get out of order, and also finished in the manner that becomes telephone apparatus.

The Atwater-Kent Mfg. Works, of Philadelphia, has devoted a large amount of time and considerable expense in developing an instrument of this type, which is now being placed on the market under the name of the "Monoplex" telephone. A number of advantages are claimed for this type for use on short lines.



The hook has a long lever, and consequently there is a maximum motion at the contacts with the least motion of the hook. The receiver is of the watch-case type, and aside from the rubber ear cap is in one piece. There is thus no chance for a change in adjustment or of parts becoming loose. All connections are soldered, and the binding posts are so marked that there is no chance of mistake in connecting. Two wires are all that are needed between any two instruments, and complete directions for setting up are sent with each telephone. The Monoplex telephone will talk over a distance of three miles, and is thus admirably adapted for use in office, factories, hotels, apartments and private houses.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 6 [illegible] 4½ per cent. for thirty to sixty days. In spite of the high rates for call money, and sensational breaks in manipulated specialties, the general stock market was strong with an advancing tendency. New high-price records were made in a number of leading stocks, but the market on Friday declined in consequence of the fall in various specialties and "curb" stocks, the principal of which was International Power. This stock at one time advanced to 199, but dropped during the course of the week to 85, closing on Saturady at 90; the net loss for the week being 103 points. Steel stocks were dull and heavy, being unfavorably affected by reports about the company's position. There was general weakness in tractions and electric stocks, and all showed net losses on the week's business, with the single exception of Westinghouse 1st pfd., which closed with a net gain of 3 points. Westinghouse common closed at 220 ex-div., being a net decline of 5¼ points. General Electric was off 5 points, closing at 323; and Western Union ⅞-point, the closing quotation being 91⅜. Brooklyn Rapid Transit closed at 67⅛, being a net loss of 3⅛ points, and Met. St. R'y at 150½, a net loss of 1¾. Am. Telephone and Telegraph closed at 181 in New York, being a net loss of 2¾ points; in Boston it remained unchanged. American Dist. Telegraph rose to 40, thus making a net gain of 1½ points. In Boston, Western Telephone common closed at 28½, and preferred at 102. The closing quotations of May 6 follow:

NEW YORK.

	Apr. 29.	May 6.		Apr. 29.	May 6.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric Boat pfd.....	50	50	Tel. & Tel. Co. America..	—	4½
Electric Lead Reduc'n...	3⅞	—	Western Union Tel.....	92¾	91⅞
Electric Vehicle	7	7	West. E. & M. Co.....	224	219
Electric Vehicle pfd.....	12½	—	West. E. & M. Co. pfd....	225	220

BOSTON.

	April 29.	May 6.		April 29.	May 6.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
General Electric pfd.....	326	—			

PHILADELPHIA.

	April 29.	May 6.		April 29.	May 6.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Elec. Storage Battery...	86½	91½	Philadelphia Electric ...	5⅝	5⅝
Elec. Storage Batt'y pfd.	86½	91½	Pa. Electric Vehicle	1¾	—
Elec. Co. of America.....	7⅛	7⅛	Pa. Elec. Vehicle pfd....	5	—

CHICAGO.

	April 29.	May 6.		April 29.	May 6.
Central Union Telephone.	—	—	National Carbon pfd.....	91	89
Chicago Edison	167	170	Northwest Elev. com.....	37¼	38
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chicago Teleph. Co.....	—	—	Union Traction pfd.....	59½	56

*Asked.

CHICAGO EDISON COMPANY REPORT.—The Chicago Edison Company has issued its annual report for the year ending March 31, 1902. The latest showing surpasses all previous reports in that the net earnings amount to the million mark for the first time, the exact sum being $1,085,789.71, against $902,959 last year, $812,390 in 1900, $740,256 in 1899, and $327,854 in 1892. Dividends of $515,982 were paid during the year, with $300,983 of fixed charges. The allied Commonwealth property earned net $271,763, against which the fixed charges were $167,260. In the previous year the Chicago Edison net was $902,958, and the Commonwealth $218,871. President Insull is to be congratulated upon the brilliant success of his administration, at once progressive and conservative.

LEASE OF PHILADELPHIA TROLLEYS.—At a special meeting, on May 5, of the stockholders of the Union Traction Company, which controls all of the street railway lines in this city, resolutions were adopted favoring the lease of the company's franchises to the Philadelphia Rapid Transit Company, and empowering the officers to execute the lease which becomes operative July 1. Of the 600,000 shares of the company, 442,623 were voted in favor of the project. Another resolution was adopted empowering the Directors to issue $1,500,000 fifty-year, 4 per cent. collateral gold bonds to fund the company's debt. The lease is for a period of 999 years.

TROUBLES IN DENVER.—The Denver Gas and Electric Com[illegible] to collect a note for $15,000, and on application of plaintiff, H. L. Doherty was appointed receiver for the company. The company is capitalized for $3,500,000, of which $2,650,000 is outstanding. It has authorized an issue of $5,500,000 gold bonds, and is responsible for $2,300,000 of 6 per cent. bonds now out. Its available cash assets are $250,000, and liabilities $500,000. It has been in financial troubles since it lost the contract for street lighting, over which litigation is pending.

KANSAS CITY MERGER.—It is understood in banking circles that as a result of the prolonged visit of representatives of the Armour interests to Kansas City radical and important changes are about to be made in the Metropolitan Street Railway Company and the Kansas City Electric Light Company. According to the reports the two companies are to be consolidated. The companies are capitalized at $33,000,000.

INTERNATIONAL POWER, with which Mr. J. Hoadley is prominently connected, has had violent fluctuations the past week, in connection also with General Carriage, under kindred control. The collapse of these securities has carried down more than one house in Wall Street, and has hurt the market generally. The underlying values have been hard to determine, and a feeling of insecurity has resulted.

KEYSTONE TELEPHONE.—In a circular just issued, the Keystone Telephone Company, of Philadelphia, says: "There have never been any negotiations to sell to the Bell Company, and all reports to that effect have been inspired by persons unfriendly to our interests; furthermore, there is a State law prohibiting a combination of competing telephone and telegraph companies."

BOSTON EDISON.—A special meeting of the stockholders of hte Edison Electric Illuminating Company, of Boston, is called for May 14, to vote on increasing the capital stock. The business of the company is growing with unparalleled rapidity, and plant must be installed to keep pace with it. President Edgar has been in New York during the past week.

ORDERS FOR LIGHTING PLANT.—It is stated that the Norristown, Pa., Electric Light and Power Company has just placed orders for three Ames engines of 250, 225 and 100 hp, two 250 hp Heine boilers, a Weber stack, 150 feet high, and General Electric dynamos, to be direct connected. Mr. D. A. Bertolette is superintendent.

BELL INSTRUMENTS.—The increase of 31,436 instruments in the net output of the American Telephone and Telegraph Company for the month ended April 20 is reported, as compared with the same month last year.

NEW HAVEN TROLLEYS.—An increase has been made in the capital stock of the Fair Haven and Westville Street Railway, New Haven, Conn., from $3,000,000 to $5,000,000.

GENERAL ELECTRIC STOCK.—At Schenectady, on May 5, General Electric stockholders voted to increase its capital stock to $45,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received by the mercantile agencies indicate that the seasonable weather throughout wide areas has helped distribution at retail, and improved re-order business with wholesalers. There are some exceptions, however, due to conditions affecting crops. In all industrial lines exceptional activity continues. In the building trades there is an active demand for material of all kinds, and the extreme activity continues. All obtainable measures of April trade point to its having been a satisfactory month. New business in iron and steel was generally in small lots, not because the demand is smaller but because supplies will not admit of large deliveries. A rather unique situation in the rail market is the price of old rails fit for relaying, which were held $4 above the nominal price for new rails. Slow deliveries of standard sections interfere with important terminal work at Pittsburg and other points. Finished products are scarce and high, and some mills are booked with orders far into 1903. Some very large orders for structural material were placed during the week. The number of business failures during the week, as reported by Bradstreet's, aggregated 174, as against 181 the week previous, and 163 the same week last year. The copper market remains quiet; transactions were few and of light volume. Prices are slightly lower, Lake being quoted at 11¾@12c.; electrolytic in cakes, wire bars and ingots 11⅜@11½c.; in cathodes 11⅛@11¼c., [illegible]

ELECTRIC PLANT FOR BRAZIL.—Labria, located in the wilds of Brazil, about 700 miles in a southwesterly direction from Manaos, is to have a complete up-to-date Yankee electric plant, which will be the first of its kind in that part of the world. The outfit, which will entail an expenditure of nearly $11,500 before it reaches its ultimate destination, is intended for lighting and pumping purposes, the water now used in Labria being conveyed from the river to the town by means of hand buckets. The plant is to consist of a 30-kw direct-connected generator, to be built by the C. & C. Electric Company; an engine of 50-hp from the Harrisburg Foundry and Machine Works, a Babcock & Wilcox water-tube boiler, a C. & C. switchboard, etc., and a triplex pumping outfit, which has not yet been ordered. There being no railroad within at least 1,000 miles of Labria, the plant will, on arrival at Manaos, be placed on a lighter and hauled up the river Purus to its destination. The time in transit from Manaos will be almost 15 days, and the freight charges alone will exceed 50 per cent. of the New York cost of the plant. The contract was secured through the Brazilian house of Bytton Brothers, whose New York offices are 117 Pearl Street, New York. The chief engineer of the firm, Mr. Charles A. Seibert, formerly connected with the C. & C. Electric Company and the Sprague Electric Company, who has come up from Brazil in connection with the Labria and other contracts, stated to a representative of the ELECTRICAL WORLD AND ENGINEER that negotiations are also being carried on with other small towns in Brazil for the installation of somewhat similar plants, and that there is an important market waiting development in that part of the world for small dynamos, ranging, say, from 5 hp to 10 hp, to be driven by kerosene oil engines. These outfits are wanted chiefly for lighting purposes on plantations. Mr. Seibert, according to present arrangements, will return to Brazil in about six weeks.

BUFFALO FORGE COMPANY.—The usual brisk demand for goods manufactured by the Buffalo Forge Company, of Buffalo, N. Y., is reported. Among the many contracts recently awarded to them might be mentioned the equipment of the Pennsylvania Steel Company's forge shop, at Philadelphia, Pa., with 20 down-draft forges, by means of which all smoke and gases are immediately and completely exhausted. Three large fan system heating plants for the Lake Shore and Michigan Southern Railroad shops, of Collinwood, Ohio, may also be mentioned. This contract consists of the heating and ventilating of the woodworking mill, passenger coach, paint shop, and the freight car repair shop. The Bowery Bay Building and Improvement Company, New York City, are to be furnished with a 200-hp horizontal, center-crank engine for electric lighting plant. This firm bought the company's engine awarded a gold medal at the Omaha Exposition in 1898, which has been in active service at their plant since date of purchase. The order now entered calls for the same type engine of a larger horse-power. The Buffalo Forge Company are also to furnish the Seaboard Realty Company, of New York, N. Y., six 120-hp engines and two 95-hp engines for the electric lighting plant of this company.

YANKEE METHODS and British workmen are still performing feats that startle the English public, which has hardly had time to cease from wondering at the records made in brick laying at the British Westinghouse Company's works, at Manchester, when it is called upon to admire the huge chimney stack of the generating station of the Mersey Railway Company, at Liverpool. Begun about Christmas time, the stack, which is about 250 feet in height, has been completed already, and stands a record-breaker, as far as expedition in building is concerned. The work has been carried out by the British Westinghouse Company, who have the contract for converting the Mersey Railway tunnel from steam to electric traction, and the work has been done by British labor under the direction of Messrs. J. Stewart & Co., famous for record-breaking time in the construction of the Manchester Works, the Galveston Docks and the renowned grain-elevator, "Kalumet K." From nearly every part of Liverpool the Mersey chimney, decorated with the American and British national flags, stands out plainly on the sky-line as the highest structure in that part of Cheshire.

COOLING AND CONDENSING PLANTS FOR ENGLAND.—The Wheeler Condenser and Engineering Company, 120 Liberty Street, has received the contract to supply three sets of cooling towers for the Stuart Street Station, of the Manchester Corporation Tramways. The plant is to be capable of dealing with 300,000 gallons of water per hour. Other British contracts recently secured include one for a cooling and condensing plant, to be installed in the Lister Drive Station, at Liverpool, to deal with 42,000 pounds of steam hourly. Another order is for extensions at the London United Tramways power house, Chiswick. This comprises a cooling tower with condensing plant capable of handling [illegible] also under order a cooling tower and condensing plant for the station at Lowestoft, and a similar equipment for a power house at Helsingfors, Finland. Five large sets have also been recently requisitioned for the Great Northern Railway power station, London, and a set each for the Erith, Blackheath and Greenwich electric light stations.

U. S. EXPORTS.—The United States maintains its position at the head of the world's exporting nations, despite the temporary reduction in the value of exports due to the shortage in corn available for exportation. The export figures for the nine months ending with March, as shown by the report of the Treasury Bureau of Statistics, indicate a drop of $58,681,957 in the total value of exports. When it is considered, however, that the value of corn exported fell, owing to the shortage in the corn supply, fifty-two million dollars below that for the corresponding period of last year, and that cotton, owing solely to a decrease in price, fell twelve million dollars below the exports of the same period of last year, the entire decrease is more than accounted for. Notwithstanding the reduction of fifty-nine millions in exports, the grand total of domestic exports from the United States exceeds that of any other country. The figures of domestic exports for the nine months ending with March are: From the United States, $1,062,432,158; United Kingdom, $1,019,466,437.

THE WESTINGHOUSE ELECTRIC & MFG. CO. has made an agreement with the Lorain Steel Company, whereby the Westinghouse Company acquired on May 1 the electric railway equipment business of the Lorain Company, formerly carried on under the name of the Steel Motor Company, at Johnstown, Pa. The Westinghouse Company will still continue to maintain the works at Johnstown, and sell the "Steel Motor" as an adjunct to its own electric railway business. It is important to note that, in view of the fact that the Westinghouse Company now controls the manufacture of the Lorain motors, these equipments hereafter shipped may be supplied with the nose spring suspension, covered by the patents controlled by the Westinghouse and General Electric Companies.

WAGNER MOTORS FOR BRAZILIAN PRINTING PLANT.—The state printing plant at Manaos, Brazil, is to be equipped with a number of small American motors, intended for printing presses, paper cutters, etc. Orders have already been placed through the export house of Bytton Brothers, for eight Wagner single-phase machines, varying from ½ to 2½ hp. Power to drive these motors will be derived from the existing Yankee electric lighting plant in that Brazilian city.

MOTORS FOR CEMENT WORKS.—The Sprague Electric Company has been awarded the contract for furnishing all the electric motors and generators to be used in the cement works at Hannibal, Mo. The order was given by the Atlas Portland Cement Company, which is the largest cement manufacturing company in the world, and the equipment consists of three 400-kw engine-type, split-pole generators and over seventy motors, ranging in sizes from 15 hp to 125 hp.

MR. EMMANUEL TSAKONAS, of Athens, Greece, advises us that he has established there a firm known as "Enterprises Generales D'Eclairage, Emmanuel Tsakonas," to supply electric light, power and acetylene apparatus. He has been engaged in business for some years with his brother. Catalogues, etc., should be forwarded to 45 Rue de Stade, Athens.

WESTINGHOUSE, CHURCH, KERR & CO. have been appointed engineers by the Pennsylvania, New York and Long Island Railroad Company for the construction of the electric underground road to connect the Pennsylvania railway at Newark with the Long Island Railway at Long Island City.

ENGINES FOR BEET SUGAR PLANT.—Two engines, built by the Ball Engine Company, Erie, Pa., direct-connected to Crocker-Wheeler generators, will be used to furnish electric light and power for the new beet sugar plant of the Macomb Sugar Company, Mt. Clemons, Mich.

POWER EQUIPMENT.—The Chillicothe Electric Railway, Light and Power Company, Chillicothe, Ohio, is preparing to make purchases of power equipment for its new power house. General Superintendent Joseph Myers was in Cleveland recently securing estimates.

IRON WORK CONTRACT.—The Milwaukee Electric Railway and Light Company will soon let the contract for the iron work for its new general office building, central car house and terminal station in this city. The building will be 320 feet by 200 feet, and five stories high.

LIGHTING PLANT PROJECTED FOR HONDURAS.—A scheme for the establishment of an electric lighting plant in Belize, British Honduras, is at present under consideration. In all probability the machinery will be purchased in the United States.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., have contracted with H. B. Coho & Co. (Inc.), 149 Broadway, New York, to represent it in the sale of "Onondaga" dynamos and motors in New York, New Jersey, Philadelphia and New England.

LIGHTING AND POWER EQUIPMENT.—Electric lighting, power equipment and electric elevators will be required for a large power building to be erected in Cleveland by J. V. N. Yates. Watterson & Clague have the contract.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended April 25: Antwerp—21 pkgs. material, $1,869; 2 pkgs. machinery, $90. Amsterdam—1 pkg. material, $11. Argentine Republic—52 pkgs. material, $1,317. Brazil—108 pkgs. material, $7,319; 4 pkgs. machinery, $410. British Australia—8 pkgs. material, $353; 54 pkgs. machinery, $13,268. Bremen—10 pkgs. material, $90. British East Indies—37 pkgs. material, $2,339; 6 pkgs. manufactures, $1,380. Breslau—2 pkgs. machinery, $19. British West Indies—6 pkgs. material, $75. Cuba—482 pkgs. material, $5,245. Central America—10 pkgs. material, $96. Chili—3 pkgs. material, $41; 1 pkg. machinery, $116. Christiana—1 pkg. material, $12. Copenhagen—3 pkgs. machinery, $121. China—15 pkgs. machinery, 375. Dutch West Indies—2 pkgs. material, $20. Dublin—41 pkgs. machinery, $4,345. Ecuador—42 pkgs. material, $672. French Possessions in Africa—2 pkgs. material, $250. Frankfort—1 pkg. material, $21. Glasgow—67 pkgs. material, $1,927; 1 pkg. machinery, $45. Hong Kong—24 pkgs. machinery, $750. Havre—19 pkgs. machinery, $851; 5 pkgs. material, $220. Hayti—11 pkgs. material, $106. Hamburg—16 pkgs. material, $794. London—262 pkgs. machinery, $15,569; 138 pkgs. material, $3,890. Liverpool—258 pkgs. machinery, $10,192; 34 pkgs. material, $1,293. Manchester—3 pkgs. material, $175; 361 pkgs. machinery, $45,012. Mexico—404 pkgs. material, $3,517; 3 pkgs. machinery, $263. Milan—4 pkgs. material, $2,500. Newcastle—13 pkgs. machinery, $964. Newfoundland—11 pkgs. material, $160; 1 pkg. machinery, $100. Nova Scotia—1 pkg. machinery, $23; 36 pkgs. material, $443. Naples—5 pkgs. material, $300. Nice—9 pkgs. material, $350. New Zealand—172 pkgs. material, $1,255; 86 pkgs. machinery, $10,000. Peru—37 pkgs. material, $1,499. Philippines—375 pkgs. material, $9,170. Siam—31 pkgs. material, $2,310. Southampton—103 pkgs. machinery, $6,350; 5 pkgs. material, $904. Santo Domingo—13 pkgs. material, $191. Stockholm—5 pkgs. machinery, $418. U. S. Colombia—12 pkgs. machinery, $180; 109 pkgs. material, $557. Venezuela—8 pkgs. material, $320. Zurich—3 pkgs. machinery, $95. Following is a list of the exports from New York during the week ending May 3: Antwerp—7 pkgs. material, $756. Argentine Republic—1 pkg. material, $186. British West Indies—12 pkgs. material, $103. British East Indies—55 pkgs. material, $7,974; 1 pkg. machinery, $107. Bremen—16 pkgs. material, $1,807. British Guiana—41 pkgs. material, $916. Bradford—2 pkgs. fire alarm machinery, $180. Brazil—32 pkgs. material, $1,280. British Australia—40 pkgs. machinery, $1,716; 140 pkgs. material, $9,799. Berlin—2 pkgs. material, $50. British Possessions in Africa—1 pkg. machinery, $45. Cuba—1 pkg. machinery, $125; 58 pkgs. material, $1,428. Central America—124 pkgs. material, $1,068. Copenhagen—2 pkgs. machinery, $500. Chili—9 pkgs. material, $314. Christiana—2 pkgs. machinery, $88. Dutch Guiana—1 pkg. material, $32. Dublin—15 pkgs. material, $975. Glasgow—3 pkgs. material, $121. Havre—25 pkgs. material, $1,572; 6 pkgs. machinery, $371. Hamburg—2 pkgs. material, $60. London—44 pkgs. machinery, $3,075; 235 pkgs. material, $5,198. Liverpool—155 pkgs. machinery, $9,400; 86 pkgs. material, $4,160. Mexico—28 pkgs. material $911; 17 pkgs. machinery, $3,596. Manchester—871 pkgs. machinery, $62,632. Newcastle—14 pkgs. motor machinery, $1,340. Rotterdam—7 pkgs. machinery, $1,379. Southampton—20 pkgs. machinery, $4,800; 4 pkgs. material, $190. Venezuela—142 pkgs. material, $539.

SOME C. & C. CONTRACTS.—The C. & C. Electric Company, of Garwood, N. J., whose New York offices are at 143 Liberty Street, reports recent receipt of a number of interesting contracts for both the foreign and domestic markets. Mr. C. R. Heap, of 47 Victoria Street, London, S. W., British agent of the C. & C. Company, has just sent over an order for five motors, varying from 4 hp to 20 hp each. The Seaboard Realty Company, of 127 West Forty-second Street, New York City, has ordered plants for three apartment hotels, which the concern is interested in up-town. The outfits consist of six 75-kw and two 60-kw generators for direct connection to 110-hp and 90-hp engines, respectively. The engines will be built by the Buffalo Forge Company, 39-41 Cortlandt Street. The Old Dominion Iron and Nail Works, of Richmond, Virginia, are to be installed with a 50-kw belted generator and nine motors varying in capacity from 6 to 25 hp each for machine shop use. The Gold Hill Copper Company, N. C., has requisitioned for a 50-kw generator, switchboard, and all-line material from the C. & C. people. The generator is to be direct connected to a 75-hp Harrisburg engine. This equipment is intended to be used for the Southern Company's smelting plant. A repeat order has been obtained from Moran Brothers, of Seattle, Wash., for four 20-hp vertical motors, for operating dry dock pumps. The Agnew Hotel, Atlantic City, will be equipped with a 50-kw C. & C. generator for lighting purposes. The Wheelwright Paper Company, of Wheelwright, Mass., has ordered a 125-hp generator and a 50-hp motor for power use. The Collins Manufacturing Company, of Philadelphia, has also ordered, for power purposes, two direct connected dynamos of 100-kw capacity each. A Durham, N. C., tobacco factory is to have 130 hp of motors. The Henriette Coal Mining Company, of Dunlo, Pa., has called for a 125-kw belted generator and switchboard, for lighting and running machinery at its mines. The new Astor Hotel, New York City, is to be furnished with a further lot of C. & C. equipment, six slow-speed, direct-connected motors, having just been ordered, for operating blowers. The motors will vary from 5 hp to 15 hp each. Further contracts now in hand include some 75 motors, varying from 5 hp to 50 hp each, for ventilating work, and about 10 dynamos for direct connection to gasolene engines, from 4 kw to 15 kw each.

SOME RECENT HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry and Machine Works, 203 Broadway, report receipt of a number of engine orders within the last two weeks. Mayer & Flockhart, of Newark, N. J., have requisitioned for a Harrisburg standard engine of 150 hp for direct connection to a 100-kw generator, to be built by the Crocker-Wheeler Company. The outfit is to be used for power and lighting purposes in the New Jersey concern's foundry plant. Two 50-hp engines have been ordered for lighting use in the Soldiers' Home, Washington, D. C. The Sprague Electric Company is to furnish two 35-kw generators for direct connection to these engines. The Newport News Shipbuilding and Dry Dock Company has ordered three 40-hp Harrisburg engines for direct connection to General Electric motors. These outfits are intended to be installed for lighting work in the new Old Dominion steamship now building at the Virginia yards.

THE WARREN ELECTRIC COMPANY, of Sandusky, Ohio, is preparing to expand its business. The company has recently been reorganized, and E. P. Breckenridge, a wealthy Toledoan, has become interested. The new officers are C. C. Warren, president and treasurer; E. P. Breckenridge, vice-president; Frank Warren, secretary, and H. B. Warren, chief electrician and engineer. Extensive improvement will be made to the plant. Plans have been prepared for additions, and, with property recently purchased, the plant will have a total frontage of 621 feet and a depth of an entire block from north to south. An electric crane, capable of handling 30 tons, will cover the new building, which will be 165 feet in length, and used as machine shop. Considerable new machinery will be installed, and the power capacity will be increased. The improvements will cost about $100,000.

OVERHEAD EQUIPMENT FOR NEW ZEALAND.—The electrical engineering and contracting firm of J. G. White and Company, of 29 Broadway, New York City, is about to make shipment of a quantity of overhead equipment to New Zealand, for the city of Auckland electric traction system, the contract for the construction of which was recently secured by their foreign department in London. The material to be covered in the shipment referred to is being supplied principally by the Albert & J. M. Anderson Manufacturing Company, of Boston, Mass., and the Ohio Brass Company, of Mansfield, O.

THE CHICAGO CITY RAILWAY COMPANY has projected improvements involving an outlay of $8,000,000. They include new car shops and the remodeling of the power supply system. A new $3,000,000 power plant, having a capacity of 30,000 horse-power, will be located at Thirty-ninth and Halstead Streets; the entire South Side system will be supplied from this plant. The consolidation of the generating plants is to be supplemented with the substations, which are to be connected with the central power station by trunk lines.

THE HYATT ROLLER BEARING COMPANY, of Harrison, N. J., is having plans prepared for a modern shop, to be erected on the property adjoining its present plant. The building will be 50 x 200, two stories high. The demand for the Hyatt roller bearings has reached such proportions that the company has entirely outgrown its present facilities. Samuel M. Green, of Holyoke, is the architect. This new shop is but part of the improvements which are being contemplated in order to take care of increasing trade, at home and abroad.

CONDUIT FOR SPRINGFIELD, MASS.—Mr. Guy M. Gest, of Cincinnati and New York, has taken contracts at Springfield, Mass., for two conduit systems, one for the United Electric Light Company, and the other for the Springfield Street Railway Company, being a duplicate contract to that of last year. The railway conduit will contain the feeders for the overhead trolley. The order covers half a million feet of conduit construction.

BOOSTERS FOR BROOKLYN EDISON COMPANY.—The Brooklyn Edison Company has just placed a contract with the C. & C. Electric Company for the furnishing of three special boosters, to be installed in its three stations. Each booster is to be composed of three machines, one 150-hp motor for driving two 50-kw double commutator dynamos.

THE NEW JERSEY TRACTION COMPANY has placed a contract with the General Electric Company for three generators of 1,500-kw capacity each.

General News.

THE TELEPHONE.

SAN JACINTO, CALIF.—The Suburban telephone system, San Jacinto, will install 24 miles of extensions during the month of May.

SAN FRANCISCO, CALIF.—The Farallones Cable Company, which was recently incorporated in San Francisco with a capital stock of $75,000, expects to lay a submarine cable from a point near the Cliff house to the Farallon group of islands. The cable will be 28 miles in length and the shore line to the city will be about 8 miles in length. After considering the merits of a wireless telegraph system, it was decided to install a cable, costing $50,000. A bill is pending in Congress for the creation of a Farallon cable or for the promotion of such an enterprise started by private individuals. The company hopes to secure aid from this fund. The incorporators, including L. G. Boardman and James F. Swift, intend to begin work as soon as permission is obtained from Washington to establish a cable landing on the islands. In exchange the company will allow the Weather Bureau the use of its wires.

FARMER CITY, ILL.—The Gibson Telephone Company has begun the erection of a new brick exchange building.

CHICAGO, ILL.—The Chicago Telephone Company has prepared plans for a new exchange at Hyde Park, to cost about $25,000.

CHICAGO, ILL.—The Union Electric Telephone and Telegraph Company, Chicago, has increased its capital from $2,500 to $400,000.

ELGIN, ILL.—The Chicago Bell Telephone Company has recently moved into its new building in this city. The new plant has a present capacity of 1,100 subscribers, and cost $74,000, including a $25,000 switchboard.

GALESBURG, ILL.—The Galesburg Union Telephone Company proposes to increase its capital stock from $100,000 to $150,000 and will hold a meeting on May 20 for the purpose of voting on the proposition. The plant will be enlarged to about twice its present capacity, and the company also intends to extend its service.

NEW CASTLE, IND.—The New Castle Telephone Company is installing a system which is to be in operation by June 15. The plant will be operated in opposition to the Central Union Telephone Company.

BEDFORD, IND.—The Star-City Telephone Company is putting in a switchboard of the latest and most improved pattern, and will soon have its system in operation. The company will give free connection with all the independent lines in this (Lawrence) county.

INDIANAPOLIS, IND.—The Parker Telephone Company, of Parker, has increased its capital stock to $10,000. The Plainfield Telephone Company has increased its stock from $10,000 to $25,000. Both companies will make improvements and extend their service.

MULBERRY, IND.—The Peoples' Co-operative Telephone Company of this place is extending its lines in every direction. The demand for telephones among the farmers is far greater than the company can supply and lines cannot be extended fast enough to satisfy the people in the country who want telephones in their homes.

ROCKPORT, IND.—The bitter telephone war which has been waging between the Cumberland and Home Telephone companies for several weeks past has been stifled by a restrictive ordinance passed by the Council, providing that no electric, telephone, or telegraph company can place any poles or wires on the streets without first submitting specifications of the same to the Street Committee of Council. All controversies arising over the placing of poles or wires are to be referred to this committee.

INDIANAPOLIS, IND.—The Philadelphia Telephone Company, of Philadelphia, Ind., has filed articles of incorporation with the Secretary of State, with a capital stock of $3,000. The line will be operated through Hancock County. Clinton Parker, J. M. Duncan, J. M. Smith and Burt Cohee are the directors. The Modoc Telephone Company, with headquarters at Modoc, Ind., has been incorporated. Capital, $5000. Directors: Sylvester Willis, Peter Stepanak, R. H. Hunt, H. A. Gaddis and F. F. Whelan.

WASHINGTON, IND.—There is a war among telephone companies in this county for supremacy. For a number of years the Bell Company has been located at Washington, but has given poor service, and when an independent company proposed to put in a new line the proposition was accepted by the citizens. The new company intends to erect a system extending over the entire county. Consequently the old company immediately began the construction of county lines. The war has begun and the people are waiting for the rate-cutting, which is sure to come.

SHENANDOAH, IA.—An independent telephone system will be built here as soon as a franchise can be secured therefor.

DES MOINES, IA.—The Linden & Adel Telephone Company, capital $6,000, has been incorporated by H. Howell and others.

DES MOINES, IA.—The Colfax Telephone Company, with a capital stock of $10,000, has been incorporated here, with Henry Fellows and others as incorporators.

DES MOINES, IA.—The Midland Telephone Company, of Milford, has been incorporated with a capital of $25,000. P. Rasmussen, C. Torstenson, L. C. Fuller, H. S. Abbott, O. A. Hemphill, J. O. Stephenson, W. E. Hall, G. A. Paton, G. E. Blunt and J. T. Way are the incorporators.

DAVENPORT, IA.—The Iowa Telephone Company, at its annual meeting at Davenport, April 24, passed a resolution amending the articles of the incorporation of the company as follows: That the $1,275,000 of stock issued and outstanding of the company's $4,000,000 authorized capital should be common stock and that all stock issued in the future shall be preferred stock, drawing 5 per cent. annual interest. The acceptance of this rule is made optional with the present shareholders who may, if they wish, exchange their present stock for preferred stock. The change affects nearly $2,000,000 stock still to be issued. The following officers were elected: C. E. Yost, of Omaha, president; F. H. Griggs, vice president; J. B. Mason, secretary and treasurer, and E. B. Smith, general manager.

TOPEKA, KAN.—The Seneca County Telephone Company has increased its capital stock from $5,000 to $10,000.

JACKSON, MICH.—The Rollin Telephone Company will extend its line from Hudson to Jackson.

JACKSON, MICH.—The Peoples' Telephone Company has forfeited a check for $1,000, deposited with the city treasurer to insure the completion of the plant by March 31. Construction work has been held up through the financial difficulties of the Federal Telephone Company, which controls the plant.

JEFFERSON CITY, Mo.—The Southern Union Telephone Company of Illinois filed evidence of incorporation, with a capital of $10,000, of which $1,500 is to be used in Missouri, with office at Cape Girardeau.

CARTHAGE, MO.—The consolidation of the independent telephone companies of the mining cities of southwest Missouri was effected April 24. The formal transfer of stock was made to the New officers of the consolidated company. The new company is known as the Mineral Cities' Telephone Company and its capital is $300,000. The independent companies are those of Joplin and Carthage, Webb City and Centerville, Mo. J. W. Layne, of Carthage, is the promoter and president of the new company and the general offices will be in Joplin.

OMAHA, NEB.—The Henry County Telephone Company, of Mt. Pleasant, has increased its capital stock to $15,000.

BUFFALO, N. Y.—The Frontier Telephone Company will lay new telephone conduits. The contract involves an expenditure of about $400,000.

STATESVILLE, N. C.—The telephone company which is to build a line from Ronda to this place has been organized, with John Sowers, of Ronda, as president, and a capital of $1,000.

GRAFTON, N. D.—The Northwestern Telephone Company will build another line from Grafton to Langdon via Park River.

SULPHUR SPRING, OHIO.—A new telephone exchange is to be established here.

WAUSEON, OHIO.—The Northwestern Ohio Telephone Company is constructing a line to Pettisville.

WAKEMAN, OHIO.—The Wakeman Mutual Telephone Company has been incorporated, with a capital of $6,000.

ELYRIA, OHIO.—The Elyria Southern Telephone and Toll Company has increased its capital stock from $20,000 to $40,000.

ADA, OHIO.—The Ada Telephone Exchange has increased its capital stock from $30,000 to $75,000. Improvements will be made.

HASKINS, OHIO.—The Haskins Mutual Telephone Company has been incorporated, with $10,500 capital stock, to build a local system.

COLUMBUS, OHIO.—The Collinwood Home Telephone Company, of Collinwood, has increased its capital stock from $30,000 to $40,000.

WILSHIRE, OHIO.—The Citizens' Telephone Company, of Wilshire, is building lines to Steele and Wilshire, connecting up a large number of farmers.

CINCINNATI, OHIO.—The Cincinnati Telephone Company, a Kentucky corporation, has been authorized to do business in Ohio, with headquarters in this city.

WOOSTER, OHIO.—The local telephone exchange is to be greatly improved. New cables are to be put up and the common battery system is to be installed in the exchange.

WASHINGTON, C. H., OHIO.—The Citizens' Telephone Company is enjoying rapid growth. It has placed 366 telephones during the past year, a gain of over 50 per cent.

COLUMBUS, OHIO.—The Manchester Telephone Company has been incorporated with $1,500 capital to construct telephones in Manchester and through Adams and Brown counties.

MANSFIELD, OHIO.—The Star Telephone Company is building lines to Pleasant Valley and Germany, connecting up a number of farmers in these districts. The company has 600 telephones in Mansfield.

TOLEDO, OHIO.—All the necessary material to complete the plant of the Toledo Home Telephone Company is in the city, and the construction work is being pushed rapidly. It is expected the system will be ready not later than June 1.

DELAWARE, OHIO.—The Delaware Citizens' Telephone Company has placed a contract with the Stromberg-Carlson Telephone Company for a new improved multiple central-energy switchboard of 1,800 lines capacity. The company now has 960 telephones in operation and is growing rapidly.

TOLEDO, OHIO.—Representatives of the Putnam County Telephone Company, the Northwestern Telephone Company and the Napoleon Home Telephone Company held a conference with representatives of the Toledo Home Telephone Company a few days ago, relative to toll line and farmer line rates.

DAYTON, OHIO.—The Dayton Home Telephone Company, recently sold by the Federal Telephone Company, is now in the hands of Dayton and Columbus people. Work on the conduit system is to be pushed at once and an exchange building is to be erected at Fourth and Jefferson streets. The company has over 4,000 contracts for telephones.

BELLEVUE, OHIO.—The Bellevue Home Telephone Company has elected directors as follows: H. C. Stall, B. F. Bell, W. M. Halliday, F. A. Knapp, D. Calhoun and C. R. Callighan. F. A. Knapp was elected secretary and W. M. Halliday, treasurer. The company has 410 telephones in operation and made a a net gain of 40 telephones during the year.

LORAIN, OHIO.—Directors of the Black River Telephone Company met a few days ago and decided to double the capital stock of the company and to increase the capacity of the exchange to 1,000 lines. A new building will be erected and a common battery system installed. Considerable quantities of poles, cables, copper wire and batteries will be purchased. A. W. Hoge, consulting engineer, has charge of the work.

NORWALK, OHIO.—The Huron County Telephone Company is making numerous improvements to its property. It has about 800 telephones in operation and numerous country extensions have been projected which will increase the list of farmer subscribers. A new line will be built from New Washington to Sulphur Springs, giving direct connection with Bucyrus. The earnings of this property have increased rapidly and a recent proposition to sell has been turned down by the present owners.

NORWALK, OHIO.—The Norwalk Telephone Company has just been reorganized with a large amount of new capital. The work of rebuilding the line is being pushed vigorously. All new poles are being set, new wires strung, and it is to be a new plant all through. It is to be a full metallic circuit, all copper wires, on the central energy system. The Bell Company, a few weeks ago, doubled its rates, but now it is seeking to regain many of its old customers. The Norwalk Company will maintain the old rate of $1 a month for houses and $2 a month for business places.

BAKER CITY, ORE.—A new telephone line between this city and the Virtue Mining District has just been completed. Gradually the telephone company is connecting all of the important mining camps of Eastern Oregon with the central office in this city. Several more lines will be constructed this year.

PHILADELPHIA, PA.—The Delaware and Atlantic Telegraph and Telephone Company has decided to construct an underground conduit from Philadelphia to Wilmington, which will pass through all the boroughs along the line of the Chester pike.

NASHVILLE, TENN.—The Jackson Home Telephone Company, of Madison County, capital stock $110,000, has been incorporated by James L. Dunn, James D. Lloyd, R. F. Spragins, J. H. Hoffman and W. D. Nelson.

SHIRO, TEX.—The Shiro Telephone company will extend its line to Loma.

SALT LAKE CITY, UTAH. The Rocky Mountain Bell Telephone Company is installing an exchange at Lander, Wyo., and will at once start building north to Thermopolis and into the Big Horn country.

SALT LAKE CITY, UTAH. The Rocky Mountain Bell Telephone Company has doubled the Ogden exchange in the past six months and has just added another section to the local switchboard, capable of handling 800 new subscribers.

RICHMOND, VA.—The Goochland Telephone Company has been organized with a minimum capital of $500 and a maximum of $5,000. H. D. Leake was elected president; C. H. Powell, secretary; Dr. W. M. Holman, treasurer, and R. H. Monteiro, general manager.

BANGOR, WIS.—Bangor Telephone Company has incorporated, with a capital stock of $5,000.

LA CROSSE, WIS.—The Interstate Telephone Company has increased its capital stock from $100,000 to $150,000.

OSSEO, WIS.—The Osseo Telephone Company has decided to issue bonds for $8,000 to build new lines to Fairchild, Fall Creek, etc.

McFARLAND, WIS.—The McFarland Telephone Company, capital, $2,500, has been incorporated by E. N. Edwards, M. D. Larson and others.

CHEYENNE, WYO.—The citizens threaten to organize an independent home telephone company unless the Rocky Mountain Bell Telephone Company reduces the rates for telephones in and around Cheyenne.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—The city of Montgomery has contracted with the Montgomery Light and Power Company for 242 arc lights for ten years at $51 per light per year. This is is said to be the lowest price for similar service in the United States. This low rate is due to power being generated by water power at Tallassee Falls, 35 miles away. Electric power for manufacturing purposes is to be offered at prices lower than steam plants can produce it.

SAN FRANCISCO, CALIF.—The Santa Fe Pacific Railroad has made an appropriation for improvements at the shops in Needles, Calif., and will install an electric lighting plant.

SAN FRANCISCO, CALIF.—The General Electric Company through its Salt Lake City agency recently closed a contract with the United States Mining Company for two additional electric locomotives. The company now has in use an electric haulage system with three electric locomotives.

SAN FRANCISCO, CALIF.—The City Council of Chehalis, Wash., will take action on an ordinance recently introduced granting the Snoqualmie Falls Power Company a franchise for an electric power line. Chehalis is on the line of the company's proposed extension from Puget Sound to Portland, Ore.

SAN FRANCISCO, CALIF.—The United Gas and Electric Company, which was recently incorporated in San Francisco by C. E. Green, W. Gregg, jr., C. O. Poole, J. E. Green and C. H. Pennoyer, has a capital stock of $2,500,000. Several of the incorporators are also connected with the Consolidated Light and Power Company, which is in close relations with the Standard Electric Compan. The United Gas and Electric Company will take the place of the Consolidated Company as the distributor of the Standard Electric Company's current in the counties south of San Francisco. It has also arranged to purchase the Electric [illegible]

solidated Company will be placed under one roof. The system will be extended wherever there is a demand for elctric light and power and gas.

HARTFORD, CONN.—The woolen mills at Buckland of the E. E. Hilliard Company are now operated by electric power generated at the Hockanum River water-power plant, which was bought by the Hilliard Company several months ago. Power is transmitted a third of a mile to the Hilliard mills. Besides the power used in the mills, there is a surplus sufficient to light the buildings. The plant is designed to provide for a change from electric power to steam on short notice.

CHICAGO, ILL.—The United Water and Light Company of Chicago, has been incorporated. Capital stock, $200,000. Incorporators: Waldo F. Tobey, Gail Dray and George C. Madison.

EDWARDSVILLE, ILL.—At a special meeting of the City Council a franchise was granted for furnishing electric lights and power for public and private use, for a term of fifteen years to J. R. Bennet, of Wyandotte, Mich. The franchise provides for 50 street arc lights for the city at a rate of $69 per year each. The franchise held by the Edwardsville Electric Light and Power Company expires October 14 of the present year.

ST. CHARLES, MO.—T. W. Crouch and other capitalists of St. Louis, have bought for $100,000 the St. Charles electric plant, which supplies both light and power. It is the intention of the new owners to enlarge the plant considerably and to widen the scope of its operations. Those interested with Mr. Crouch are F. W. Child, Paul A. Furz, Edgar A. Tilton and Edward S. Lewis.

CANTON, MO.—The Canton Electric Light Company has asked an injunction to prevent the town of Canton from building and operating an electric light plant, on the ground that this is not one of the functions of the municipality. The town recently made arrangements to furnish itself and its citizens with light and the old company seeks to prevent the consummation of these plans. The case has been submitted on briefs in the United States District Court in St. Louis.

LEBANON, OHIO.—The recent election resulted in favor of an issue of $6,000 electric light bonds.

LA RUE, OHIO.—A proposition to issue bonds for the purpose of building a municipal lighting plant has been voted down.

CANTON, OHIO. The Canton Light, Heat and Power Company is installing a new electric coal conveyor system in its power house.

LOVELAND, OHIO.—Gen. T. T. Heath, of this place, is organizing a company with $100,000 capital stock to erect an electric light and water works plant.

BRADNER, OHIO.—The village of Bradner is securing estimates on the cost of a municipal lighting and water works plant. This is the second time bids have been called for.

ZANESVILLE, OHIO.—The Citizens' Electric Light Company, which has secured a franchise for an electric lighting and hot water heating system, is preparing plans for its new plant. It is probable that water power will be used. William Scott, of Chicago, and C. G. Griffiths, of Zanesville, are the chief promoters.

COLUMBUS, OHIO.—The East Columbus Heat and Light Company has applied to the city for a franchise to furnish heat, light and power, steam and hot water in a certain district in this city. Electricity for lighting is to be furnished at 15 cents per kilowatt for 12½ years, with discounts for cash from 10 per cent. on $20 or less to 40 per cent. on bills of over $100. For power the rate is to be 7½ cents per kilowatt. After 15 years the city is to have the option of acquiring the plant at a price set by arbitrators.

ALTOONA, PA.—The Citizens' Electric Light Company, with a capital of $150,000, has been organized here. S. S. Reighard is president of the new company.

MONTREAL, QUE.—The first cement plant in Canada to be operated by electric power is that of the National Portland Cement Company at Durham, Ont. All of the cement-making machinery in this plant will be driven by induction motors supplied with current by two Westinghouse 450-kw three-phase alternators. The Westinghouse Company also furnishes the 8-panel switchboard and instruments.

SALT LAKE CITY, UTAH.—Active work is now under way for securing more water power at the falls near Spokane, Wash., to be used in operating the mines at the Cœur d'Alene.

SALT LAKE CITY, UTAH.—A Chicago company will build a large power plant on the Shoshone Falls of the Snake River in Idaho. Power will be transmitted over a radius of 100 miles.

SALT LAKE CITY, UTAH.—The county commissioners of Ada County, Idaho, have granted a franchise to The Electric Power Company, Limited, for the erection and maintenance of a pole line throughout the highways of the county. The franchise runs for 50 years.

SALT LAKE CITY, UTAH.—The Cascade Electric Company, of Idaho Springs, Colo., will immediately double the capacity of the transmission line from Georgetown to Idaho Springs, and in addition will build its lines into Gilpin County for the purpose of furnishing power to the mines in that section.

SALT LAKE CITY, UTAH.—A. H. Tarbertt, of Salt Lake City, has entered into contract with the Westinghouse Electric and Manufacturing Company for the construction at American Falls, Idaho, of an electric plant to develop 3,000-hp, to be utilized for lighting the city of Pocatello, and to furnish power for the operation of the Union Pacific shops. A contract has already been entered into between the railroad company and Mr. Tarbertt.

SALT LAKE CITY, UTAH.—A company, headed by F. J. Bridge, vice president of the American Falls Water Power, Light and Irrigation Company, [illegible] to erect a power and pumping plant at American Falls. With the power thus obtained water will be pumped to an

elevation which will enable the irrigation of a vast tract of land situated in the Fort Hall reservation, Idaho. Nearly all the members of the company are from Joliet, Ill.

SALT LAKE CITY, UTAH.—The Mitchell-Copeland Power Company, recently incorporated in Los Angeles, Calif., will erect a large power plant at Butte, Mont., using the waste heat of discarded slag from the smelters. By the power thus derived the company will operate the street railway and lighting systems of the city. It is estimated that the smelters at Jerome, Ariz., handle more than 900 tons of ore a day, throwing away about 600 tons of slag every twenty-four hours. It is claimed that from the discarded slag one and one-half pounds is equal to a pound of coal for the purpose of generating power. Mr. Mitchell has made an offer, which has been accepted, to work the slag at Butte, where he will furnish the copper plant with free power, and with the surplus he will light the city and operate the street railway system.

YAKIMA, WASH.—The Yakima Water, Light and Power Company will install an additional generator in North Yakima, and will extend the electric system.

WAUKESHA, WIS.—The city has awarded a 20-year franchise to the Waukesha Electric Light Company for street lighting.

THE ELECTRIC RAILWAY.

BANGOR, ME.—The Hancock County Railroad Company has purchased water powers on Union River to the value of $30,000 for the purpose of generating electric power for a trolley line, to connect the principal towns of Hancock County. The railroad company announces its intention to expend $300,000 on its system, in addition to the $30,000 paid for water powers and the expense of building a dam.

MUSKEGON, MICH.—An electric railway from Manistee to Muskegon is being promoted by L. S. Mace, J. S. Huey and R. H. Lanyon, of Chicago.

DETROIT, MICH.—Motormen and conductors on the lines of the Detroit United Railways are endeavoring to secure an increase in pay of from 20 to 25 cents per hour.

JACKSON, MICH.—The Detroit, Ypsilanti, Ann Arbor and Jackson Railway has been opened to Jackson. The first car made the run from Detroit to Jackson in 3 hours 45 minutes.

HOLLAND, MICH.—The Grand Rapids, Holland and Lake Michigan Railway has reduced the fare between Grand Rapids and Holland from 90 to 70 cents round trip, to meet the competition of the steam road. Two new generators have been installed in the station at Jenison which will permit of the operation of twice as many cars as at present.

KALAMAZOO, MICH.—When the interurban line was in process of construction between Kalamazoo and Battle Creek the farmers protested vigorously against the line, claiming it would injure farm values. Instead of having been a detriment the road has increased the price of land enormously. For a distance of eight miles out of Kalamazoo land is now held at $150 per acre, while equally as good land at the same distance from the city, but away from the electric line, can be purchased at $75 per acre.

NASHUA, N. H.—Articles of incorporation have been filed for the Nashua and Pepperell Street Railway Company, with a capital stock of $50,000. The directors are Wallace D. Lovell, Newton, Mass.; Edmund B. Fuller, Haverhill, Mass.; G. F. Marshall, Malden, Mass., and A. W. Dean, H. G. Holden, J. L. H. Marshall and O. B. Tilton, all of Nashua.

SYRACUSE, N. Y.—The new trolley road from Syracuse to the Indian Reservation has been completed, and cars are now running.

TROY, N. Y.—A new electric railway from this city to Williamstown, Mass., is to be built this summer. It will be 50 miles in length. George E. Greens, of Hoosic Falls, is president of the company that will build the road.

GUTHRIE, OKLA.—A charter has been issued to the Topeka, Lawrence & Kansas City Electric Railway Company for 20 years to establish a railway between Topeka, Kan., to Kansas City, Kan., and Kansas City, Mo., via Lawrence, Kan., the estimated length of the road being 75 miles. The capital stock is $2,000,000 and the principal offices are to be at Lawrence, Kan., and Oklahoma City, O. T. The officers of the company are J. B. Adams, H. M. Levan, R. Levan, T. S. Salathiel, Independence, Kan., and M. L. Adams and E. R. Salathiel, of Oklahoma City.

AKRON, OHIO.—The Northern Ohio Traction Company has announced a voluntary increase of wages on its surburban roads.

MANSFIELD, OHIO.—The Citizens' Railway, Light and Power Company, which owns the Shelby-Mansfield road, is planning to extend the line to Plymouth.

TIFFIN, OHIO.—The James G. Corcoran Company, of Pittsburg, has the contract for building and equipping the line of the Tiffin and Southern Railway Company.

TOLEDO, OHIO.—The Toledo, Bowling Green and Southern Railway is now operating cars through Toledo to Findlay, the connecting link having been completed.

CINCINNATI, OHIO.—The Cincinnati, Newport and Covington Street Railway Company contemplates extending the Ft. Thomas line to Cold Springs, Ky.

EAST LIVERPOOL, OHIO.—J. N. Taylor is president and W. L. Smith secretary of a company formed by local people to build an electric railway from Canton to East Liverpool.

WARREN, OHIO.—The Trumbull County commissioners have granted a 35-year franchise through the county to the Conneaut and Southern Railway, which proposes to build from Conneaut to Youngstown.

LIMA, OHIO.—Seven additional miles of the Western Ohio Railway were placed in operation April 23. Cars are now in regular operation from Lima to New Bremen. The Minister extension will be opened in a short time.

SPRINGFIELD, OHIO.—The county commissioners have granted a 25-year franchise to the Springfield and Washington C. H. Traction Company permitting it to cross county roads. L. B. Corry, Dr. Gotwald and others, of Springfield, are promoters.

CLEVELAND, OHIO.—John Hoefgen, promoter of the People's Street Railway Company, popularly known as the three-cent-fare road, has deposited a certified bond for $25,000 with the city auditor to insure the building of the roads, in compliance with the terms of the ordinance.

CLEVELAND, OHIO.—The Canton Bridge Company is erecting a 400-foot bridge across the Vermillion River, on the line of the Cleveland, Elyria & Western Railway. When this is completed, about six weeks hence, the Norwalk extension of the road will be opened for traffic.

IRONTON, OHIO.—The Ohio Valley Traction Company has been incorporated, with $100,000 capital stock, by Levi D. York, Raymond D. York, Samuel P. Baird, John H. Lange and Henry W. Miller. The same parties are interested in the Portsmouth Street Railway.

STEUBENVILLE, OHIO.—The Steubenville, Mingo and Ohio Valley Traction Company is surveying and grading for its extension from Brilliant to Martin's Ferry and Wheeling. Manager Flynn states that power equipment for the new station has been contracted for and that a site will be purchased at once.

CLEVELAND, OHIO.—General Manager Andrews, of the Eastern Ohio Traction Company, is securing estimates on a storage battery plant of 400-ampere-hours capacity for the power station at Gates Mills. The company has two large storage battery stations on its Chagrin Falls division which are giving satisfactory results.

NEW CARLISLE, OHIO.—The Village Council has passed a resolution instructing that suit be brought against the Dayton, Springfield and Urbana Railway for the purpose of damages and to eject the road from the streets of the corporation of New Carlisle. This portion of the road is known as the Springfield and Western Railway.

CLEVELAND, OHIO.—The Callinan Construction Company has placed a contract with the Carnegie Company for twenty miles of 75-pound T-rails for the Indianapolis, Greenwood and Shelbyville Railway. It was originally intended to lay 60-pound rails, but these could not be obtained for nine months, whereas the manufacturers agree to deliver the heavier rails within three months.

CINCINNATI, OHIO.—The Newport & Alexandria Traction Company has received estimates on the cost of building the road. Double-track line from Newport to Fort Thomas and single track the balance of the distance will cost $390,000, and the average grade will be about 2½ per cent. The power house will be erected near Newport and the company will enter the lighting field in that place.

FINDLAY, OHIO.—The promoters of the Findlay and Marion Railway Company claim to have completed negotiations in New York for the financing of their project. A 30-foot private right of way has been obtained from Marion to Findlay, with a branch from Carey to Fostoria, a total of 62 miles. The road will be a connecting link between Toledo and Columbus and it will cost about $1,500,000 to build. It is stated that work will commence at once.

STEUBENVILLE, OHIO.—The Steubenville Traction and Light Company has elected officers as follows: M. W. Stround, president and treasurer; W. McMiller, secretary and attorney, and J. R. Ross, superintendent. Directors: Morris W. Stround and John C. Lowrey, Philadelphia; R. G. Richards, J. C. Ross and M. McD. Miller, of Steubenville. The company is making extensive improvements to its road and will shortly be operating cars to Toronto.

TOLEDO, OHIO.—The Toledo, Columbus, Springfield and Cincinnati Railway Company has adopted a unique plan of selling its stock and at the same time popularizing the road by making as many people as possible interested in its early construction and operation, to the end that it may prove a financial success. The plan is to sell applicants for positions a share of stock for $10 and then place their applications on file, assuring them the preference for appointment when the road is ready to operate. The company is building from Lima to Bellefontaine and hopes to extend to both Toledo and Columbus.

NEW INDUSTRIAL COMPANIES.

THE CHIPMAN ELECTRIC PURIFYING COMPANY, of New York, has been incorporated; capital, $200,000. Directors: J. R. Davies, Brooklyn; W. R. Chipman and I. E. Doying, New York.

THE MAGNETO-ELECTRIC PURE WATER COMPANY, of Greater New York, has been incorporated; capital, $1,000,000. Directors: John T. Harris, George S. Bixby and Horatio S. Burne, of New York, and Smith M. Weed, of Plattsburg, N. Y.

THE AMERICAN ELECTRIC ALARM COMPANY has been incorporated in Jersey City, N. J., to manufacture electric alarm devices; capital, $500,000. Incorporators: L. B. Dailey, H. O. Coughlin, Paul Tissen, Aug. S. Meeker and K. K. McLaren.

OBITUARY.

MR. J. H. CASSIDY. John H. Cassidy, the manufacturer of electric and [illegible] West [illegible] Mass., [illegible] He was 82 years old and was one of the oldest established dealers in his line in New York. His widow, who was a Miss Deborah Jones, of Philadelphia; a daughter, Mrs J. B. McCoy, of South Orange, and a son, J. C. Cassidy, of [illegible]

PERSONAL.

MR. M. K. [illegible] the recent reorganization of the Buckeye Electric Company.

MR. J. C. CHAMBERLAIN has resigned as vice president and general manager of the Electric Launch Company of Bayonne, N. J.

MR. H. H. GEARY has been put in entire charge of the selling organization of the Fostoria Incandescent Lamp Company, of Cleveland, Ohio.

MR. C. A. COFFIN, president of the General Electric Company, has been elected a member of the New York Chamber of Commerce.

MR. W. DULLES, JR., has just been elected to the presidency of the American Stoker Company and as a resident member of the New York Chamber of Commerce.

MR. W. C. HUMSTONE, the well-known superintendent of the Metropolitan Division of the Western Union Telegraph Company, has resigned from that position.

MR. H. R. SUTPHEN has been appointed general manager of the Electric Launch Company of Bayonne, N. J., and is now actively directing affairs at the yards on the Passaic.

MR. W. B. JACKSON, traveling engineer for the Stanley Electric Manufacturing Company, has sailed this week on the "Kronprinz Wilhelm" for an extended European trip.

PROF. W. E. GOLDSBOROUGH, chief of the department of electricity at the St. Louis World's Fair, has just issued his first circular to the electrical industry in regard to that subject.

MAJ. G. W. FOSTER.—Under the recent reorganization of the Southwestern Telephone and Telegraph Company, Maj. George W. Foster, formerly of Toledo, has received the appointment of assistant general manager, with headquarters in Dallas, Texas.

MR. FREDERICK DARLINGTON, who is connected with the Stanley interests at Great Barrington, Mass., goes abroad this week, accompanied by Mrs. Darlington, on board the North German Lloyd "Kronprinz Wilhelm" for a brief vacation in Europe.

MR. M. C. RYPINSKI, who for the last five years has been associated with Mr. L. T. Robinson in the General Electric Laboratory at Schenectady, N. Y., has severed that connection in order to take charge of the factory of the Empire Electrical Instrument Company, in New York City.

MR. FRANK S. GORTON, secretary and treasurer of the Chicago Edison Company and one of that company's original organizers, has resigned and will retire from business on May 1. After a trip to Europe he will return to Chicago to devote his attention to his personal interests.

MR. REGINALD J. WALLIS-JONES, of the English firm of Wallis-Jones & Dent, is now visiting this country and is making a tour of inspection, etc., in regard to electrical matters. He has had a long connection with electric lighting and other work, and is in close touch with all the later developments.

MR. ARTHUR D. WHEELER.—At the meeting of the directors of the Central Union Telephone Company, in Chicago, Mr. Arthur D. Wheeler was elected first vice president in place of Col. R. C. Clowry, who has recently removed to New York as president of the Western Union Telegraph Company.

MR. CESARE PIO, a well-known contributor to the columns of the ELECTRICAL WORLD AND ENGINEER, has recently made a tour of the world for pleasure and to investigate electrical conditions, and at the present time is connected with the Electric Construction Company, of Wolverhampton, one of the leading concerns in the field in England.

DR. H. MORTON. Marked improvement is reported in the condition of President Henry Morton, of the Stevens Institute of Technology, at his home in Hoboken, N. J. President Morton underwent a surgical operation on April 15 last, but recently suffered a relapse. The doctors in attendance are very much encouraged and expect his recovery.

MR. C. L. ETHERIDGE, for some years assistant chief engineer of the Chicago Telephone Company and recently western agent of the Evans-Almirall hot-water heating system, has been recently appointed chief electrical engineer of the Pullman Company, to take the place of Mr. D. Avery Kimbark, who recently left to go into business for himself.

MESSRS. A. C. PAIN, of Belliss & Morcom, Ltd., the high-speed engine builders of Birmingham, England, and T. H. Parrott, of Edgbarton, the general manager, are now visiting this country, studying the application of steam and other engines in electric light and electric railway work, and inspecting machine tools, etc. They will be about a month in the United States.

MR. W. M. McFARLAND, acting vice president of the Westinghouse Electric and Manufacturing Company, will deliver a lecture on "Electric Power Distribution in Manufacturing" at Cornell University, on Friday, May 9. The several different systems of distribution and their relative advantages will be discussed and the manner of applying electric motors to machinery will be illustrated by a large collection of stereopticon views.

MR. JAMES F. CUMMINGS, manager of the British electrical engineering and contracting firm of Maguire & Baucus, London, which concern represents the British interests of the European Maguire Manufacturing Company, Limited, the Aultman & Taylor Machinery Company, of Mansfield, Ohio, builders of the Cahall boilers, and other American manufacturing concerns, is [illegible] Broadway and Thirty-second street, New York.

[illegible] of the Emerson Electric Manufacturing Company, of St. Louis, Mo., who is well and favorably known among the electrical fraternity in that section, will, after May 1, assume the management and control of the New York office of the Ohio Brass Company, of Mansfield. This appointment has been made owing to the fact that Mr. Alfred B. Edes, formerly manager of this office, has been appointed sales manager of the company, and will hereafter be located at the main offices at Mansfield.

MR. E. M. MULFORD, JR.—It is announced from Chicago that Mr. Edward M. Mulford, Jr., manager of the Chicago office of the Western Union Telegraph Company, has been promoted to be manager of the New York office and has left there to assume his new duties. J. C. Smith, manager of the Galveston, Texas. office, has been appointed to succeed him. taking charge May 13. Mr. Mulford has been in the service of the Western Union for the past eighteen years. At various times he served as manager at Camden, N. J., Philadelphia, and Champaign, Ill. In 1899 he entered the Chicago office as clerk and stenographer and was steadily promoted. He was born at Greenwich, N. J., January, 1865.

MR. C. VANDERBILT.—A telegram from Albany states that Mr. Cornelius Vanderbilt, as the representative of the New York Central Railroad, has been in consultation with the officials of the General Electric Company at Schenectady as to the possibility of substituting electricity for steam on the entire system. Mr. Vanderbilt spent several hours at Schenectady discussing the problem, and it is said has concluded to advise the change. The General Electric people were asked by Mr. Vanderbilt what the maximum expense would be to change the motive power on the New York Central system, and the figure given, although kept a secret, is said to have surprised Mr. Vanderbilt because of its lowness. It was suggested at the conference that sufficient electric power to propel all trains on the New York Central could be supplied from Niagara Falls.

MR. AND MRS. C. ODILON MAILLOUX, of No. 48 West Seventy-third street, New York City, entertained with an elaborate dinner on Sunday evening a number of guests in honor of M. Maurice Leblanc, of Paris, the well-known electrical engineer, who is about to return to France. Among those present on this pleasant occasion were M. de Laval, of Pittsburg; Mr. Carl Hering, past president of the American Institute of Electrical Engineers; Dr. M. I. Pupin, of Columbia College; Mr. William C. Gotshall, president New York & Port Chester Railroad Company; Mr. Ralph D. Mershon, electrical engineer of Montreal and New York; Dr. Raley Husted Bell, the well-known litterateur; Dr. Samuel Sheldon, of the Brooklyn Polytechnic; Mr. John W. Lieb, general manager New York Edison Company, and Mr. Gano S. Dunn, electrical engineer of the Crocker-Wheeler Company.

MR. PAUL M. LINCOLN.—The announcement that Mr. Paul M. Lincoln has resigned his position as resident electrician for The Niagara Falls Power Company will come as a surprise to many of his friends and acquaintances. Mr. Lincoln entered into the work of installing the dynamos at the power-house at Niagara Falls in February, 1895, and carried through most successfully the entire installation of the electrical equipment. Many new problems were necessarily met in this, the first plant of its kind, and each was successfully solved; and that the operation of the power-house has been so satisfactory thus far is largely due to Mr. Lincoln's ability. Mr. Lincoln is a member of the American Institute of Electrical Engineers, the American Electro-Chemical Society, and other like organizaiions. Recent attention has been called to his work because of several important devices which have been patented by him, one of the most widely known being the Lincoln synchronizer, which has been fully described in these columns. He leaves to accept a position with the Westinghouse Company, of Pittsburg, Pa.

MR. B. BROOKS.—The New York Press has the following breezy item: American District Telegraph seems to have found sudden favor in Wall Street, owing, no doubt, to the new blood from Denver and Chicago. Belvidere Brooks—odd name, isn't it? Belvidere means "fine prospect," and that is what Brooks, of Denver, presents when in action. This new general superintendent of the Western Union and A. D. T. is more of a Texan than President James Stillman, of the City National Bank, for he was both born and raised in the "Lone Star" State, whereas Mr. Stillman merely happened to be born there en passant. Mr. Brooks is nearly 43 years old. He started at the bottom as a messenger at Navasota, Tex., in 1871, and in six years was an operator, train dispatcher, etc., of the Houston & Texas Central Railroad. In 1879 he was manager of the Western Union office at Navasota, subsequently taking charge of offices at Waco, El Paso and Galveston. In 1890 he was manager at Denver, and in 1893 assistant superintendent. To-day—general superintendent in New York. Notwithstanding his unusual abilities, he is said to be immensely popular with his men.

EDUCATIONAL.

LEHIGH UNIVERSITY.—The Register of Lehigh University, South Bethlehem, Pa., just issued, shows the attendance of 554 students, from 26 States and 9 foreign countries. There are 49 in the teaching staff. Eleven courses of instruction are offered at the University: The classical course, the Latin-scientific course, the courses in civil engineering, mechanical engineering, metallurgical engineering, electrical engineering, mining engineering, analytical chemistry, geology, physics and electrometallurgy. A list of the graduates of the University, 1,203 in number, during the 36 years of its existence indicates that this institution is exerting a very marked influence on the industrial development of the United States, and also of foreign countries.The following scholarships will be open to competition at the annual examinations in June: Two in the classical course of $150 and $100 each. One in the Latin-scientific course of $125. Five in the following courses: Civil engineering, mechanical engineering, electrical engineering, mining and metallurgical engineering, and chemistry, of $150 each. Provision is made for worthy and needy students whereby they may postpone payment of tuition until after graduation.

Trade Notes.

REMOVAL.—Mr. A. O. Schoenmaker, electrical dealer, has removed his place of business from 158 William street to 221 Fulton street, New York.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, is planning to make important additions and improvements, which will greatly increase its output of lamps.

MR. J. S. FISH, manager of the Shelby Electric Company, has just returned from an 8,000-mile trip through the country, calling on the larger class of lamp trade.

THE MOLONEY ELECTRIC COMPANY, of St. Louis, has opened a Chicago office at 408 Stock Exchange Building. Walter Krausnick will look after the Chicago territory.

THE CONLEY ELECTRIC FURNACE.—We have received an inquiry for the address of the Conley Electric Furnace Company, of New York, which controls the electric furnace described and illustrated in our issue of April 26.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, recently made an important shipment of its Cross oil filters to different cities in India, China, Japan and other countries of the Far East. The sale of its products has extended to 28 different countries.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, has recently added very materially to its equipment and has also enlarged its plant. Its present output is 10,000 lamps per day, which has been rendered necessary by the increasing demand for Buckeye lamps.

THOMPSON, SON & CO. have removed from 107 Liberty street, New York, into a suite in the new Engineering Building, 114 Liberty street. Their new storeroom and factory are now located at 90 Verona street, Brooklyn, and are equipped with all the latest improved machinery and appliances.

JENNEY ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., has just issued a letter to linotype users, calling attention to the fact that it has recently supplied the *Chicago Tribune* with 43 of its motors for linotpye work, and has also equipped a number of other newspaper plants.

PORTABLE FORGES.—The Buffalo Forge Company, in a 48-page pamphlet, describes and illustrates a long line of portable forges, almost 30 types being shown in excellent engravings. Lines of hand-blowers, blacksmith's drills, punches, shears and other blacksmith's tools are also shown.

VALVES AND FITTINGS.—The Crane Company, Chicago, Ill., has issued a 96-page catalogue devoted eptirely to extra-heavy valves, fittings and pipework for extreme pressures. All the pipes and fittings listed are tested at 800 lbs. pressure to the square inch, and are suitable for a steam pressure of 250 lbs. to the square inch.

THE DRIVER-HARRIS WIRE COMPANY has moved from Newark, N. J., to Railroad avenue, Harrison, N. J., across the river from Newark. It has a new building and much better facilities for the production of its various lines of wire. This company, as is well known, manufactures Climax resistance wires and fine wires in all metals.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Cleveland, Ohio, (lamp and glass works, Fostoria, Ohio,) reports that it is now manufacturing 61 different styles of inner globes. It is its intention to manufacture every style of globe for which there is any demand whatever, in an effort to make good its claim that it is headquarters in this line.

EMERSON FANS.—The Emerson Electric Manufacturing Company, St. Louis, is sending to its patrons a postal card bringing to mind the approach of the fan season. An illustration shows a portly gentleman as he would appear on a hot day were he deprived of the services of an electric fan. But little text is required to supplement the telling illustration.

THE "LONG-ARM" SYSTEM COMPANY, Cleveland, Ohio, very completely describes and illustrates the "long-arm" system doors for use on steamship bulkheads. The doors are operated pneumatically, the pump for compressing, storing and regulating the delivery pressure of the air to the system being driven either by electric motor or direct by steam.

ELEVATORS.—The Eaton & Prince Co., Chicago, Ill., in a 32-page catalogue gives a large number of illustrations with accompanying descriptions, of the many types of elevators of its manufacture. Among those are a number of electric elevators, passenger and freight, both direct-coonnected and belted. One of these types is for a speed up to 300 feet per minute.

PUMPS.—Rumsey & Co., Seneca Falls, N. Y., have issued the 53rd edition of their illustrated catalogue of hand and power pumps, in a handsome cloth-bound volume of 256 pages. More than 300 illustrations are included, showing pumps for every purpose and in size, from a small hand pump to waterworks steam pumps. The latter part of the catalogue is devoted to special hydraulic appliances and to hydraulic fittings.

"THE LITTLE STORY OF A BIG ORDER."—With this title the Crouse-Hinds Electric Company, Syracuse, N. Y., issues a unique pamphlet consisting mainly of reproductions in full size of telegrams. The initial telegram asks for references previous to awarding to the Crouse-Hinds Company a contract, and the following telegrams are from large firms for which that company has done work, and recommending it in high terms.

ELECTRIC HEADLIGHTS.—The Crouse-Hinds Electric Company, Syracuse, N. Y., in a pamphlet just issued, illustrate and describe various types of portable electric headlights of its manufacture. A frontispiece illustrates a steam train in our highways, contrasting with the horseless of the old stage coach, and having the very pertinent caption: "You are using electricity to light your cars. Why not in your headlight?"

WHITE STAR OIL FILTER.—The unusual demand for the White Star oil filter has forced the Pittsburgh Gage and Supply Company, Pittsburgh, to again enlarge its [illegible] its business in [illegible] its new works, 3101-3111 Liberty street, for its exclusive manufacture. The greater part of the second floor will be devoted to holding a large stock of all sizes of the White Star oil filters, this enabling prompt shipments to be made.

ALBERGER COOLING TOWERS.—The Alberger Condenser Company, 95 Liberty street, New York, has issued a well-written and illustrated catalogue on the Alberger system of cooling towers. The illustrations show in detail all the features of the system and include several cuts showing plants as completed. The description very clearly explains the principles of the system and their applicatioon. Those interested in the subject will find much instructive information in this pamphlet.

THE KEYSTONE TELEPHONE COMPANY (independent), of Philadelphia, has issued a handsome folding circular advancing arguments in favor of its system and of the independent telephone movement in general. Much of the information is given in condensed form as answers to questions. For example, the answer to the question: "Don't the Bell own all the principal patents on telephony?" is: "The Independent Telephone companies own and control more patents on telephone systems and apparatus than the Bell; the Independent patents cover superior systems."

BUCKEYE LAMPS.—In a folder entitled, "To Our Friends, the Critical and Careful Public," the Buckeye Electric Company, of Cleveland, Ohio, sets forth its qualifications as a manufacturer of lamps and gives the specific guarantee which its makes to purchasers. Among these guarantees are, that the candle-power will be within the limits of 15-17 cp; that the candle-power will be maintained to 80 per cent. at the expiration of the guaranteed life, and that a life of 600 hours is guaranteed for 3.1-watt lamps, 800 hours for 3.5-watt lamps and 1,000 hours for 4-watt lamps, under a voltage fluctuation of 2 per cent.

BELT CONVEYERS.—The Jeffrey Manufacturing Company, Columbus, Ohio, in Catalogue Noo. 67, illustrates and describes its "Century" system of rubber belt conveyors. A large number of illustrations show different applications of this type of conveyor and details of the rollers, trippers, etc., employed in connection therewith. The catalogue also illustrates the same company's systems of bucket elevators, wood and metal apron conveyors and endless pan conveyors. Several pages are also devoted to Jeffrey crushers, screens and electric elevators. Those interested in elevators and conveyors will find this pamphlet an instructive contribution to these subjects.

KEYSTONE HAIR INSULATOR.—In a leaflet just issued by the H. W. Johns-Manville Company., New York, are shown the results of recent tests of Keystone hair insulator and other heat-insulating materials. The hair insulator, according to the report, shows a gain of 25 per cent. over hair felt and cork construction; 33 per cent. over 1-in. air space construction, and 42 per cent. over solid construction. This report is condensed from a paper read by Mr. John E. Starr before the convention of American Warehousemen, held at Buffalo, last October. The company has also issued a pamphlet describing and illustrating the varied uses of its Keystone hair insulator, which will be of interest to those concerned in insulation of heat, cold and sound.

AMERICAN SCHOOL OF CORRESPONDENCE.—An arrangement has been made with the Armour Institute of Technology, Chicago, whereby this institute will co-operate with the American School of Correspondence in providing technical education by correspondence. Dr. Frank W. Gonsaulus, president of the Armour Institute of Technology, is the head of the Advisory Board of the American School, and the faculty of the Armour Institute is associated with the faculty of the school in the instruction of students of the latter. All examination papers from students in the vicinity of Chicago will go directly to the faculty of the Armour Institute for correction and criticism, and the American School students will receive full credit toward a degree in the Armour Institute for work done in the American School.

THE ELECTRONIC THEORY.—In *The Popular Science Monthly* for July of last year Prof. J. J. Thomson described his important investigations demonstrating that atoms can be split up into smaller bodies. In the current issue of the same magazine, Prof. J. A. Fleming, the eminent British physicist, explains in clear and readable language the electronic theory of electricity, to which Professor Thomson's researches were such an important contribution. All ideas regarding electricity, matter and ether, as held even by those who have followed the progress of physical science, must, it appears, be revised. It is necessary to regard electricity as atomic in structure, the atoms of electricity being attached to the atoms of matter and separable from them. The regular free movements of electrons create what we call the electric current in a conductor, whereas their vibrations when attached to atoms are the cause of ether waves whether of light or heat. The atom is a kind of planet accompanied by other smaller satellites which are capable of an independent existence and are then the so-called negative electricity. The inertia of matter is due to the electron, and all mechanical and material effects must be translated into the language of electricity.

BEFORE THE TROLLEY.—In those days—back in the Mexican War period—Michigan was a wilderness, the railroads were built with strap rails, and time cards and the telegraph were unknown. One man, with a foot-power lathe, did all the repairing for the entire system (Michigan Central Railroad); every coach bore a name, generally immortalizing some town along the road. The engineer was also the conductor and the fireman officiated as brakeman. To put on brakes a long lever was let down on the tender and the brakeman stood upon it, that being the only brake used in those primitive days. Night trains were not thought of until some time after; the first "owl trains" carrying a headlight which burned lard oil that, in cold weather, had a habit of freezing up, when the light would flicker out, leaving the train wrapped in Michigan darkness. Trains were as apt to be ten or fifteen minutes ahead of time as thirty or forty minutes behind time, and passengers never calculated on getting to the depot on the minute, as in these days. Night freights used no headlights, and there were no brakemen on any freight trains, for there were no brakes. A conductor and a greaser constituted the crew.—From "Along the Railroads," in *Four-Track News* for April.

Record of Electrical Patents

[illegible] PATENTS ISSUED APRIL 29, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau st., N. Y.]

698,532. TROLLEY CONTROLLER; P. D. Milloy, Buffalo, N. Y. App. filed March 28, 1901. The trolley rope leads around a pulley to a spring drum. The pulley is carried at the end of a spiral spring normally under tension. When the trolley leaves the wire, its upward movement trips the spring which draws the pulley and the rope downward. The spring drum takes up the slack.

698,575. ELECTRIC ARC LAMP; P. H. F. Spies, Mount Vernon, N. Y. App. filed June 5, 1901. Details of the general construction.

698,612. TELEPHONIC WALL SET; C. E. Wilson, Philadelphia, Pa. App. filed July 26, 1901. (See Page 820.)

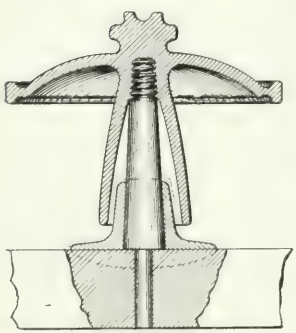
698,613. BASE-PLATE FOR TELEPHONE TRANSMITTER-ARMS; C. E. Wilson, Philadelphia, Pa. App. filed July 26, 1901. (See Page 820.)

698,637 to 698,693. The fifty-seven patents comprised have for subjects Electric Meters, Electrical Measuring Instruments, Direct-Current Meters, Alternating-Current Meters, Alternating-Current Motor Meters, Induction Motor Meters, Polyphase Motor Meters and Motor Meters. The patentee is Thomas Duncan, of Fort Wayne, Ind., and Chicago, Ill. The dates of filing of applications are from Feb. 7, 1898, to March 10, 1900.

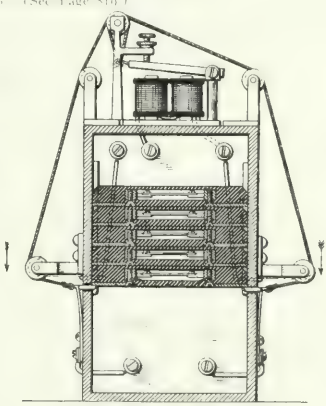
698,696. PROCESS OF MAKING PARIS GREEN; R. Franchot, Niagara Falls, N. Y. App. filed Aug. 17, 1901. (See Page 819.)

698,738. ELEVATOR; A. B. Roney, Chicago, Ill. App. filed Oct. 10, 1901. A rotating drum attached to the elevator car and having a large worm on its exterior engaging with a rack on the side of the shaft, is rotated by an electric motor inside of the drum to raise and lower the car.

698,766. PROCESS OF MANUFACTURING GLASS; A. Voelker, Ehrenfeld, Germany. App. filed Sept. 27, 1900. (See Page 819.)



698,976. Sleeve for Protecting Insulator Pins.



699,045. Safety Fuse Box.

698,792. ARC LIGHT HANGER-BOARD; H. M. Buck and W. H. Strippy, Baltimore, Md. App. filed June 15, 1901. The lamp is suspended from two pivoted levers which are at the same time the movable elements of an electric switch. When the lamp is removed, the levers automatically bridge the terminals on the board.

698,811. LOCK; H. G. Carleton, New York, N. Y. App. filed March 18, 1901. Details of construction of an electric lock designed to prevent tampering with the circuit.

698,812. LOCK; H. G. Carleton, New York, N. Y. App. filed April 17, 1901. A device constituting the locking number consisting of a three-armed lever, supported upon a knife-edge bearing; one arm is an armature and the other arms are operated by the key and knob apparatus.

698,813. ELECTRIC ALARM AND FASTENING DEVICE; H. G. Carleton, New York, N. Y. App. filed April 23, 1901. A burglar alarm circuit closer, serving at the same time as a lock for a sash.

698,827. CONTROLLER FOR ELEVATORS; F. K. Fassett, St. Louis, Mo. App. filed Sept. 9, 1901. A modification of that form of control wherein the car cannot be started until the door at the landing is closed, in which certain limiting devices are introduced, permitting the car to be started before the door is closed, but stopping and returning the car automatically in case the door has not been eventually closed.

698,902. CONDUIT; C. D. Budd, St. Louis, Mo. App. filed Dec. 9, 1901. Cement blocks having corresponding grooves to form passages when placed together, and tongues and grooves to prevent displacement.

698,931. ELECTRIC ARC LAMP; C. Gilbert, Bridgeport, Ohio. App. filed [illegible]

698,944. SIGNAL STATION; J. W. Harrison, Detroit, Mich. App. filed May 13, 1901. A signal for trolley stations, in which the presence of a would-be passenger in the station will, by his weight on the tilting floor, set a signal to stop the car.

698,965. CONNECTION OF STRIKERS TO MOTOR VEHICLES FOR MECHANICALLY-OPERATING ELECTRIC SWITCHES; W. Kingsland, London, Eng. App. filed Aug. 28, 1901. The striker is mounted at the free end of a horizontal arm, the opposite end of the latter being carried upon a vertical pivot-pin, which is supported from the axle box.

698,976. SLEEVE FOR PROTECTING INSULATOR PINS; F. M. Locke, Victor, N. Y. App. filed Nov. 11, 1901. A sleeve for an insulator-pin, constructed of porcelain or similar material, having a flange at the bottom extending out to a point beyond the point at which the base of the insulator would intersect the cross-arm in case the insulator-base was extended.

698,978. TROLLEY WHEEL; G. Loffi, Norwalk, Ohio. App. filed Sept. 7, 1901. The flanges and treads are assembled upon a bushing and confined between two nuts threaded on the ends of the bushing.

698,979. TROLLEY ARM HEAD; F. J. Ludolph, Irondequoit, N. Y. App. filed Aug. 31, 1901. Guards are formed on the head to retain the wheel on the wire.

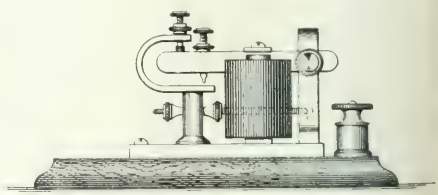
698,981. ELECTRIC FURNACE FOR MAKING GLASS, ETC.; J. Luhne, Aachen, Germany. App. filed Dec. 26, 1899. (See Page 819.)

698,985. ELECTRIC CLOCK; E. Meyer, Jersey City, N. Y. App. filed July 19, 1901. Details.

699,012. PROCESS OF OBTAINING TIN BY ELECTROLYSIS; E. Quintaine, Argenteuil, France. App. filed April 24, 1900. (See Page 819.)

699,025. AUTOMATIC DEVICE FOR THE SAFE OPERATION OF ELECTRIC CONDUCTORS WITH OR WITHOUT GUARD WIRES; E. E. Shultz and C. S. Y. Orfila, Barcelona, Spain. App. filed Aug. 21, 1900. An automatic cut-out, effective in case the trolley or other conductor breaks.

699,029. CONTROLLER FOR ELECTRIC VEHICLES; A. L. Simpson and H. B. Palmer, New York. App. filed Dec. 13, 1901. Means for forming a short circuit around the contacts of rheostat at the instant when the arm is moving from one to another.



699,056. Telegraph Sounder.

699,045. SAFETY FUSE BOX; J. T. Watson, Scranton, Pa. App. filed July 8, 1901. A number of fuse-blocks are supported one above the other and sustained by latches, the lower fuse being the one in circuit. When the lower fuse is destroyed, an electro-magnet withdraws the latches, allowing the lower block to drop out of position and the next one to come into the circuit.

699,055. ALTERNATING CURRENT REGULATOR; T. E. Adams, Cleveland, Ohio. App. filed Dec. 2, 1901. The regulator is constructed in such manner that the use of counter-balancing weights or springs independent of the weight of the coils and core and the frames which carry them, will be avoided; this being accomplished by balancing one part against another

699,056. TELEGRAPH SOUNDER; J. A. Albertson, Lansford, Pa. App. filed June 20, 1901. The back-stop is provided with a cushion, so that it will give out a different sound from the front stop, when struck by the armature.

699,060. RAIL BOND; F. B. Badt and G. M. Willis, Chicago, Ill. App. filed Dec. 2, 1901. The end-pieces adapted to enter holes in the rail, have conical plugs inserted in each end, which are adapted to be driven inward to spread the end.

699,064. RHEOSTAT, ELECTRIC HEATER, ETC.; H. P. Ball, Mount Vernon, N. Y. App. filed June 27, 1898. A unit element consisting of a plug of porcelain, having a resistance wire wound or embodied in it, the device being adapted for insertion into the frame of an electric heater.

699,119. AUTOMATIC SIGNAL FOR ELECTRIC RAILWAYS; C. H. Storm, Waterloo, Iowa. App. filed Jan. 19, 1901. The trolley wheel operates an overhead switch at the ends of the blocks to change the color of the signal lights.

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NOTICE TO ADVERTISERS.

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THE CONVENTION.

The meeting in Cincinnati, next week, of the National Electric Light Association not only brings to a natural close one term in the existence of that body, but its results are likely to have no small effect in determining its future. The indications are quite hopeful, for the association has rarely, if ever, had so good a programme laid out for it, or so many good papers prepared. It now remains to see what the attendance is, and how thoroughly the papers and topical questions are discussed. We venture to believe that an excellent showing will be made, and that the association will gather up both new strength and new members. There are many opportunities for good work awaiting it, and the growth of the electric light and power industry will certainly bring it many more as new problems come up for settlement.. The association has never yet lived up to its ideals, because those ideals are constantly advancing, and it can to-day set its standard of achievement higher than ever. We trust Mr. Doherty will feel rewarded for the hard work he has been doing as president, by the record of the coming week in Cincinnati; and if any of our readers who should be there have not yet started, we can only urge upon them to attend and lend their best aid and support to the association which represents their interests.

THE FAREWELL TO LORD KELVIN.

It was an altogether happy impulse which prompted Mr. Anthony N. Brady to give a dinner in honor of Lord and Lady Kelvin last week, prior to their sailing for England. A trip which began with a notable reception by the scientific electrical engineering element was thus rounded out with the hearty farewell good wishes of those who are handling the largest electrical plants in the world—for lighting, transportation, telephony, etc.—men glad to be able to welcome as one of themselves the great physicist, who, beginning his inventive career as a submarine cable engineer some fifty years ago, is in full touch with, and has keen appreciation of all the later practical applications and developments. It is, indeed, this freshness of mind and ready grasp of what is now being done that has impressed all who have met Lord Kelvin this time, after so rich and rounded a life of public service; and his felicitous utterances at the banquet last Thursday have naturally made quite an impression, as evidenced by the daily newspapers. No better augury as to the future of our great electrical industries could be asked than this evident desire of the leaders in them to do honor to the other leaders from whom the fundamental, underlying ideas must come upon which such arts must be founded. It was a pleasant thing, also, that Edison, Sprague and Tesla were all able to be present on so interesting and memorable an occasion.

DEMAND SYSTEMS OF CHARGING.

A recent editorial of ours has stirred a most esteemed correspondent to a vigorous defense of the Wright demand system. Now, we have nothing against this or any other system of charging, and are very far from holding a brief for the flat rate, but we must recognize the fact that the authorities generally, and particularly a body with the plenary powers of the Gas and Electric Light Commissioners of Massachusetts, have the last word in the debate. A very specious argument might be put up to show the inherent and eternal propriety of making a

customer's rate directly proportional to the square of his distance from the station, or a function of the load curve expressed in polar coördinates, or any one of half a dozen other things which bear on the cost of service. But business men have to adopt broad business methods and charge up to profit and loss many things that the bookkeeper might wish were otherwise disposed of. What would happen to a dry goods store that charged against each purchase the cost of the salesman's time in showing the goods? There would be an element of essential justice in the proposition, but customers would go elsewhere, and if stores united to enforce the rule we should see the most hair-raising anti-trust statutes yet enacted.

So it is in the electrical business. Corporations which can do business at all only in virtue of a public franchise have to walk Spanish in many particulars, and their methods in the long run must meet the requirements of the general public if they are to succeed. We therefore find a strong tendency to adopt broad and liberal business methods to encourage the general and liberal use of the product, and to meet the public more than half way. Within limits, a demand system of charging may be, and has been, applied with an advantage to all concerned. But the moment it is so applied as to conflict with the broader interests of the community there is liable to be trouble. A lighting company does not merely deal with its customers personally, like a grocery store, but it deals with them as members of a corporate community on which it confers and to which it owes benefits. A recognition of these reciprocal obligations is the keynote of success. If, as our correspondent indicates, the application of a particular method of charging makes the price of electrical energy prohibitive to any considerable number of customers, these will certainly, as members of a franchise-granting community, demand a new deal in no uncertain terms. It will be no defense to allege that a loss can be figured out on these customers, for in most fundamental relations a public service company is dealing with the community as a whole, and not merely with individual members of it. Hence the existence of commissions and similar bodies, with power to regulate rates. There are those who deny on ethical grounds the propriety of such regulation, but that question is neither here nor there, for they exist, and are sometimes unpleasantly active. The question of charging methods is, therefore, like the larger question of rates, a thing that sooner or later has to be settled with the representatives of the community. Its demands are sometimes reasonable, and sometimes quite otherwise, but it has the ultimate power of enforcing them. Any method of charging, therefore, by maximum demand, or otherwise, must meet general as well as special requirements, else it will come to grief. The Woburn plan is being tried by this touchstone, and will be judged, fairly, we hope, by its practical results. We should be extremely gratified at the acceptance on the part of the public of the principle of the demand system, for no one can deny its equities. On the other hand, there is a danger that its forcible application may in instances give rise to a situation not at all to the interest of a public service corporation.

Electric Cables.

In the February number of the Bulletin of the Société Internationale des Electriciens, appears an interesting discussion upon the subject of the tests and specifications for electric cables, an abstract of which recently appeared in the Digest. A committee of the society appears to have sent a circular letter of inquiry to a number of cable manufacturers and experts, eliciting their views on the subject. The main results of the inquiry are speedily summarized. They recommend a volt-resistance test of 100 per cent. pressure over and above that of full normal load, if the test is applied before laying, and 25 per cent. extra pressure after laying. Ohmic insulation is very properly relegated to a subsidiary position, but for subsidiary use, kilometric insulations are recommended on the following sliding scale; 700 megohms for cables up to 1 kilovolt, normal working pressure; 3,000 megohms up to 4 kilovolts, and 6,000 megohms up to 10 kilovolts. Just why these particular numbers were selected it is hard to discover. They suggest, to some extent, in a profane mind, the numbers that come to light in the Book of Revelations. To the ordinary mind, seven hundred megohms-kilometres per kilovolt would appear sufficient to cover the premises. Concerning tastes, however, *non est disputandum*. M. Grosselin, in discussing the outcome of the correspondence, criticises this sliding scale, and, in our opinion, justifiably. He suggests that five hundred megohm-miles would be sufficient for all pressures of normal operation. In general, it would be better to secure reliable means for preventing the occurrence of abnormal rise of pressure in a cable, than to spend much money upon so great a thickness of insulation as would withstand all the rise of pressure that could ever occur in it unchecked.

Practical Transformer Testing.

The desirability of testing all transformers before putting them into service has been so long sounded in the ears of central station men by convention papers and in other ways, that further argument or urging upon that point would seem to be unnecessary. The large central stations now all do this, and the smaller ones which are considering it care more to know of practical methods for performing this testing in a rapid and sufficiently accurate manner, than to have discussed the abstract question of the desirability of such testing. Indeed, upon the simplicity and commercial practicability of the actual testing methods available will depend the central station man's decision on whether or not to test all transformers purchased. It is just this kind of practical detailed information that is given in an article by Mr. R. F. Schuchardt, of Chicago, in another column. Mr. Schuchardt's connection with the testing department of one of the largest central station companies in the country gives this article the authority of one who comes in daily contact with this class of work, and who, consequently, is in an excellent position to know the practical requirements and the "short cuts" that are possible without seriously interfering with accuracy. It is one thing to know the theory of testing and quite another to evolve by long practical experience methods not too cumbersome for rapid daily use.

It goes without saying that not every small central station can afford a testing apparatus as elaborate as that described, nor the experts to work it, but there are few, indeed, that cannot make part of the tests, and it is not essential in the smaller plants to analyze the total losses in any transformer to the extent outlined by Mr. Schuchardt. The tests for regulation and core loss or voltage drop between no load and full, and watts lost in "leakage" or magnetizing current, are the most essential and also, fortunately, with modern instruments, the most easily made. For these two tests a good portable indicating wattmeter and a voltmeter, of range adapted to the secondary circuit, are all that is necessary, and these are instruments that have plenty of other uses around small central stations. We do not wish to be for a minute understood as considering the methods outlined by Mr. Schuchardt as too elaborate for the larger companies, but on the other hand, the smaller companies should not be discouraged through insistance on tests as extensive as are made by the large stations.

One sentence in the article referred to might well be put in larger type for emphasis. It is that calling attention to the importance of

keeping instruments accurately calibrated. Very few men outside of those on the technical side of the electrical instrument business seem to have any conception of the importance of frequent comparison of portable instruments with standards and the liability of instruments to get out of calibration. A feature of this paper, which will interest many, is the table of average results obtained from transformers of the best modern manufacture. Representing as they do, the results of hundreds of tests rather than a test on one or two samples, and tests made by unprejudiced engineers, the figures given deserve a permanent place of more than ordinary prominence in transformer engineering data.

The Field of Force in Wireless Telegraphy.

It is both curious and entertaining to observe the various and opposing theories concerning the *modus operandi* of wireless telegraphy which are, or until very recently have been, in vogue among practical electricians. Some of these are discussed in Mr. de Forest's article published in this number. Of course, many details concerning the action and propagation of these waves are far from clear, and will require elucidation in the light of future experimental research; but there can be no reasonable doubt, at this time, that the action is propagated in the space above the earth, or, popularly speaking, in the air. In so far as the action is conducted below the surface of the earth it is prejudicial.

In the case of an insulated aerial telegraph wire employing ground return, it is well known that the waves which run over its surface terminate on the ground perpendicularly, if that surface is electrically conducting; and that the field of force in that case is just as though the earth were removed from beneath the wire and a parallel return wire substituted at a distance vertically beneath the original wire of twice its original height above the surface. The assumed perfectly conducting surface is then coincident with the natural zero equipotential surface midway between the real wire and its "image." As a matter of fact, however, the earth's surface is never perfectly conducting, and consequently the hypothetically resulting field of force is automatically modified to meet the actual condition. Strictly speaking, therefore, the electrostatic capacity of an aerial telegraph wire must vary, for a given elevation above ground, with the conductivity of the soil, being greater in moist weather, or over the surface of salt water, than in dry weather, or over the surface of non-conducting rock. As a rule, however, the insulation of aerial wires is not sufficiently high to enable this difference in capacity to be observed experimentally.

In a similar manner each vertical antenna of a wireless telegraph system, when grounded at its base, is virtually united to an image antenna, of the same length, hung vertically below it and with the earth removed. The real antenna with its image beneath, would permit of one complete vibration in the time during which the charge made one complete to-and-fro motion, or had run both up and down the two antennæ, or over four times the length of the real antenna. This is why the length of the real antenna is always approximately one-fourth of the wave length of the emitted wave. A fifty-metre antenna (164 feet), grounded at its base, emits waves two hundred metres long, or having a frequency of one and one-half millions of cycles per second. The field of force of the emitted waves, with the earth assumed perfectly conducting, is always to be found by considering the Hertz oscillator, formed of the antenna and its image, plotting the waves in tri-dimensional space, and then ignoring all below the mid-level-plane bisecting the system through the junction of the real and image antennæ, which plane is coincident with the conducting earth's surface.

Just as in the wire-telegraph case, the field of force of wireless expanding waves is modified by the fact that the earth's surface is neither quite level nor perfectly conducting. In so far as the curvature of the earth is concerned, the waves follow it or conform to it, just as they conform to the surface of a wire in wire-telegraphy. It is not more wonderful that wireless waves bend slowly to a radius of about 6000 kilometers than that wire-led waves in ordinary telegraphy turn a sharp corner when the wire is bent suddenly, as at a street crossing. In so far as concerns the imperfect conductivity of the earth, the field of force is modified, because the waves, instead of being completely reflected at the earth's surface, are only partly reflected, and the remainder penetrate into the earth, until, after having traversed a number of strata in succession, nearly all the wave energy is reflected and practically none is left to sink deeper. Now all the energy that is reflected from the top surface is thrown back into the ether, or air, and aids or intensifies the advancing wave in the air; but the deeper the layer at which reflection occurs, the less the chance of the reflected energy emerging above the ground to swell the air-wave, for the energy ascending through the ground tends again to be reflected downwards, or in the wrong direction. The energy which sinks into the ground tends, therefore, to be scattered and absorbed as heat, to the loss of the advancing air-wave. It is easy to see, therefore, why an ocean-surface is so much better to telegraph wirelessly over than an ordinary moist land-surface, and this, in turn, than a dry or desert-land-surface. It is conceivable that a very intense and powerful Hertz oscillator of the vertical type, *i. e.*, a grounded antenna, might be used to diffuse warmth into the ground below the immediate surface, around the antenna, for some particular purpose, in which it was desired to raise the temperature of the soil by indirect electromagnetic energy, as distinguished from the sun's rays. In such a hypothetical scheme the usefully acting radiation would be that part which for wireless telegraphy we call useless or wasteful, or the part expended in the ground.

We are in doubt as to whether the mid-day difficulties in wireless signalling to which Mr. de Forest refers are due to any change in conductivity of the air, or alteration of the field of force. In the absence of conclusive evidence, we incline to think that the difficulty referred to lies in the coherer, as affected by feeble atmospheric discharges at these times of day, and that if the coherer could be operated at all times with equal sensitiveness and freedom from atmospheric disturbance, the signalling would be continuously maintained. It is evident that good ground to a wire telegraphist means any good connection to a stratum of conducting soil, however deep, and that the surface of the ground may be non-conducting if the wire telegraphists can reach a deeper conducting layer. On the other hand, good ground to a wireless telegraphist means a good conducting surface or top soil (to a frequency of a few millions of cycles per second), and deep-seated good conductivity is not nearly as good as superficial good conductivity. Curiously enough, the e.m.f. which actuates the coherer, or receiving wave-detector, is similar to that developed in a dynamo with stationary armature and moving magnetic field. The magnetic field of wireless telegraphy extends in expanding rings concentric to the sending antenna, and these horizontal circular lines of force, on reaching the radius of the receiving station, "cut" the receiving antenna, and induce the sudden impulse of e.m.f. in it that influences and actuates the coherer.

N. E. L. A. Convention Programme.

The programme for the convention of the National Electric Light Association, at Cincinnati, next week, has been provisionally arranged as follows by President Doherty, who will give an opening address at 10 A. M., on Tuesday. The papers will then come in the subjoined order as nearly as possible, with a "question box" period in each session:

"Does It Pay to Treat Poles With Creosote, Oil or Other Compounds," W. E. Moore, Augusta, Ga. "Performance of the Present 220-Volt Lamp," Fred W. C. Bailey, Columbus, Ohio. Report of Committee on Standard Rules for Electrical Construction and Operation. Afternoon session, 2 o'clock—"Three-Phase vs. Two-Phase for City Distribution," B. A. Behrend, Cincinnati; Chas. F. Scott, Pittsburg. "Protection of Long-Distance Telephone Transmission Lines," F. A. C. Perrine, Pittsfield, Mass.; L. Denis, Quebec; P. N. Nunn, Provo, Utah; P. M. Lincoln, Niagara Falls, N. Y.; H. G. Gille, St. Paul, Minn. "Boiler Firing with Oil," Jas. W. Warren, Los Angeles, Calif.; H. T. Edgar, El Paso, Texas. Report of Committee on Legislation Regarding Theft of Current.

Wednesday, May 21, 1902, morning session, 10 o'clock—"The Advantages of Gas Engines," Chas. H. Williams, Madison, Wis. "Are Free Lamp Renewals Desirable?" James English, New Haven, Conn.; F. Ellwood Smith, Somerville, Mass.; F. W. Little, Peoria, Ill.; W. J. Greene, Cedar Rapids, Iowa. "Hot Water vs. Steam Heating," J. F. Porter, Alton, Ill.; P. H. Korst, Janesville, Wis.; C. R. Maunsell, Topeka, Kan.; D. F. McGee, Red Oak, Iowa. Report of Committee on Analysis of Flue Gases. Report of Committee on Uniform Accounting. Afternoon session, 2:30 o'clock—"What Efficiency Lamp Should be Used?" Henry L. Doherty, Samuel E. Doane, Marlborough, Mass.; L. G. Van Ness, Denver; Francis W. Willcox, Harrison, N. J. Report of Committee on Photometric Values of Arc Lamps, Henry L. Doherty, chairman. Report of Committee on Standard Candle Power of Incandescent Lamps. Evening session, 8 o'clock—"Display Lighting, Signs and Decorations," Russell Spaulding, New York. "Possibilities of Sign and Decorative Lighting," E. J. McAllister, Newark, N. J.

Thursday, May 22, 1902, morning session, 10 o'clock—"Rates," Henry L. Doherty, Denver; L. A. Ferguson, Chicago; Alex. Dow, Detroit; L. R. Wallis, Woburn, Mass.; Ralph J. Patterson, Waterville, Me.; Samuel, Scovil, Cleveland, Ohio. "What Improvement is Desired in Meters?" Robert Ferris, Monmouth, Ill.; C. A. White, Somerville, Mass.; H. H. Scott, Lincoln, Neb. Report of Committee on Amendments to Freight Classification. Afternoon Session, 2:30 o'clock—"Are Loose-Leaf Ledgers Desirable for Electric Companies' Records?" G. E. Tripp, Boston, H. H. Fairbanks, Worcester, Mass.; Geo. W. Davenport, Boston; Charles R. Price, New Bedford, Mass. "What Changes Should Be Made in the Plan of Uniform Accounting?" J. P. Crowley, St. Paul, Minn. "Caring for Consumers' Complaints," Irvin Butterworth, Denver. Executive session—Reports: Secretary and Treasurer; Executive Committee; Committee on Amendments to By-Laws; Committee on Legislative Policy; Election of Officers; Committee on Finance.

Electrical Engineers of the Day—XLVI.

WALTER S. MOODY.

Walter Sherman Moody was born in Chelsea, Mass., a suburb of Boston, in 1864. After the completion of his studies in the public schools of his native city, he entered the Massachusetts Institute of Technology in 1883, finishing his course in electrical engineering in 1887, after which he was immediately made an instructor in the laboratories of Physics and Electricity at that institution. Not wishing to make teaching a profession, Mr. Moody resigned his position in June, 1888, to accept an offer from the Thomson Electric Welding Company, of Lynn, Mass., which had just been organized to develop commercially the electric heating and welding of metals under patents of Prof. Elihu Thomson.

The knowledge gained during the four years in which Mr. Moody was assistant engineer with the welding company was of exceptional value compared with any equal period in his fourteen years' experience as an electrical designer. In connection with the handling of currents of extremely small pressures but enormous volumes, sometimes exceeding 100,000 amperes, self-induction first became a commercial obstacle outside of the arts of telegraphy and telephony, and to counteract this all apparatus for welding had to be designed for a frequency much lower than that prevailing at the time, which was 125 cycles or higher.

At the end of about four years' service with the welding company Mr. Moody resigned his position to enter the engineering department of the Thomson-Houston Company, and for the first few months was engaged in the design of direct-current machines, but soon returned to more congenial work on alternating-current apparatus.

For the past eight years most of Mr. Moody's time has been devoted to the design and manufacture of the great number and variety of transformers built in his department, although a great diversity of alternating-current apparatus, such as feeder regulators, reactive coils, condensers, fan motors, etc., come under his charge. There have been manufactured under Mr. Moody's direction up to the present time nearly 200,000 transformers, including over 3,500 designs, the present rate of production being about 280,000 kilowatts per annum. The introduction into America of the "core" type of transformer was due to Mr. Moody, and his name is inseparably associated with the development of the now widely known



"H" transformer, as manufactured by the General Electric Company.

The "air-blast" type of transformer was also first developed by Mr. Moody. There are in use at present over 300,000 kilowatts of such transformers built to Mr. Moody's designs, some operating at as high as 35,000 volts, and including among others such plants as the Niagara & Buffalo transmission, Metropolitan Railway Company of New York City, Central London Railway, Southern California system and Cauvery transmission, India.

Numerous suggestions have been made to build transformers with hollow conductors, the idea probably originating with Prof. Rowland several years ago, but Mr. Moody is the pioneer in reducing the same to practice. As a result, many such transformers are now in use where large units with low-working voltages for electrolytic work are required. Transformers of this description have been made in capacities ranging from 750 to 2,200 kilowatts, and are employed in the manufacture of carbide of calcium, carborundum, graphite, and aluminum.

Much of Mr. Moody's success in life is but the natural outcome of exceptional capacity for organization and the control of men, coupled with a broad and general business knowledge and a clear and comprehensive understanding of engineering problems, from the design of apparatus to its subsequent use. Moreover, he is an indefatigable and enthusiastic worker, and possesses in a marked degree that personal magnetism which arouses in those in his service a spirit of emulation that brings forth their best efforts in his behalf.

The Cincinnati Gas and Electric Company

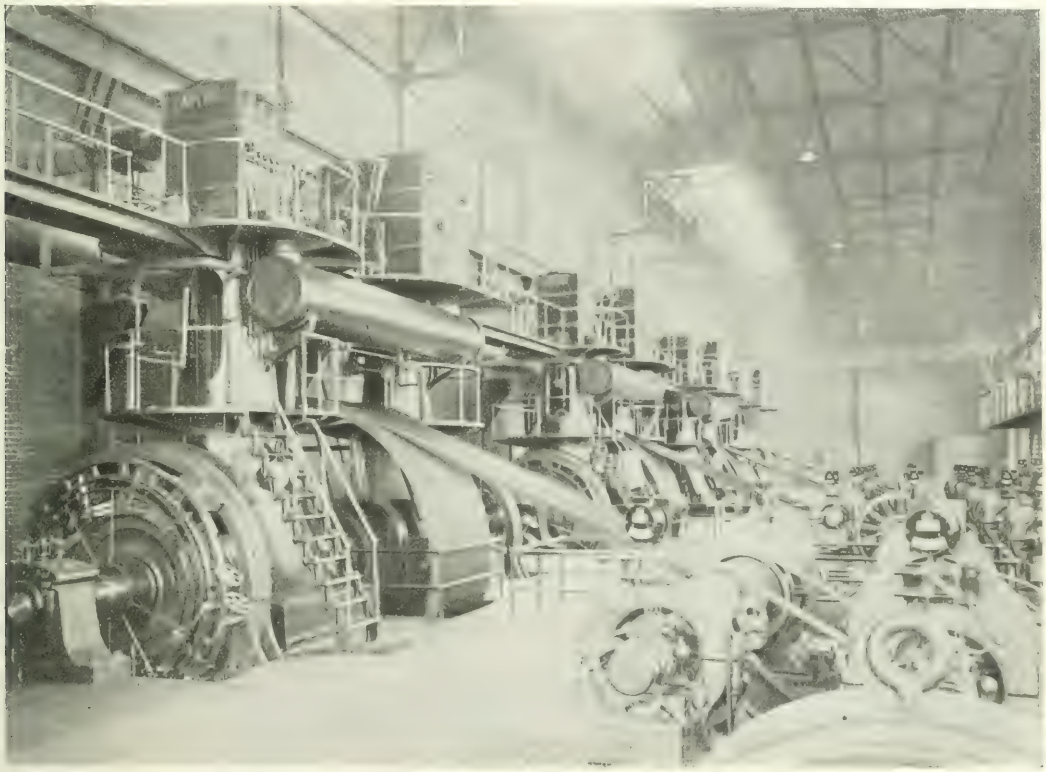
VISITORS to the National Electric Light Convention of 1902, at Cincinnati, will find the electric light central station work of that city undergoing a great change. The present time marks a transition period in the electric light station work in Cincinnati. For a number of years previous to 1901 there were in Cincinnati three electric light companies controlled by the Cincinnati Gas Light and Coke Company besides the Cincinnati Edison Electric Company. The three companies controlled by the Cincinnati Gas Light and Coke Company were the Jones Brothers Electric Company, the Brush Electric Light Company and the First Cincinnati Edison Illuminating Company. The war between these three allied companies controlled by the gas interests on the one hand, and the Cincinnati Edison Electric Light Company on the other, waged hot for several years. Indeed, it is doubtful if a more fierce competition in the electric light business has taken place in any large city in the United States in recent years.

After several years of this war, in which rates were cut indiscriminately and a great tangle of pole lines run over the city, a consolidation was effected early in the year 1901, by which all the electric light central station companies and the gas company were merged into the Cincinnati Gas and Electric Company.

The officers of the Cincinnati Gas and Electric Company are: General A. Hickenlooper, president; Norman G. Kenan, first vice-president; C. W. Wetmore, second vice-president; Henry W. Sage, secretary; Charles J. Foust, treasurer.

The electrical department has as its general superintendent, H C. Hutchinson, with Charles Jones, superintendent of stations, and H. J. Pfiester, superintendent of electrical distribution. These gentlemen have before them no small task. In place of supplying energy from four different central stations, three of which are out of date, everything is to be changed over for supply from one central generating plant. This central generating plant will be the one formerly used by the Cincinnati Edison Electric Company, but very much enlarged in capacity and changed in various details to be described later. At the present time, in Cincinnati there is an immense net-work of wires overhead in the down-town district. The old Edison three-wire net-work was, of course, underground, but everything else was overhead.

A most important change now being made is the putting underground of all the wires within a certain district in the down-town portion of the city. The territory covered by the company's lines, both overhead and underground, can be seen from the accompanying outline map, Fig. 6. This territory is roughly 43 square miles. The greatest distance from the power house, from which current is supplied, is eight miles. The underground district recently established is irregular in shape, about 6,000 feet long by 3,200 feet wide. The main power house, from which all current is to be supplied, and which is now furnishing the largest part, is at Plum and Charles Streets.



Engine and Generator Room, New Plant.

During the present season underground conduit is to be laid in 43 miles of street. This conduit will be supplied by the American Vitrified Conduit Company, and laid, under contract, by Guy M. Gest. The underground lead-covered cable to go in this conduit is being made by the Safety Insulated Wire and Cable Company.

At the present time all of the street lighting of the city is being done by continuous current, series, 9.6 ampere arcs, supplied by

Brush arc machines. There are now 3,408 of these lamps on the city circuits, for which a price of $84.90 per year is obtained. These are to be replaced by 4,400 enclosed, alternating current, series arcs of 300 watts capacity, or 4 amperes at 75 volts. For these new lamps the contract price is $72.00 per year in the underground district, and $60.00 per year in the outside, overhead district. In the underground district the cable used for the series arc lighting will be No. 6 copper wire with rubber insulation 7-32-inch thick, lead covered.

In the underground district the neat forms of iron pole and brackets, shown in Figs. 4 and 5, will be put up. In the overhead districts iron brackets of the form shown in Fig. 2 are to be used for supporting the city arc lamps. The base, shown in Fig. 4, has a flange bolted to the sidewalk and a portion extending 30 inches below that. Both poles and brackets are the work of the Electric Railway Equipment Company, an order being under way for 1,000 poles and 3,600 brackets. The arc lamps are of a new type of the General Incandescent Arc Light Company, Fig. 3.

As the central station is situated in close proximity to the downtown district, the direct-current, three-wire, 110-220-volt net-work will be retained for supplying light and power for the underground district. This district will be supplied direct from the power house by direct-current generators, as heretofore. All the resf of the company's current will be generated as 60-cycle, alternating-current. three-phase, with 4,000 volts between each phase and 2,200 volts between each leg of the circuit and the neutral wire when connected [illegible] for the series arc lighting, this will be transformed



FIG. 2.—ARC LAMP BRACKET FOR WOODEN POLES.



FIG. 3.—ARC LAMP TO BE USED ON ALL STREET LIGHTING.

by General Electric "tub" transformers located at the central station to supply 4-ampere, 60-light circuits. For light and power in the residents or outlying districts, the four-wire, three-phase system is used. Where motors are to be run from this alternating current circuit, the motors or their transformers are connected delta fashion to the three outside legs of the circuit without making use of the fourth or neutral wire. For residence lighting, transformers wound for a primary voltage of 2,200 are connected between the outside legs of the 4,000-volt circuit and the neutral wire.

The transformers will, of course, be distributed so as to maintain as nearly as possible the necessary balance between the three phases. Secondaries of these transformers are wound for 110-220-volt, three-wire circuits. At the present time, these secondary distributions in the residence districts are not run as connected together net-works, although they are arranged so that they can be so run if desired. Each transformer now supplies its own section of secondary wiring, and there is no connection between the secondary circuits supplied by one transformer and those of another. The reason for this separation is that it has been found there is too much danger of overloading some of the transformers connected to the net-work, in case the fuses blow out on other transformers connected to the net-work.

Cincinnati is divided by its almost mountainous hills into a number of fine residence districts, each of which is located on its own hilltop. The incandescent lighting of such districts is supplied by two of these four-wire, three-phase feeder circuits, shown diagram- [illegible] Hyde Park, Clifton, Avondale, Mt. Auburn and Walnut Hills. The number of transpositions and the way in which transformers are balanced between the various circuits can be seen from Fig. 6. Considerable care was used to see that these circuits were all transposed at proper intervals. As will be seen, there are three transpositions between the power house and the point where feeders begin to be tapped, making a complete transposition of the three-phase, four-wire mains. The method of accomplishing the transposition is shown by Figs. 7, 8, 9 and 10. Fig. 7 is the ordinary arrangement of wires on the cross-arm before reaching a transposition. In Fig. 8, the first step in the transposition has been made by putting a second cross-arm below the main cross-arm and dropping one of the four wires to the lower cross-arm. In Fig. 8 the wire 1 is the one which has been dropped. In Fig. 9 the second step in the transposition is made by running wire 1 diagonally across to a pin on the opposite end of the lower cross-arm from that occupied in Fig. 8. Here also, wires 2, 3 and 4 on the upper cross-arm have all been moved one pin to the right, leaving vacant the pin at the left end o fthe cross-arm. In Fig. 10, wire 4 has been placed on the upper cross-arm, and the pole line resumes its normal form. The insulators on the 4,000-volt, alternating-current lines, as well as on the new series arc circuits, are 4¼-inch diameter glass, made by the Hemingray Glass Company.

In the central generating station, as well as on the street, visitors will find a great change going on. Not only is the station being enlarged to take care of the entire business formerly supplied from a number of stations, but part of the machinery installed is being changed. This plant formerly consisted of a mixture of series arc and direct-current, direct-connected, 110-volt dynamos. To be more explicit, the equipment early in this year in the generating room consisted of five 1,600-hp, vertical, cross-compound, condensing, Reynolds Corliss engines, each driving, by means of a counter shafting, twelve 100-light Brush series arc machines; moreover, each engine also had direct-connected on its shaft two 110-volt direct-current dynamos for supplying the Edison three-wire net-work. Each engine unit thus supplied both arc and incandescent lighting, which was a very flexible arrangement in one way, because there would be portions of the day when there would not be sufficient arc lighting to take the full capacity of one engine. In addition to the combination units just enumerated were two 2,500-hp engines of a similar type, direct connected to both direct-current and alternating-current generators. The plant, as it existed before the present charges were inaugurated, can be seen in Fig. 7. The counter shafting for driving the arc dynamos was driven from the engines by a rope drive and the arc dynamos belted from the counter shafting. The arc dynamos are now all being taken out and the direct-current dynamos on these engines are also being removed to make way for larger direct-connected machines, equal to the full capacity of the engine unit.

In place of these small direct-connected generators on the old engines there will be placed one 2,500-kw, three-phase Bullock alternator and four 450-kw. direct-current generators, for supplying the direct current Edison net-work. In addition to these direct-current. direct-connected units for suppying the Edison net-work at light-load periods; and in order to make most economical use of the various generating units in the station, two 500-kw motor-generator sets have been ordered. These motor-generators will be arranged to take the 4,000-volt, three-phase alternating current at the motor end and generate 300-volt direct current for the outer wires of the Edison net-work. A 2,500-kw, direct-current machine will also be installed later.

The three-phase alternator, built by the Bullock Electric Manufacturing Company, is designed for 2,500 kw, normal load, and 3,120 kw, continuous overload. It will generate 4,500 volts between terminals, and operate at 75 r. p. m. The generator has 96 poles, and, therefore, produces alternating currents of 60 cycles.

The conditions for which this machine had to be designed are rather exceptional, as may be seen from the fact that the machine is the largest of its kind in this country. The generators in some of the New York traction companies' stations have a larger output, but they are designed for 25 cycles and have not more than 40 poles, while the generator built by the Bullock Company for the Cincinnati Company has 96 poles. It is apparent that the construction of a machine which requires the placing of so many poles on the circumference of a wheel offered problems to be solved by the engineers of a nature far more difficult than those that have to be solved for

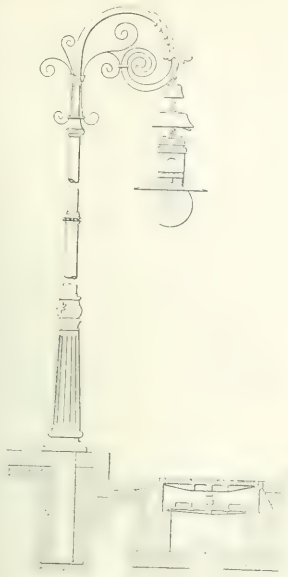


FIG. 4.—IRON ARC LAMP POLE.

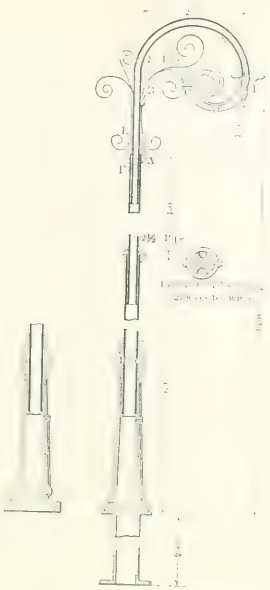
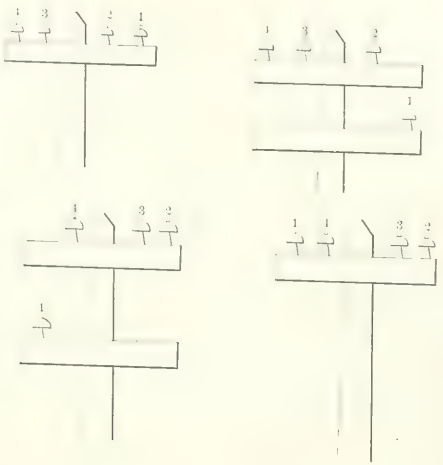


FIG. 5.—LONGITUDINAL SECTION OF IRON ARC LAMP POLE.



FIGS. 7, 8, 9 AND 10.—TRANSPOSITION DIAGRAMS FOR POLE LINE.

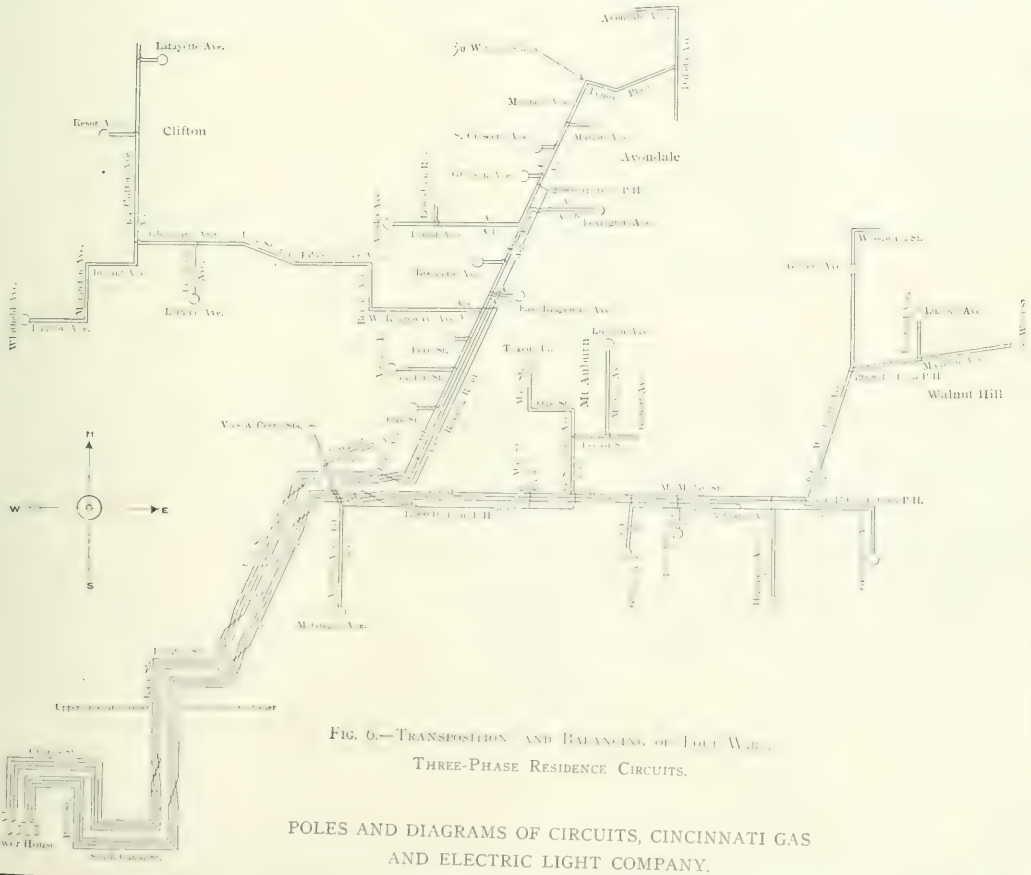


FIG. 6.—TRANSPOSITION AND BALANCING OF POLE WIRES.
THREE-PHASE RESIDENCE CIRCUITS.

POLES AND DIAGRAMS OF CIRCUITS, CINCINNATI GAS AND ELECTRIC LIGHT COMPANY.

low-frequency generators, requiring only a moderate number of poles.

The general construction of the alternator may best be seen from Figs. 7 and 8, showing a detailed assembly and an outline of the generator, respectively. The question that had to be solved at the outset was whether it would be advisable to build the generator as a fly-wheel generator, using the fly-wheel to carry the poles, or whether the generator should be built as a self-contained, engine-

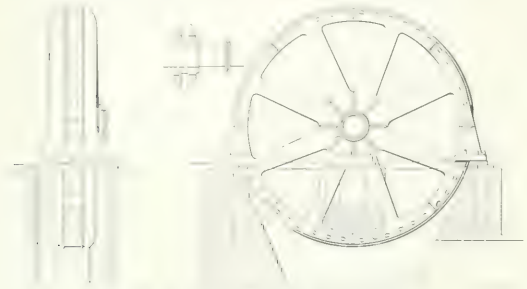


FIG. 7.—ELEVATIONS OF ALTERNATOR.

type machine with a separate fly-wheel alongside of it. There are some advantages and some drawbacks in either construction. The fly-wheel-type generator requires a large diameter in order to be able to reduce the weight of the fly-wheel for a given moment of inertia, which necessitates a heavier construction for the large armature to obtain rigidity and stiffness. On the other hand, the engine-type generator, being of smaller diameter, requires the construction of a special rotor to carry the poles, and thus the advantage obtained by a smaller diameter of the generator might well be considered compensated for by the necessity of making two revolving parts and the greater space taken up by the combination.

Aside from the greater engineering difficulties connected with the building of generators of very large diameter and narrow core, there are several great advantages connected with a large machine in which the armature is narrow. As is apparent in looking at the drawing, the radiating surfaces of this machine are very large, and, therefore, it is possible to design economical machines in which the temperature rise does not exceed 30° C. at normal continuous load.

It will be interesting to give some of the dimensions of this mammoth machine. The outside diameter is 30 feet and the inside diameter is 34 feet. The length of the pole, measured along the shaft, is 11 inches. It will also be instructive to study the weights of this machine, and we give, therefore, in the following, a general idea of the distribution of copper, steel and iron in the machine:

The total weight of laminated steel in the armature and poles is 42,000 lbs. The total amount of copper on the armature and on the fields is 13,100 lbs. The shields, the construction of which will be presently described, weigh 128,400 lbs. The whole stationary part, including steel and armature copper, weighs 200,000 lbs. The revolving part, which is the fly-wheel of the steam engine, the weight of which will, of course, be determined by the inertia demanded by the engine builders, is 374,800 lbs. The total weight of machine is thus 574,800 lbs.

On account of the large size of the armature, it is built up between two shields, each of which was made in eight sections, as clearly shown by the drawings. The armature itself is made up in 24 sections, each of which can be removed. The winding is placed in open slots, there being two slots per pole and per phase.

The electrical guarantees of this machine will be of interest. The regulation at 100 per cent. power factor and full load will not exceed 7 per cent. The efficiencies are as follows: 1½ load, 96½ per cent.; 1¼ load, 96½ per cent.; full load, 96¼ per cent.; ¾ load, 95½ per cent.; ½ load, 94 per cent.; ¼ load, 91 per cent.

The temperature rise at full load after 24 hours will not exceed 30° C.; at 25 per cent. overload after 24 hours, it will not exceed 40° C.; and at 50 per cent. overload after one and one-half hours it will not exceed 50° C. It will be of interest to call attention to the fact that this generator requires only 24 kw for excitation at full load in spite of the good regulation obtained.

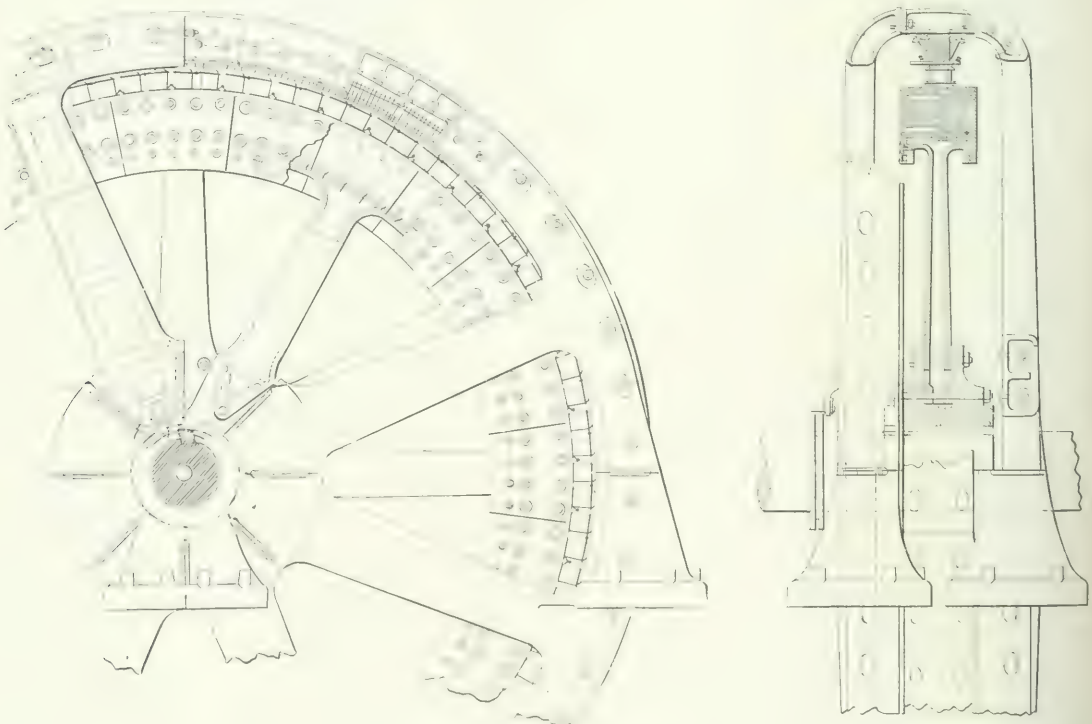


FIG. 8.—SECTIONAL DETAILS OF ALTERNATOR.

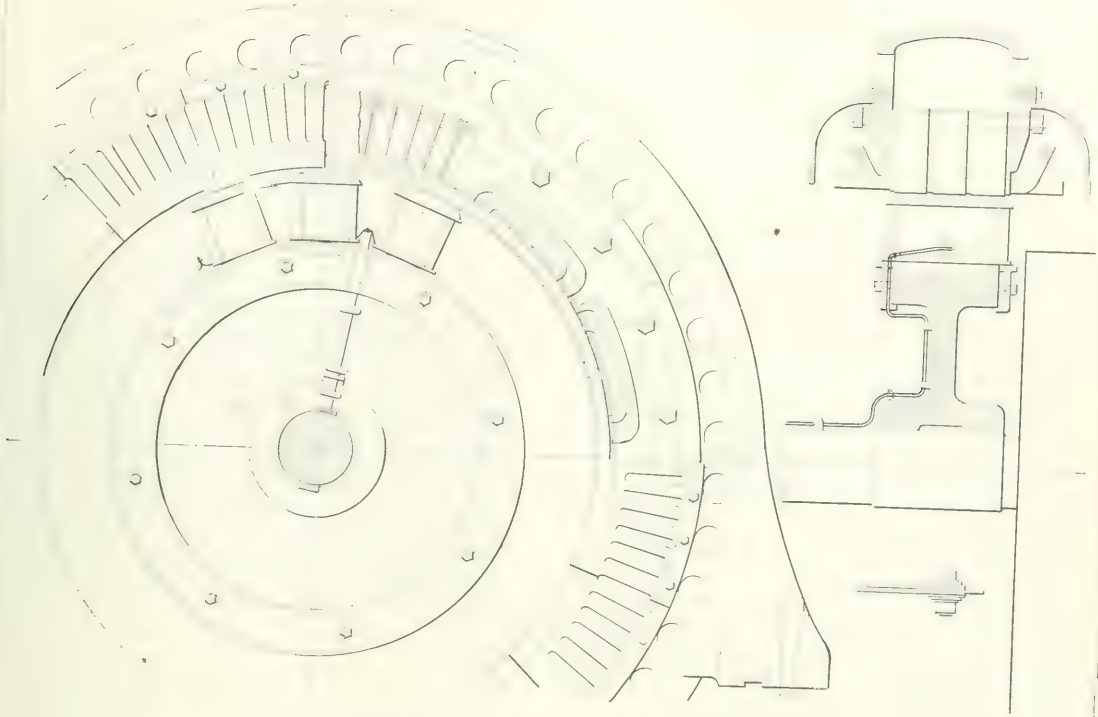


Fig 9.—Sectional Details of 500-kw Motor-Generator Set.

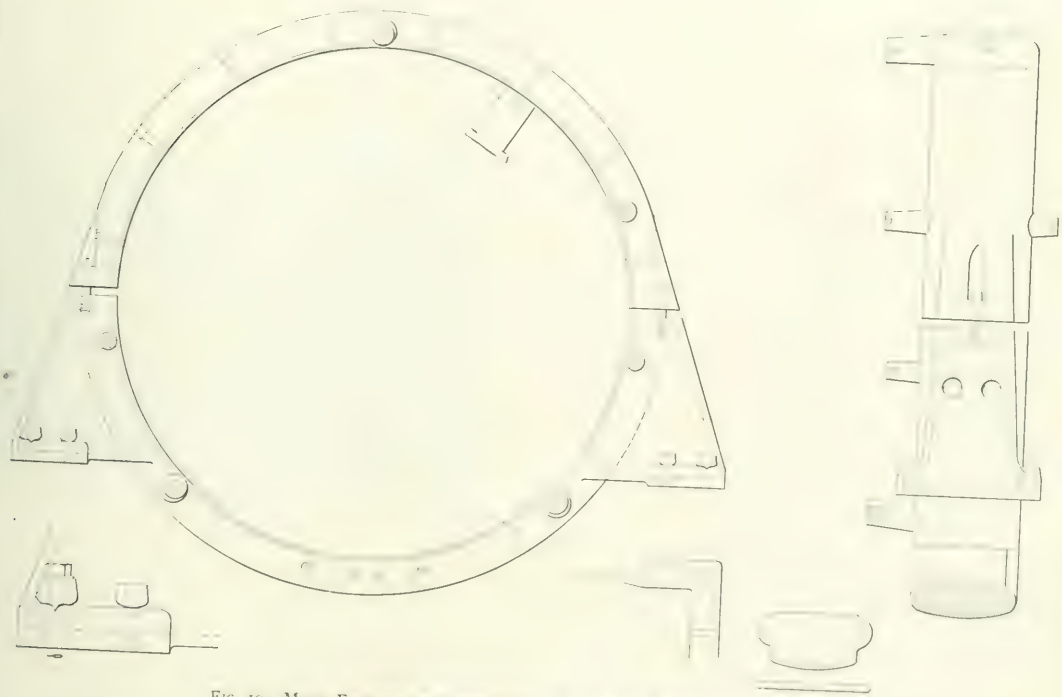


Fig. 10.—Main Features of Construction of 1500-kw Engine-Type Generator.

Figs. 9 and 11 show the 500-kw motor-generator sets. The synchronous motor is wound direct for 4,500 volts, and operates at 450 r. p. m. It, therefore, has 16 poles. The revolving element consists of a steel wheel, in which slots are milled to receive the dove-tails of the laminated poles. These revolving fields are mechanically so well constructed that they can stand the enormous peripheral speed of two miles per minutes, or more. The general construction of



FIG. 11.—ELEVATIONS, 500-KW MOTOR-GENERATOR SET.

these synchronous motors is identical with the construction adopted by the Bullock Company for its revolving field alternators.

The direct-current machines that are to be installed by the Bullock Company comprise seven units, four being engine-type generators, rated as 450 kw, 150 volt, 120 r. p. m., and two rated as 500 kw, 300 volt, 450 r. p. m., which latter are to be driven by synchronous motors, and one rated as 2,500 kw, 300 volt, 75 r. p. m.

Fig. 10 shows the main features of construction of the four 450-kw engine-type generators. The field yoke consists of an annular cast-iron ring, with inwardly projecting poles. The poles are built up of laminations of sheet steel in such a manner as to reduce to a minimum the effect of armature reaction. The poles are held in place by fillister-head cap screws. By taking out these cap screws it is possible to slide the poles out parallel with the shaft without disturbing either the armature or the field yoke. The armature spider has its arms milled at the outer ends so as to fit into dove-tailed notches in the armature segments. This method of construction for armatures built up of segments produces an armature in which the stresses due to centrifugal force are resisted by the strength of the armature steel, and the only stress put upon the cast-iron spider arms is of a crushing nature.

The armatures of these machines are well provided with ventilating ducts and, as the armature coils are held in the slots by means of wooden wedges, these ventilating ducts are not closed by any bands or wire around the outside. The commutator sleeve is cast in one with the front end head of the armature, thus making the commutator an integral part of the armature.

In commutators having diameters equal to or greater than those in the present machines, the front ring is cut into segments to facilitate handling.

Fig. 12 is an outline of the 2,500-kw, 300-volt, engine-type generator. This machine has 48 poles with an external armature diameter

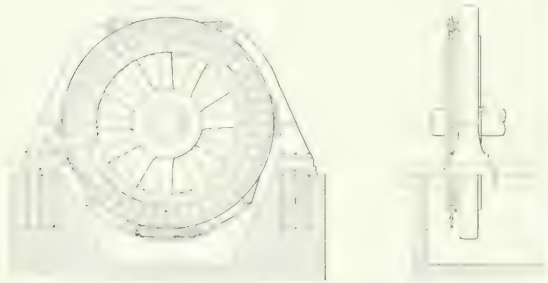


FIG. 12.—ELEVATIONS OF 2,500-KW ENGINE-TYPE DIRECT-CURRENT GENERATOR.

of 20 feet. In construction it does not differ materially from the 450-kw generator described above. One feature shown in this drawing that is peculiar to the large engine-type generators of the Bullock Company's manufacture is the device for oscillating the rocker arm carrying the brush holders. By means of this addition, a motion of the brushes is obtained parallel to the shaft which is similar to the end play of the armature in a belted machine, whereby the brushes are prevented from wearing grooves in the commutator.

While the nominal rating of this generator is 2,500 kw, it is guaranteed to carry continuously a 25 per cent. overload, and is also guaranteed to have a full load efficiency of 95 per cent.

Additional land has been purchased adjoining the present station at Plum and Charles Streets, and the power house is to be enlarged by the addition of two 4,000-hp Reynolds Corliss engines, to be built by the Allis-Chalmers Company. These are to be of the combined horizontal and vertical type, similar to those being put in

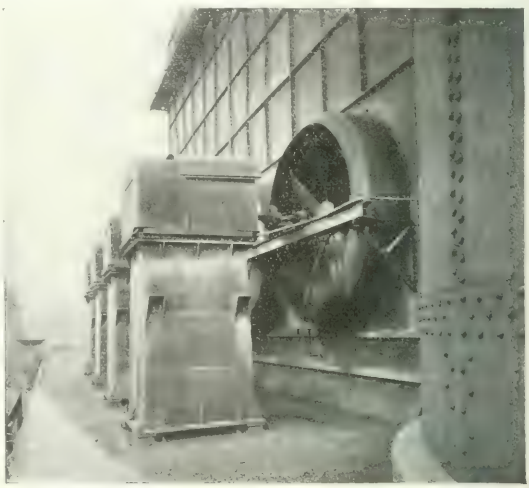


FIG. 13.—COOLING TOWER.

the Manhattan Railway power station, in New York. To one of these engines the above-mentioned 2,500-kw, direct-current Bullock generator, for supplying the outer mains of the Edison net-work, will be connected. On the other engine a 2,500-kw, three-phase, 4,000-volt alternator, also to be made by the Bullock Company, will be placed.

The present boiler plant has six 550-hp and two 300-hp Babcock & Wilcox boilers, with American under-feed stokers. The coal bins above these boilers provide for the storage of 2,000 tons of coal.

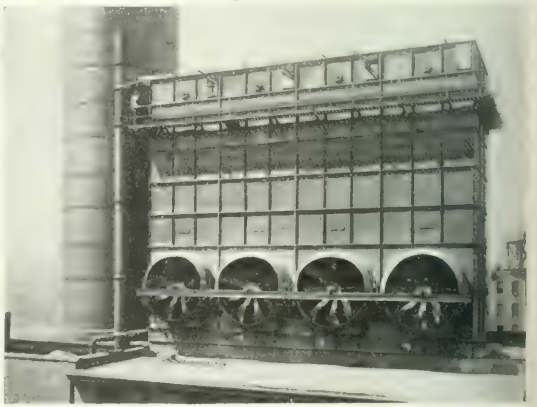


FIG. 14.—ROOF VIEW ON PLUM STREET.

The McCaslin conveyor system carries the coal from the wagons, where it is unloaded to the bins. The plant is all designed to operate condensing, as it adjoins the Miami and Erie Canal. Condensers are supplied by the Southwark Foundry and Machine Company, the central feature of the boiler room being an immense Weiss condenser. The condensers are supplied by a Birbus rotary pump, driven by Southwark engines. As it frequently happens that "the powers that be" see fit to let the water out of the canal without warning, it has been necessary to put a Wheeler cooling tower on

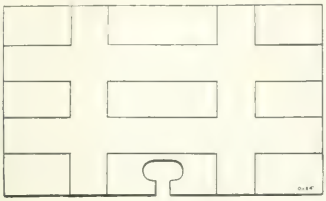


FIG. 15.—DIAGRAM OF CITY BLOCKS AND STREETS.

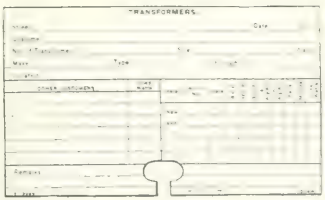


FIG. 16.—TRANSFORMER RECORD CARD.

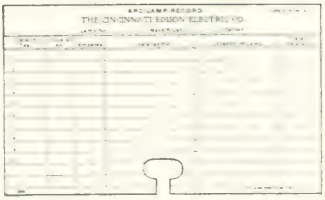


FIG. 17.—ARC LAMP RECORD CARD.

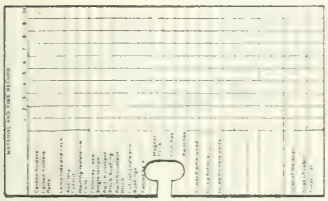


FIG. 18.—BACK OF ARC LAMP RECORD CARD.
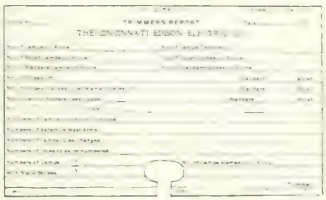


FIG. 19.—TRIMMERS' DAILY REPORT CARD.

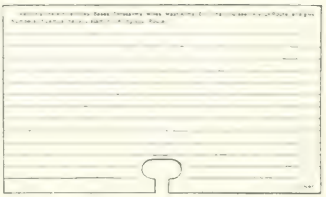


FIG. 20.—BACK OF TRIMMERS DAILY REPORT CARD.

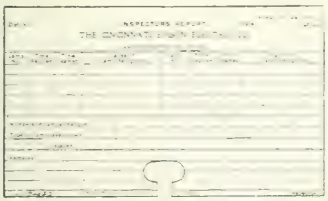


FIG. 21.—NIGHT INSPECTOR'S REPORT CARD.

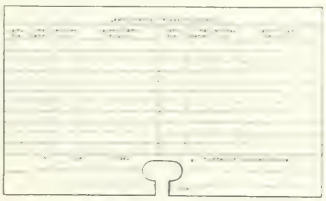


FIG. 22.—BACK OF NIGHT INSPECTOR'S REPORT CARD.
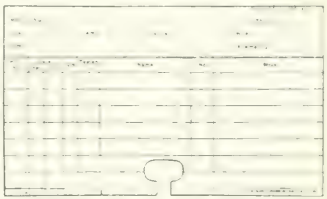


FIG. 23.—TEST REPORT CARD OF METER ON LINE.

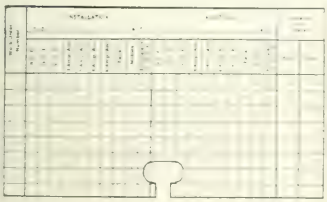


FIG. 24.—BACK OF TEST REPORT CARD OF METER ON LINE.
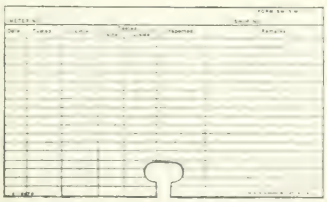


FIG. 25.—SHOP TEST METER RECORD CARD.

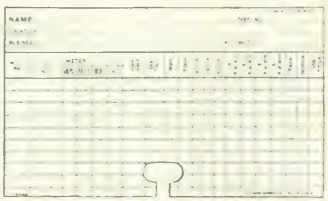


FIG. 26.—METER LOCATION CARD.



FIG. 27.—METER REPAIR CARD.

CARD INDEX SYSTEM OF THE CINCINNATI GAS AND ELECTRIC COMPANY.

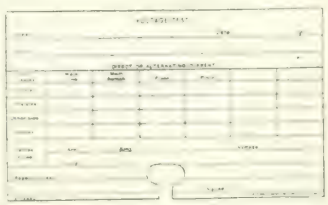


FIG. 28.—VOLTAGE TEST CARD.

the road which can be seen in Figs. 13 and 14. Fig. 14 is a view on Plum Street, showing the exit of the overhead lines from the station, along the canal. Many of these wires are soon to go underground, and some idea can be obtained from this as to the amount of the underground work necessary. In the new part of the plant are to be eight 550-hp Sterling boilers, equipped with McCaslin conveyors.

Near the center of down-town distribution the company has a large storage battery of the chloride type connected to its Edison three-wire net-work. This battery is on Government Place, near Fountain Square, in the building formerly used for the general offices of the Cincinnati Edison Electric Company. The battery capacity is 4,400 ampere-hours, discharging at a one-hour rate. The total number of cells is 166, and there are five cells on each side of the three-wire system which are not used. In connection there are two booster sets. Each set consists of two generators driven by a 175-hp engine. Each of the booster generators is capable of increasing the voltage on its side of the Edison three-wire system 70 volts, and of passing 800 amperes.

Since the consolidation much effort has been expended in systematizing the details of operation, so that the heads of departments might be familiar with everything going on over the entire system, and the exact condition of affairs. The company now has a large map of the city of Cincinnati, showing the location of every pole owned by the company. Such a map is, of course, of immense value, but is also the result of an immense amount of work after the consolidation of so many small companies, some of which kept no records of construction. The company has now some 15,000 poles planted in the city of Cincinnati. Mr. Pfiester makes extensive use of the card index system in keeping track of the details of construction and operation pertaining to the distributing system. In view of the completeness of this system, it will, no doubt, be of interest to reproduce here some of the cards used.

When transformers are installed their data and location are noted on a special card for the purpose, which is kept on file, a copy of which is here shown in Fig. 14. On this all the important information about the transformer can be seen at a glance. The first customer on the transformer is put at the top part of the card, and a space left for other customers on another part of the card, as seen. On the back of the same card is a diagram of a city block and streets in blank, upon which the location of a transformer on a block can be marked and the street names and numbers filled in. With a card index of transformers properly kept up there is no danger of the overloading of a transformer, and much trouble is saved by being able to tell in a moment at the office whether additional customers can be put on any transformer and whether prospective customers are in reach of transformers already up. When a transformer is taken down or the wiring of a district remodeled, the cards are simply taken out of the index and new ones filed, so that the index is not burdened with dead records as would be the case with any bound-book system.

Records of arc lamps are kept on a card for the purpose, one of which is here reproduced. On the front of this card, Fig. 17, is the lamp number and make, with blanks for date of test and location. On the back, Fig. 18, are spaces for entering material and time expended in the repair of the lamp. As the company has heretofore had four types of lamps in use, there are four different colored cards. The front and back of the cards for the old Brush lamps are those here reproduced. Trimmers of street arc lamps make out a daily card report of the form shown, Fig. 19, and on the back of this report, Fig. 20, note is made of all defective poles, bases, cross-arms, wires, etc., that the trimmer sees on his route, and gives also the numbers of the lamps that failed to start when the current is turned on. In this connection it may be well to mention that each trimmer is required to "O.K." his route every night before being let off for the day. That is, he must see that all the lamps trimmed by him during the day have started, and if they have not started to fix them before leaving. Routes are arranged as far as possible, so that trimmers will not have to travel far to see whether all their lamps have started.

For the 3,408 city lamps there are 31 trimmers. There are 3,758 direct-current, constant-potential, enclosed arc lamps in commercial service, and 14 trimmers take care of this commercial work. Very close track is kept of the city street lamps, both by the police department of Cincinnati and by the company. Lamps out are reported promptly by the police department to police headquarters, and from there to the electric light company's offices. The man on duty at the latter office immediately calls up the inspector or trouble man in the district in which the lamp is out, giving him the number of the lamp. A book is issued by the company for the use of the policemen and the company's employees, giving the location of every street lamp in the city and the number of the lamp. Policemen in reporting lamps out, report simply the lamp number. Nine inspectors, or trouble men, are kept on duty all night to answer calls of this kind. Each man is given a certain district, so that in times of emergency a trouble man from one district may be transferred to another district if one man has more trouble than he can attend to. The inspectors of each district turn in a card report, Figs. 21 and 22, every day showing the lamps reported out, lamps started and lamps changed. As a check on this there is the record of the night telephone man at the electric light office, taken from the lamps reported out by the police department.

Meter inspection and repair records are also kept by a card index. This company represents probably the extreme in the matter of frequent taking down meters for inspection and calibration. The Thomson meter is the standard, though some others are in use. Every meter is taken down and tested in the shop once a year without regard to its previous record. In addition to this, every meter is tested in its place at least twice a year with indicating wattmeter and stop-watch. There are nine men in the meter department doing this work, and the company has about 7,000 meters, including those that are in service and those that are in stock and undergoing calibration. For testing meters on the line, a yellow card, Figs. 23 and 24, is used, and for shop testing of meters a white card, Fig. 25. For the location of meters a buff card, Fig. 26, is used, The record of meter repairs is kept on Fig. 27. Voltage tests are frequently made at various places over the system and records of these tests are also kept by a card index system, using the form shown, Fig. 28.

The rates for electric light are 10 cents per kilowatt-hour, with a sliding scale giving discounts as high as 40 per cent. for consumption for over 9 kw-hours per month per 16-cp lamp installed. In addition to the discounts allowed by the sliding scale, 5 per cent. discount is allowed on all bills paid within five days. For power, the rate is 10 cents per kw-hour, with a sliding scale allowing a discount up to 60 per cent. when over 800 kw-hours are used in a month. The total of incandescent lights and power now being supplied by the company amounts to a maximum equivalent of 340,847 incandescent, 16-cp lamps. A few of the down-town streets of Cincinnati are partially lighted, independent of the city lamps, by arches of 32 incandescent lamps. These arches consist of gas pipe extended from curb to curb. This lighting is paid for by the merchants along the street, $34 a month being received for each arch.

The capital stock of the Cincinnati Gas and Electric Company is $29,000,000, no bonds being issued. Of this about $9,000,000 is in the electric department.

In addition to the regular light and power business, the company is under contract to furnish power for the "electric mules," as the electric locomotives are called, which are to supplant the mule on the Miami and Erie Canal. The Miami and Erie Transportation Company has built a track and ordinary overhead trolley along the towpath for this purpose. The lines of the Southern Ohio Traction Company for some distance out of Cincinnati will also use power from the Cincinnati Gas and Electric Company.

Telephony in Baltimore.

At Baltimore, Md., on May 8, a committee of the city council held a meeting to consider the ordinance which authorizes the Independent Maryland Telephone Company to raise its rates. The company was represented at the meeting by President Bouton, of the telephone company, and the former president, Mr. George R. Webb. The ordinance which Messrs. Webb and Bouton are trying to push through provides for an amendment of the ordinance under which the company is now doing business, so that the present rate for telephones —$48 a year for a business house or office, and $36 for a dwelling— may be raised. The company asks for an office rate not to exceed $78 a year until more than 12,000 telephones are in use, and not to exceed $84 until more than 15,000 are in use. For homes they ask a rate of not more than $60 a year until more than 12,000 telephones are installed, and not more than $72 until more than 15,000 are installed. Messrs. Webb and Bouton explained that the cost of operation of a telephone system increases by a geometrical ratio.

A Successful Suburban System.

By Alton D. Adams.

GREAT systems of electrical supply command a share of attention that is out of proportion to their part of total lighting and motor loads for all plants. Important as it is that the few plants of surpassing extent should include generating stations of high efficiency and flexible, economic systems of distribution, these features are still more desirable for the great body of small and medium plants that do the greater part of electrical work. Thus far the great systems have been, as a rule, more ready to adopt the best engineering methods than the smaller ones. It is, therefore, especially interesting and important to note advances of the latter along these lines. Most managers of central stations will, perhaps, agree that a service area composed almost entirely of suburban territory is not the easiest one to serve with satisfactory results.

Such a territory constitutes the field of operations for the Malden Electric Company, the subject of this sketch. Opposite that part of Boston called Charlestown, just north and east of the Mystic River and Lakes, are the suburban cities of Everett, Medford, Malden and Melrose. Though cities in name, these four municipal corporations are really a part of the great residential and manufacturing district of which the older part of Boston is the business center. Throughout the territory such distinguishing marks of cities as large retail stores, theaters and hotels, usually important customers of central stations, are almost entirely absent.

The scattered character of the service supplied by the Malden system may be gathered from the fact that while the population of the territory covered by its lines was only 89,206 on June 30, 1891, the length of the overhead lines was 3,447,021 feet, and there was also 1,200 feet of wire in conduits. This length of distribution lines is greater than that of any other system in the State, except one at Boston. To support these lines 8350 poles were in use, a number surpassing that of any other plant in Massachusetts. The overhead wires just mentioned extend over 147 miles of streets. Further intimation of the character of the lighting load in the territory of the Malden plant may be found in the fact that with 1419 customers using commercial incandescent lamps on the date above named, the total number of such lamps connected to the system was 33,451, or an average of only 23 lamps per customer.

A comparison is here instituted between the station equipments, connected loads, energy outputs and fuel consumption of the Malden system in the calendar years of 1898 and 1901, because the earlier year shows a typical plant of the old style, while the later one shows the change to improved generating machinery and methods of distribution nearly completed.

On Jan. 1, 1898, the generating station of the Malden Electric Company contained the following equipment:

Nine boilers rated at 125 hp each, a total of 1,125 hp. Four of these boilers were made by Roberts, three by Kendall and two by the Atlantic Works.

Eight engines, with a total rating of 1025 hp. These engines included five made by Armington & Sims, each with cylinders 13x12, and rated at 300 r.p.m. and 80 hp. One McIntosh & Seymour, cylinder 14½, 15, 125 hp at 225 r. p. m. Two Green engines, each with cylinder 20x42, and rated at 250 hp and 100 r.p.m. The six smaller engines were each belted direct to a generator, but the two larger engines were each belted to a 5-in. shaft 25 ft. long. These two shafts could be coupled by a friction clutch.

The arc lighting equipment comprised six Thomson-Houston dynamos, four of 50-lamp each, one of 45-lamp and one of 75-lamp capacity. There was also one Brush arc dynamo, with capacity for 75 lamps, making a total of 440-lamp capacity for the seven dynamos. These lamp ratings are all based on nominal 1200-candle arcs, taking 6.8 amperes.

The equipment of alternating generators included two of 2400, one of 2000, one of 1400, one of 1200 and one of 600 lamps capacity, giving a total capacity for 10,000 lamps in the seven machines. These alternators were all of the Thomson-Houston make. Three dynamos for direct currents were in use, one of 500-lamp capacity at 10 volts, and two at 500 volts of 7½ and 62 kilowatts respectively, all being of the Thomson-Houston pattern.

The switchboard in 1898 was of the skeleton type, 10 feet high, and with a total length of about 75 feet.

This old equipment thus comprised 9 boilers, 8 engines and 17 dynamos, all of the latter being belt connected.

Engines were all simple and non-condensing, and the boiler gases escaped directly to the chimney.

In contrast with this old equipment, the station now contains the following apparatus: Two Cahill horizontal water-tube boilers, each with 192 tubes 18 ft. long, two 42-in. steam drums, 68 sq. ft. of grate surface and rated at 450 hp. Also, four return-tube boilers, each 6 ft. in diameter, 16 ft. long, containing 126 tubes of 3 ins. diameter, 36 sq. ft. of grate surface and rated at 125 hp. The present boiler capacity is thus 1500 hp.

Instead of the eight engines formerly employed only four are now in regular use, namely: one Ames tandem-compound, cylinders 15½x26½x18, rated at 385 hp; one Rice & Sargent tandem-compound, cylinders 14x28x36, rated at 500 hp; and two Rice & Sargent cross-compound, each with cylinders 18x36x42 and rated at 750 hp. These four engines have a combined rating of 2385 hp and are all operated condensing. Condensers for the 385 and 500-hp engines were made by the Deane Steam Pump Co., and for the two 750-hp engines by the Geo. F. Blake Mfg. Co. Water for these condensers is cooled in a water tower of 1000-hp capacity, and two more of these towers are to be erected.

A Green economizer of 1000-hp capacity now receives the boiler gases and heats the feed water for the boilers.

The main electric generating equipment now consists of four dynamos, instead of the seventeen machines formerly employed. All of these generators are of the alternating monocyclic type, made by the General Electric Company, and operate at 2,200 volts. One generator has a capacity of 250 and one of 300 kw, while the other two generators are of 500 kw each. The smallest of these generators has a revolving armature, but in the other three the magnets revolve. The combined capacity of these generators amounts to 1,550 kw. Two exciter sets are regularly employed with these generators, each set consisting of a 30-kw, 125-volt, direct-current dynamo coupled to a 40-hp, 220-volt, three-phase motor. There is also one engine exciter set for use in emergency only, consisting of a 30-kw, 125-volt dynamo, belted to a 14½ x 15 single-cylinder engine. All of the main generators are direct connected to the engines previously named.

The present switchboard is made up of twenty-five marble panels, each 30 ins. wide and 90 ins. high, so that the total length of the board is 62.5 ft.

With the old equipment the alternating lines were operated at about 1,000 volts. To correspond with the later equipment, all transformers have been changed to those of 2,000 volts primary and of the H type. At the beginning of 1898, 551 transformers were connected to the lines of the system, having a total capacity of 826 kw, and an average of 1,500 watts each. On January 1, 1902, the number of transformers so connected stood at 580, with a total capacity of 1,160 kw and an average of 2,000 watts each. The fact that in spite of the changes of transformers it has been necessary to keep the average capacity at so low a figure illustrates again the very scattered character of the service.

During the four years from January 1, 1898, to the like date of 1902, the number of electric meters installed increased from 887 to 1,600, a gain of 713. In the same period the number of customers supplied by the system rose from 1,119 to 1,628, showing a gain of 509. The addition of meters has gone on faster than that of customers, because the policy has been to change from contract to meter service. As may be noted, only twenty-eight customers were without meters on the later date. Commercial incandescent lamps to the number of 23,730 were supplied by the Malden system on June 30, 1898, and by the like date of 1902 the number of these lamps stood at 33,450, an increase of 40 per cent. Public arc lamps stood at 270 on January 1, 1898, and at 300 four years later, a gain of sixty. Meantime the arc street lamps have been changed from direct to alternating-current enclosed arcs, operated by three constant current transformers located at the generating station. Each of these transformers has a capacity for 100 lamps, taking 6.6 virtual amperes. From the beginning of 1898 to that of 1899 the number of commercial enclosed arc lamps supplied by the system increased from 15 to 125, a gain of 110. Some commercial arc lamps are still operated by the old arc dynamos, but the change to alternating arcs is being rapidly made.

The number of incandescent street lamps supplied by the Malden system is larger than that from any other plant in the State. At

the beginning of 1898 the number of these lamps was 2,168, and they were operated from the alternating dynamos on the old bank line system. On this system several large single-wire mains were run from one pole of the alternating machine to the different portions of the lighting district. About fifty smaller single wires led out from the switchboard to the street lamps in series, each wire connecting between forty and sixty of these lamps, and then joining one of the large mains. These incandescent street lamps were of 25 cp, and each required 3.5 amperes at 25 volts. Constant current was maintained in these circuits by varying the numbers of lamps connected at the bankboard in the station and by cutting in transformers to raise or lower the voltage of individual lines. It is estimated that these methods of regulation involved a loss of 90,000 kw-hours yearly.

One of the first changes in the old system was the operation of constant-current transformers to operate these incandescent street lamps. For this purpose ten constant-current transformers were installed at the generating station, each of 30-kw capacity at 5.5 virtual amperes, making the maximum voltage 5,454 at full load. It was found desirable to change from 3.5 to 5.5 amperes for these street lamps, because at 5.5 amperes each lamp requires only 16 volts, so that the number of lamps per circuit can be much increased. In this case the original lamp lines were joined in pairs to form the new circuits, one of which is connected to each transformer. The large mains for street lamps and ten of the lamp lines were taken down after the constant-current transformers were adopted, and the use of about $3,000 worth of wire was thus gained. On January 1, 1902, the number of these incandescent street lamps stood at 2,665, showing a gain of 497 during the four years. These street lamps are now controlled from three marble panels, each 30 ins. wide and 90 ins. high, in contrast with the old bankboard, which was 20 ft. long and 8.5 ft. high.

In July, 1900, it was decided to operate the Malden plant twenty-four hours per day, and to change the motor service from direct to alternating, so as to operate only one engine during the hours when the demand for light is small. The change to alternating service for motors was completed in January, 1901, and since that date the motor business has shown a large increase. On the date just named the system was supplying nineteen motors, with an aggregate capacity of 92 hp, and on like date of 1902 the number of motors stood at fifty-two, with 350 hp of total capacity. This amounts to a multiplication of the motor capacity by six during two years. No doubt this large increase of motor business is in part due to the greater area covered by the present 2,000-volt lines over that reached by direct current at 500 volts. The unusually large average of nearly 7 hp each for the capacity of the motors points to a probable use of a part of their number in the small factories that abound in the service area of the Malden system.

Much the greater part of the commercial incandescent lamps supplied by this system have Thomson-Houston bases, and such lamps cost one cent more each than do those with Edison bases. As the Malden company may adopt the policy of free lamp renewals in the near future, it has ordered a sufficient number of adapters to change all sockets for Edison-base lamps. That such a change is highly desirable may be seen from the fact that the company carries a stock of lamps for 104, 106, 108 and 110 volts, and of 4, 8, 16 and 32 cp; also all of these voltages and candle-powers in ground glass globes. The yearly consumption of lamps is about 30,000.

Having noted the structural changes that have been made in this system, it is interesting to study their effects on its operation. During the four calendar years from January 1, 1898, to the like date of 1902 the kilowatt outputs and coal consumption of the Malden station were as follows:

Calendar Year.	Pounds of Fuel.	Kilowatt Output.
1898	10,924,940	1,471,682
1899	11,863,480	1,622,924
1900	13,067,360	2,008,231
1901	13,075,235	2,420,018

From this data it appears that the kilowatt output was greater by 61 per cent in the latest than in the earliest year. During the same period the fuel consumption increased only 25 per cent.

In 1898 the average consumption of fuel was 7.4 lbs. per kw-hour, and for the three following years the figures are 7.3, 6.5 and 5.6 lbs., respectively. This amounts to a gain of 30 per cent in the energy output per pound of fuel. During the year ending December 31, 1901, the energy outputs of the Malden station to its several classes of service were as follows:

	Kilowatt Hours.
All commercial lamps	1,112,065
All street lamps	930,676
Electric power	353,675

Dividing each of these numbers by the total output in kilowatts, it appears that commercial lamps consumed 46, street lamps 38 and motors 14 per cent. of this total.

This sketch would be incomplete without mention of Mr. F. C. Sargent, chief electrician of the Malden company, whose engineering skill has made such good use of the equipment put at his disposal by an able business management. Thanks are especially due Mr. Sargent for aid in the collection of the facts recorded here.

Electric Transmission and California Water Powers.

Recently there has been such a complete demonstration in California of the feasibility of transmitting electric energy at high voltage for great distances, that all important streams within 200 miles of Los Angeles or of San Francisco which are capable of developing substantial water power are being carefully studied. The two factors producing power are the volume of water and the amount of fall, hence the U. S. Geological Survey, owing to its work in gaging streams and topographic mapping, is being called upon from many quarters in connection with these investigations. Frequently investments of many hundred thousand dollars are made or rejected on the basis of these records. The demand for accuracy in the determination of the low summer flow of the stream is particularly severe, and calls are made for a greater amount of detail, both as to the number of points of measurement and as to frequency, than it has been possible to obtain heretofore with the limited funds available for this work. A comprehensive knowledge of a stream can only be obtained after several years of careful study. Manifestly capital seeking investment will not wait to compile the records itself, especially in view of the fact that the result may prove unsatisfactory.

For power developments the low summer flow of the stream is that which is most urgently desired at first. These low volumes doubtless will be supplemented by stored water in the near future. During the past four summers meter measurements of the lowest September flow have been made of nearly all the trunk streams on the western slope of the Sierra Nevadas and Sierra Madres. These measurements are of especial value as these years have been of unusual drought.

The crest of the Sierra Nevadas ranges in elevation from 10,000 to 15,000 feet above sea level and is distant from 50 to 60 miles from the low San Joaquin Valley lands, the elevations of which are less than 500 feet. The streams issuing therefrom have very short steep gradients. Profiles of a large number of them, taken from the contour maps of the United States Geological Survey, are given in Water Supply and Irrigation Paper of the United States Geological Survey, No. 40.

The upper portion of the main streams and their tributaries naturally contain the steeper gradients, and though usually showing smaller volume of water they afford the greater power possibilities because of the higher available pressure heads. These streams are largely within the various National Forest Reserves. One of the interesting characteristics that has been learned, is that during the late summer months when the water is low, practically all of it comes from the highest portions of the drainage basins, say above elevation of 6,000 feet. In fact, some rivers like the Kern, the Kings and the San Joaquin decrease in volume in the lower half of their mountain courses owing to losses by seepage and evaporation.

Arrangements have lately been made with the Forestry officials of the Interior Department for their superintendents in the future to measure these streams at trail crossings, at high elevations, during their low summer stages, under the direction of J. B. Lippincott, the resident hydrographer of the Geological Survey. It is believed that this will add much to the knowledge of California streams in the upper courses. Heretofore they have not been accessible owing to their remoteness and the absence of any reliable observers.

Bristol, England, Central Station Supply.

ONE of the first English cities to adopt the alternating-current system was Bristol, which in 1893 established a municipal plant on that system. Single-phase, alternating-current machinery was installed to generate at 2,000 volts and a frequency of 93, the secondary pressure being 105 volts. For arc lighting, a direct-current plant was installed. Recently a new station has been erected at Avonbank to supplement the old one at Temple Back.

The latter station is equipped with a boiler plant consisting of 12 Lancashire boilers, 24 ft. x 8 ft., and two Babcock & Wilcox boilers. These supply steam at a pressure of 125 lb. per square inch to eight two-crank engines (for the exciters and arc machines), and 10 three-crank engines directly coupled to the alternators. All the engines are of the Willans type, and, with the exception of one Ferranti alternator, all the dynamos are of Messrs. Siemens Bros. & Co.'s make. The four largest alternator sets have each a capacity of 400 kw, and the total capacity of the plant is 3,150 kw, of which two 125-kw and four 52-kw machines furnish continuous current for exciting, arcs and power. The old station has total connections to its mains equivalent to 3,670 kw for private lighting, 156 kw for public lighting, and 732 b. h. p. of motors, and the maximum load on the station recorded Dec. 23d last, was 2,535 kw. The necessity thus, for a new station was pressing, there being no more room to extend in the old one, and the idea is gradually to take up all the lighting load for this new station as new plant is required, and ultimately to supply power exclusively from the old station.

The site of the new station at Avonbank is almost ideal for the purpose. It is well within the supply area, but yet sufficiently far from the residential district to ensure no trouble on account of smoke and steam, and it is bounded by railway lines and the Feeder River. Adjoining the works is a small colliery.

The building resembles a warehouse when viewed from a short distance. Its design is strictly utilitarian, and its main features are four red brick walls with practically no relief, and a glass roof. The interior is not of artistic appearance either, but is very light. The walls are lined with white glazed bricks to a certain height above the ground, and the large glass roof lets in plenty of light.

One of the most interesting parts of the works is the coal-conveying plant which is of the C. W. Hunt Company's make. Combined with the Hunt chain bucket conveyer is a gravity conveyer to carry the coal from the weighing machine above the barge to the hopper which feeds the chain of buckets. The general arrangement of the conveyer plant is shown in Fig. 5. The coal after being lifted

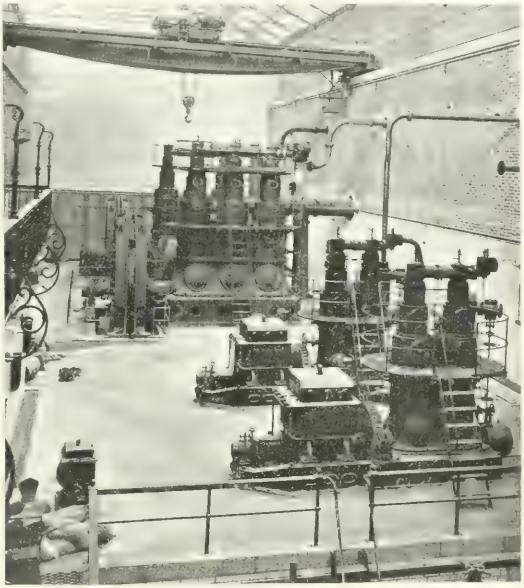


FIG. 2.—ANOTHER VIEW OF BRISTOL PLANT ENGINE ROOM.

up out of the barge to the automatic weighing machine is delivered to the car of the Hunt gravity conveyer or "automatic railway," and the car moved by gravity down the incline track and tips its load of coal into the hopper feeding the chain conveyers. Before

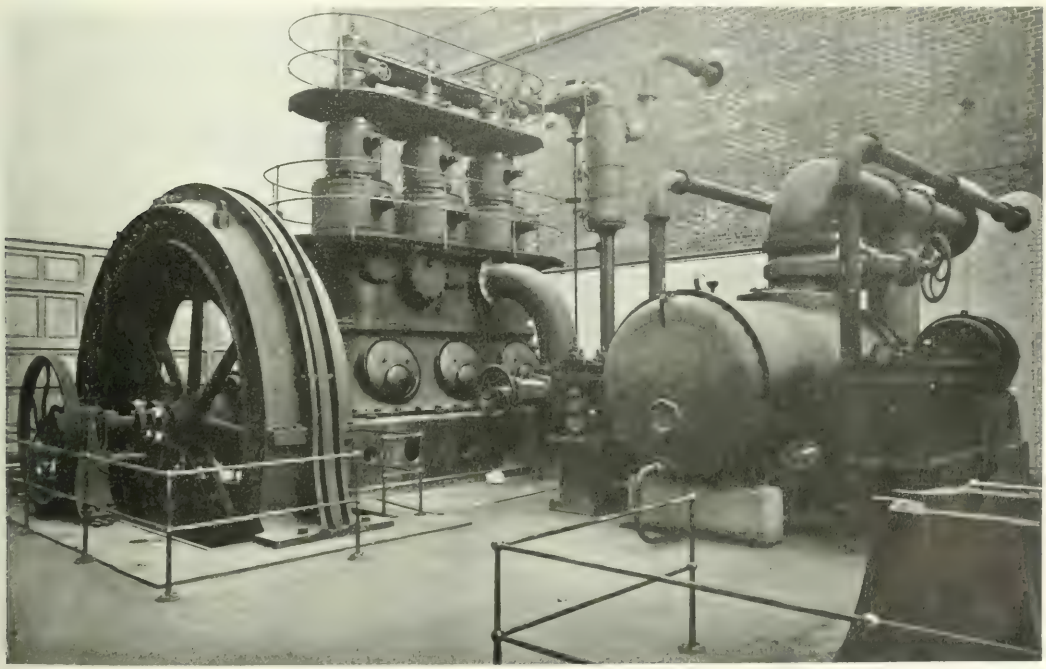


FIG. 1.—A CORNER OF THE ENGINE ROOM, BRISTOL PLANT.

reaching its destination, however, the car picks up a cable and lifts a weight. Part of the kinetic energy of the car is thus utilized and stored in the weight, and when the coal has been discharged and the car is lighter, the weight falls and carries the car back to the starting place above the barge. The weight only hauls the car a certain distance over the track, the momentum gained being sufficient to carry it the remainder of the distance. One man only is needed to operate the railway. He starts the car when filled, but

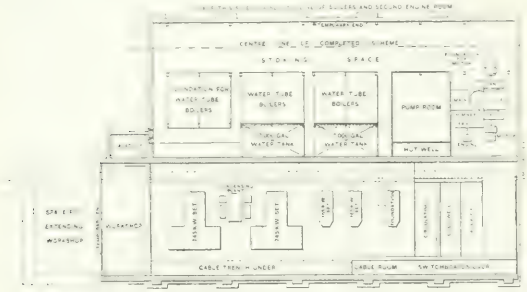


FIG. 3.—PLAN OF STATION.

does not accompany it. The car makes a trip of 300 feet, dumps its load and returns in about 35 seconds.

The gravity conveyer delivers the coal into an elevated steel hopper placed near the gable end of the boiler house. There is a second hopper fixed with its upper edge level with the ground and into this a chute from the upper hopper delivers. This is arranged so that should it be necessary to bring coal in by carts they can tip into the lower hopper. On the mouth of this lower hopper there is fixed a regulating valve which controls the flow of coal into the mechanical filler of the ordinary Hunt bucket conveyer. This conveyer carries the coal to the top of the boiler house, and passes over the coal bunkers for their entire length. Dumping cams and levers are fixed at intervals over the bunkers, by which the buckets are tipped and the coal discharged. The conveyer then passes down at the opposite end of the boiler house and travels along the basement, and, in order to provide depth for the lower coal-receiving hopper already mentioned, the conveyer dips down, as it once more leaves the boiler house and passes into a pit in which the mechanical filler is placed and coal is received.

Provision is made for retrimming the coal in the bunkers, should it be necessary to take it from one part of the bunker and dump in another part. This is done by carrying 12-in. diameter steel

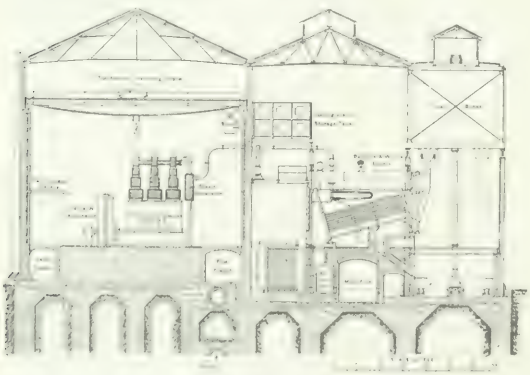


FIG. 4.—CROSS-SECTION OF STATION.

pipes from the bottom of the bunkers through the boiler house floor, and into the basement along which the conveyer runs. These pipes terminate with balanced double-jaw valves, and a rotary mechanical filler travels on a rail track, and can be brought under each of these valves to receive coal and fill the conveyer buckets. The coal can thus be carried up over the bunkers again and dumped where required.

The conveyer is driven by a Siemens semi-enclosed 10 b. h. p. electric motor, but it is estimated that only 6 to 7 b. h. p. will be required to drive the whole of the conveyer plant when raising 40 tons of coal an hour. It is unnecessary to describe the chain buckets in detail, as they are known to our readers. Buckets of fairly large size are employed, and the speed is 35 ft. per minute.

The boiler room contains at present four Babcock-Wilcox boilers, with superheaters, Scotch furnaces and Meldrum automatic stokers. A steam pressure of 200 lb. per square inch is employed. As noted on the plan of the works, the idea is, when extending to double the boiler room and build a second room on the other side of it and both old and new engine and boiler rooms can be extended longitudinally.

An interesting feature in the works is the system of induced draught employed. The chimney is only 70 ft. high, and of steel. A fan engine is located at the bottom of the chimney, fan chamber beneath it, the speed being regulated automatically by an ingenious device in such a way that, when the boiler steam pressure rises, the speed of the fan engine drops, and when it falls again the engine is speeded up. This automatic steam regulator is composed of a flattened steel tube similar to those used in steam traps, and the varying pressure inside the tube causes it to expand or contract, the action resembling that of a Bourdon pressure gauge. The throttle valve spindle is attached to the end of the tube and is controlled by its position. There is an adjusting spring and screw to regulate the opening of the valve to the desired point. Thus, with an increase of boiler pressure, the steel tube expands and so partly closes the throttle valve on the engine, and its speed and that of the fan is reduced, the supply of air to the boiler furnaces is reduced and a further rise in steam prevented. Each of the fans and engines were tested, and passed 97,000 cubic feet of air per minute each at 2½-in. water pressure. The water consumption during the three hours' test came out at 21.5 lb. of steam per indicated hp-hour non-con-

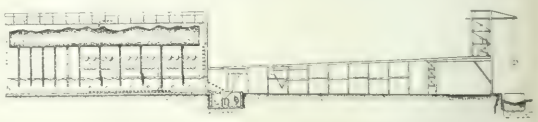


FIG 5.—ELEVATION OF COAL CONVEYOR.

densing, and 19.6 lb. per indicated hp-hour when condensing to 20-in. vacuum.

Figs. 1 and 2 are two views of the engine room, one taken from about the level of the switchboard gallery, the other showing one of the large steam alternators and a condenser at closer range. The alternators, of which there will be three, are by Messrs. Siemens Bros. & Co., and, as at the Temple Back station, have revolving armatures and stationary fields. They are rated at 745 kw normal load and 920 kw emergency load. The Willans engines driving them are three-crank triple expansion. So far the exciters have been machines put down temporarily and driven by ropes from the alternator shafts. Whether this arrangement will be adopted or directly-coupled exciters has not yet been determined; the latter are more convenient, but dearer, owing to the relatively slow speed—295 r. p. m. Two continuous-current machines, also Willans-Siemens combinations, supply power at 500 volts for the various motors used on the works, and are also of suitable type for the outside power supply if required at any time. These are 165-kw machines, the engines two-crank and the dynamos two-pole undertype and compound-wound.

Surface condensers are placed in the engine room, and the circulating water is taken from the river and supplied by centrifugal pumps, one of which is motor driven. The make-up feed is taken from the river and softened in a Doulton water softener (probably caustic soda will be used only in this); and the condensed water is pumped through an oil separator on the baffle-plate principle. A Green economizer is also employed.

The steam range is short, as the boilers back the engines. Each boiler delivers into a section of steel main, which is connected to the adjacent one by a wrought-iron bend. At the end of this range is a loop for the feed and circulating pumps, but practically the range may be regarded as single and not duplicated.

There is a crane in the engine room with a capacity of 25 tons.

Ferranti switchboards are employed, located on a gallery in the engine room on the opposite side to the boiler house. These are more or less on the usual Ferranti lines, the chief exception being

that spiral contact plugs are employed. There are two main bus-bars and a "hospital" bus-bar, and the machines are not paralleled directly, but first through an impedance coil with movable core, which is gradually withdrawn. This system has always been in use in the old Bristol station. Provision is made for running the alternators



FIG. 6.—GENERAL VIEW OF COAL CONVEYING PLANT AND STATION.

in parallel with those at Temple Back, but this had not yet been tested.

The two stations are connected together by three 0.3 sq. in., high-pressure trunk mains. These are Siemens concentric paper-insulated, lead-covered and steel-tape armored, laid directly in the ground, armored cable laid in this manner being used throughout in Bristol. Three-core, lead-covered and armored distributors are largely used for the three-wire distributing network. After the cables are laid they are covered with light soil, then common red bricks are placed over them to mark their position, and the trench

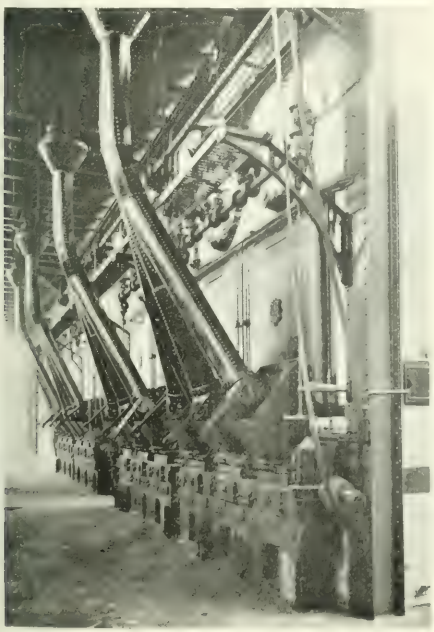


FIG. 7.—BOILER PLANT—HOUSING COKERS.

filled up. The engineers in charge state that, although the cable system now includes 380 miles of conductors, there have been no more than three electrically-caused breakdowns in it since the works were started, and in nearly all cases the outer jute covering has not perished. In all there are 55 substations in various parts of the district

Transformer Testing by Central Station Companies.

By R. F. SCHUCHARDT.

The importance of testing all transformers bought is now so well recognized that almost every very large central station company has provisions for such tests. The object of this paper is to outline the usual tests made, to describe briefly methods of testing which give results of ample accuracy and which are most commonly used, and to give a description of a simple testing table with which some of these tests can be made rapidly. The tests generally made are as follows: 1. Insulation, 2. Resistance, 3. Core Loss and Leakage Currents, 4. Copper Loss, 5. Impedance, 6. Heating.

1. For the insulation test a high potential transformer should be used and the guaranteed voltage applied between coils and core. For a 2,000-volt primary transformer this voltage is generally not less than 2,000 volts between primary and secondary and between primary and core, and 2,000 volts between secondary and core applied for a period of five minutes. The secondary should be grounded on the core when testing between primary and secondary or core; and all primary leads should be connected together as well as all secondary leads, to prevent undue strain in any parts of winding.

2. The resistance of the coils is best measured by the drop of potential method, *i. e.*, by measurement of the volts drop across the coil for a given current, from which the resistance is found by Ohm's law.

3. The core loss and magnetizing current are measured at the secondary. An alternating current of the rated secondary voltage and of proper frequency is applied at the secondary terminals, and an ammeter and a wattmeter are inserted in the circuit to read respectively the leakage current and the core loss watts. The amperes thus found must be divided by the ratio of the transformer to get the leakage current. From the data obtained in this test the no-load power factor is calculated. Care must be taken in making this test to have the primary leads clear, as full voltage will be on the coils.

4. The copper loss can be calculated from the measured resistances $C_1^2R_1 = I_1^2R_{11}$, where I_1 is the primary current including

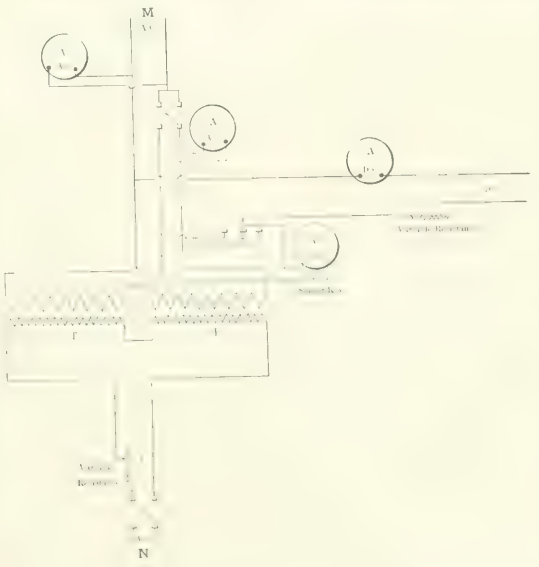


FIG. 1.—DIAGRAM OF CONNECTIONS FOR TRANSFORMER TESTING.

leakage; I_{11} is secondary current; and R_1 and R_{11} are primary and secondary resistance respectively), or it can, with sufficient accuracy, be measured directly in connection with the impedance tests.

5. The impedance test is made as follows: The secondary coils are short-circuited through an a. c. ammeter of negligible resistance, and a pressure of proper frequency is impressed upon the

primary coils, sufficient to cause full load current to flow, or this full load current can be measured on the primary side (neglecting the small leakage current), the secondary coils then being short-circuited direct. The reading of a wattmeter on the primary side in this test will be (nearly) the copper loss at full load, while the voltage represents the impedance drop, and is generally expressed in per cent. of the rated primary voltage. The measured watts include, in addition to the I^2R loss, the core loss at the low voltage used and eddy current loss in copper and iron, which values are,

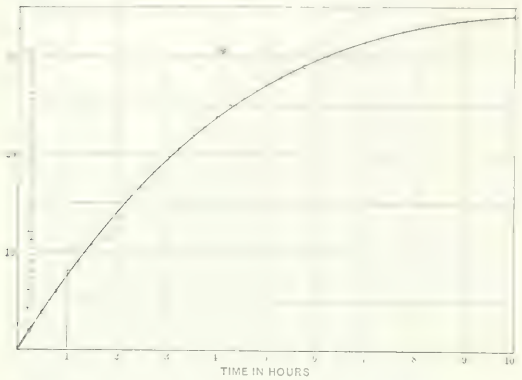


FIG. 2.—TEMPERATURE CURVE OF AN OIL-COOLED TRANSFORMER.

however, so very slight as to be entirely negligible in commercial measurements.

The above-described tests should be applied to every transformer before it is connected to the lines. In addition to this at least two transformers of each capacity in every lot received should be subjected to a heat test. The most satisfactory method to use for this is the one commonly known as the "motor generator" method. Two transformers of like capacity and voltage are tested together. The connections are shown in Fig. 1. The secondaries of both transformers are connected in parallel to an a. c. circuit M of voltage equal to rated secondary pressure, thus supplying from this side the full core loss. The primaries are connected in opposition and an alternating current of voltage equal to the sum of the impedance volts of the two transformers is impressed on the open terminals N, connected as shown. This voltage on the priamries should be adjusted for full loal current in the a. c.

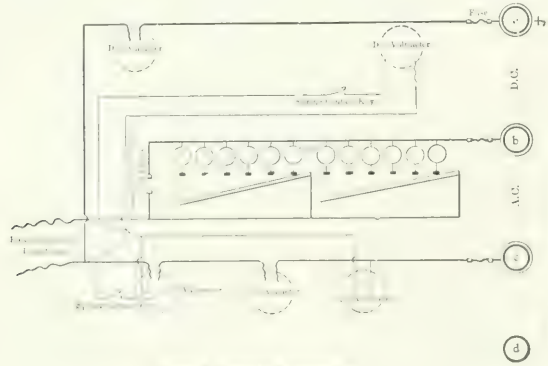


FIG. 3.—WIRING DIAGRAM.

ammeter when switch S is closed, and before pressure is applied from the secondary side. Then, when pressure is applied from both sides, the two transformers are practically under full load working condition. Direct-current connections are made, as shown, through switch S_2. At the beginning of test the resistance of the secondary coils is measured by means of the direct current, thus giving resistance at room temperature. At regular intervals (twenty-minute readings are sufficient) during the test the a. c. switches are opened, S_2 is closed for resistance measurement first on one coil and then on the other. The average temperature of the coils are calculated from these measured resistances, using the equation

$$t \text{ (rise in degrees C.)} = \frac{Rh - R}{0.004\ R}$$

where R is the resistance at room temperature and Rh = resistance when hot. This is the same as dividing the per cent. increase in resistance by 0.004, which figure is approximately the temperature co-efficient of resistance of copper at 25° C. For every 10° above

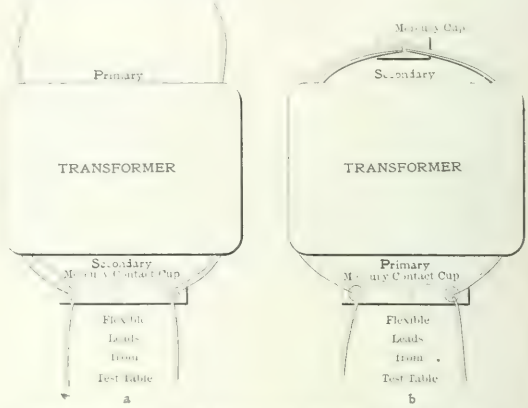


FIG. 4.—CONNECTIONS FOR MEASURING CORE LOSS AND LEAKAGE.

25° C. this co-efficient should be increased by about 1.5 per cent. These measurements should be made rapidly so as not to keep the alternating current off long enough to affect the heat test. The direct current used should be of about the same amperage as the a. c. for full load. The voltmeter key should not be closed until S^2 is closed, in order to avoid injury to voltmeter from the inductive kick. They should also be opened before S_2 is for same reason. S_2 must, of course, remain open when a. c. switches are closed. The leads connecting secondaries to switches and S_2 should be of sufficient size so their resistance will not be appreciable. This

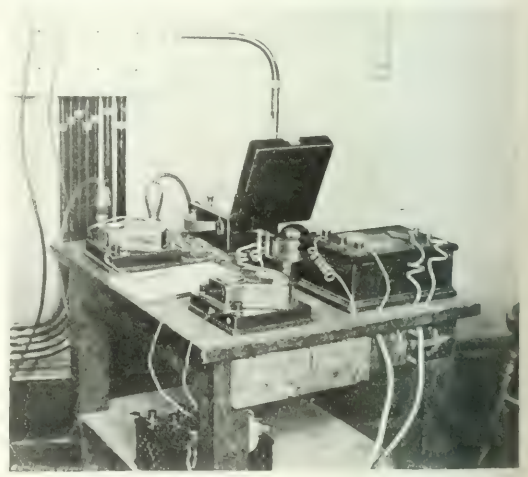


FIG. 5.—TESTING TABLE.

heat test should be continued until constant temperature is reached, which requires about ten hours. From the data obtained the heat curve is plotted.

Fig. 3 shows the diagram of wiring of a table which was designed for making all the tests mentioned above, except those for insulation and for heating. The transformer under test is connected to the flexible leads from the test table through mercury contact "cups," as shown in Fig. 4, in which *a* shows the connections for measuring core loss and leakage current, and *b* the measurement of

copper loss and impedance volts. These flexible leads are about 5 feet long, which permits from 10 to 12 transformers being grouped around on three sides of the table and tested without any change except swinging transformer around and moving mercury cups along to each transformer in turn. Thus core loss and leakage current (or resistance) test can be made on all the transformers in a row, the transformers then turned around and, on going back the copper loss and impedance volts (or resistance) can be measured. This arrangement results in a very material saving of time and trouble, especially if the transformers are nearly of the same capacity, in which case the rheostat setting (number of lamps on) will not be changed much for the different transformers. Current is conducted to the test table from a plug board on which are found a. c. (115-v. and 230-v.) d. c., and water rheostat terminals.

Referring to Fig. 3, *a* and *b* are the plug reeptacles on test table, used when measuring resistance (d. c.), and *b* and *c* for all a. c. measurements. *d* is a "dead" receptacle for inserting one of the plugs when the circuit is to be open. All wiring of the table is underneath, except where the leads come through the top for meter connections, and is of ample size so the *IR* drop is in it is negligible. A sheet of asbestos covers the wiring to protect it from the heat of the lamps, which are arranged horizontally along the sides of the table under the top. In measuring the secondary resistance of transformers the drop in the flexible connecting leads will be an appreciable amount of the voltmeter reading, and must be taken into account. The resistance of these leads can readily be determined by inserting the ends of both leads in the same mercury cup and with two primary or two secondary coils to have the coils measured in series if so desired. These mercury cups are holes bored into the side of a block of wood nailed upright to a base board. They are about 8 inches high.

The table described here has been in use for more than two years and is found very satisfactory. Fig. 5 is a photograph of the table with all meters connected ready for test. By closing the switch which short-circuits the lamps, the table can be used for testing motors up to the capacity of the wiring.

The *meters* best suited for testing transformers of capacities ranging from 1 kw to 30 kw with primaries not over 3,000 volts, are as follows:

1 direct-current ammeter with two scales, 0 — 1 and 0 — 10 amperes.

1 direct-current voltmeter with three scales, 0 — .15, 0 — 1.5, 0 — 15 volts.

1 alternating-current voltmeter, 0 — 150 volts.

1 alternating-current ammeter, 0 — 2 amperes.

1 alternating-current ammeter, 0 — 15 amperes.

1 alternating-current wattmeter, 2 amperes, 150 volts, scale, 0 — 300 watts.

1 alternating-current wattmeter, 15 amperes, 150 volts, scale, 0 — 1,500 volts.

An additional wattmeter for 5 amperes and 150 volts, with scale 0 — 750 watts, is very desirable, though not an absolute necessity. The d. c. ammeter is preferably a meter with separate shunt. It should be ordered for the proper shunt ranges and for a full scale

Make	Number	Type	Capacity in Watts	Ratio of Transf.	Date of Test	Pri. Res. Coils in Series	Sec. Res. Coils in Par.	Impedance Drop. Per cent.	Copper Loss Watts.	Core Loss Watts.	Leakage Current	P. F. at No Load Per cent.	Regulation Per cent.	Full Load Efficiency Per cent.	Room Temperature Deg. C	Remarks
xxx	xxxxx	x	1,000	2000 — 115 1000 — 230	4-15-02	7.25	.1152	4.0	81.0	38	.0222	65.0	3.44	94.25	23	
			1,500	" "	"	11.1	.0906	3.6	41.0	38	.0280	65.0	2.75	95.18	23	
			2,000	" "	"	38	.0491	3.7	53.5	45	.0332	65.0	2.60	95.33	23	
			2,500	" "	"	24.0	.0490	4.0	60	50	.0370	65.0	2.38	95.70	23	
			3,000	" "	"	18.0	.0440	3.9	70	56	.0414	65.0	2.32	95.97	23	
			4,000	" "	"	11.4	.0300	3.8	92	95	.0480	65.0	2.28	96.24	23	
			5,000	" "	"	10.6	.0200	4.1	102	74	.0547	65.0	2.06	96.56	23	
			7,500	" "	"	6.50	.0156	3.7	145	100	.0740	65.0	2.00	96.78	23	
			10,000	" "	"	4.61	.0114	3.4	192	130	.0960	65.0	1.92	96.88	23	
			15,000	" "	"	3.64	.0078	3.6	290	165	.1220	65.0	1.98	97.00	23	
			20,000	" "	"	2.61	.0054	3.5	395	190	.1405	65.0	1.96	97.02	23	
			25,000	" "	"	1.72	.0048	3.4	480	210	.1554	65.0	1.93	97.32	23	
xxx	xxxxx	x	30,000	" "	"	1.38	.0035	3.4	525	250	.1850	65.0	1.77	97.48	23	

FIG. 6.—DATA OF TRANSFORMER TESTS.

measuring the voltage drop for a given current. If No. 6 wire is used, this resistance will be about 0.004 ohms. The leads to the d. c. voltmeter should be of same resistance as the regular leads belonging to the meter used, and the spring contact key should be kept clean. If the d. c. voltmeter has a low resistance its current must be substracted from the indications of the ammeter to get accurate results. The a. c. voltmeter connection should be open when the d. c. readings are taken, as this meter is in shunt with the transformer coil under measurement.

In measuring leakage current the wattmeter pressure circuit is left open while the ammeter is read, and then closed by depressing spring key for measuring core loss. For copper loss measurement the ammeter is brought to the correct primary full load, with wattmeter pressure circuit open, and the voltage is read. The wattmeter reading is then found for the same voltage. The connections of the wattmeter pressure wires, as shown in Fig 3, are for meter which has a compensating coil for the pressure circuit current. For wattmeters without this compensating coil the pressure connection should be made on the other side of meter. As mentioned before, the leads are of ample cross-section so the small *IR* drop in them will be well within the accuracy of the meters as read. Therefore, for commercial measurements no fine corrections need be applied. In addition to the plug rheostat (which contains lamps of various cp) a water rheostat with terminals on the plug board is found a great convenience for accurate adjustments. In Fig. 4 one of the mercury contact forks is shown with three "cups." This is to permit of transformers deflection of the meter itself, with its leads on 100 millivolts. This latter condition can be obtained from the manufacturer without additional cost, and it practically adds another useful meter to the equipment of the testing department. It will also be found useful to have a second scale, reading 0 — 300, on the a. c. voltmeter, and have the wattmeters provided with pressure coils for both 150 and 300 volts. It is, of course, needless to emphasize the necessity of keeping all meters in accurate calibration.

The data obtained in the tests outlined above should be recorded in some such form as shown in Fig. 6, except that a separate sheet should be used for each capacity of transformer so the results can be easily compared. The figures given in the table, Fig. 6, are approximately average values representing good modern manufacture. The values given under the heading "Regulation" are for non-inductive load and are calculated from the following formula:

$$Reg. = \frac{Copper\ loss\ watts}{Total\ input\ watts} + \left(1 - \sqrt{100^2 - \text{Imp. drop}^2}\right)$$

For example, take the 2,500 watt transformer in table of Fig. 6. I^2R loss = 60 watts or 2.3 per cent. of the input. Drop due to impedance $1 - \left(\sqrt{100^2 - 4^2} = 0.08\%.\right)$ Regulation for this transformer is, therefore, 2.38 per cent. To facilitate rapid calculation of this value a curve plotted between "impedance drop per cent" and $(1 - \sqrt{\quad})$

or per cent. regulation due to impedance, will be found convenient. Fig. 7 shows such a curve, with impedance drop per cent as ordi-

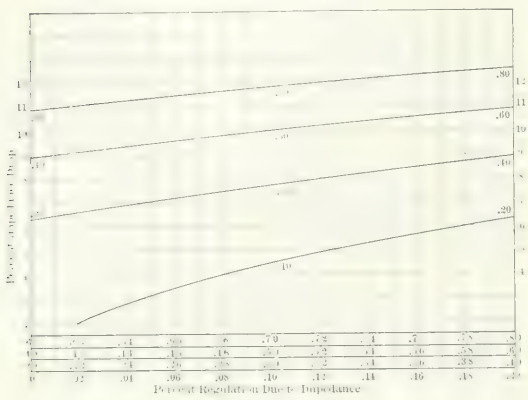


FIG. 7.—PER CENT REGULATION DUE TO IMPEDANCE.

nates, and per cent. regulation due to this drop as abscissa. The several lines of this curve are the continuations plotted above the

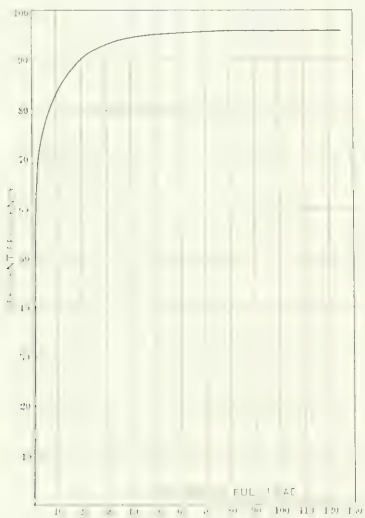


FIG. 8.—EFFICIENCY CURVE.

first part in order to obtain the curve in compact form. The calculated values from which the curve is plotted are as follows:

Impedance Drop. %	Regulation due to Impd. drop. %	Impedance Drop. %	Regulation due to Impd. drop. %
2	.01900	7.5	.28125
2.5	[illegible]	8	.32100
3	.04500	8.5	.36325
3.5	[illegible]	9	.40625
4	.08000	9.5	.45150
4.5	.10200	10	.50000
5	[illegible]	10.5	.55150
5.5	.17600	11	.60700
6	.18140	11.5	.66750
6.5	[illegible]	12	.72250
7	[illegible]	12.5	.78500

CALCULATED DATA FOR EFFICIENCY CURVE.

Load in Watts	Pri. Cur. (including exc. leakage)	Sec. Cur.	Pri. I^2R loss.	Sec. I^2R loss.	Total loss Copper loss and Core loss	Input Watts	Efficiency.
250	1.57	2.174	.59	.23	50.82	300.82	83.1
625	.837	5.435	2.73	1.45	54.18	679.18	92.0
1250	.937	10.870	9.75	5.78	65.53	1315.53	95.0
1875	.937	16.305	21.08	13.08	84.16	1969.16	95.72
2500	1.237	21.740	36.6	23.2	109.80	2609.8	95.79
3125	1.537	27.175	56.5	36.1	142.6	3267.6	95.64

The efficiency curve of the 2,500 watt transformer of the table is shown in Fig. 8. The above data show the necessary calculated values for this curve.

The Field of Force in Wireless Telegraphy.

By Lee de Forest.

FROM the time when public attention was first drawn to experiments in space telegraphy by means of Hertzian waves, speculation has been rife as to the *modus operandi* of the transmission. Numerous theories, many vague, more fantastic, have been advanced, and remarkable when the array of facts which directly and clearly contradict them are considered.

Thus a French writer was early to assert that these oscillations traveled and returned in earth strata of differing conductivity; although a countryman of his demonstrated very clearly that a few feet of damp earth was completely opaque to such vibrations. The theory of transmission through an electrically stratified atmosphere has found its adherents—and one experimenter who figured prominently in Marconi's early work, suggests, in explanation of the earth's influence in transmission, that by charging and discharging the sending antenna we merely alter the electrical density of a point on a sphere. The induction and conduction theories have also been advanced.

Naturally the wave theory has had numerous champions, but with surprising disregard for the actual phenomena. Thus, in early days, when Lodge and Marconi repeated Hertz's classifical work with parabolic reflectors, and straight line propagation was obtained, the exact analogy between these "wireless" oscillations and those of polarized light was asserted. The analogy has been clung to generally and persistently ever since; and this notwithstanding the remarkable effects obtained from grounding the sending instrument, the marked difference in transmission over land and sea, the failure of obstacles to obstruct, the strange falling off in transmission during very hot weather, et cetera.

In 1899, when Marconi first transmitted signals over a hill of water completely shielding his two antennæ, the failure of the light analogy to explain was equally convincing as on December 21st last; yet it required transmission over an eighth of the globe to show some that these strange oscillations were not exactly like light waves, and did not travel in straight lines. Only last summer an eminent American physicist asserted the impossibility of transmitting signals where the curvature of the earth intervened.

Much of this misunderstanding and false work might have been prevented had attention been more widely drawn to a paper which appeared in May, 1899, in the London *Electrical Review*. Its author, Taylor, there sets forth, I believe, for the first time, the ground work of a theory which seems capable of explaining most of the transmission phenomena thus far observed by workers in the wireless field. Several scientists have gone more deeply into the same theory, notably Blondel and Abraham, and there exists already some mathematical work on this fascinating and highly important subject.

The theory is briefly this: The oscillations employed in "space telegraphy are truly Hertzian waves, not static disturbances, not induction currents; radiated outwardly from the upright conductor or not pure space radiations. The radiator may be regarded as half of the familiar Hertz oscillator, and the waves sent out as corresponding to the waves on wires first investigated by this distinguished savant. They are more exactly waves traveling over the surface of a conducting plate. If this be a perfect conductor

(and over sea the analogy is sufficiently maintained), the field of force is very similar to that plotted by Hertz from his dumb-bell oscillator, but cut in half by this reflecting, conducting surface, in its equatorial or plane of symmetry.

The spark-gap lies nearest this plane and one terminal is grounded thereto. Assume that the antenna (corresponding to the upper arm of the oscillator in Fig. 2) is positively charged. The opposite negative charge is found on the surface of the earth in its vicinity, and we have the static lines of force extending from the antenna to the conducting surface, somewhat as shown in the figure.

During disruptive discharge and the rush of positive charge to earth, these force lines will spread out; their upper and inner ends may be regarded as running down the surface of the antenna into the



FIGS. 1 AND 2.—FIELD OF FORCE IN WIRELESS TELEGRAPHY.

earth; their higher curved portions traveling outward and upward, expanding exactly as do the lines of force from the dumb-bell oscillator. A portion of the electrostatic wave is thus entirely detached from the antenna, but with both ends of each line of force grounded, and slipping outward over the surface of the earth. The upper portions go on expanding, increasing in altitude, attenuating, but also traveling outward from the axis of the antenna.

Another portion of the original static energy, larger or smaller as the oscillating system is less or more strongly damped, re-enters the antenna at the spark-gap, changing into electromagnetic energy or current, to provide the following oscillations of the wave-train.

During the next half period, the oscillation traveling upward on the surface of the antenna, is reflected at its top without change of static sign, giving an electrostatic loop at this free end, while a corresponding loop of the electromagnetic standing wave exists at the base or one quarter wave length distant.

The detached or radiated wave takes now the form shown in sectional planes in Figs. 3 or 4, the directions of displacement currents being as indicated. Since, however, the earth is never a perfect conductor we have not a pure transverse wave. These static lines are not entirely perpendicular to the surface at their bases; there is a tangential component, larger in the case of transmission over land than sea.

The electromagnetic lines of the radiating wave are in ever-widening circles, concentric with the antenna. Hertz has shown how to separate the effects of the electrical and magnetic components in waves along wires; and that even here the two are of the same order of magnitude in their mechanical effects. The limiting condition

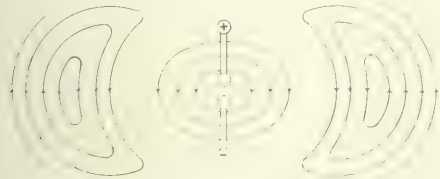


FIG. 3.—SECTIONAL PLANES OF WAVES.

as to when this relation begins is that of true dielectric waves, of so high a frequency as to travel in the skin of the (perfectly conducting) wire alone, giving us a conductor inside a train of waves. As the wire approaches infinite thinness the magnetic component comes into prominence. On the other hand, the broader the surfaces attached thereto the more is the magnetic force overpowered by the electric.

So here, even in transmission over sea water, practically opaque to oscillations of the order of millions per second frequency (*i. e.*, an excellent conductor for them) the electromagnetic energy is but a small portion of the energy of the wave; what there is of it lies largely in the equatorial region, nearest the surface. There, too, it is most certain of obstruction, being absorbed in Joulean losses in conducting obstacles. Blondel, in direct opposition to this view, states that the electrostatic lines radiated from the antenna go rapidly to earth, and that transmission at a distance is, in consequence, by the magnetic components. The correctness of this assumption, however, is not at all borne out by experiments in the upper atmosphere, such as those to which we shall presently refer.

By this modern "Taylor's theorem" then, many puzzling facts in wireless are explained. Here we have our electrostatic waves, plane polarized, but "grounded" traveling outwardly from the antenna in all horizontal directions alike, with a velocity approximating that of light, crests separated by a distance twice the height of the upright wire; the base of the waves following the curvature of the earth, traveling over hills of conducting material if these are not steep

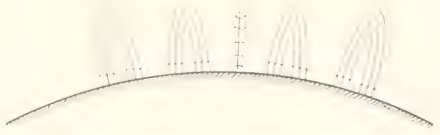


FIG. 4.—SECTIONAL PLANES OF WAVES.

relative to the wave length, or absorbed by such if precipitous; as well as by trees, steel masts, cordage, building frames, etc.; and passing *through* similar hills and obstacles if of a non-conducting nature.

If over dry soil the equivalent conducting surface may be indeterminant in location, lying at depths varying to several hundred feet below upper earth, with the crests of the waves correspondingly depressed.

Thus is made clear the strange effects observed over various qualities of country and under differing conditions apparently so puzzling. For example, Prof. Fessenden reports that it required seven times as much power to transmit signals over 47 miles of frozen earth as was needed over the same range after a thaw. Ice, of course, is a splendid dielectric to electric oscillations of such frequencies.

Again, over dry, arid land, transmission is always poor, as it is also over heavily wooded country, especially in the spring and summer. It is best over low, marshy stretches where vegetation attains no great height.

The grounded radiating wave will tend to follow and concentrate upon that path affording greatest conductivity. Thus Prof. Slaby found that a loose wire laid along the ground between his two instruments considerably improved the transmission, while a similar one under water allowed no such effect. Hence in the same way the earth will tend to absorb energy waves, whose lines of electric displacement are parallel thereto, and thus arises the necessity for vertical rather than horizontal antennæ.

In connection with this maximum conductivity path, it may be expected that the grounded wave will follow the course of a river, even if tortuous, in preference to straight line transmission over land. No data on this point has yet been reported, but experiments are shortly to be carried out to determine this interesting question.

As Hertz first pointed out, the energy of his wave decreases with the sine of the angle between the vector leading from a point on its surface to the spark-gap, and the axis of the oscillator. Hence, the chief electrostatic energy also resides nearest the equatorial plane, at least over water where obstacles have not too far consumed the same.

Very interesting in this connection are the experiments which have been made with receiving instruments attached to the upper ends of wires suspended from balloons, at various distances from the sending antenna and at different altitudes. Thus Le Carme in his observations among the Alps obtained signals from a 50-meter wire suspended 600 meters directly above a similar upright on the earth's surface, showing that the same did not give off a purely transverse wave. By Hertz's theory this axial line was that of least radiation of energy. But when 6,000 meters from the sending wire Le Carme reports signals obtainable at a greater height, 800 meters, thus illustrating the upward expansion of the wave which accompanies its outward radiation.

Captain Ferrie has also investigated this distribution of the Hertzian field in the atmosphere. He used for sending antenna a conductor 50 to 100 meters length, supported by a balloon; and for receiving one of 50 to 200 meters, suspended from a large captive

balloon capable of rising to a height of 800 meters, and containing the receiving instrument.

When the sending antenna was 100 and receiver 200 meters in length, and 20 kilometers distant, the receipt of signals was equally good in all altitudes up to 800 meters. By reducing the length of receiving wire one-half he found 400 meters altitude as the upper limit. Other experiments showed that signals could not be obtained with his apparatus at heights between 800 and 1,000 meters, at the distance named.

In this connection it is of interest to note that the best effects were obtained here when the receiving wire was twice the length of the sending upright. This was to be expected, inasmuch as the one was a freely oscillating, unearthed system; the other grounded and representing but one-quarter wave length. From such observations is made clear the role which the earth plays in transmission in preventing the dispersion of the field into space—another instance of Nature's mercifulness to man.

It has been frequently observed that during mid-day hours in extremely warm weather wireless transmission for great distances is practically impossible. Thus in the French experiments between Biot and Calvi communication was practically suspended between 10 and 11 A. M. Such facts have been explained by the light wave, rectilinear-transmission theory, as due to refraction from the rarefied gas nearest the earth's surface. If the feet of our lofty lines of displacement are well grounded, why should this rarefied strata offer an obstruction?

Several continental physicists have determined, however, that air of only slightly diminished density is a practical conductor, even to such relatively low frequencies as we have in wireless telegraphy. This means that the rarefied layer lying nearest the water will take upon itself the role of conducting surface, and our electric wave will, therefore, travel over head and out into space. We should, therefore, expect to find such experiments as those of Le Carme and Ferrie successful at higher altitudes during heated periods than at other times.

Consider now the sending apparatus, using merely a capacity instead of ground connection. The reason that long-distance transmission is never accomplished by such arrangement is evident; but the influence of the earth as a conducting medium still exists, though diminished. If, as in Fig. 1, we have two oppositely charged bodies, and near them a conducting plane *M M*, a portion of the lines of static displacement will run into the conductor as shown. When a discharge occurs between the two bodies all of the lines of force will not be sent off self-closed, but a portion will travel over or into the sheet *M M*. Thus if the capacity at base of the spark-gap lies in the vicinity of earth and the system be set into sufficiently rapid oscillation relative to its dimensions, we will still have to a certain extent transmission over the conducting surface. A large portion of the lines, however, being self-closed will radiate rectilinearly into space, or be actually reflected from the earth's surface.

When the advancing wave train encounters any conducting obstacle, sections of the lines of displacement composing such wave are cut out of it, as it were. The obstacle, if large relative to the wave length, will cast an electromagnetic shadow, but where the wave length is of several hundred feet an ordinary upright conductor, owing to the phenomenon of diffraction, will not essentially shield another situated a little behind it. As Heavisides has so well illustrated, the lines of the displacement wave advancing in a direction normal to their length will cut into a metallic conductor in their path, and entering therein in directions nearly perpendicular to the surface of the conductor, will, therefore, travel up or down the same, as the wave advances. This action means merely the excitation in the skin of the conductor of actual conduction currents, of the same frequency as that of the exciting oscillation; or if this be strongly damped, or a periodic, the single impulsive charge will cause the conductor to discharge or oscillate at its own natural period of vibration. Thus the action upon the receiving upright is inductive, though not in the ordinary interpretation of the word. This, being a volume effect, would vary as the inverse cube of distance, while were the action due simply to the static charge upon the top of the sending antenna, the law would be that of the inverse square; if from the wire, as the first power of the distance, as actually tested in the laboratory. Lietz, using as receivers a Klemencis thermo-element and Ruben's balometer, has found this law to be intermediary between the two. On the other hand, the inductive effects from the two forces increase as the square and the first power respectively of the intensity of the source.

Ascoli, reasoning from Neuman's formula, has shown that the mutual action between the two single antennæ should vary directly as the product of their heights, or, if equal, as the sqare of one; and inversely as the distance apart. Much data from the field corroborates the correctness of this law, making due allowance for the extra increase of range arising from better transmission over obstacles of the longer wave lengths.

With an antenna arrangement as shown in Fig. 5, the quarter wave length may be greatly increased, but there is also the liability of harmonics, or multiple vibrations from the antenna as a whole and its component parts. If its electromagnetic pulsations be too slow, they are unaccompanied by any alternating static field, and do not emit radiant energy; the waves are not detached from the conductor, there is no Hertzian decrement of damping, and any action at a distance is by simple induction.

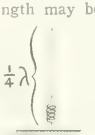


FIG. 5.—ANTENNA ARRANGEMENT.

Sufficient figures have not yet been reported to establish a general law as to the relation between actual range in the field and length of spark-gap or potentials. The connection between these latter is by no means as simple as it might appear, largely because of the changes in wave front and length of wave train introduced by alternations in the nature of the spark-gap.

Spokane-Coeur D'Alene Water Power Plant.

A large addition is to be made to the plant of the Washington Power Company, of Spokane, Washington, which when completed will make the plant one of the largest in the West. The new building, including the present one, will be 115 x 120 feet, and furnish 13,800 square feet of floor space, to which will be added a switchboard gallery on the west end. The hydraulic machinery will be installed in the new portion, and will be supplied through two steel pipes 10 feet in diameter. The present dam will be largely extended. The addition of these two new pipe lines will give the company five lines, two of the pipes for the present plant being 9 feet in diameter, and one 10 feet. The latter pipe, however, has only been thus far used on special occasions when the others were under repair.

Near the new building will be erected a standpipe 66 feet high, which will be connected with the two new lines, in order to regulate the water pressure. The pipes will supply two large turbines capable of developing each 4,000 hp. The turbines will be direct-connected to the shafts of two generators having a rated capacity of 3,000 hp, and each capable of developing 4,000 hp. A new switchboard of blue Vermont marble will be erected on the gallery and occupy the whole end of the building. From this gallery the operator will be able to observe the entire plant.

The company expects that all work on the new dam, the pipe lines, standpipes and building will be completed by Jan. 1, 1903. Surveys for the pole lines between Spokane and Cœur D'Alene will be finished in a couple of months, and the conductors erected during the fall. All the machinery has been ordered and will be on the ground by fall. The new generators will each weigh about 45,000 lbs. and stand 12 ft. high. A 20-ton crane will be erected in the generating room.

The hydraulic extension will give a head of 70 feet, which will render available at least 20,000 hp; by going up to the upper level of Spokane Falls, 30,000 hp could easily be secured. The company expects to transmit power to the Cœur D'Alene mines, where most of it will be used in the operation of pumps, compressors, crushers, concentrators and other mining machinery; also for lighting the Wardner, Wallace, Burke and other mines. The pole line to Cœur D'Alene will be about 100 miles long. This line will also furnish power and light for intermediate towns or mines. About 1,000 hp will be used for arc lighting in Spokane.

Wireless Telegraphy to Block Island.

It is reported that a wireless telegraph system will be operated between Providence and Block Island, R. I. Negotiations have been entered into for the purpose by the American Marconi Company.

Synchronous Motor Calculations.

By F. G. Baum.

THE constantly recurring questions coming up when we operate synchronous motors, especially on a transmission line, makes it desirable to have some simpler method of solving synchronous motor problems than those generally used. The method here given will, I believe, commend itself to busy engineers who have to deal with the question.

The great difference in the amount of mental and physical effort required to solve a given problem concerning the electric generator and one concerning the synchronous motor would lead us to suspect—since the motor may be regarded as the inverse of the generator—that there is a simpler way of solving synchronous motor problems than the one commonly used. In the electric generator we always have three pressures to consider. (1) The generated pressure, (2) the terminal pressure, or the pressure at some point on the line, and (3) the pressure to overcome the synchronous impedance of the generator and the line. These three pressures always so related as to form a closed triangle. In the synchronous motor we have, similarly, three pressures to consider. (1) The back e. m. f. of the motor, (2) the impressed pressure at the terminals of the motor, or the pressure at some point on the line, and (3) the pressure to overcome the impedance of the motor. These pressures are also so related as to form a closed triangle. We have exactly similar terms to consider in each problem, which makes the simplicity of generator calculations and the complexity of synchronous motor calculations surprising. The difference must de due to the method of attacking the synchronous motor problem. I will attempt to show in this paper that it is as simple to solve any problem concerning a synchronous motor as it is to solve any problem concerning a generator.

Figure 1 may represent a generator or motor. The synchronous reactance, x_0, and the resistance, r_0, of the generator or motor may be considered as connected outside, leaving a perfect generator or motor, developing a pressure E_0. The pressure E is the delivered pressure by the generator, or is the pressure applied to the motor. (If E is not at the terminals of the motor or generator the reactance of the line must be added to the synchronous reactance, and the resistance of the line must be added to the resistance of the generator or motor). E^1 is the pressure consumed by the impedance between E and E_0. E_0 is the pressure developed by the generator or the back e. m. f. of the motor.

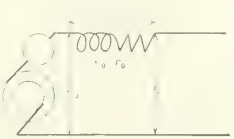


FIG. 1.—GENERATOR OR MOTOR.

The measurable quantities which may be determined by direct measurement in the case of a generator are the terminal pressure, the current and power delivered, from which the power factor may be computed. The value of E_0 and E^1 may be indirectly determined, E_0 from the excitation, and E^1 by calculation from the current and the impedance. The important quantities in the case of the generator are the terminal pressure, the current and power factor at terminals. Knowing these and the synchronous impedance, the value of E_0 for any load and any power factor may be determined in several ways.

In the synchronous motor, the measurable quantities are the same as above, the important quantities being again the impressed pressure, the current and power factor. For a given input into the motor, the current supplied will depend on the excitation; conversely, in the generator the excitation for a given load depends on the power factor of the load. The determination of the excitation so that the power factor at a given load shall be a certain value is not as easy, however, as the determination of the excitation for a given load and power factor in the case of the generator. It will here be shown that one problem is as easy of solution as the other. Let us first obtain a diagram showing the value of E_0 for the case of a generator for *any load* and *any power factor.**

When we have receiver loads of different power factors, we get simpler results if we consider the total current delivered by the generator divided into two parts: (1) The power component, and (2) the wattless component, and regard each as flowing separately over the impedance of generator and line. If I is the total receiver current and θ the angle of lag of the receiver current behind the receiver pressure, the power component of the receiver is $I \cos \theta$ and the wattless component is $I \sin \theta$ (for non-inductive load $\theta = 0$). Let oa (Fig. 2) be the pressure E considered constant and equal to 100%. The pressure consumed by the resistance

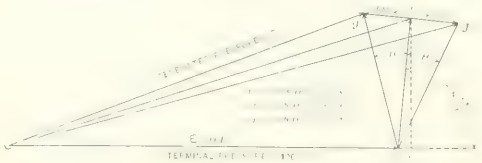


FIG. 2.—GENERATOR DIAGRAM.

and reactance due to the power component of the load current is $I \cos \theta$. In Fig. 2, $ab = I \cos \theta \, r_0$,

$$bc = I \cos \theta \, x_0$$

Therefore $ac = I \cos \theta \, r_0 + I \sin \theta \, x_0 = I z_0$, z_0 being the impedance. ac represents then in magnitude and direction the pressure consumed over the impedance z_0 by the power component of the receiver current. ac is proportional to the output since E is constant. If for a lagging current we make the angle $cag = \theta$ (θ is the angle by which the receiver current lags behind the receiver pressure), and the angle $acg = 90°$, then

$$cg = I \sin \theta \, r_0 - I \cos \theta \, x_0 = I \sin \theta \, z_0$$

as can be proved by simple geometry. That is, cg represents in magnitude and direction the pressure consumed over the impedance by the wattless component of the current. If the current leads the receiver pressure by the angle θ, then cg^1 is equal to the pressure consumed by the wattless component of the current. The line ag, therefore, represents in magnitude and direction the pressure consumed by the total current delivered by the genrator. ab and bc are laid off in percentage of E. oc is the pressure generated for a non-inductive load. For the same load and a power factor corresponding to the angle θ and lagging receiver current, og is the pressure which must be generated. For the same load, but leading current, og^1 is the pressure generated. ac may represent the percentage pressure consumed by full load non-inductive current. Then $ac/2$ will represent half load, etc. Fig 3 shows the same diagram with lines drawn at right angles to ac at one-quarter, one-half, three-quarters, and full load. Radial lines making angles with ac corresponding to $\cos \theta = 1$, $\cos \theta = .98$, have been drawn. With o as center and radii equal to 95%, 100%, 105%, etc., circular arcs have been drawn. From this

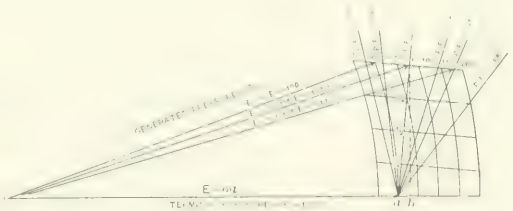


FIG. 3.—GENERATOR DIAGRAM.

figure we see that the generated pressure for non-inductive full-load must be 7½% higher than the terminal pressure. For a power factor equal to .95, lagging current, the generated pressure must be 17½% higher than the delivered pressure. At a power factor of .85 and three-quarter load, the generated pressure must be 20% higher than the delivered pressure. For a power factor of about .97, leading current $E_0 = E$.

With 100% receiver pressure laid off to a scale of about ten inches, it is possible to get results accurate within 1%. As this is as close as measurements could be made on any generator with the best obtainable commercial instruments, this graphical method is perfectly satisfactory.

Let us now see what change takes place if we operate this generator as a motor. Leaving the pressure E_0 as before, we must reverse E, and the direction of the current, so that power is now

*A Simple Diagram Showing the Regulation of a Transmission System for any Load and any Power Factor. By F. G. Baum. *Elec. World and Eng.* May 18, 1901.

absorbed by the motor. The terminal pressure E is again assumed constant and laid off horizontally, but to the left of a. Fig. 4 shows the method of constructing the synchronous motor diagram when the current is in phase with E.

[illegible]

ac, so long as the current is in phase with E, is proportional to the power output, since *ac* is proportional to the current (the mechanical output will be equal to the electrical input minus the losses. The



FIG. 4.—SYNCHRONOUS MOTOR DIAGRAM.

friction and iron losses are constant, and the variable loss is equal to I^2r_0). The excitation for an input corresponding to *ac* is $oc = E_0$.

Suppose now the current to lag behind the impressed pressure by the angle θ, Fig. 5. The pressure consumed by the power component of the current for the same input is still $ac = I \cos Oz_0$. If the current lags, the pressure consumed by the wattless component of the current, $I \sin O$, is $cg^1 = I \sin Oz_0$. The pressure consumed by the impedance z_0 by the total current is $ag^1 = Iz_0$. The value of E_0, the excitation of the motor, which will give a power factor equal to $\cos \theta$, lagging current, for an input corresponding to *ac*, will be og^1. If E_0 is made equal to *oc*, then for the same input the current becomes in phase with the pressure E. (A given input means prac-

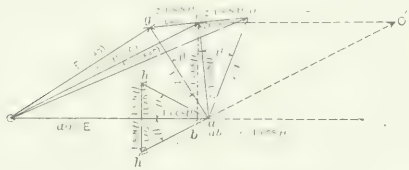


FIG. 5.—SYNCHRONOUS MOTOR DIAGRAM.

tically a given output, since the variable loss due to the change of I is small.) If the excitation for the same input is raised to the value *og* the current will lead the pressure by the angle θ. The point i is found as follows: Suppose, for example, we consider a motor for one thousand volts and 100 amperes, the resistance of the motor being .2 ohm, and the reactance 4 ohms (in a polyphase motor these would be the quantities per phase). E is laid off horizontally equal to 10 inches, say, = 1,000 volts. $ab = .2 \times 100 = 20$ volts = .2 inch. $be = 400$ volts = 4 inches. *ac* may then be drawn. *ac* will always represent an input of 1,000 times 100 = 100 kw. For 150 kw *ac* would be increased in proportion. In Fig. 6, lines have been drawn at

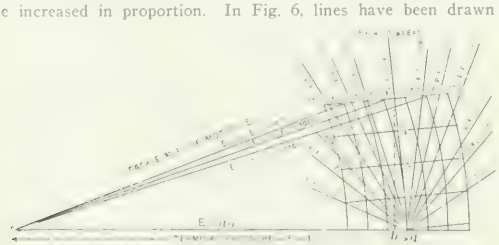


FIG. 6.—SYNCHRONOUS MOTOR DIAGRAM.

right angles to *ac* at points marked ¼, ½, ¾ and full-load. Circular arcs, with *o* as center and radii, equal to 95%, 100%, etc., have been drawn. Radial lines making angles corresponding to different power factors have been drawn from *a*. The power factor and wattless current for any particular load and excitation, or the excitation for any load and any power factor may be determined at once from the figure. The use of the diagram will be shown later.

For motors of different sizes and of different make the ratio of *ab* to *bc*, the pressures consumed by resistance and reactance will be different. The angle between *ab* and *ac* will generally be between 85° and 90°. If the resistance and reactance of a line is added the angle between *ab* and *ac* may be smaller than 85°. For the same ratio between *ab* and *bc*, *ac* will be a different percentage of the terminal pressure E in different motors. *ac* will generally vary between 25% and 50% of E. In Fig. 7 has been drawn a case corresponding to an angle of 84½° between *ab* and *ac* (the limiting value of this angle is 90°, shown by the dotted line.) Points along *ac* have been marked 10%, 20%, etc. These represent the percentage pressure consumed by the load component of the current; *e. g.*, at full load a given motor may consume 40% of pressure by its impedance when the current is in phase with the pressure at its terminals. Then the point 40% would represent full load on the motor, 20% one-half load, 60% one and a half load, etc. It will be seen that all lines in this figure remain the same except the power factor lines which rotate about *a*, so that *ac* makes the angle $= \tan^1 \frac{x_0}{r_0}$ between *ao* and *ac*. From this diagram may be obtained:

(1) The excitation to give any particular power factor at any load.

(2) The excitation to give any required wattless current at any load.

(3) The power factor and wattless current for any load and excitation.

(4) The angular swing of motor for any load and excitation.

(5) The maximum input or output for any particular excitation.

(6) The V-curves between current and excitation.

These will be illustrated by examples, the numbers referring to the numbers above. We will assume a motor in which the impedance consumes 40% pressure on full-load current.

(1) Find the excitation which will give a power factor of unity at full load: go along *ac* to the point marked 40% (assuming that 40% pressure is consumed by the impedance by full-load current), and we see that the motor must be over excited 4%. If $\tan^1 \frac{x_0}{r_0}$ were practically 90° the motor would have to be over-excited about 8%, as may be seen by going along g^1g to the broken line which makes an angle of 90° with *ao*. To give a power factor of .8 leading current, go to the point g: excitation 1.35 E. To give .8 power factor, lagging current, go to the point g^1; excitation .75 E.

(2) What excitation will make the wattless lagging current equal to one-half the load current when the motor is carrying half-load? Go along the line at right angles to *ac*, at the point 20%, a distance equal to one-half the distance from *a* to 20%: excitation equals .9E.

(3) Suppose the excitation to be .9 E at one-quarter load, what will be the power factor and wattless current? The intersection of $E_0 = .9$, with the line at right angles to *ac* at 10%, gives a power factor of about .7, and a wattless current equal to the load current.

(4) For any particular position of E_0, the electrical angle through which the motor must swing from no load to the new load is equal to the angle between E_0 and E (this assumes that instead of the true self-induction and the magnetizing or demagnetizing effect of the armature, we may use the synchronous reactance). The mechanical angle will be equal to the electrical angle divided by the number of poles.

(5) What is the maximum input when $E_0 = E$? Follow the circular arc $E_0 = E$ until we get maximum projection on *ac*; the projection on *ac* gives the load. The length along *ac* is seen to be 110%; therefore the input is 110/40 = 2.75 times full load. The power factor as shown would be about .75. The current in the motor is ag_2, and may be scaled off.

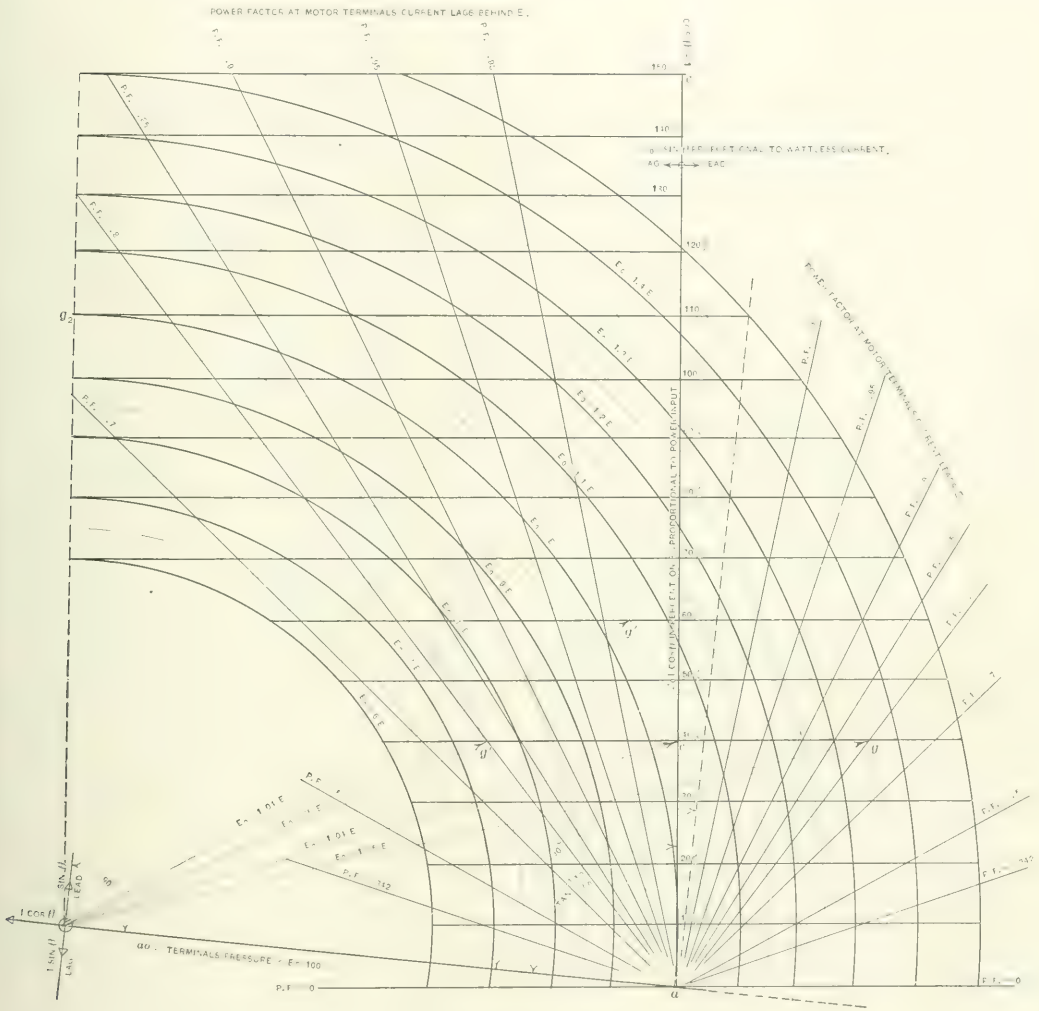
(6) To determine the V-curves, assume different excitations for the same load. For full-load: if $E_0 = 1.04\ E$, the current is a minimum, and equal to the length from *a* to the point along *ac* marked 40%. If $E = .75\ E$, the armature current is ag^1. If $E_0 = 1.35\ E$, the armature current is *ag*. For any other load move along the line at right angles to *ac* at the point corresponding to the load.

COMPOUNDING OF SYNCHRONOUS MOTORS.

Suppose this motor to be working at the end of a transmission line, and it is desired to vary the excitation so that changes in load on the motor will not cause a drop in pressure at the motor terminals with constant pressure applied to the transmission line at the generating end. The synchronous motor may be driving a direct-current generator, in which case the load on the motor would be proportional

to the output of the generator. The motor excitation may be raised from no load to full load by carrying a series winding around the field of the motor, the current in the series winding being taken from the load on the direct-current generator.

For this problem we must first draw a figure, Fig. 8, showing the regulation of the transmission line for any load and any power factor of the motor. In Fig. 8, the pressure E equals 100%, is the pressure to be maintained at the motor terminals (the point o is not shown in the figure). ab is the resistance pressure (equal 8% of E), and bc is the reactance pressure (equal 21% of E) consumed over the line by *full load motor current* when the current is in phase say that at ¾-load on the motor the current shall be in phase with the pressure at the motor terminals. For this load there is no wattless current drawn over the line, and the value of E_0 is given by the point .75 along ac. Draw a circular arc through this point with O as center, shown by the heavy line. At any other load the pressure at right angles to ac, consumed by the wattless current, must reach this circular arc. We see that the generator pressure is to be 7% higher than the receiver pressure at all loads, since the 7% arc passes through the point marked .75. Let us first determine the excitation of the motor when the D. C. generator to which it is connected is carrying no load. If the losses in motor



the shunt excitation of the synchronous motor equal to .85 E at no load. Then with ¾-load on the motor adjust the current in the series coil until the motor draws non-inductive current. The excitation on the motor then will increase with the load, the motor drawing lagging current at no load, non-inductive current at ¾-load,

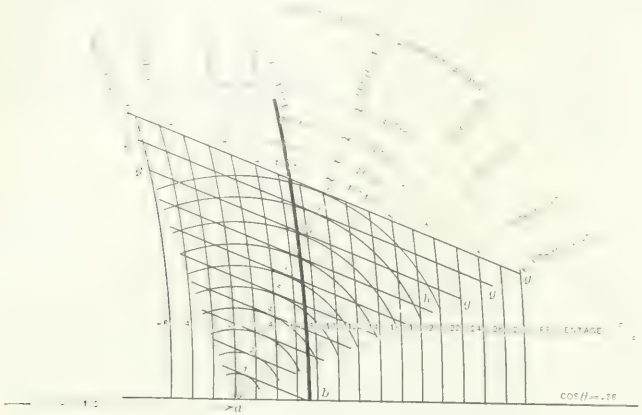


FIG. 8.—REGULATION OF TRANSMISSION LINE.

and leading current with power factor of about .99 at full load. At full load the excitation will be about 1.09 E. From no load to full load the excitation changes from $E_0 = .85\ E$ to $E_0 = 1.09\ E$, or is raised 24%.

Exhibits at the Annual Exhibition of the French Society of Physics.

At the annual exhibition of the French Society of Physics, held in Paris on April 5 and 6, a large number of interesting exhibits were shown. As the rooms were only opened to the public a few hours on each of the days, there was considerable complaint on the part of visitors, since the time admitted of only a rapid examination of the numerous exhibits.

M. and Madame Curie gave an exhibition of radium rays. Solutions of sulphate of zinc and radium chloride were placed in separate bulbs connected by a tube, and it was shown that the former becomes phosphorescent from the influence of the latter. The light emitted by the latter is, however, about 1,000 times more powerful than the light emitted from the radium. The diameter of the connecting tube may be made extremely small—in fact, it may be a capillary tube—but cutting the connection between the two bulbs stops the influence of the radium.

Prof. Blondel showed no less than six interesting pieces of apparatus. One of these was a high-speed revolving mirror for the study of Hertzian waves. The mirror is secured to the shaft of a small steel Pelton wheel of extremely small diameter, which is revolved by a stream of gas from a cylinder of carbonic acid. With this device a speed of 1,000 r. p. m. was obtained. A "Foucault current" telephone was shown for use in wireless telegraphy. The principle is an application of the phenomenon of repulsion of induced alternating current, discovered by Prof. Elihu Thomson. The telephone consists of a coil through which pass currents of high frequency taken, for example, from a receiving antenna; there is an aluminum diaphragm in which the coil induces Foucault currents. Whenever oscillatory current passes through the coil, there is a repulsion and the telephone indicates all the interruptions and variations of the oscillations.

A Blondel bifilar oscillograph was shown having a permanent magnet, and presenting a great improvement over other types of bifilar oscillographs with respect to facility of construction and sensitiveness. The mechanism is simple of adjustment, and its sensitiveness reaches 10,000 to 12,000 periods and 200 to 250 mm. per ampere at one meter with a permanent magnet; and three times these figures with an electromagnet. The synchronoscope and the mounting are the same as in the case of the soft iron oscillograph.

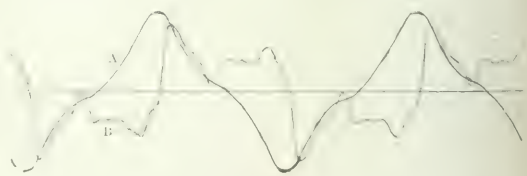
A Blondel chronograph was shown, consisting of a simple soft iron oscillograph with electromagnets, having a periodicity exceeding 50,000 p. p. s. In operation the current to be studied is passed through the coil and each rupture produces a series of oscillations, which may be recorded alongside a curve of the phenomenon under investigation. By this means a measure of time is obtained much more sensitive and of greater limits than with electro-diapasons.

Prof. Blondel also showed a cinemato recording oscillograph, which will register on a photographic band 100 successive oscillations, or even more, such as a variable alternating current in function of time. The band is wound on a roller operated by a constant speed electric motor of a type which gives a result much superior than is attained with the usual cinematograph arrangement.

A Blondel fluxograph was shown, which consists of a galvanometer without directing force or damping, and which records the curves of variation of magnetic flux in circuit. A trial bobbin is placed around an iron core subject to a variable flux; the induced e. m. f. is at each instant proportional to the variation of flux, and the coil is connected to a small transformer without iron, of which the secondary is connected to the galvanometer. In the latter, granting that the time constants of the circuit are rendered negligible, a current passes proportional to the second derivative of flux. The galvanometer having neither a directing couple nor damper, its deviations register a cycle rigorously proportional. These deviations proportional to the time are reflected by a revolving mirror having a constant velocity, as in the case of an oscillograph, and the curve of the flux is thus obtained in function of time. The galvanometer consists of a small coil enclosed in an iron box, which shields it from all exterior fields; the coil acts on a small magnetized bar pivoted between jewels and enclosed in an exhausted glass tube. If instead of a mirror of constant velocity, there is employed to reflect the rays a plane mirror fixed to a galvanometer, having its axis horizontal to the oscillations, and through which the magnetizing current passes, it is possible with the aid of a fluxograph to trace directly the magnetizing periods of a specimen of iron by the Hopkinson or tore methods.

The Abraham rheograph, a form of the Blondel oscillograph, was shown connected with a street lighting circuit supplied by a Ferranti generator. By means of a variable inductance in the circuit, the different harmonics in the circuit up to the eleventh were shown. The third and fifth harmonics were particularly perceptible.

Prof. Hospitalier exhibited his "ondograph," which is based on the Joubert or point-by-point method of plotting periodic curves. While this instrument is not fitted for registering variations of a non-periodic character, it is of simple construction and easy of manipulation. A succession of periods is used in connection with condensers, the charges of which pass through a Weston voltmeter, the reading of which gives points of the curve. Displacing the



SPECIMEN RECORD FROM ONDOGRAPH.

charging contact of the condenser by determined angles and reading the voltmeter for each position of the contact, gives corresponding points of the waves, which consequently may be plotted point by point. The charging and discharging commutator is run by a synchronous motor operated from the system furnishing the wave to be plotted. The accompanying curves are specimens of the records taken by the apparatus. Curve A is the wave form of the Rive Gauche alternating system, and curve B is the wave of secondary current.

Prof. Hospitalier also showed a manograph to represent the pressures in a gasoline motor. The diagram is represented on a screen of ground glass by means of a moving mirror. The piston displace-

ment deflects the mirror in one direction, and the variation of pressure in the cylinder deflects it in another direction. The resultant motion produces the curve, and the persistency of luminous impression on the eye gives the effect of a complete curve. Photographic reproductions of the card may be obtained from the ground glass representation.

An acetylene process of soldering metals was shown. High temperatures are obtained by an oxyacetylene blow-pipe similar to the well-known oxyhydrogen blow-pipe; it is claimed, however, that the former is more efficient and cheaper and gives a temperature as high as 3200° C.

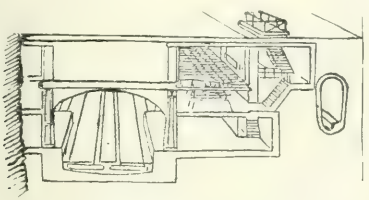
M. Nodon showed an aluminum-carbon electrolytic rectifier, a full description of which will appear later. A number of arc lamps were shown; among others, the Froment lamp, which is the first enclosed arc lamp of French origin. A large number of radiographic appliances were exhibited, and it is to be noted that in this line of work there is a tendency toward the use of static machines as preferable to other sources, experience having shown that better results may be obtained from their use.

Rolling Platform for Paris.

A plan has recently been proposed by a well-known French engineer, M. Casalonga, for providing Paris with a rolling platform, running from the Place de la Concorde to Place de la Bastille under the Grand Boulevard, a total length of 6 miles.

The present service of the existing omnibus line, called the Madeline-Bastille, is known to be far from satisfactory, with respect both to capacity and schedule. Moreover, this line passes through crowded districts where the traffic will be congested and slow in spite of all improvements. The traffic of this line is very heavy, corresponding to 15,000,0000 passengers a year, and could reach 30,000,000 were it possible to supply vehicles and seats.

A rolling platform, it is believed, would have a very great advantage, and the traffic would thereby be further increased owing to the superior facilities and the less fare proposed by the promoters of the scheme. Stairs would be installed every 650 feet, one set for going in and another for going out of the shallow tunnel of the running platform. The maximum distance to walk to a station would, therefore, be 325 feet. The uniform fare proposed is 2 cents.



CROSS-SECTION OF TUNNEL.

The platform itself would consist of three parallel parts running with speeds of 2.4, 5 and 7 miles per hour, respectively. A passenger walking on the third platform could thus attain a speed of 9 to 10 miles. The promoters are contemplating even a quadruple platform, making the higher speed as great as 12 to 14 miles per hour.

A cross-section of the tunnel proposed is shown in the accompanying cut, running parallel to a proposed line of the Paris Metropolitan. The expense is estimated at $1,700,000 per mile of double track, and the running expenses, calculated from the experience gained with the rolling platform of the Paris Exposition, which transported more than 70,000,000 passengers in 1900, would amount to $400,000 per year.

Wireless Telegraphy in the Navy.

The information comes from Berlin that the U. S. Navy Department has decided to adopt the Braun-Siemens-Halske system of wireless telegraphy, and that a large consignment of apparatus will be sent to Washington in June.

Farewell Dinner to Lord and Lady Kelvin.

On Thursday, May 8, a farewell dinner was given by Mr. Anthony N. Brady, president of the New York Edison Company, in honor of Lord and Lady Kelvin, who sailed May 10, after a stay in this country of barely three weeks. This interesting and delightful function took place in the roof garden at Delmonico's, on Fifth Avenue. During the afternoon Lord Kelvin, escorted by the officers of the company, visited the fine new Waterside Station of the Edison Company, on the East River, recently described in these pages, and spent considerable time in making a thorough inspection of the equipment and the various engineering features. In spite of the fatigue imposed by this and other sight-seeing during the day, Lord Kelvin was in the best of health and spirits when he arrived at Delmonico's with Lady Kelvin, and, together with Mr. and Mrs. Brady, held an informal reception before the dinner. The following were present:

Lord and Lady Kelvin, Graham J. Blandy and Mrs. Blandy, John Bottomley and Mrs. Bottomley, A. N. Brady, president New York Edison Company, and Mrs. Brady; N. F. Brady, vice-president and treasurer New York Edison Company, and Mrs. Palmer Gavitt; J. C. Brackenridge, general manager Brooklyn Rapid Transit Company, and Mrs. Brackenridge; E. P. Bryan, general manager Rapid Transit Subway Company; J. J. Carty, chief engineer New York Telephone Company, and Mrs. Carty; Prof. F. B. Crocker, Columbia University; C. L. Edgar, president Boston Edison Company, and Mrs. Edgar; Thomas A. Edison and Mrs. Edison; Walton Ferguson, director Brooklyn Edison Company; Anson R. Flower, director Brooklyn Rapid Transit Company, and Mrs. Flower; Harrington E. Gawtry, president Consolidated Gas Company; Lewis B. Gawtry, secretary New York Edison Company, and Mrs. Gawtry; J. L. Greatsinger, president Brooklyn Rapid Transit Company; E. A. Leslie, general manager Brooklyn Edison Company, and Mrs. Leslie; John W. Lieb, Jr., associate general manager New York Edison Company, and Mrs. Lieb; W. M. McFarland, vice-president Westinghouse Electric Manufacturing Company; E. A. Maher, president Union Railway Company, and Mrs. Maher; W. S. Mallory, secretary to Thomas A. Edison, and Mrs. Mallory; T. Commerford Martin, editor ELECTRICAL WORLD AND ENGINEER, and Mrs. Martin; John B. McDonald, contractor Rapid Transit Subway, and Mrs. McDonald; Rear-Admiral Geo. W. Melville, U. S. N.; D. O. Mills, president Niagara Falls Power Company; Thomas E. Murray, general manager New York Edison Company, and Mrs. Murray; Stephen S. Palmer, director New York Edison Company; Henry Sanderson, president New York Transportation Company, and Mrs. Sanderson; Frank J. Sprague and Mrs. Sprague, M. G. Starrett, chief engineer Metropolitan Traction Company, and Mrs. Starrett; Lewis B. Stillwell, consulting electrical engineer Rapid Transit Subway Company and Manhattan Railway Company, and Mrs. Stillwell; H. G. Stott, superintendent motive power Manhattan Railway Company, and Mrs. Stott; Nikola Tesla, Charles Trippe, Anglo-American Cable Company, and Mrs. Trippe; J. Van Vleck, mechanical engineer Rapid Transit Subway Company; and Geo. G. Ward, vice-president Commercial Cable Company, and Mrs. Ward.

There were but two toasts after the dinner, it being desired by Mr. Brady that the affair should be a social rather than a formal function. In proposing the health of Lord and Lady Kelvin, the toastmaster said that the occasion might be likened to a gathering of the captains of electrical industry, in view of the representative character of the men assembled from all branches of the science and art, but, considering the shape of the board around which they sat, they might also be styled "Knights of the Round Table." They were indeed warranted in accepting this designation, for never were quests more daring and venturesome than those upon which the founders of the utilizations of electricity had embarked. Indeed, it would not be unseemly to compare with the mystical cup of the Holy Grail, which evaded the grasp of those who sought it, the pure and beautiful incandescent light which the genius of Edison and others had actually put into the hands of the world, or even those wonderful tubes of Tesla, in which the rarefied air beating the crystal walls of its prison burst into such an effulgence as "never was on land or sea." The French poet Maeterlinck had said that scientists and inventors were but camp followers of great forces which they could not see. This was not true, for such men as were around that table

that night were not followers, but leaders; men who had risked much to confer upon the world the inestimable benefits of electricity.

In proposing the health of Lord and Lady Kelvin, it was hoped that this would be by no means the last time that an opportunity would be afforded to greet them in this country, but they must not forget that it was full 60 years since Lord Kelvin had established his famous parallel between the phenomena of heat and those of electricity and had laid the basis of his own imperishable association with electrical development. His first trip to this continent had been connected with the memorable work, which, as John Bright said, had "anchored the old world alongside the new." That there should be no more sea was a promise of prophetic Scripture. That there should be no more sea was the resolve, 40 years ago, of undaunted Cyrus Field and modest William Thomson, so far as the intercommunication of intelligence as concerned, and the results which had crowned their work were known to all men. Since then, Lord Kelvin had added to his gifts to the world and to mariners, his perfection of the compass and his deep sea sounding apparatus. They might now in fairness ask him to abolish the physical drawbacks due to the existence of the ocean, and if Britannia could not rule the waves straight, they might at least ask Lord Kelvin to reduce the Atlantic to one wave length.

Since the guests of the evening had landed on the present trip, Lord Kelvin had gone through four American universities in sixteen days. This gave but a fair indication of the unusual calibre of the man. It took most Americans at least four years to go through one university, and even then if they got any kind of degree with credit they were lucky. Lord Kelvin had wound up his rapid transit university courses by receiving an LL. D. degree from Yale, which for the first time in 100 years had assembled a special convocation for such a purpose. It was safe to say that at least 100 years would pass before Yale would have another opportunity to confer such a degree again so worthily and properly.

And now having escaped from the tender mercies of the professors, Lord Kelvin was among those who could claim the closest bonds of fellowship with him as brethren identified with all the great electrical developments of the age, represented at the banquet that night. When Lord Kelvin began his career, not a cent was being spent on electrical applications in this country. Not long since their host of the evening, Mr. Anthony N. Brady, had published a most interesting article in the *North American Review*, on the development of electrical applications, and taking those figures as a basis, it would appear that every American man, woman and child was now spending upon the average seven dollars a year for electricity. In fact, it might almost be claimed that Americans were spending as much for electricity as for daily bread, a fact which contributed, doubtless, in no small degree to the rapid advance which this country had made; a fact, moreover, which was largely due to the science, the inventive ability and the many beautiful pieces of apparatus which they owed to Lord Kelvin. The toastmaster, therefore, in proposing the health of Lord and Lady Kelvin, asked them to drink with three times three to their distinguished comrade-in-arms, the greatest physicist of the age and the leading electrician of his time.

Lord Kelvin was enthusiastically received, and in acknowledging the honor done to himself and Lady Kelvin, disclaimed very modestly his right to have so large a part of the electrical advance put to his credit, but avowed his deep and unceasing interest to-day, as ever, in the work which was being accomplished to put electricity at the service of mankind. He spoke of the intense pleasure which he had had in visiting that day the splendid Waterside Station, constructed by the New York Edison Company, of which Mr. Brady was the head, and he said that among the things which gave him pleasure there was not only to ascertain the fact that the Edison circuits were now distributed from one end of the city to the other, but that the big generators in the station illustrated the polyphase ideas which Mr. Nikola Tesla had done so much to forward. It had also delighted him to see the splendid development of the electric railway work in New York and throughout the country, due to the work of such men as Mr. Frank J. Sprague. So far as New York was concerned, it must be regarded as the best lighted city in the world, thanks to electricity—he had almost said in the universe—but he was not quite sure what they were doing in Mars. If, however, the Martians had their eyes fixed on this world, they certainly would be contemplating Manhattan Island, as the brightest point to fix their attention. Lord Kelvin then referred to the interesting developments which he had seen in photography at Rochester, as the guest of Mr. Eastman, and the interesting utilization of Westinghouse apparatus at Niagara Falls. He said that the Great Cataract would not only remain a beautiful spectacle, but that, thanks to electricity, it would be able to give up practically its entire energy for the benefit of the welfare of mankind, and he did not know any higher use to which it could be put. They were now developing at least 40,000 horse-power there, and he would himself like to be able to see the time when Niagara was giving up at least 4,000,000 horse-power of her energy, distributed over an area of hundreds of square miles.

Lord Kelvin referred emphatically to the great debt which the world owed Mr. Edison, whose light, he said, was now in use throughout the civilized world, not only in America but all over Europe and Asia, and even among the Zulus in South Africa. In conclusion, Lord Kelvin, for himself and Lady Kelvin, thanked the electrical men of America from the bottom of his heart for their sympathy and friendliness, and said that they would carry away with them the most pleasant and agreeable recollections of this visit to the United States.

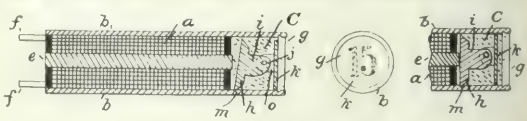
Lord Kelvin's remarks were received with the most unbounded applause and with three cheers. Rear-Admiral Melville then proposed the health of Mr. Anthony Brady, in acknowledgment of the felicitous opportunity he had given them all to pay their honor and respects to the guests of the evening; and the party then broke up. It should be noted that a very handsome menu was provided, designed by the drafting department of the New York Edison Company, and possessing unusual artistic merit. It was a large quarto, in dark slate outer cover, bearing in gold the Kelvin coat of arms. Inside were four pages, on heavy white paper, in tint. A portrait of Lord Kelvin occupied the central space, and in medallions around it were pictures of the Great Eastern and of the various instruments invented by Lord Kelvin and connected with his work and fame.

New Telephone Patents.

The issue of May 6 contains three patents directly relating to the art of telephony, and on or two others having more or less bearing on matters telephonic, such as cable-hangers, iron poles and a detail improvement on that ingenious apparatus, the telegraphone.

Mr. Charles Chandler Blake, of Brookline, Mass., is the patentee of an annunciator of a novel type, in which the target works in a small chamber in front of the magnet, hermetically sealed by a glass window. The chamber contains, besides the armature and target, a quantity of dark-colored liquid, which serves to conceal the target when it is not pressed against the window of the chamber. In the drawings a preferred form of annunciator is shown, though various ways of carrying out the idea may be devised, and Mr. Blake claims broadly the method of restoring an annunciator by placing the target in a glass-fronted chamber containing an opaque liquid which conceals the target in one position and allows it to be seen when in another.

Referring to the drawings, Figs. 1 and 3 are sectional views, and Fig. 2 an end view of the preferred form of annunciator; *a* the



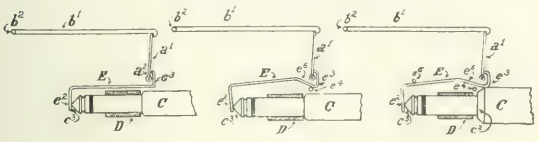
FIGS. 1, 2 AND 3.—BLAKE ANNUNCIATOR.

electromagnet is enclosed in an iron sheath *b*, which projects beyond the end of *a* and is provided with an internal groove in which is secured a glass disk *g*, which closes the chamber *C* and serves as a window. Within the chamber *C* is a tilting armature *h*, in the form of a truncated cone, and having an arm *i* extending from its end pivotted at *j* to the arm *o*, projecting from the rear of the disk-target *k*. In the unattracted position of the armature, as indicated in Fig. 1, the target presses against the inner surface of the window *g*. The face of the target is of a distinctive color, and may carry the number, or the number may be on the window *g*, if preferred. The chamber *C* is fitted with water, having in solution some coloring matter, which will render it opaque. Nigrosine, a blue-black, coal-tar dye is suggested.

In the form of indicator shown, the target is exhibited when the magnet is inert, and is withdrawn, and concealed by the opaque

liquid, when the magnet is energized and e is attracted. By putting the armature at the other end of the core and subjecting it to the tension of a spring, the target will be shown when the armature is attracted, and concealed when it is unattracted, the armature and target being joined by a connecting-rod passing through the center of the core.

Mr. Henry M. Fisk, of Wheaton, Ill., is the inventor of a combined drop and jack, embodying a mechanical self-restoring movement of a type that has become moderately familiar since the idea of a self-restoring drop first became spread abroad. As shown in the drawings, Mr. Fisk's method of causing the answering-jack to effect the restoration of the drop-shutter has no feature of very startling novelty. In the drawings, Figs. 4, 5 and 6 show clearly the means



FIGS. 4, 5 AND 6.—FISK COMBINATION DROP AND JACK.

used in conveying the motion of the plug to the shutter, and Fig. 7 shows the complete drop and jack. The connection consists of a slide, E, which is pushed in along the jack by the tip of the plug, and whose outer end, e^3, bent upward, engages with the drop-shutter and pushes it home. To make the action of E a little more positive, it is provided with a curled-in end at e^3, and with a bend e^5, and bearing e^4 and e^6 to steady it, the shoulder of the plug-handle also serving as a bearing for the lower side of the bent end e^3, as shown in Fig. 6. In the complete organism of combined drop and jack, the slide E is provided at the inner end with an insulating stop e^7, to prevent metallic contact between the plug and the slide. No means of retracting the slide from its inner position after the withdrawal of the plug is shown; presumably the falling of the drop-shutter is depended upon for this, but it seems probable that in actual working the drop would at times remain locked by the slide.

A telephone-circuit system, devised by Mr. Ellis F. Frost, of Washington, D. C., has for its object the provision of a common return wire for an exchange telephone system, the common return also serving as a battery supply line. This is effected, and therein lies the principal novelty of the invention, by connecting the common return to earth through condensers of large capacity, thus making the common return wire into an artificial earth, having all the con-

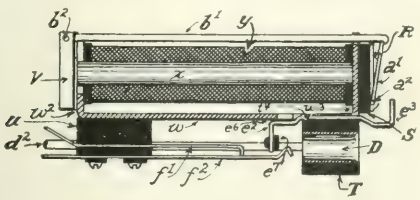


FIG. 7.—FISK COMBINATION DROP AND JACK.

veniences of a direct connection to earth with none of its disadvantages, such as the introduction of cross-talk and of sneak currents. A highly ingenious idea, but of doubtful practical application, since to imitate the earth by means of condensers would imply the use of megofarads instead of the humble microfarads of commerce.

Mr. Ellis's theory is that "the earth, except for very short distances, and under favorable conditions, does not serve as a return for a circuit connected to the earth at both ends. In other words, no flow of electricity takes place through the earth between the ends of the line. The earth only serves as a vast reservoir of an infinite capacity, whose state at one place is kept in equilibrium with that of another, however disturbed, not by a current flow through the earth, but by an adjustment of the capacities between the places through inductive relation." Mr. Frost is his own patent attorney, and his specification suffers accordingly, as this extract shows. That "only" in connection with the earth as a vast reservoir is naïve; while the explanation of the "adjustment of the capacities" of the globe we inhabit is hardly convincing.

Referring to Fig. 8, it will be seen that Mr. Frost's invention is exceedingly simple. A, B and C represent three of any number of telephone exchanges, 1 and 2 at each exchange represent subscribers' lines; at exchange C, 13 and 14 are subscribers' lines, enjoying a local connection through cord circuit 15, the other lines are connected, 1 in A to 1 in B by trunk line 10, 2 in A to 2 in C by trunk line 11, and 2 in B to 1 in C by trunk line 12. From each exchange a line, 3, of comparatively low resistance extends to each subscriber of that exchange. This line serves as a common return for all the lines of its exchange. All of these common return lines, 3, are connected together by the common return trunk-line 4. At each exchange there is a battery, 5, one pole connected to earth, the other to common return line 3, thus making 3 a battery supply line for all the subscribers' stations to which it extends. The common return and common return trunks should be of a resistance comparatively low in relation to that of the telephone lines, so as to reduce all tendency to cross-talk to a negligible quantity.

When a telephone line is connected for talking purposes the battery

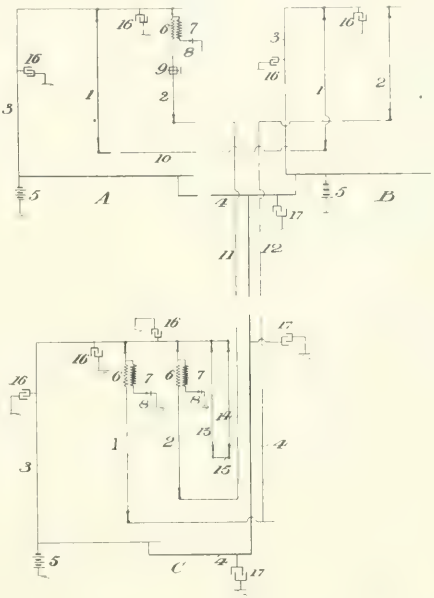


FIG. 8.—FROST TELEPHONE CIRCUIT SYSTEM.

supply line is connected to earth through the primary, 7, of the induction coil and the transmitter, 8. This completes an earth return circuit for the battery over the line 3. To overcome the cross-talk that would result when two or more lines are so connected, the line 3 is connected to earth through condensers, so as to give it a high static capacity. A sufficient number of condensers, 16, is used, and they are so distributed along the line as to insure a great static capacity to the line. The common return trunk line, 4, is similarly equipped with condensers, 17. The high static capacity given to the lines 3 and 4 by the condensers is calculated to prevent cross-talk and to "iron out" disturbing currents from other sources. Mr. Frost does not specify of what capacity he would make his condensers.

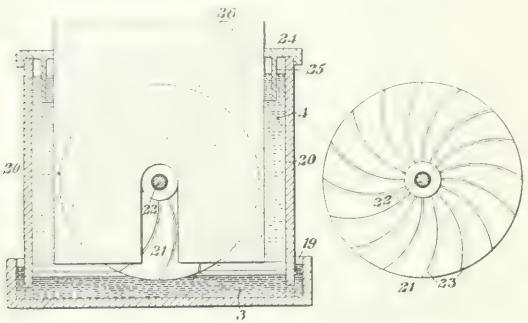
Meeting of the Engine Builders' Association.

The following is the programme for the meeting of the Engine Builders Association of the United States, at Pittsburg, next week, beginning Thursday, May 22, 1902. Welcoming address—President W. M. Taylor. Paper—"Engine Forgings," H. F. J. Porter, New York; discussion. Paper—"Engine Requirements for the Parallel Operation of Alternators," E. M. Tingley, Pittsburg; discussion. Paper—"Piping Materials for Steam Plants," John B. Berryman, Chicago; discussion. Paper—"The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders," H. M. Longwell, Pittsburg; discussion. On Friday, there is, among other things, a visit to the Westinghouse Engine Works, and a dinner at the Schenley in the evening.

Mercury Cathode Cells—Electric Combustion Furnace—Artificial Camphor.

[illegible] [illegible] FOLWELL.

In two patents Mr. Charles J. Reed, of Philadelphia, covers improvements in the production of chlorine and caustic alkali by the mercury cathode process. The improvements relate both to the form of the cell and to a peculiar arrangement of several cells in series whereby is assured the presence of a sufficient quantity of sodium in the mercury to prevent oxidation of the latter metal in the caustic compartments. Figs. 1 and 2 show one form of construction of the



FIGS. 1 AND 2.—CONSTRUCTION OF REED CELL.

new cell, in which the controlling idea is the distribution of the mercury in both compartments in a thin film over metal plates or discs, thus returning to the early idea of Atkins and Applegarth. The carbon anodes, 26, are immersed in sodium chloride solution, 4, in a cell, 20, sealed at the bottom by mercury in open troughs, 19, and at the top by a cover, 24, with depending flanges, 25. The cathodes, 21, which may be grooved discs of copper, are rotatably mounted on the shaft 22, and dip into mercury, 3, contained in a series of transverse troughs communicating with the lateral troughs, 19. By the rotation of the cathode discs the mercury is taken up by the groove 23, distributed evenly over the surface of the discs, there becoming charged with alkali metal, and the resulting amalgam is collected by the mercury in the troughs; this amalgam then flows through the troughs 19 to the oxidizing cell, precisely similar in form to that illustrated, there to function as anode and be denuded of its alkali metal.

In this cell, as in the Castner type, the mercury acts as a bipolar electrode, constituting the cathode in the decomposing compartment and the anode in the oxidizing or caustic cell. If, however, the entire current passing to the mercury as cathode passes also from it as anode, some danger is incurred of oxidizing the mercury as well as the sodium. In Castner's original construction this was guarded against by such electrical connections as would insure a slight excess of current in the decomposing compartments. In Kellner's modification provision was made for short-circuiting a fraction of the current in the oxidizing cell, thereby assuring the same preponderance on the decomposing side. Reed accomplishes the same result by the series arrangement of the cells diagrammatic-

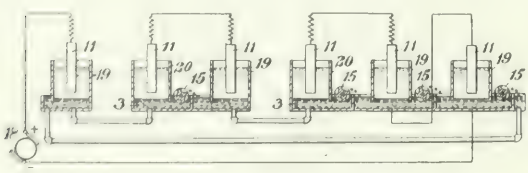


FIG. 3.—CELLS IN SERIES.

ally shown in Fig. 3. The direct connection through the mercury, 3, is broken at four points by transfer devices 15, and the current carried around the gaps by circuit 11, as shown. It follows that the four cells indicated by the numeral 19 are decomposing cells in which the amalgam is produced, whereas in the two cells marked 20, the amalgam functions as anode and the oxidation of the sodium to caustic occurs. Since all cells are connected in series, and since the number of decomposing cells is in excess of the number of oxidizing cells, it is clear that an excess of sodium above that required for carrying the current is insured, and that no oxidation of the mercury can occur.

ELECTRIC COMBUSTION FURNACE.

By providing an electrically heated combustion-tube for carbon determinations, Mr. William M. Carr, of East St. Louis, Ill., adds to the growing list of laboratory appliances controlled by the current. The usual combustion-tube, carrying at one end a roll of copper gauze and at the other a body of granular copper oxid held in place by perforated platinum discs, is surrounded by a porcelain or other tube upon which the coils of the heating circuit are wound. A suitable nonconducting jacket, as magnesia, encloses the whole, and the material for analysis is placed in the usual platinum boat in the center of the combustion-tube. The heating circuit is divided, the ends of the tube being surrounded by two coils connected in series, and the central section by an independent coil; a switch and contacts are so arranged that the current may be sent first through the end coils to bring the copper and oxid to the necessary temperature, and then through all coils in series to provide an evenly distributed heat. During the entire operation a current of oxygen passes through the tube, and the products of combustion are led through the usual collecting train. The advantages of cleanliness, ease of control and quick application of heat, all tending to rapidity and accuracy in the determination, are with this device.

ARTIFICIAL CAMPHOR.

Owing to its interest, reference may also be made to the new method developed at Niagara Falls, for the production of artifical camphor—a method which has, however, no electrical side. Under this name a compound known to chemists as pinene hydrochloride, and having the odor but not the valuable technical properties of camphor, has been noted in chemical literature. We have now a true artificial camphor, prepared by the action of oxalic acid upon turpentine, and capable of replacing Japan camphor in its various uses in the arts. This process, which is among the most original yet credited to American chemical research, is due to Nathaniel Thurlow, of Newark, N. J., his patent, issued April 29, being the property by assignment of the Port Chester Chemical Company, of New York.

Briefly, the method is as follows: Turpentine of a suitable grade, *i. e.*, consisting largely of either laevo or dextro-pinene, is gently heated with anhydrous oxalic acid, in proportion of five parts by weight of dehydrated turpentine to one part of the acid. There results a mixture containing camphor, borneol (Borneo camphor, related to common camphor as an alcohol to a ketone), and the formate and oxalate of borneol. Caustic lime in excess is added to break up these ethereal salts, and by distillation with steam, camphor and borneol are carried over. By a well known reaction the borneol is then oxidized to camphor, which requires purification only to fit it for commercial use.

This is not the first synthetic production of camphor, rather the first method which has seemed to offer commercial possibilities. The hydrochloride above referred to may be converted by weak alkali to the compound camphene capable of yielding camphor by oxidation.

The claims of the patent are limited to the employment of turpentine as raw material for conversion, although the specification states, as indeed would seem probable, that any product containing a sufficiency of pinene may be used; the oils of juniper, eucalyptus, sage, etc., possess this terpene as their chief constituent.

Wireless Telegraphy in London.

A special cable dispatch from London, May 10, to a New York daily newspaper says: The Slaby-Arco Wireless Telegraphic Syndicate has opened an office in London and is preparing to start business in opposition to the Marconi syndicate. The latter is considerably perturbed and is considering the advisability of taking legal action to maintain the validity of its patents. Mr. Marconi is adverse to going to law, preferring to rely on what he contends is the superiority of his system and the cast-iron 14 years' agreement which gives him a monopoly of the use of Lloyds signalling stations.

Duncan Meter Patents.

While not breaking the record set several years ago by an issue at one time of more than 100 telephone switchboard patents to one inventor, the issue of last week of 57 meter patents to Mr. Thomas Duncan, of Lafayette, Ind., makes a record that is a good second. All of the patents are assigned to the Siemens-Halske Company of America.

Of the patents issued, 15 are for improved means of obtaining a magnetic field (in the shunt or pressure coil of single-phase wattmeters), that is 90° behind the impressed electromotive force, or in quadrature with the magnetism of the series or current field coils when the latter are traversed by a non-lagging current. This condition permits of these meters being used to measure the real or true watts on loads of any power factor. The numbers of these patents are 698,638, 698,639, 698,659, 698,652, 698,650, 698,649 698,646, 698,644 698,643, 698,642, 698,637, 698,641, 698,693, 698,640 and 698,669.

Patents Nos. 698,667 and 698,668 are also improvements in single-phase integrating wattmeters, but are designed with the object of reducing the cost of manufacturing to the lowest limit consistent with accuracy of registration. Nos. 698,654, 698,658, 698,660, 698,662 and 698,663 are improvements in two-phase wattmeters, and Nos. 698,664 and 698,674 improvements in three-phase integrating wattmeters. Nos. 698,655, 698,656 and 698,657 are on induction-type indicating and integrating meters, for measuring the so-called "wattless" component; while Nos. 698,665 and 698,666 are for the same purpose, but of the commutated type. No. 698,691 is a commutated meter which measures both the "real" watts and the "wattless" or magnetizing component, and Nos. 698,670, 698,671 and 698,672 are meters of the induction type for accomplishing the same result. Nos. 698,673 and 698,675 show means for eliminating or compensating for the inductance in the armature windings of commutator wattmeters when extreme accuracy is required in the measurement of alternate currents. Nos. 698,676, 698,677 and 698,689 are for improvement in commutated wattmeters used for the measurement of very heavy currents, and belong to the double-armature type.

Nos. 698,651 and 698,648 are for series transformers, used in connection with measuring instruments, and are designed with the object of eliminating the errors incident to this type of transformer by causing the ratio of transformation between primary and secondary to give a straight line characteristic instead of a rising or increasing one, as is usually given by transformers of this type. This improvement allows the instruments to give a true measurement of the energy passing through the primary of the transformer. No. 698,686 is for an improved means of indicating the line loss or drop without the use of pressure wires in an alternating-current system of distribution, and comprises a compensating transformer with three windings; one in shunt to the pressure mains, one in series with the main line, and the third receiving currents by induction from the resultant action of the two former, and having its terminals connected to a voltmeter which indicates the line pressure at the center of distribution.

Nos. 698,679, 698,680, 698,681, 698,682, 698,683, 698,684, 698,685 and 698,687 cover a variety of voltmeters and systems for indicating the drop in volts over the supply mains and means for maintaining the proper pressure at the center of distribution. No. 698,678 shows a commutated meter, with means to prevent sparking at the brushes. No. 698,647 is an indicating instrument for direct currents, arranged to be dead-beat in its action by having the movable coils wound upon an aluminum drum that is embraced by the poles of a permanent magnet.

No. 698,661 is an integrating wattmeter, designed for use in connection with electric vehicles or other purposes or places where there is a great deal of jar and vibration. The moving parts of this meter are very light, and the wire around the armature is in the form of an inverted cup, within which is situated a stationary laminated iron core to draw the flux through the armature coils. The retarding elements of this meter are well protected from the series coils by having a magnetic shield interposed between the series coils and the permanent magnets. This arrangement insures permanency of the retarding magnets, and is very necessary where extreme accuracy is desired. No. 698,688 is an induction coulomb meter, and is constructed with its motor and retarding elements combined, and placed in a detachable receptacle containing oil. Accuracy and cheapness being the main points of the patent.

No. 698,653 is a commutated motor-meter, the principal features of which are means whereby the several parts of the meter may be taken apart for the purpose of cleaning, repairing and recalibrating. Patent No. 698,690 shows another meter of the commutated integrating type with field coils and armature, having cores of comminuted magnetizable material, such as iron-filings, with the view of keeping down hysteresis and retentivity where iron is used. No. 698,692 is also an integrating wattmeter, but of the oscillating type. It comprises, with means for renewing the current in the shunt circuit, an armature consisting of two coils placed at right angles and moving through ninety degrees within suitable series coils carrying the main line current.

Since describing specifically all of the foregoing patents would require more space than is here available, only a few of the more important ones will be noticed below in detail.

Patent No. 698,640 is an induction motor-meter, capable of measuring the true watts on any frequency in commercial use, with both inductive and non-inductive loads. In meters of the induction type, it is a well-known fact that their shunt or volt field magnetism must be in quadrature with the line electromotive force to enable them to measure inductive loads correctly. The means in most common use to produce this magnetic quadrature is that of lagging a derived current that supplies the shunt or volt field coil to as near ninety degrees as possible; then supplementing said field coil with another coil carrying a current that lags 180 or more degrees behind the line pressure; then adjusting the strength of the current in the latter coil until the resultant magnetism of the two coils is in quadrature with the impressed or line electromotive force. In this patent the supplemental coil, carrying a lagging current of, approximately, 180 degrees, is dispensed with, and in its stead is employed an adjustable solid or unlaminated iron or steel core, placed within the volt field-coil proper. When the volt or pressure coil is placed in series with an inductance coil and has the current therein lagged to as nearly 90 degrees as is practicable, the action of the solid core, through hysteresis and reluctance, is employed to further lag or retard the magnetism to exactly 90 degrees. It is also possible with this combination to make the meter measure upon widely different frequencies with a very small percentage of error, something which is very desirable among the central station fraternity, where they often have two different frequencies in use, and are compelled to carry meters in stock specially tested for each of these frequencies.

Patents Nos. 698,655, 698,656 and 698,657 are meters which may be classed as new in the art, and consist of a means whereby a measurement of the "lagging" or "wattless" component may be made. The importance of a means for measuring accurately and instantly the lagging component of the current is apparent in central stations which supply alternating current to motors of considerable size and number. The difficulty in regulations which is experienced under these conditions does not arise from the amount of energy which these motors require, which is, as a rule, no more than that of direct-current motors carrying the same load, but from the influence of the "lagging" or "wattless" currents resulting from the various inductances of the circuit.

Even when the lagging current is measured by a comparison of volt-amperes with watts indicated by instruments of the same type and comparatively calibrated, accurate results are not obtained. For example: if the apparent watts or volt-amperes exceed the true watts by only one per cent., it means that there is upon the line a wattless or magnetizing current with a strength fully 14 per cent. of that of the energy current. If the excess is two per cent., the magnetizing current is 20 per cent. as great as the energy current; that is to say, if the true watts are 100, and the apparent watts 101, the lagging component, which is found by taking the square root of the difference of the squares of the true and apparent watts, will be 14; and if the true watts are 100 and the apparent watts 102, the lagging component will be 20. From these illustrations it will be apparent that very great and disturbing variations of the wattless output affect but slightly the indicated volt-amperes. These three patents show three different ways of measuring the lagging component, all of which, however, provide means whereby the currents in the series and shunt coils are exactly in phase when the load of the main current is non-inductive.

Patent No. 698,665 is also for measuring the magnetizing component, but is a commutated meter, while the three foregoing are of the induction type. In this meter the shunt circuit is provided with means whereby the armature is supplied with a current that is 90 degrees behind the line pressure. This 90 degrees lagging current

is obtained by winding two coils upon a laminated iron core, one of said coils being in series with the armature. The other or second coil is connected in series with an adjustable non-induction resistance and having its terminals in shunt to the work circuit. The current through the first coil, that is, in series with the armature lags to as nearly 90 degrees as practical; then the other coil upon the same core, and which is in series with the non-inductive resistance, acts as a primary, and induces in the first coil and armature circuit a secondary electromotive with a current that lags, approximately, 180 degrees or more, thereby giving in said armature circuit a current which is the resultant of two currents, and is adjusted to exact quadrature by means of the variable resistance in series with the second coil.

Patents Nos. 698,670, 698,671, 698, 672 and 698,691 are double meters, and are so constructed that they may be used to measure or indicate either the true watts or the magnetizing component. The instruments consist of series coils, rotating armature, and double shunt coils, one of which is traversed by a current in phase with the line pressure, the other lagging 90 degrees behind the line pressure. Each of these shunt circuits is provided with a switch or depression key, so that either reading may be taken in an instant. In this manner the difference between the real watts and the magnetizing component may be had by simply depressing one key, noticing the reading or indication; then releasing this key and depressing the second one.

Among the patents for meters to measure very heavy currents, possibly No. 698,677 is the most unique. It consists of a cast-copper field, which is in the form of the letter S, and has two armatures—one within the upper curve and another within the lower curve.

Kelvin at Edison's Laboratory.

Lord and Lady Kelvin were conducted to Orange, N. J., on Friday, May 9th, by Mr. and Mrs. W. S. Mallory, representing Mr. Edison. Mr. J. W. Lieb, Jr., associate general manager of the New York Edison company, was invited to accompany the party. They were met at Orange by Mrs. Edison, and drove directly to Mr. Edison's residence at Llewellyn Park. The beautiful and balmy spring day made the lawns and shubbery of the Edison place look particularly attractive, and the party enjoyed the walk around the grounds.

The laboratory addition to the house, which Mr. Edison has recently built, and in which he is now conducting researches and investigations, was next visited, and Lord and Lady Kelvin enjoyed the explanations of the several lines of experimental work which Mr. Edison, with the co-operation of Mrs. Edison, is pursuing.

Adjournment was taken for luncheon, at which Lord and Lady Kelvin, Mr. and Mrs. Edison, Miss Madeline and Master Edison, Mrs. Colgate, Mr. and Mrs. Mallory and Mr. Lieb were present. It can well be imagined that the subjects of conversation coupled in wonderful harmony a genial flow of humor, good stories and scientific lore.

The party then repaired to the Edison laboratory at the foot of Orange Mountains, and were shown through the shops for the construction of experimental apparatus. Mr. Edison explained in detail the construction of his new storage battery to Lord Kelvin, while Mrs. Edison displayed an intimate knowledge of the details in her explanations to Lady Kelvin. A number of experiments with the phonograph were shown, including its operation backward, with the production of a new language and wondrous feats of euphonic composition. It is needless to say that the party was very much interested in the battery and other inventions. An inspection of the phonograph works closed a most interesting visit, the party returning to New York late in the afternoon.

Electrocuting Old Horses.

A cablegram says: No wonder horses are so frequently electrocuted in Paris. Three clever swindlers were arrested this week in the act of leading a worn-out hack to a spot where they had previously unscrewed a cap at one of the electric "plugs," where the animal was to meet its doom. The practice was proved to be an habitual one. An old hack is bought for a mere song, led to the death trap and a heavy claim for damages is served upon the tramway company. The chief culprit is a former tramway employe.

Fire Losses and Causes.

Some interesting data as to fire losses and causes is given in the Insurance Chronicle fire tables for 1901, a handsome volume of 475 pages, giving the statistics for 1900. It may be noted that in view of the universal tendency of American reporters—and others—to attribute every big, mysterious fire to a "defective wire," electricity comes off pretty well, as it may be taken for granted that "electric fires" include most of those set by firebugs and due to arson. It would be interesting to have the loss of life due to the use of the various illuminants in the same period.

Fire Losses in the United, States During 1900.

Cause.	*No. of fires.*	*Loss due to fire.*
Coal:		
Defective flues	12,595	$9,394,410
Stoves	3,013	1,712,830
Locomotive sparks	1,287	2,123,925
Ashes and hot coals	860	661,940
Furnaces	832	3,951,765
Stove pipes	717	304,440
Open fireplaces and grates	461	150,540
Stationary boilers	341	2,476,450
Defective heating apparatus	109	397,075
Smoke stacks	82	374,660
Total	20,207	$21,548,035
Oil:		
Lamp, etc., explosions	2,244	$1,466,760
Lamp and lantern accidents	1,806	1,081,915
Oil stove explosions	719	176,890
Oil, grease, etc., ignition	459	175,115
Oil stove accidents	450	72,490
Oil explosions	183	1,032,665
Total	5,861	$4,005,835
Gasoline, etc.:		
Gasoline stove explosions	$1,302	$305,955
Gasoline explosions	532	397,245
Alcohol and benzine explosions	100	73,415
Alcohol and benzine ignitions	47	113,470
Total	1,981	$890,085
Gas:		
Explosions	410	$738,415
Ignition, gas jets	1,195	391,105
Total	1,605	$1,129,520
Electricity:		
Lights and wires	1,054	$4,120,700

Cause of fire.	*Average loss per fire.*
Electric lights and wires	$3,910
Coal and its applications	1,061
Gas	704
Oil	683
Gasoline	440

Fires in Dwellings and Tenements.

Cause of fire.	*No. of fires.*
Oil lamp explosions	1,602
Oil lamp accidents	1,151
Oil stove explosions	560
Oil stove accidents	327
Oil explosion	102
Total	3,742
Gasoline stove explosions	1,078
Gasoline explosions	250
Total	1,328
Gas explosions	161
Electric wires	117

There was a total of 79,249 fires reported in 190..

Tesla Patents Decision.

The United States Circuit Court of the District of Rhode Island handed down an opinion, May 12, sustaining the Tesla patents, in a suit of the Westinghouse Electric Manufacturing Company against the Royal Weaving Company, of Pawtucket, R. I. The suit was on a preliminary injunction against the infringement of certain patents which the court states were the same as those sustained in a suit against the New England Granite Company, the opinion in which suit was reprinted in our columns at the time. The opinion states that the defendant relied principally on a French patent issued to Dumesnil, Aug. 8, 1884, and on a French patent issued to Cabanellas, April 9, 1885. The contention was that these patents disclosed what was not before the courts in the Granite case, namely, that two single-phase synchronous motors could be coupled together, as for example, by having their armatures mounted on the same shaft; and that these two motors might be run each by its own circuit of alternating currents, which might be supplied either by two single-phase generators so mounted on the same shaft as to give currents out of phase with each other; or that a single generator, such as is known in the prior art, and which furnished alternating currents differing in phase, might have been used as the source of supply. The court considers that the above-mentioned patents, if produced in the Granite State case would not have affected the decisions as to the nature and novelty of the Tesla invention and as to the validity of the patents in suit. Referring to the Dumesnil patent, the court considered that to couple two single-phase synchronous motors upon one shaft, displacing the poles of one armature angularly with respect to the other so that one motor expends its maximum effort while the other expends its minimum effort, does not seem to exhibit the Tesla invention as described and claimed in the Tesla patent. Referring to the Cabanellas patent, the court said that this patent, upon many readings, seems to it to be fairly characterized by the complainant's counsel as "expressed in such obscure and indefinite terms as to be hopelessly unintelligible except in a few unimportant particulars," and as requiring an exceptional exercise of the imaginative powers in translating its phrases into electrical diagrams. The opinion further states that the Dumesnil and Cabanellas patents at best were based upon the use of two motors of an old type having the characteristic defects of such motors, and lacking the characteristics of the Tesla motors. Even if two of these motors can assist each other, by so timing their mechanical efforts that one exerts its maximum effect while the other exerts its minimum effect, the court does not find in such a combination of the two machines the invention of Tesla, nor the rotary field which was apparently conceded by the defendant in prior suits to be proper subject matter of controversy in determining the validity of the Tesla patent. The court decides that the question of infringement seems to be substantially determined by the prior decisions. The questions as to whether the defendant may be permitted to continue temporarily the use of the motors now installed, and if so, upon what terms, were reserved by the court.

CURRENT NEWS AND NOTES.

DR. A. E. KENNELLY has accepted the newly founded chair of Electrical Engineering at Harvard University.

SALE OF POLYPHASE MOTORS.—In a recent suit involving the Tesla patents, testimony was given to the effect that in the period from Jan. 1, 1898 to June 1, 1901, the Westinghouse Company had sold motors embodying the Tesla patent, aggregating 120,000 hp., and that the General Electric Company in the period from March 31, 1896 to the date of the suit had sold induction motors aggregating about 169,000 hp.

AMERICAN STREET RAILWAY INVESTMENTS.—The valuable annual bearing this title, issued as a supplement to the *Street Railway Journal*, has just made its appearance for the current year, being corrected up to as recent a date as April 15. The present handsome quarto volume contains over 300 pages, with the usual liberal allowance of large and small maps, and it is full of data with regard to the financial and physical condition of every street railway system in the country. The preface embodies also a most useful comparative compilation of the gross earnings of no fewer than 246 systems, arranged in five groups, as to magnitude. The astounding fact emerges that with many of the larger roads left out, these properties are earning gross $178,000,000 a year. The total for all the 900 systems must be well above $200,000,000.

GAULARD-GIBBS PATENT VOID.—In a suit against the Stanley Electric Manufacturing Company, the United States Circuit Court for the District of Massachusetts, Judge Colt has just declared void the reissued letters patent No. 11,836 to Gaulard and Gibbs, assignors to the Westinghouse Electric and Manufacturing Company, which covered broadly the use of step-down transformers in systems of distribution. This patent was originally involved in a suit against the Sun Electric Company, and was subsequently reissued. The court in the present suit held that the commissioner exceeded his powers in granting this reissue, and dismissed the bill with costs.

MARTINIQUE DISASTER.—As all the world now knows, the French island of Martinique, West Indies, has been visited by fearful disaster, due to the eruption from Mont Pelee, and the city of St. Pierre now lies a mass of ashes and debris, with, it is said, 30,000 dead inhabitants. The whole northern end of the island has been devastated. The adjoining British island of St. Vincent has similarly suffered from the volcanic eruption of La Souffriere, and reports already 1,600 dead. At St. Pierre, the West India and Panama Telegraph Company's steamer, "Grappler," was overwhelmed and destroyed, and the cables in the vicinity were broken. The French cable steamer, "Pouyer-Quertier," at the island escaped, and cable service has now been repaired, but is extremely slow and unsatisfactory.

WIRELESS TELEGRAPH CONTRACTS.—Gen. Greely, chief of the Signal Corps of the Army, has approved the proceedings of the board of signal officers who have had under consideration the proposals for the installation of wireless telegraphy stations in Alaska. The award for stations at Nome and St. Michael has been made to Queen & Co., of Philadelphia, who will put in the system invented by Prof. Fessenden, an American device. Gen. Greely has also determined to accept the proposal made by the Marconi Company to install a system between Fort Gibbon and a point on the Tanana River, near Bates Rapids. The proposals from the Arco-Slaby Company, the De Forest Company and others were not considered, as none of these companies would agree to install and work their systems for ten days prior to their acceptance by the Signal Corps. It is hoped that the systems will be in working order by Oct. 1 of this year.

ANNUAL MEETING OF THE INSTITUTE.—The nineteenth annual meeting of the Institute will be held at 12 West Thirty-first Street, New York, on Tuesday evening, May 20th, at 8:15 o'clock. The annual reports of the board of directors and of the treasurer will be presented. The committee of tellers will report the result of the balloting for officers of the Institute. Papers will be presented as follows: "Some Notes on European Practice in Electric Traction with Three-Phase Alternating Currents," by Carl L. de Muralt, of Baden, Switzerland. "A Novel Combination of Polyphase Motors for Traction Purposes," by Ernst Danielson, of Westeras, Sweden. An extra meeting will be held on Wednesday, May 28, at 8:15 P. M., at the house of the American Society of Civil Engineers, 220 West Fifty-seventh Street, New York City, which will be devoted to the general subject of Electricity in the Army and Navy. Members of other national engineering societies have been invited to attend, also members of the Society of Marine Engineers and Naval Architects. One of the principal objects of the meeting is to demonstrate the advantage of the government's calling upon the engineering societies for advice in their work, and for this reason officers of the Army and Navy and others especially interested in the subject are invited. There will be papers by Captain John Stephen Sewell, Chief of Engineers, U. S. A.; Lieut. W. Van N. Powelson, U. S. N.; Lieut. Henry George, U. S. N.; Dr. Louis Bell, consulting engineer; Colonel Samuel Reber, U. S. Signal Corps; Lieut. A. M. Beecher, U. S. N.; Mr. Caryl D. Haskins, General Electric Company; Mr. W. M. McFarland (late U. S. N.), Westinghouse Electric and Manufacturing Company, Pittsburg, and others. The offices and library of the Institute have been removed from 26 Cortlandt Street to the seventh floor of the White Building, 95 Liberty Street, one block directly south of the former location.

LECTURE ON THE BUREAU OF STANDARDS.—Prof. S. W. Stratton, director of the National Bureau of Standards, lectured, May 7, before the Western Society of Engineers, at Chicago, on the work of which he is a director. He gave some of the causes leading up to the law of 1901, which established the national laboratory of standards, chief among which he said was the fact that American manufacturers were going abroad for their standards. The plans for the two new buildings, which will be built for this purpose in a northwestern suburb of Washington, D. C., were shown by stereopticon, and, in conclusion, considerable discussion (all favorable) took place as to the metric system and the bill now before Congress. This bill makes the metric system compulsory in the United States government specifications and documents (except as relating to public lands) after Jan. 1, 1904, and makes it the legal system after Jan. 1, 1907, although, of course, anyone can use the old system of measurements after that time if so determined. The interest and attendance at the meeting was gratifyingly large, and a good proportion of the audience were electrical people of Chicago.

STATE ELECTRIC LABORATORIES.—We have noticed in the recent daily press of New York a statement to the effect that a commission has been appointed and has met to consider the question as to whether a state electrical laboratory should be established in New York state, to provide means for testing electric measuring instruments, and keeping standard electric pressures and currents on tap. We sincerely hope that no such state laboratory will be established, as it would be worse than useless expense. The Bureau of Standards at Washington is a National body, charged with doing this precise work among other duties. There is no immediate likelihood of this bureau being so far overwhelmed with electrical work as to be incapable of supplying the demand. No sub-standardizing bureaus should be called into official existence without being annexed to the National bureau at Washington. A number of state electric standardizing bureaus are likely to lead to just as many different values of the volt ampere and watt, besides involving much reduplicated labor and expense. Were the states generally to indulge in the practice, the situation might become particularly unbearable to the manufacturing companies doing business all over the country.

A WATER-PROOF LAMP AND SOCKET.—A patent was issued recently to Lester Thayer, a well-known electrical engineer of Peoria, Ill., upon an incandescent lamp combined with a water-proof socket. In order to get the water-proof socket Mr. Thayer has thickened the glass around the base of the lamp so as to permit of a gasket joint between the glass of the lamp bulb and the socket. The drawing in the patent shows Mr. Thayer's idea as used with the Edison form of screw lamp base. The socket proper can be made of porcelain or other water-proof insulating material capable of being molded or turned to the desired shape. The glass of the lamp bulb at the gasket joint between the socket and the bulb matches with the socket exactly, so as to make a smooth exterior surface, not only neat in appearance, but of a shape not likely to invite the retention of moisture at the socket joint. Mr. Thayer's invention attacks the problem of a water-proof socket for out-door incandescent lamps is an entirely new way, as the gasket joint, if tight, will keep all water away from the screw base of the lamp, and the usual rusting together of base and lamp socket cannot occur. Those who have had much of exterior decorative lighting to do with incandescent lamps where sockets are exposed to the weather, know how common this trouble is.

BOSTON MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The forty-fifth meeting of the American Society of Mechanical Engineers will be held at Boston, Mass., May 27 to 30. The professional sessions will be held at the Massachusetts Institute of Technology, and the headquarters will be in room 14 of the Institute Engineering Building. A very full programme has been prepared for the instruction and entertainment of those in attendance at the meeting. The Technology Club, St. Botolfs Club and the Boston Art Club have extended their privileges to members of the Society during the meeting. Excursions in the city and vicinity have been arranged for the ladies with the party, and arrangements made for a number of professional excursions. Among the papers to be read are the following: "Construction of Atlantic Avenue Power Station, Boston," by I. E. Moultrop and R. E. Curtis; "Liquid Fuel Consumption," by Chas. E. Lucke; "Electricity in Cotton Mills," by W. S. Smith-Whaley; "Some Details of Direct-Connected Generator Sets," by Wm. H. Bryant, and "Elevator Safeties," by Chas. R. Pratt. At the meeting there will be considered the final report of the committee appointed to codify and standardize the methods of engine tests, and a report by Mr. Geo. H. Barnes on tests of steam pipe coverings.

PRIZES FOR AN ELECTROLIER.—The Municipal Art Society of New York announces a competition for a design for an electrolier, to be combined with an "isle of safety," to be placed at the intersection of Fifth Avenue and the south side of Twenty-third Street. The electrolier, when completed, will be presented by the society to the city. It is desired to obtain a simple and beautiful street fixture to serve as an example for future work; by its placing to divide the traffic so as to force it to follow the rules of the road and keep to the right; to supply a place of safety for foot passengers in crossing the avenue, and to give a place for the necessary lighting, signs, etc., for the convenience of the public. The competition will be judged by a jury of fifteen members, ten professional artists and five laymen, and will be open to artists, without distinction of age or sex. Drawings and models must be delivered, addressed to the secretary of the society, at the Architectural League, on or before June 14 next. The first prize will be a commission to execute the necessary full-sized drawings and such modeled details as are required for the execution of the proposed work, for which $500 will be paid. The second and third prizes will be $100 and $50, respectively. The designs shall not call for an expenditure of more than $1,500 for the complete execution of the electrolier.

A MISAPPLIED REVIEW NOTICE.—Some months ago we printed a review of a book entitled, "Recording and Integrating Electric Meters," which only called for notice in our columns on account of its extreme worthlessness, which we pointed out for the benefit of readers who otherwise might have been led to buy the book. Recently we have received from a number of indignant purchasers of the book, a copy of a circular in which this journal is quoted as highly recommending this work, which, as a literary freak, ranks with "English as She is Spoke," and as a technical treatise betrays a profundity of ignorance on the part of the writer which cannot be characterized otherwise than as phenomenal. Upon reference to the review notice, we find that the circular quotes some parts of the same, but divorced from a context far from commendatory. Below we print the first paragraph of the review notice, with the part in italics which the author uses in his circular: *"This treatise is a gem. Not for an instant could the reviewer hesitate to heartily recommend the purchase of a copy to everyone who even imagines that possibly some day he will be interested* in electricity. Those who have as yet forgone a technical education will find the statements in the book so curiously and wonderfully involved that they cannot possibly learn anything from it that would hurt their minds (we say nothing about helping them); while those who are a little further along can get a fair average of two laughs per page out of it, not to mention the aggressively apparent moral of the whole: Refrain from attempting to say what you cannot express, and don't imagine that a smattering of knowledge means mastery of a subject."

LETTERS TO THE EDITORS.

The Heyland Motor.

To the Editors of Electrical World and Engineer:

Sirs—I have just seen the letter of Mr. H. St. Martin, which appears in your issue of Dec. 28, 1901, in which Mr. Martin says that priority as to the form of a synchronous motor, known as the Heyland motor, and so described in your journal, must be conceded to M. Latour.

This is evidently the result of a misunderstanding. M. Latour's publications refer to quite another subject, as will be seen by referring to the ELECTRICAL WORLD AND ENGINEER, of April 12, 1902 (p. 658), and *L'Industrie Electrique*, of May 10, 1902.

For the motors of my system, as they were described in the ELECTRICAL WORLD AND ENGINEER, of Aug. 31, 1901 (p. 347), and of Jan. 4, 1902 (p. 34), I have applied for patents in Europe and America; the German application has already been accepted by the

Patent Office. I may add that most of the important European manufacturers of electrical machinery have already taken licenses under my patents.

BRUSSELS, BELGIUM. A. HEYLAND.

Improvement of the Telegraph.

To the Editors of Electrical World and Engineer:

Sirs.—Concerning the complaints made from time to time that few improvements are applied in telegraphy, the cause is very plain to my mind. Consider the manner in which a telegram is sent and received. A person, often in a hurry to have his message delivered, comes to a telegraph office, usually takes one of its blanks and writes the message; this is sent to the operator, who, while reading, transmits, and it is rewritten (likely much faster than it was written by the person sending) by the operator at its destination. It is then sent out and delivered.

What can be quicker than that? It is true it possibly might be written by the person sending, on some prepared paper and photographed at the other end, but it has hardly come to that yet. If the message is to be sent by some rapid process, it has to be read and arranged to suit; while that is being done, it could be at its destination and delivered, or on its way to delivery. As a general thing, the telegraph lines allow messages to be received as fast as they can be sent, which is not at all slow; and no improvement can do more. In my opinion, the telegraph is the most complete of all electrical arrangements.

BALTIMORE, MD. ALFRED G. DELL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Self-Exciting Alternators.—HEYLAND.—An article in which he explains the differences between his self-exciting non-synchronous alternator and the self-exciting shunt-alternator of Latour (both of which have been noticed in the Digest). Latour's shunt alternator consists of a stator with three-phase winding and a rotor like a direct-current armature, with three brushes supplying the three-phase currents to it. All these parts agree exactly with a non-synchronous three-phase motor, devised by Georges, in 1891. This motor gave good results; it had even at synchronism a certain self-excitation which was shown by the fact that at this speed the phase-difference between current and e. m. f. disappeared. But Latour has found that such a motor can be equally well operated as generator, and this he has patented. On the other hand, Heyland's alternator is characterized by the fact that it belongs to the type of induction machine with an armature winding closed in itself. It is known that such machines can be operated as motors as well as generators. There exist different methods for self-excitation of such alternators, and the object of Heyland's invention is a new method of self-excitation characterized by the new device of introducing magnetizing currents into the rotor winding closed in itself. In Latour's shunt alternator the currents induced in the rotor by the revolving field will be communicated to the network through the brushes. The proper operation is with zero slip, which Latour can accomplish by adjusting the brushes; at the same time it will be necessary to increase the exciting current. The slip when it is produced will be greater than in Heyland's alternator, in which it will remain within ordinary limits without any adjustment. The essental difference between Latour's and Heyland's machines is that in the former the total rotor current must pass through the brushes, while in the latter, which is of the induction type, only a part passes through the brushes; namely the magnetizing current, the balance passing through the ring which short-circuits the rotor-winding. Heyland had already remarked that Latour's machine will not work on account of the sparks at the brushes; "for this reason Georges has abandoned his analogous experiments of 1891, and if Latour and Poincare prove, by theory, that the sparks must disappear, I would only say it all depends on the theory which one applies. In practice, they will not disappear." The reason is that a field generated by single or polyphase alternating currents rectified by a commutator, is never absolutely constant, as would be, for instance, a field generated by direct current. In a field produced by rectified alternating currents, there occur—at least in certain parts of the field—oscillations due to the commutation. This can be proved by the following elementary experiment. If, in a direct-current machine, copper brushes are replaced by carbon brushes, it is known that sparks which occur at the copper brushes, will disappear, or at least be diminished. If now the same armature is supplied through three brushes with three-phase currents in synchronism with the angular speed of the armature, there is no appreciable change in the sparks, when carbon brushes are substituted for copper brushes. This is explained by the oscillations produced by the commutation of the alternating current. These oscillations represent a certain amount of energy which must be destroyed by the rupture of the circuit, and which manifests itself in the sparks at the brushes. Evidently the material of the brushes can here make no difference whatever, while in direct-current machines the only phenomenon to be considered, the effect of the short-circuiting of two adjoining segments, undergoes variations when the material of the brushes is changed. Hence in the Latour machine the sparks cannot be suppressed. This is the reason, and the only reason, while all commutator motors, which he calls conduction motors (evidently to distinguish them from induction motors) are unsuccessful for alternating currents, in spite of the great number of particular good properties. On the other hand, such oscillations do not exist in induction machines. They are suppressed by the damping (amortisseur) effect of the short-circuited rotor winding. The practical consequence of this fact, utilized in the Heyland alternator, does not seem very evident at first sight, and it seems even paradoxical to combine a commutator with a winding which is short-circuited in itself; it would seem that currents could not be introduced into a winding closed in itself, or, at least, that when they enter their magnetizing effect would be zero, on account of the opposite direction which they would take; as they are alternating currents, it would seem that they must produce short-circuited currents in the winding which would prevent any production of a magnetic field. This apparent impossibility explains why for 12 years, since Georges' experiments, experiments have been made in this line, without the very simple idea of introducing alternating currents into the short-circuited armature of induction motors. The new idea of Heyland's invention is, therefore, to introduce, by means of a commutator, alternating currents for excitation into the rotor of an induction machine, although the winding is short-circuited. This is done by the use of an armature short-circuited in itself by means of a ring of a certain resistance which at the same time serves as commutator. In practice a single ring cannot be used because there does not exist a material of suitable resistance. A ring consisting of a number of segments connected together by electric conductors is therefore used, the resistance of which has a certain relation to the resistance of the winding. Such a commutator becomes very simple on account of the small number of segments which can be used without any danger of sparks being produced. This shows why a commutator, while inadmissible for any other type of alternating current machines, does not present any inconveniences when used on an induction machine with short-circuited rotor. The field in the rotor is absolutely constant, as though it were produced by direct current. Hence there are no oscillations of the field, no extra-currents, no sparks at the brushes. The short-circuited rotor winding represents an excellent damper (amortisseur) against any oscillation of the field. The commutator behaves like a single solid ring, which it is, in principle. For all positions of the brushes, there are no sparks. In recent designs he uses three or four segments for the distance between two brushes, while in direct-current machines 20 to 30 are generally used. The novel result obtained is, therefore, the excitation of a constant field without oscillations in the rotor, by means of rectified alternating currents. The difference between Heyland's and Latour's machines becomes more evident for single-phase currents. Boucherot has found that in Latour's

machine, single-phase, alternating current does not produce any effect. On the other hand, the first Heyland machine actually built, and which has given perfect results, was excited by single-phase currents.—*L'Ind. Elec.*, April 10.

LATOUR.—A brief reply to Heyland's article. He objects to Heyland's historical notes (about Georges), and says that never before has a shunt alternator been constructed. Concerning Heyland's device, he say that the network, as a whole, will in any case have a much smaller resistance than the resistances placed by Heyland in parallel with the excitation circuit.. Hence, through the "short-circuiting" commutator ring only a very small portion of the currents induced in the rotor will pass; the circuits of the currents will be largely closed through the brushes. The resistances between the segments cannot be considered as a short-circuiting ring, but ought to be considered as shunts introduced to avoid sparks. "Heyland must have noticed that the motors subjected to his tests could turn at and above synchronism; he will agree that these are induction motors of a very special kind." He thinks that Heyland's and his machine are of the same type. Heyland applies only a special device for avoiding sparks. He says he can do without Heyland's device, as the troubles in the commutation are due only to the harmonics of the field and can be avoided.—*L'Ind. Elec.*, April 25.

REFERENCES.

Variable Speed Motor.—An illustrated description of a shunt-wound motor, the field magnets of which are hollow and contained within them are closely fitting iron plungers, which, by means of gearing, may be moved toward or from the armature, so that the reluctance of the magnetic circuit may be varied at will. The motors are said to have an operative speed range from normal or minimum speed to from 100 to 150 per cent. above minimum.—*Eng. News*, May 1.

Direct-Current Motors.—MCCORMACK.—A discussion, by means of simple mathematical formulas, of the effect of variation of field on power and speed of a constant potential motor.—*Elec. Rev.*, April 26.

Alternating-Current Engineering.—BEHREND.—An illustrated article on the development of alternating-current engineering.—*Cassier's Mag.*, May.

LIGHTS AND LIGHTING.

Interior Lighting.—SMITH.—An illustrated article giving the results of a study of certain shades and globes for electric lights, as used in interior illuminations. He speaks very well of Holophane glass; the efficiency of the globes is excellent, the light can be thrown practically in any desired direction, and the diffusing action is practically perfect; they also excel in the uniformity existing among individual globes of the same type, and in the precision with which they allow the determination beforehand of the results to be obtained. He describes a method of determining the illumination on a surface and gives the results of an application of this method to a special case, the results being discussed in detail. It is just as easy to calculate what the result will be in simple cases, using opal globes, ground glass balls, etc., as with Holophanes, because the distribution curves are similar in different azimuths; but it is not so simple to calculate and produce a given scheme, because one does not have the same effective method of producing various distribution curves in the same character of globe, and of combining these according to necessities of the case. Similarly, one can by many types of reflectors produce distribution curves as desired, but diffusion is either absent or imperfect; and in many cases the distribution curves differ in different shades and in different azimuths in the same shade, so that each shade strictly ought to be adjusted to exactly the desired position and then always returned to the same. With the Holophanes all this difficulty is avoided.—*Tech. Quart.*, March.

REFERENCES.

Railroad Car Lighting.—A description of the electric lighting equipment of the railroad mail cars of the German Post Office. The current is obtained from storage cells which are placed into the cars, after they have been fully charged.—*Elek. Mitthei.*, March.

Incandescent Lamp.—A well illustrated description of the works of the Sir Hiram Maxim Electric & Eng. Co., Ltd., and of the actual processes involved in incandescent lamp manufacture. The filament used in the Maxim lamp is made from cellulose, obtained from Japanese paper and other material by a secret process.—Lond. *Elec. Times*, April 24.

POWER.

Small Water-Power Transmission Plant.—HARDESTY.—An illustrated description of a small water-power electric transmission plant for local lighting service in Utah County, Utah; this is considered as a good example of what could be done in utilizing the natural fall of many mountain streams in the West for the benefit of neighboring settlements. There is at present installed a 250-kw, 60-cycle, 6,600-volt, three-phase generator. The current is transmitted to a substation 5 miles distant, where the voltage is reduced to 2,000. From there the current is transmitted to different places for lighting and power, 115 to 200 being the voltages used respectively for these purposes. The hydraulic installation is described in detail.—*Eng. News*, April 17.

REFERENCES.

Alternating Current Transmission.—STURDEVANT.—A reprint in full of an illustrated paper read before the Cleveland Electric Club. He first gives a general graphical review of the phenomena taking place in alternating-current circuits, and then makes an application to a simple numerical case of power transmission. No use is made of higher mathematics.—*West. Elec.*, April 19, 26, May 3.

Boilers.—The whole issue, of more than 100 pages, consists of a profusely illustrated description of American stationary boilers and furnaces and feed-water heaters, compiled apparently largely from trade publications.—*The Eng.*, April 15.

TRACTION.

Electric Traction on Normal Railroads.—HUBER.—A paper read before the Engineers' Club of Zurich (the author is a director of the Oerlikon Co.); he refers to electric traction under steam railroad conditions. He says that, while single cars running at short intervals are suitable for passenger service, electric traction on normal railroads has to take care also of the freight traffic and handle the transfer of heavy freight trains between different main or branch lines. For these reasons he believes the electric locomotive must be used. To insure economy of operation, a high voltage must be used; this is said to make the use of three-phase currents prohibitive, as two overhead contact wires would be required, and they would not be insulated sufficiently to fulfil all requirements of safety. Only a single overhead contact wire can be considered reliable. He therefore recommends single-phase alternating current for transmission. This alternating current is converted into direct current by a motor generator placed on the locomotive, and this direct current is supplied to the motors.

The direct-current side of the motor-generator is separately excited, which gives an excellent method of speed regulation, starting and braking, and returning power to the line on descending grades. Such a system has been proposed before by Ward Leonard, and recently by Mordey. The Oerlikon Co. has worked out the practical details of the system, and has recently made an offer to the Swiss Railway Department to install the system on a road of its network. A locomotive is being built with four axles, for receiving alternating current at 15,000 volts, for a capacity of 700 hp at the drawbar, the total weight being 44 tons. This shows that such a locomotive is not too heavy. To drag a train of 250 tons weight, with a speed of 40 kilometers, on a grade of 1 per cent, about 565 kw are required, which, for 14,000 volts and a phase difference of 10 per cent, means that 45 amp. are to be taken off from the contact wire. This current is not excessive. The only serious objection of the use of alternating current for traction with rail return is the reactance of the rails, which causes too high a voltage loss, if the frequency is, say, 42 periods (Burgdorf-Thun). He believes that although the weight and the cost is thereby increased, it will be necessary to use a lower frequency, say 16 periods. He gives numerical calculations which show that the losses are small on a long line which is equipped with this system and on which several trains are running at the same time. The feeding points are proposed to be placed at distances of 120 km. He thinks that a lower voltage than 15,000 is insufficient and a higher voltage undesirable, as 15,000 volts is said to be the highest e.m.f. which can be produced directly in machines with safety and without special difficulties. The Oerlikon Co. has worked out a new system of suspending the contact wire, which gives a very great freedom in its alignment; it runs at the side of the road, and the trolley poles slide along it, being movable around an axle in the direction of the car and being pressed upwards by a spring. He claims that the arrangement of the switches becomes very simple. Illustrations

are promised in a future publication. He thinks that for traction in general, with the exception of high-speed roads and track and pinion mountain roads, the use of any other but direct current for feeding the motors is wrong.—*Schweiz. Banzeit.*, v. 39, Nos. 10, 11, 12.

Berlin-Zossen High-Speed Railway.—A rather full account of the most interesting results obtained on this experimental railroad, the equipment of which has been described in detail in ELECTRICAL WORLD AND ENGINEER. The problem of the current feed to the carriage seems to have received a successful solution; the pressure of the contact bows against the trolley wires amounted to 4 or 6 kilograms; there was very little sparking at the contact devices, in spite of the high speed of 130 ft. per second; where sparks appeared they would be traced to slight defects in details. When starting for a speed of 60 miles full speed was reached within 1.2 to 1.8 miles, the acceleration being from 5 to 8 ins. per second; these accelerations are not high; on the Elevated and Underground Electric Railway of Berlin the acceleration is 24 ins. on starting. Since, however, rapid starting wears the locomotives considerably, and since the stations will not be very close on high-speed lines, the question of rapid and reliable braking is of much more importance than that of rapid starting. The cars are fitted with Westinghouse air brakes, with hand brakes and with counter-current brakes. The General Electric Company of Berlin furthermore added an electromagnetic brake, fed from an independent source of current—a special battery of storage cells on board. The Westinghouse brakes could exert a pressure equivalent to 3,640 kilograms, equivalent to 95 per cent. of the weight per brake-block. The brake ratio was 1 : 1,002. Both the time and the space interval of the Westinghouse brakes were determined, the air pressure being 6 atmospheres. The original appliances did not answer, and the valves had to be altered in the course of the experiments. As the brake-blocks, and also the wheel tires, became very hot, experiments were also made with hollow, water-cooled blocks. It will be found advisable for high speeds to apply brake discs to the axles and not to let the brakes act directly upon the wheels, lest the tires should slip. The hand brakes are, of course, used for emergencies. The cars could be stopped within 2,350 ft., and the retardation amounted only to 2 ft. per second. Braking by current reversal is not to be recommended, as it endangers the motors. The conclusion arrived at is that further means of efficient braking will have to be devised. The results of the brake tests are summarized as follows: When the speed in miles was 96.5, 68.5, 68.5, the brake interval was: the space in miles 1, 0.31, 0.34, the time in seconds 67, 35, 32, respectively. Figures are given for the energy consumption, which show an efficiency of 90 per cent. for the motors, 85 per cent. for the electric installation and 45 per cent. only for the whole plant; but the power station was further off than it would be in a special railway plant; it would be futile to base any estimate as to working expenses on these tests. The rise in the air pressure did not extend beyond a distance of 11 ft. in front of the carriage; the rounding off of the carriage on the sides and at the roof was found to be a very important feature. No particular increase in the pressure was noticed on the rear portion of the car, nor was any noteworthy suction effect observed in the wake of the car. When the speed exceeded 75 miles, the signals could no longer be well distinguished, and the rain striking the windows interfered very much with the visibility of the signals. The latter will, therefore, have to be made very large and clear, and will have to be placed quite a mile in advance of their "destination." It is also intended to try signals on board, to be actuated from the signal boxes, and to repeat the respective signals by bells along the track. While the experiments do not allow a final opinion to be passed upon electric high-speed traction, they have been sufficiently satisfactory to justify a continuation of the work after the road-bed has been improved.—Lond. *Eng'ing*, April 25.

Automatic Block Signals on Heavy Electric Railways.—An article discussing automatic block signals as used on elevated railways. The first system described is that used in Boston. One of the track rails is used as a return, and the other rail is laid in insulated sections, and is used as part of the circuit for operating the block signals. As the structure itself is of iron, there is plenty of metal in the return circuit when only one rail is used as a return. As will be seen, the system is operated by a 100-volt circuit. In connection with the block signal system an automatic train stop is used. If the car should pass the signal of danger, a valve connected with the air brakes is opened by a trip located alongside of the track, and the brakes are automatically set. The block signals used on the Chicago elevated lines are then discussed. Unlike the Boston system, the cars themselves provide the power for operating the signals by running over a treadbar which winds up a spring. The mechanism used to operate the semaphore is electricity, and in case a motorman fails to regard the danger signal, the brakes will be applied in the same way as at Boston. The current for operating the semaphore is taken from storage battery cells.—*St. R'y Jour.*, April 5, and Int. Ed., April.

Wires, Wiring and Conduits.

Notes on Wiring.—BROADBENT.—An article in which he refers to the fact that electrical fires are now of comparatively rare occurrence in England, although the wiremen do not generally follow the many conflicting wiring rules in existence. He remarks that an electric fire may be the result of, rather than in spite of, wiring rules. He refers to a case in which a fire was due to the methods of earthing an interior wiring, both of which were in accordance with the Board of Trade requirements. He recommends taking good care in making earths, and suggests connecting together at frequent intervals all water pipes, gas pipes, lead and steel sheathings, and every other underground metal conduit; the leakage current in each would thus be so reduced that electrolysis would not be feared to such a degree as it now is.—Lond. *Elec. Rev.*, April 11.

Air-Spaced Telegraph Cables.—FLETCHER.—An abstract of a paper read before the Manchester section of the (British) Institute of Electrical Engineering. He specifies that the paper covering round the conductor should be whipped with a hemp twine of about ½-in. pitch, and the strength of the paper should be such that a strip 1 in. wide will bear a strain of 4 lbs. for each mil of thickness. For 64-lb. conductors he uses paper 4 mils thick and 1 in. wide; for 150-lb. conductors, 5 mils thick and 1¼ ins. wide; and for 200-lb. conductors, 6 mils thick and 1½ ins. wide. He specifies that the cable must be dried at a temperature not exceeding 225 degs. Fahr., after the wires are laid up and before lead covering. The minimum radial thickness of the lead covering should be 100 mils for a five-pair cable, and not necessarily more than 150 mils for a larger cable, and the lead tube should be capable of withstanding an internal pressure of 75 lbs. per square inch. He recommends that the cable should be tested under an air pressure of 20 lbs. per square inch, and when under this pressure passed slowly through an observation trough at least 18 ft. long and containing water. The insulation resistance specified between wire and wire and wire and sheath is at least 10,000 megohms per mile, and the capacity 0.09 microfarad per mile for 64-lb. conductors, and 0.1 microfarad per mile for conductors of 100 lbs. per mile and over. He calls attention to the necessity of lightning arresters in connection with the wires, as the cables are used in conjunction with overhead wires. It is pointed out that the spark gap in the lightning arrester must be smaller than the air space at any point throughout the cable. There are now about 90 miles of air-spaced cables in use on the London & Northwestern Railway, varying from one pair to forty pair, and representing 1,700 miles of single conductors. They are used underground at crossings over the main lines of rails, on station yards, and in tunnels. They have proven very satisfactory. They are laid "solid" in wood trunking, the trunking being grooved out of solid timber and the groove being very little larger than the cable. He does not approve of the drawing-in system, and instances a case in which the lead sheathing of a ten-pair cable 300 yds. long, after being drawn into iron piping, gained 18 ft. over the conductor. If the lead and conductors are anchored together, he says, there is a tendency towards the production of pinholes in the lead.—Lond. *Elec.*, April 18.

Electro-Physics and Magnetism

Electric Oscillations in Coils.—LUEDIN.—After Hertz's method, it is usual to produce electric oscillations with the aid of sparks. But oscillations may also be obtained by simply closing or opening a circuit in which a coil of a sufficient number of turns is inserted. He detects the existence of these oscillations by means of a coherer simply attached to some part of the circuit at one end, the resistance being measured after each break or make. The effect is greater at break than at make. By substituting a long wire for the coherer and mounting another wire parallel to it, he was enabled to demonstrate the existence of longitudinal waves in both wires. If a coherer is attached to the end of the second wire, its resistance

falls as soon as the current is closed or opened in the primary circuit. But the strength of the resonance depends upon the length of the second wire.—*Ann. der Physik,* No. 3, abstracted in Lond. *Elec.,* April 11.

Velocity of Ions from Hot Platinum Wires.—CHILD.—An account of an investigation of the discharge from a hot platinum wire through which a constant current is flowing. The discharge carried by the positive ions and that carried by the negative ions were studied and compared. The velocity of the positive ions was found to be greater than that of the negative ions. At a certain temperature ionization is produced in the gas about the wire to greater than molecular distances. Experiments on a wire enclosed in a glass tube indicate the presence in the tube of particles which diminish very greatly the velocity of the ions. This "emanation" appears to load the ions, and thus to diminish their velocity, both when they are within an enclosed tube and when they are in the open space. Thus the particles driven off from a hot wire do not appear to aid in the discharge, but to materially check it.—*Phys. Rev.,* April.

REFERENCES.

Induction Coil.—TROWBRIDGE.—An article referring to the theoretical result obtained by Lord Rayleigh regarding the significance of the electrostatic capacity between the primary and secondary of the induction coil, and his proof that in certain cases a condenser in the primary is of no advantage, and sometimes it may be prejudicial. The present author described in detail a powerful coil devised by Heinze to be operated by his liquid interrupter. The performance of this coil justifies the points raised by Lord Rayleigh. —*Phil. Mag.,* April.

Skin Effect in Oscillators.—CHANT.—A long account, illustrated by figures and tables, of an experimental investigation into the skin effect in electrical oscillators. The experiments indicate that, both in the case of cylindrical and spherical doublets, the excessively thin gold leaf shells are quite as efficient as the solid metal bodies.—*Phil. Mag.,* April.

X-Light Tubes.—ROLLINS.—Continuations of his long serial giving "notes on X-light," in which he discusses the construction of tubes for powerful coils, the proper distance of the target from the cathode, the form of target, the cathode, the position of the cathode, the stems of the terminals and the terminal wires, vacuum regulators, the length of X-light tubes, their diameter, the length of terminals and the question of single versus double focus.—*Elec. Rev.,* April 19, May 3.

Discharge Potentials.—TOEPLER.—An account of an investigation of the discharge in air between a point and a plate. There are ten different forms of such discharges, their occurrence depending upon the difference of potential and current as well as on the distance between the two electrodes. The main point is the limiting potential at which the visible discharge sets in.—*Ann. der Phys.,* No. 3; abstracted in Lond *Elec.,* April 11.

Electromagnets.—WAGNER.—An article on attraction by electromagnets. He describes experiments made by Damon, and by Richardson and Witherspoon, and calculates from the same the intensity of induction in the air gap and the pull, under the assumption that there is no spreading of the lines of induction.—*The Rose Technic,* April.

ELECTRO-CHEMISTRY AND BATTERIES.

Soda and Bleach.—RHODIN.—An abstract of a paper, read before the Canadian section of the (British) Soc. of Chem. Ind., on the electrolytic manufacture of caustic soda and bleaching powder at Sault Ste. Marie. The Rhodin cell is used, with a mercury cathode. A storehouse cylindrical vessel, 3 ft. in diameter, with radial openings at top and bottom, the upper ones closed airtight by carbon blocks into which vertical carbon rods are screwed, is supported by a stoneware delivery pipe so as just to dip into a layer of mercury, covered with water, in a shallow cast-iron dish 5 ft. in diameter, forming the cathode. The interior is filled with brine and the dish with water; the cylinder is then rotated; when under a current of 800 to 1,000 amp. and 5 volts, sodium amalgam is formed under the lower slots, and by the turbine action of radial flanges passes to the water in the outer annular space and yields caustic soda, while the chlorine evolved in the cylinder is collected by the delivery pipe. The mercury on losing the sodium sinks and returns to the center of the bell from below. The soda lye is drawn off on reaching a desired strength, and replaced by water. By means of a central entrance and exit tubes, strong brine is supplied just above the surface of the mercury, and the spent, and therefore lighter, liquid is withdrawn at the upper level, to be strengthened and used again. The carbons are of Acheson graphite, with four times the conductivity of ordinary carbon. In the discussion it was remarked that the hearty support which the manufacturers had given to the new American Electrochemical Society showed that the policy of obscurantism in electrochemical industry had been abandoned.—Lond. *Elec. Times,* April 24.

Colors of Electrolytes.—PAULI.—An article "on some color phenomena of dissolved molecules, a contribution to the limitation of the dissociation theory." He discusses the coloring of solutions by the addition of another reagent, for instance, the fact that ferric chloride, after having been diluted to such a degree that it is colorless, gets a yellow color again after the addition of concentrated hydrochloric acid. He says that this has nothing to do with the color of the ions; he explains these phenomena by the assumption of the formation of anhydrites.—*Elektrochem. Zeit.,* April.

Manganese.—HERAEUS.—An account of a determination of the melting point of manganese, 99 per cent. pure, which was found to be 1,245 degs. C.—*Zeit. f. Elektrochemie,* April 3

REFERENCES.

Electrolytic Estimation.—The first of a series on recent researches in electrolytic estimations made in the University of Pennsylvania. The first is by Fulweiler and Smith on the precipitation and separation of silver in the electrolytic way.—*The Elec.-Chem. and Met.,* March.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Speaking Arc and Wireless Telephony.—SIMON.—An illustrated lecture, giving a summary of the experiments of various investigators with the speaking arc. Diagrams are given of different

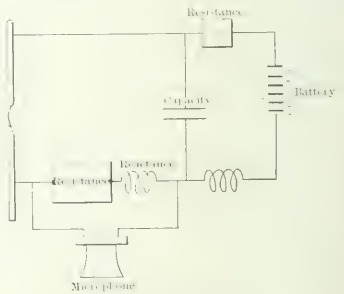


FIG. 1.—SPEAKING ARC.

methods by which microphone currents can be superposed on the direct current flowing through an arc lamp, and the arc is thereby made to reproduce the sounds spoken into the microphone. Technically the simplest arrangement is said to be that shown in the ad-

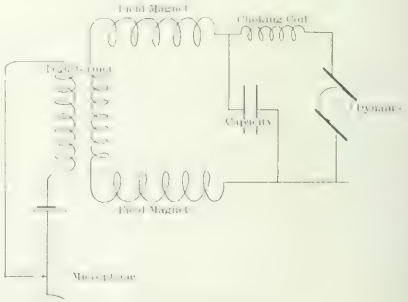


FIG. 2.—SPEAKING ARC.

joining diagram 1. He has succeeded in impressing microphone currents on the field magnet of a direct-current dynamo in such a way that the total network receives the oscillations and all arc lamps connected to the networks reproduce the sounds spoken into

the field magnet microphone; this is accomplished by the arrangement shown in diagram 2. To get loud sounds the length of the arc is important; Duddell uses arcs up to 10 cm length. The reverse of the "speaking arc" is the "listening arc," namely, the phenomenon that when the air pressure acting upon an arc varies in oscillatory way (as in sound waves), there occur analogous oscillations in the current, and these oscillations can be made to reproduce the sounds in a telephone. He discusses the experiments of Duddell, in which a direct-current arc, in parallel with a low-resistance circuit containing self-induction and capacity, begins to sound by itself, under proper conditions; he discusses this phe-

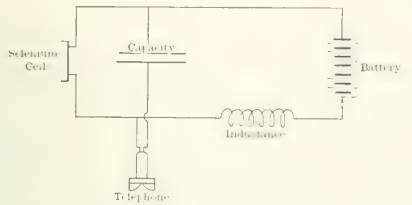


FIG. 3.—RECEIVING DEVICE.

nomenon, which is the electrical analogy of an organ pipe in action, continuous oscillation being obtained by this means; this experiment is therefore of fundamental importance for the generation of undamped electrical oscillations. He then deals with the "speaking light," i.e., the phenomenon in which the microphone currents cause corresponding oscillations of the light intensity. This gives a method of wireless telephony, on the same principle which has been used years ago for this purpose by Graham Bell. The transmitter contains the arc and a carefully cut parabolic reflector, which sends the "speaking light" into the distance; for this purpose the arc should be as small as possible; he uses an arc between a positive carbon of 5 mm, and a negative carbon of 3 mm diameter with a current of 2 to 3 amp. The receiving device, the principal part of which is a selenium cell, is shown in Fig. 3. He has succeeded in transmitting speech in this way over a distance of 2.5 km; the sounds are very clear; he thinks he can transmit speech to a distance of 4 km in this way.—*Phys. Zeit.*, April 1.

MISCELLANEOUS.

REFERENCES.

Electrometallurgy of Iron and Steel.—Three articles on the recent development in the electrometallurgy of iron and steel: the first by Ruthenberg, on the magnetic concentration of low-grade ores in the electric furnaces; the second on the Conley electric steel smelting process for the production of steel direct from the ore; the third on the Harmet process for the production of steel direct from the ore.—*The Elec.-Chem. and Met.*, March.

Blast Firing.—HEISE.—An article on the connections used in the electric firing of blasts.—*Glueckauf*, April 12.

Acheson.—A sketch, written by Fitzgerald, on the life and work of Edward G. Acheson, with portrait.—*Cassier's Mag.*, May.

New Books.

CONDUIT WIRING AND ERECTION. With special reference to the Simplex system of steel conduits. By L. M. Waterhouse. London: S. Rentell & Co. 80 pages, illustrated.

A small book of pocket size, describing in detail with many illustrations and some tables of data, the particular system of iron pipes for interior wiring mentioned in the sub-title. It is a fairly good description of the methods of installing this system of pipes and contains illustrations of the fittings made by the company which is introducing it. It cannot be considered as more than an advertisement of the system and a description of how to install it, especially as attention is called to the fact that the parts are mostly covered by patents controlled by the company, whose name appears several times. The system consists of enamelled or galvanized steel tubes and malleable cast-iron fittings and accessories. It is claimed as a fact that at the present time a very large and decidedly increasing proportion of the buildings in Great Britain are now being installed with this system. This, if true, is a good reason for publishing a descriptive booklet of this kind. At the end there are reprints of two short articles from the *Electrical Review*, of London, on this system. The title might well have been made less desceptive if it had been limited, like the book itself, to that particular system.

POWER AND POWER TRANSMISSION. By E. W. Kerr. New York: John Wiley & Sons. 356 pages, 264 illustrations. Price, $2.00.

The subject matter of this book is drawn chiefly from the author's lectures to his classes in the principles of engineering. His purpose has apparently been to present the leading principles of engineering in such manner as shall safely guide the student in the introductory part of his work, and properly introduce him to the more advanced treatment of the subject. The book is divided into three main divisions, as follows: (1) Machinery and Mechanics. (2) Steam Power. (3) Pumps, Gas Engines, Water Power, Compressed Air, etc. Covering in this way the general field of mechanical engineering, one of the most important tasks for the author is the selection of the topics for treatment and the length of treatment to be accorded to any one.

In this respect the author seems in the main to have shown good judgment, and his style of treatment is usually plain, and his statements are accurate. Occasionally, however, the demands of brevity or the desire for too great concentration have led to inaccurate statements, as on page 184, where it is stated that steam expands according to Mariotte's law, the resulting curve being a hyperbola.

Problems are introduced freely, which will add to the value of the book for the student's use. It may be here suggested that the answers to these problems would greatly enhance their value for the student who is working by himself. The book is well illustrated, and the printing and binding are in the well-known standard textbook style of the publishers.

THE ELECTRICIAN WIREMAN'S POCKET BOOK. Edited by F. Charles Raphael. London: The Electrician Printing and Publishing Company, Ltd. 330 + xiii. pages; 174 illustrations. Price, 5 shillings.

This little book, which measures 3 x 8 ins. on the page, contains a quantity and diversity of data that the title and size do not lead one to expect. The section devoted to house wiring contains the usual tables of sizes, weights and resistances of wires and cables, together with two tables showing the relations between load in lamps, current density and drop per yard (why not foot?) for standard sizes; currents allowed by the various English insurance boards, and elementary diagrams of connections. In addition to these, there are elaborate and illustrated instructions for splicing single and stranded wires, and vulcanizing joints in rubber insulation; tables of fusing points for various wires, sizes of interior conduit and mouldings, and currents required by incandescent lamps of 20 to 230 volts, 2½ to 4 watts per candle and 5 to 50 candle-power in size; abstracts of the wiring rules of the Institution of Electrical Engineers, Phœnix, Liverpool & London & Globe, and Royal Insurance Companies, and Board of Trade motor rules; directions for testing house wiring; illustrated descriptions of the concentric wiring systems, the insulating conduit, sheathed twin conductor, and Simplex conduit systems, and finally, instructions for reading, testing and fixing meters. And this is only one section. There are four others, namely, Underground Lines, Overhead Lines, Electrical Bell and Interior Telephone Wiring, and Miscellaneous. The section on underground lines includes a sub-section on distributing systems which, excepting a page or two on polyphase systems, might have been omitted without injury to the book or loss to its readers, as the diagrams are of the most elementary text-book variety and the explanation still more primer-like. Next comes a discussion of underground conduits which is excellent, and is followed by a first-rate chapter on cable testing, amply illustrated by diagrams.

The overhead line section contains many tables of properties of iron and copper wires which are extremely useful and are not commonly found in wiring books. The succeeding section on bell and telephone wiring is also unusual and commendable, except that the diagrams of bell wiring are restricted to the simplest and most obvious plans with which every wireman's helper becomes familiar after

a few months of experience. The miscellaneous section is devoted to the Johnson & Phillips and Jandus arc lamps, lightning conductors, primary batteries and accumulators, and is of about one-fiftieth the length necessary to do even scanty justice to the subjects. The primary battery discussion gives the elements and ordinary voltages of the various cells, and the government specifications for the standard Clark cell, winding up with a blaring advertisement of a book on primary batteries. At the end is the inevitable array of tables of weights, measures, conversion factors, etc., for which the average wireman has about as much use as a cat has for a watch-pocket.

Most of the contents of the book are valuable, and while much semi-didactic material might profitably have been displaced by practical matter, the book will undoubtedly be of great use to British wiremen. There are remarkably few typographical errors, and the print is clear and legible.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass, June 18-21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Engine Builders' Association of the United States. Next meeting, Pittsburg, Pa., May 22 and 23, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

Pennsylvania State Street Railway Association. Next meeting, October, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

An Electric Launch for Hospital Service.

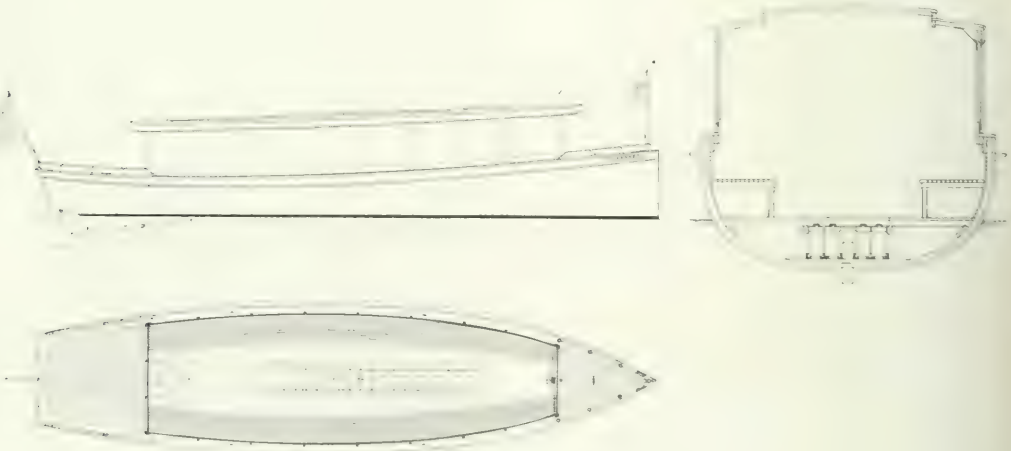
An interesting electric launch, for hospital service, has just been turned out from the shipbuilding yards of the Electric Launch Company, at Bayonne, N. J. It is herewith illustrated in Figs. 1, 2, 3 and 4. The launch has a length over-all of 38 ft.; beam, 9 ft.; draught, 24 in. It is equipped with one ship electric motor, and with storage battery capacity enabling it to cover a distance of 60 miles on one charge. The highest speed made by the launch is 10 miles,



Fig. 1.—Electric Ambulance Launch.

but speed is not one of the essential features, comfort and convenience being more desirable qualities. As usual, the batteries are placed with the motor below the flooring, not only being out of the way but increasing the stability and seaworthiness of the craft.

The launch is designed especially for transferring sick children between the floating hospitals of the St. John's Guild and the Seaside Hospital, at New Dorp, Staten Island, the floating hospital barges anchoring about a mile off shore on account of shoal water.



Figs. 2, 3 and 4.—Side Elevation, Plan and Cross-Section of Ambulance Launch.

The boat has seating capacity for 40 adults or 60 children. It is the first electric ambulance launch ever built. Power for refilling the batteries when exhausted is obtained from the electric lighting plant of the Seaside Hospital, one man being all that is necessary to operate, charge and care for the launch.

The boat is finished in white enamel and has three entrance hatches

and a wide stretcher hatch, making an opening in the roof so that a full-size stretcher can be lowered from the hospital barge directly into the launch without disturbing the occupant. The boat is constructed strongly of oak and cedar. The seating cockpit of the launch is protected by a standing roof with pantasote roller curtains of the street car type. The curtains can be quickly lowered to protect occupants of the launch from sun and wind.

The launch was launched with full power equipment and under way under its own power immediately after touching the water. It was christened "Margaret," after the pretty Japanese custom, by Mrs. Isaac N. Seligman, being named after her daughter. The name was put on the boat when it arrived at the float to take the guests for a trip on Newark Bay. This launch is a gift to the St. John's Guild by Mr. Seligman.

Adjustable Wattmeter Shunt Coil.

Recent improvements in the Thomson recording wattmeter include the addition of the adjustable shunt field coil. This device provides for the close adjustment of friction-compensation and also offsets at the critical period any increase in friction resulting from dirt, etc. In earlier meter practice it was regarded an essential to good meter operation to clean the commutator of the Thomson wattmeter, and in other respects to restore the meter to its initial condition periodically, provided it was desired to secure the highest degree of accuracy



FIG. 1.—DETAILS OF SHUNT.

in operation. Recent investigations have established the fact that the friction effect becomes practically constant after a comparatively brief period of use. Beyond this point friction increases but little, and, if instead of cleaning the commutator and restoring it to its initial condition, compensation is made for the increased friction, the meter will, except under unusual conditions, remain in a permanent condition and retain its light load accuracy.

The adjustable shunt field coil is designed to provide for this

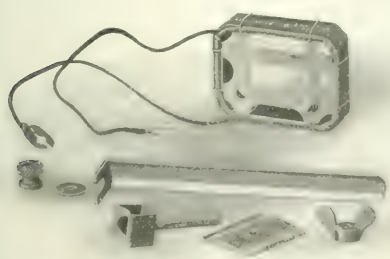


FIG. 2.—DETAILS OF SHUNT.

compensation. With this device attached, the light load accuracy may be adjusted through a range of 10 to 20 per cent. without affecting the meter's general calibration. Thus the meter, which after a period of use may run from 5 to 10 per cent. slow at light load, may be adjusted to normal accuracy in a few minutes by moving in the adjustable shunt field coil. This adjustment can be made without moving the meter and without detaching it from the service.

All Thomson wattmeters, up to and including 1,200 amperes, are now provided with an adjustable shunt field coil, and the meter with this device attached is shown in Fig. 3. The details of the shunt

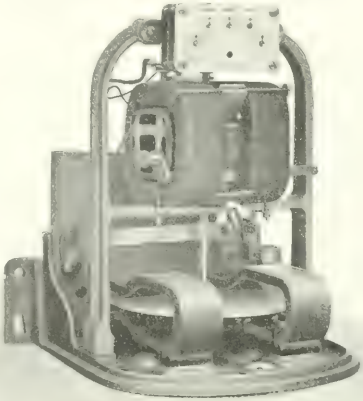


FIG. 3.—WATTMETER WITH SHUNT COIL.

device are shown in Figs. 1 and 2. This device may be attached to meters not originally provided with it.

Gold Dredging with Electric Motors.

Dredges operated by electric motors are doing much to reclaim the enormous wealth of gold lost by the wasteful methods of early placer mining. The Bucyrus Gold Dredging Company has recently purchased from the Westinghouse Electric and Manufacturing Company, of Pittsburg, a large amount of electrical machinery for the operation of its dredges in California. The chief point of activity in that State, at the present time, is on the Feather River, at Oroville. In early mining days in California, the Feather River was the scene of great activity in placer mining, many million dollars' worth of gold being taken out of Feather River Canyon. A great deal of this, owing to primitive methods of handling, was not saved, but was deposited with the "slickens" on the flats at the mouth of the canyon, below Oroville. An area of about 10,000 acres is now being partially worked over by gold dredges. Hydraulic mining having been prohibited, and the bed-rock being found at a great depth, the only feasible method of lifting this gold-bearing gravel from the bed of the river or old channels is by the dredging process of mining. The profits of operation have frequently been $1,000 per dredge daily.

Each dredger costs from $40,000 to $75,000, depending on its



FIG. 1.—ELECTRICALLY-OPERATED GOLD DREDGE.

capacity. The operation of the dredge is accomplished entirely by electric motors, the current for which is obtained from long-distance transmission companies, operating in this neighborhood. Transformers are usually placed upon the bank to lower the voltage of long-distance lines, and flexible cables run from the bank to the top of the dredge, and from there to the various motors. There are usually installed motors of an aggregate capacity of 75-hp to 200-hp on each dredge. One of the accompanying photographs shows a

variable-speed Westinghouse induction motor driving a countershaft, from which the main dredging buckets are operated. These

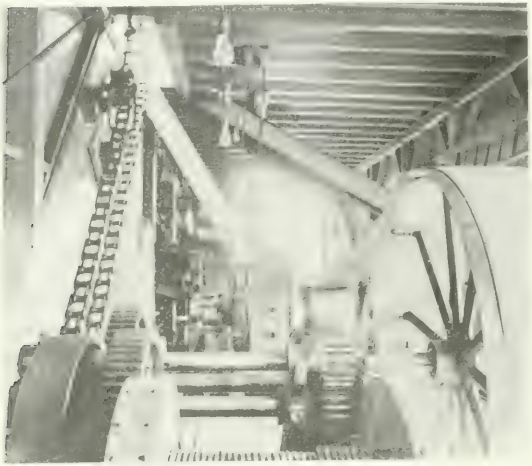
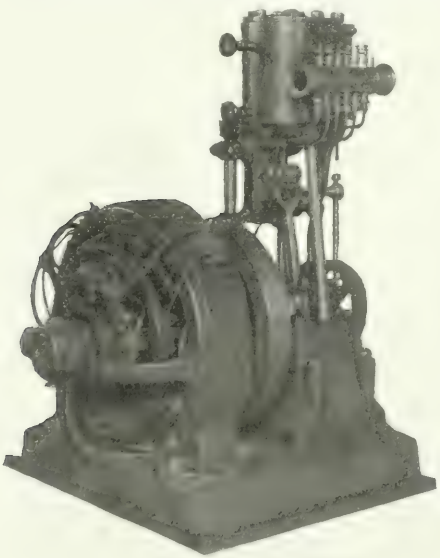


FIG. 2.—INDUCTION MOTOR DRIVING COUNTERSHAFT.

buckets raise the material from the bed of the river to the shaking screens on the top of the dredge.

Small Direct-connected Generators.

The New England Motor Company, of Lowell, Mass., is placing upon the market a line of small direct-connected generators, designed with a view of obtaining the highest possible weight efficiency. These machines are built of the six and eight-pole type,



DIRECT-CONNECTED GENERATOR.

and, as the cut herewith shows, are of a pleasing and symmetrical appearance. The commutators have very large surface, so as to be able to hold the current density at a low point, usually not exceeding 20 amperes per square inch of brush surface contact. The armatures are very finely laminated, No. 28 gauge deoxydized and annealed armature steel being used, which gives about sixty laminations to the inch. The armature coils are form wound and separately hand taped. The armature slots are insulated with micanite before the coils are placed therein. The field coils are wound on forms, very carefully taped, and painted with water-proof paint. As showing how light these sets may be built, attention is called to the 3-kw, direct-connected set, which weighs, complete with a Forbes engine, 550 lbs. Such sets would seem to have a special field in yachts and elsewhere, as well as being generally applicable.

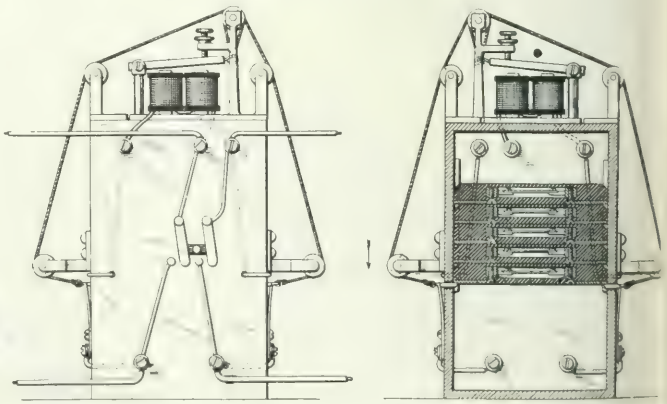
Telephone Manfacturers Association o the United States.

As previously announced in these columns, a meeting of independent telephone manufacturers of Chicago was held at the Oxford Hotel soon after the Interstate Independent Telephone Convention, for the purpose of forming an organization. At that time, a committee was appointed to draw up rules, and this committee reported to a meeting, held at the same place, May 5, at which time an organization was effected. The officers elected were: Alfred Stromberg, president; Kempster B. Miller, vice-president; James E. Keelyn, secretary, and C. F. Messinger, treasurer. The association membership consists of companies and not of individuals. It will be known as the Telephone Manufacturers Association of the United States.

The board of directors is: Frank G. Jones, American Electric Fuse Company, Chicago; H. E. Procunier, Moon Manufacturing Company, Arthur Stein, Eureka Electric Company, Chicago; L. G. Bowman, Western Telephone Construction Company, Chicago; C. W. Farr, Farr Telephone and Construction Supply Company, Chicago; H. H. Hipwell, Hipwell Manufacturing Company, Allegheny, Pa.; C. E. North, North Electric Company, Cleveland, O. Messrs. Jones, Procunier, Bowman and Hipwell constitute the executive committee, with Mr. Keelyn as its secretary. Concerns must have been engaged in the telephone business for more than a year to be eligible for membership, and must be manufacturers. There is no admission fee, but annual dues of $5 per member are to be paid in advance. A regular meeting is provided for once a month.

Magazine Fuse.

The device shown in the illustration is an improved fuse-box, having for its object to provide a means for automatically inserting fuses in an electric circuit. There are a plurality of fuse holders arranged one above another within an enclosing case; each holder having a fuse, and the bottom holder being in circuit. When the fuse in this holder "blows," the holder drops by the force of gravity, allowing the next holder with its fuse to fall into place, thereby closing the circuit again. As many holders as are desired may be used—the number depending upon the size of the enclosing case.



FIGS. 1 AND 2.—MAGAZINE FUSE.

While the device will not keep a circuit closed in case of a "dead" short-circuit (for this would not be desirable), it will keep a circuit closed during a lightning discharge or temporary short-circuit. The consumer, therefore, has protection at all times, and is assured of continuous service in the majority of instances. The device is the invention of Jas. T. Watson, of Scranton, Pa.

Wattmeter for Alternating and Direct Currents:

The Diamond Meter Company, of Peoria, Ill., is placing on the market new Scheeffer meter that may be used on direct as well as alternating currents. Although there exist objections to meters with commutators, still they are with reasonable care capable of high accuracy, and possess the advantage that they may be used indifferently on direct as well as alternating currents, and are unaffected by alternating or lag current. Mr. Scheeffer's object in the improvement in the form shown is to eliminate or reduce to a minimum the faults to which heretofore objections were made in connection with motor meters with commutators. The meter shown in the accompanying cuts is made somewhat different from what has been customary in this class of meters. The improvements are as follows:

1. The elimination of dust and dirt by using a cast case, a sheet metal case not being considered rigid enough to admit of a sure and tight fit. The case is made of cast aluminum, and fits down tight over a rubber gasket, being forced to an air-tight fit at the joints with screws. All other parts of the meter are also air-tight.

2. The armature consists of a mica disk on which are mounted three machine-wound coils; these coils are of fine wire and are very light, and being machine made admit of using a very fine wire with ease and safety. The commutator is one-eighth inch diameter.

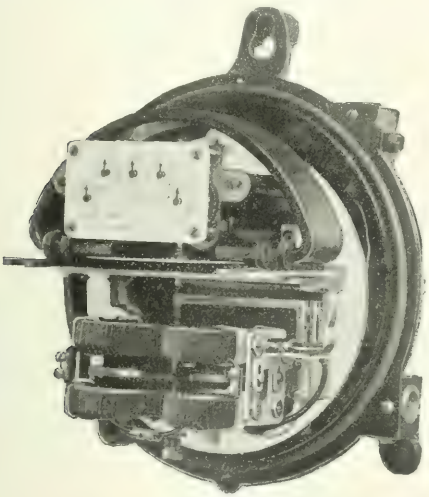


FIG. 1.—METER MECHANISM, SHOWING DAMPING MAGNET.

and has three sections; and as it is only one-eighth inch in diameter, the friction is very slight from the brushes, which press very lightly. By using the form of damping magnet shown ,a large and very powerful magnet is the result, which very high damping results from the use of a very light aluminum disk. The whole armature, including shaft, commutator and damping disk, is very light, not being heavier than those used in induction meters, and thus giving a highly sensitive armature. The armature can be taken out at any time if necessary to repair or inspect by simple taking off the movement and damping magnet, and it is as readily replaced. The brushes are two straight, highly elastic strips of phosphor bronze, which can be slipped aside very quickly to inspect or clean and repolish. The commutator and brushes are in plain sight for ready inspection.

The damping magnet is slipped on guide pieces so that they can be readily taken out or replaced at any time without disturbing the meter in any way. In calibrating the meter it is not necessary to disturb or move the damping magnet in any way, simply using the brass handle on the left side of the meter which moves a piece of iron, whereby the speed of the meter at full load is readily adjusted.

The resistance is placed in the back of meter, and consists of a disk of wire wound, non-inductively, placed on a plate which is screwed on the back. If the resistance is to be inspected, repaired or replaced, all that is necessary is to unscrew the back plate and take it out, as shown in the cut. These resistances are made in disks for 100-volt unit each. Thus, for 200-volts two disks are used in the same meter.

With the disk form of armature, shown with three coils, Mr. Scheeffer claims about double the efficiency of the regular drum armature. At 100 volts the armature current in the shunt corresponds only to 2½ watts. The drop through the series coil is very low.

The meter is direct-reading, no constant being employed. It is



FIG. 2.—ARMATURE.

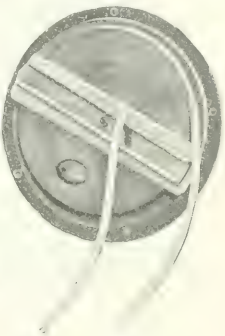


FIG. 3.—RESISTANCE COIL.

provided with the Scheeffer improved ball-bearing, which has proven in practice a very efficient bearing and much superior to a solid point; it is easily replaced with ball or jewel, and the wear is negligible because of the superior wearing qualities of a ball to those of a solid point.

The Marburg Electric Pump.

The accompanying half-tones, Figs. 1 and 2, illustrate two types of the Marburg direct-connected electric pump that has recently been placed on the market. The pump is very compact, occupying but little floor space. The discharge from this pump is continuous, which prevents "water hammer" and undue noise in buildings through the operation of the pumps.

In ordinary rotary pumps the friction has been large, and undue

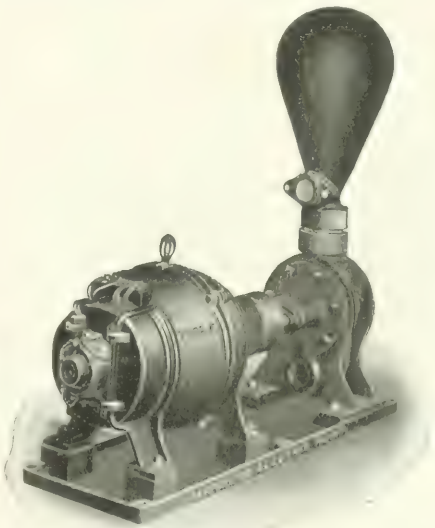


FIG. 1.—ELECTRIC PUMP.

wear has been the result. To overcome the friction in the Marburg pump, the internal pressures which are caused in all pumps, due to water pressures, have been perfectly balanced by a very simple device, thus making the pump work with normal friction only, both

at high and low pressure. The wear, depending on the friction, has in this way been almost entirely eliminated, and a very thorough test of the pump shows little or no wear.

The pump is made in a number of sizes, the various capacities

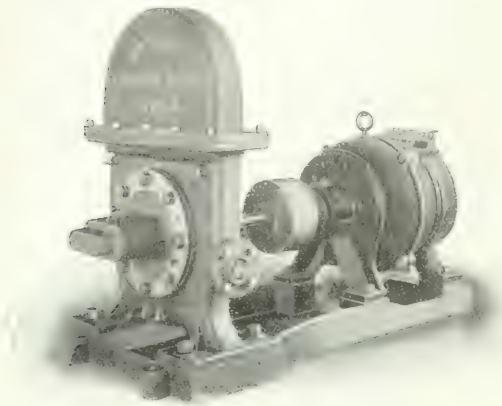


FIG. 2.—ELECTRIC PUMP.

being 300 to 1,500 gallons per hour, 60 feet high, and 3,500 gallons per hour, 125 feet high. The type shown will pump 3,000 gallons 175 feet high. These pumps are manufactured by the E. W. Bliss Company, of Brooklyn, N. Y.

Water Wheel Governor.

We illustrate herewith a recent development in governors for water-wheels driving electrical generators, from which it will be seen that the general design is quite a departure from previous practice. Fig. 1 represents a section of the governor, and Fig. 2 is an external view, showing its application to a 2,000-hp water-wheel in the plant of the Virginia Electric Railway & Development Company, at Richmond, Va.

The governor is of the hydraulic type, the gate of the water-wheel being controlled directly by a piston mounted upon a shaft, somewhat after the principle of a rotary engine, the shaft being connected to the gate shaft of the water-wheel. The piston is rectangular, and by means of substantial cast-iron packing strips, tongued and grooved into each other at the joints, a perfectly fluid-tight joint is made against the walls of the cylinder. It makes but .87 of a revolution, this being sufficient to move the gate through its full range, the limits at the ends of the stroke being formed by a partition rigidly bolted in place within the cylinder; this partition also makes a fluid-tight joint against the walls of the cylinder and upon the enlarged portion of the shaft which carries the piston. The whole of the construction is extremely massive, and well calculated to withstand the strains of controlling the heaviest gates.

Bolted to the top of the cylinder is a valve chamber and piston valve, the latter admitting the working fluid, which may be either oil or water, to ports communicating with one or the other sides of the fixed partition. This valve is controlled by a centrifugal governor, which runs loosely upon an extension of the main shaft, communication between the governor and the valve being made through a rocking lever. The governor, however, does not move the valve directly, as the friction of the latter, when made of sufficient size to produce quick gate movements, would interfere with the delicacy of the governor. Instead, an arrangement shown in the sectional view is adopted, by which it will be seen that a small inner valve, controlled by the governor, admits fluid through ports formed in the main valve to piston extensions attached thereto, the latter working in an extension of the valve liner. As the lap of the small valve is barely 1-64 of an inch, any movement which it makes causes a corresponding movement in the main valve. This arrangement enables a most delicate governor to be employed, which is in no way affected by any stiffness which may develop in the main valve.

A noteworthy feature in this governor is the method adopted for preventing racing and overrunning of the gate, one of the prime difficulties encountered in regulating water-wheels. This difficulty is caused by the fact that the water-wheel does not immediately respond to an increase or decrease in the gateage, so that after a momentary change of speed has occurred, due to a change of load, the governor would, normally, continue to move the gate until the speed of the water wheel, and, therefore, the speed of the centrifugal governor, were restored to normal; and by the time this occurred the gate would have been moved too far, thus causing the speed to vary as much, if not more, in the reverse direction. In checking this further variation, the governor would again move the gate too far for the same reason, and thus a constant oscillation of the gate, of increasing or decreasing amplitude, according to the particular conditions of the plant, would result, causing violent fluctuations in speed.

The obvious and most direct way to counteract this lag is to restore the speed of the centrifugal governor to normal, somewhat in advance of the water wheel itself, and this is the method adopted in the Sturgess governor. It is effected by slightly varying the diameter of the governor pulley, which is ingeniously designed for this purpose. The pulley consists of two cones having eight radial grooves in which set as many segments, the segments forming the face of the pulley.

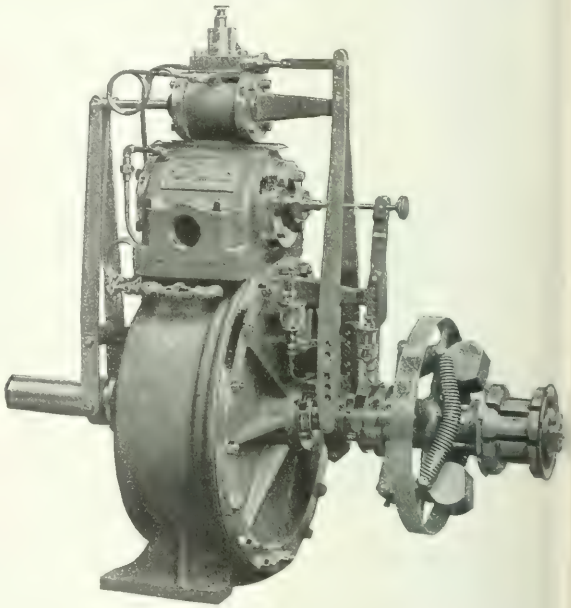


FIG. 1.—WATER-WHEEL GOVERNOR.

The outer cone is keyed rigidly to the quill of the governor pulley, and the inner cone has a slight endwise movement upon a featherway. The tension of the belt and two coiled springs concealed within the segments hold the latter in place in their grooves upon the cones. When running, the pulley is true and appears as though it were a solid piece of cast-iron with the ability to expand and contract. The sliding cone is connected through levers, and a dash-pot of special construction, which slides back and forth upon a slide formed in the valve chamber, to a cam upon the gate shaft, so that any movement of the latter, when opening or closing the gate, causes a slight movement in the cone, and, therefore, a slight variation in the diameter of the governor pulley. The variation, however, is only of sufficient duration to allow the water wheel to restore to its normal speed, for as it does so the dash-pot, which has a constant tendency to return to its central position, restores the cone to its original position, giving the pulley its normal diameter.

The restoration of the dash-pot to its central position is effected by the admission of fluid to one side or the other of its piston; this fluid is taken from the main source of supply by a pair of coiled copper tubes connected to the inlet and outlet on the valve chamber. The dash-pot has a valve chamber and slide valve on its upper face, the slide valve being connected by links to an upward extension of

the levers controlling the cone pulley. Any deflection of these levers from their central position causes the slide valve to uncover one or the other of the ports in the dash-pot, so that the dash-pot will move in a direction which would cause the ports to become again covered.

The operation of the governor will be clear from the above

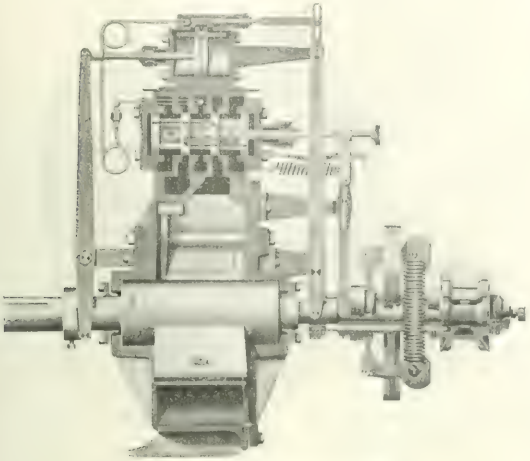


FIG. B.—SECTION VIEW OF GOVERNOR.

description of the function of the various parts. All the parts with the exception of the main piston and the piston of the dash-pot ride normally in their central positions. Briefly stated, the controlling effect is as follows:

The variations in load tend to produce constant variation in speed, and the centrifugal governor therefore tends to as frequently vary the position of the main valve and cause the gate to be opened or closed. These movements of the gate produce, through the agency of the cam, a constant tendency to change the position of the dash-pot, these changes being again neutralized by the tendency of the dash-pot to return to its normal position after the desired check has been produced upon the centrifugal governor. Stated in another way, the speed of the centrifugal governor is determined not only by the speed of the wheel but by the influence of the secondary controller comprised in the dash-pot and its connecting levers.

This governor, which is manufactured by the Sturgess Governor Engineering Company, West Troy, N. Y., is said to work very freely and without shock or apparent effort.

Spinning Jenny for Line Wires.

The accompanying illustration shows a spinning jenny, made by James S. Barron & Co., New York, for use by telephone companies. It is made in two sizes, namely, 18 inches and 24 inches long, both lengths having an inside diameter of two inches, and is claimed to be the most practical tool yet devised for elevating and binding cables to supporting wires. The operation is extremely simple. The jenny is in two parts, which enables it to be placed in position encircling the cable and supporting wire at any point on the line. The two sides are provided with dowel lockings, and are copper lined



SPINNING JENNY.

to prevent any injury to the cable. The marline for binding purposes is wound around the jenny, in one or more layers as required; the outer end being fastened at the place of starting. The rear end of the jenny is beveled so as to allow the marline to play off smoothly. The cable to be bound is elevated from a snatch block hung on the supporting wire just ahead of the jenny, and the binding is done by the spinning off of the marline as the jenny is hauled along by means of the rope fastened to the iron arm.

Crossings and Section Insulator.

The H. W. Johns-Manville Company, New York, is bringing out two types of overhead fittings to meet distinct conditions of service—an uninsulated or metallic crossing, and an insulated crossing, for use where it is desired to electrically separate the intersecting trolley wire and yet maintain perfect mechanical continuity of the trolley wires, so as to give an even under-run for the trolley wheel.

Fig. 1 shows the uninsulated or metallic crossing, a description of which will bring out the general features embodied in both types. It will be noted the crossing wires first pass through a hinged clamp after passing under a curved flange, and then pass over the top of the centrally hinged arms, forming the two parts of the crossings.



FIG. 1.—UNINSULATED CROSSING.

For the purpose of permanently fixing the wire, its path from one end to the other of the arms is well grooved. The novelty of the hinged clamps at the ends of the arms, for holding the trolley wire and firmly fixing the crossing, is to be particularly noted. This is so arranged that it will take trolley wire from 1/0 to 4/0 inclusive, and the manner in which the trolley wire enters the clamp is such that the trolley wheel as it strikes the curved flange is pressed downwardly from the wire and is caused to run on its flanged edges across the arm to the other end, where it is allowed to gradually rise and again bring the grooved portion of the wheel in contact with the wire in a very gradual fashion. The absence of solder in using these crossings will be appreciated, since in previous devices it has in almost all cases been necessary to solder the crossing to the trolley wire.

The insulated crossing is almost equally simple, but instead of the



FIG. 2.—INSULATED CROSSING.

two arms coming into metallic contact, one of the arms is fitted with an insulated cylindrical cup, so arranged that the wire connected with that particular arm passes over the top of the arm, but is kept from contact with the metallic portion of the other arm by the arrangement of the insulating cylinder. The two arms are easily separated from one another by the manipulation of two screws, upon the removal of which and the swinging of the guides which they hold in place the two arms are at once separable. The lower arm can then be connected to one trolley wire after removing the cylindrical cup therefrom and after replacing this cup and putting the upper arm in position so that it is properly pivoted thereon, and readjusting the two guides on the lower side of the upper arm, the two parts of the crossings are again in their coasting relationship. The other wire is then passed over the other arm and the entire device is ready

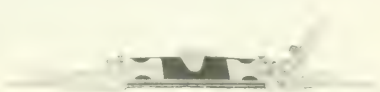


FIG. 3.—SECTION INSULATOR.

for use. An important feature of this insulated crossing is the use of a metallic running surface for the trolley wheel, located at the central portion of the crossing, but which is insulated from both arms. This metallic running surface eliminates wear at this point, which in the past has been entirely of insulation, and thus wear and tear at this point is greatly decreased and a more even operation is obtained.

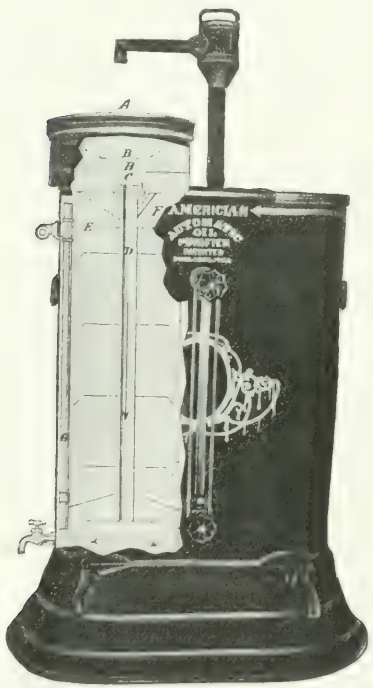
The "New" Philadelphia section insulator has also been brought

out, which embodies the same desirable features as regards the even under run, facility of attachment and universal use over a range of trolley wire sizes from 1/0 to 4/0 inclusive. The trolley wire passes into clamps at the end of this section insulator, these ends being generally similar in their arrangement to the ends of the crossing arms. Each of the metallic ends is also provided with an arrangement for feeding in or "jumping" across. The central or insulating portion of this section insulator is made up of ¾-in. thick, specially treated fibre, arranged to give a very long break between the two sections. Although these devices have only been on the market for a very short time, they have already found very extensive use, and proven highly satisfactory.

All of the castings used in the metallic crossings, the insulated crossing and section insulator are malleable iron, galvanized, and all screws and rivets are brass. In case of two wires crossing each other, one of the wires being 1/0 or 2/0 and the other 3/0 or 4/0, either round, grooved or figure 8, the crossings above described will accommodate these wires in every case without extra cost or change of parts.

Oil Filter.

An oil filter is shown in the accompanying illustration in which the filtering process is accomplished without the use of any filtering material whatever other than water. The perforated pan at the top of the filtering chamber is filled as full of water as the overflow will allow. The waste oil is poured or pumped in at *A* and passes through the strainer in the pans *BB*, which remove the larger impurities from the oil before it reaches the chamber *C*. It then flows through a perforated cap on the top of the tube *D* into the chamber at the bottom, and up through the perforated horizontally-disposed pans or strainers to the surface of water at *E*. The purified oil is conveyed to the storage tank through the overflow *F*, and the water flows out of the vertical overflow pipe *G* to the sewer.



OIL FILTER.

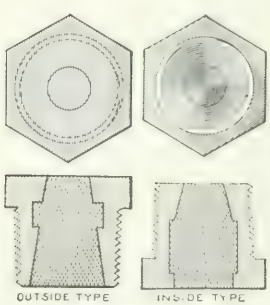
This filter is so constructed that the strainers may be removed and the purifying and filtering chamber inspected or cleansed without interfering with any other part of the apparatus. It is made of heavy galvanized iron, the filtering and storage compartments being separate. In order to facilitate the filtering process, the water used may be heated by means of a steam pipe.

This filter is manufactured by the American Oil Filter Company, Philadelphia, Pa.

Boiler Fusible Plugs.

Fusible plugs have been used in boilers for a great many years, and the Government, recognizing the important function of this boiler accessory, now requires that all plugs used on boilers of steam vessels should be made of bronze and have no other filling but pure Banca tin. Many plugs have been offered on the market, which are filled with fusible alloys composed of other metals, which, although melting at very near the same point as Banca tin, were not absolutely reliable. Since the disaster at Philadelphia, last fall, the United States Steamboat Inspection Service of the Treasury Department has taken cognizance of the fact that inferior plugs were offered upon the market, and issued a circular requiring that all fusible plugs should be filled with pure Banca tin and stamped with the manufacturer's name, and that an affidavit setting forth this fact should be filed with the inspector having charge of the boiler inspection at whatever point the plugs were used.

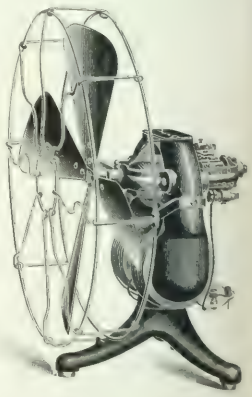
The Lunkenheimer Company has manufactured fusible plugs for a number of years, all of which comply with these specifications, and, having made affidavit before the United States Steamboat Inspection Service to the effect that its plugs comply with these requirements, the same are accepted by all inspectors throughout the United States. Below are illustrated two forms of plugs; namely, the outside and inside patterns, to be screwed in either from the inside of the boiler or from the outside through the fire-box or shell. These plugs are manufactured by the Lunkenheimer Company, of Cincinnati, Ohio, who will be pleased to give further particulars upon application.



FUSIBLE PLUGS.

Battery Motor.

The Knapp Electric and Novelty Company, 507 West Fifty-first Street, New York, is placing on the market a new design of battery motor. As will be noted from the accompanying illustration, the motor is handsome in appearance, and the makers claim that it embodies a number of points of excellence not heretofore found in battery motors. The electrical and magnetic design is such as to give an extremely high efficiency, which is a point of the utmost importance in connection with motors taking their current from primary or storage batteries. The armature is of the slotted, drum type, built up of laminated iron, the armature wires being connected to a six-part commutator. The brushes are interchangeable with the turn of a screw, and have a long spring adjustable device, giving an easy and positive contact. The bearings are self-aligning, and the binding posts and switches are mounted on a fibre base. The motor is mounted on rubber feet, and is made with two windings—for 2 to 4 volts, and 8 to 10 volts.



BATTERY MOTOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was inactive, closing at 4@5 per cent. for six months, while shorter dates brought 5½@6 per cent. The stock market was quieter, being somewhat affected by the possibility of a strike among the coal miners. There was a tendency to improvement, largely on manipulation, although high money rates, coupled with further violent breaks in specialties, and the failure of three stock exchange houses, caused some temporary unsettling of the market. Industrial stocks were somewhat neglected, although the United States Steel shares received support. The referee's decision sustaining the constitutionality of the franchise tax law had little effect on the traction stocks. The trading in this group was not large, and some support was shown in Manhattan. Amalgamated Copper remained steady, and later in the week was bought by Boston interests, reports of better conditions in the copper trade being circulated. In the traction list Brooklyn Rapid Transit closed with a net loss of 1¼ points, the last quotation being 65⅞. Metropolitan Street Railway closed at 149, a net loss of 1½ points. General Electric closed at 321, after having risen to 357½ during the week, the closing price being a net loss of 2 points. Westinghouse, common, lost 4 points, closing at 216, and first preferred lost 13½ points, the closing price being 219½. Western Union made a net gain of ⅝ point, the closing price being 92, and American District Telegraph ¾ of a point, the last quotation of the week being 39¾, ex-div. American Telegraph and Cable closed at 92, a net loss of 1 point, and American Telephone and Telegraph at 181½, a net gain of ½ point. Manhattan Elevated rached 133¾, closing at 131⅞, being 11⅛ points below the closing quotation of the week previous. Following are the closing quotations of May 13:

NEW YORK.

	May 6.	May 13.		May 6.	May 13.
American Tel. & Cable.	88	92	General Carriage	—	3
American Tel. & Tel.	182½	178½	Hudson River Tel.	—	—
American Dist. Tel.	39¾	38½	Metropolitan St. Ry.	151	147¼
Brooklyn Rapid Transit	67⅜	65⅞	N. E. Elec. Vehicle	—	—
Commercial Cable	150	155	N. Y. E. V. T. Co.	—	13½
Electric Boat	33	34	N. Y. & N. J. Tel.	—	—
Electric Boat pfd.	50	48	Tel. & Tel. Co. Am.	4½	—
Electric Lead Reducin	-	-	Western Union Tel.	91⅞	92⅛
Electric Vehicle	7	7	West. E. & M. Co.	—	—
Electric Vehicle pfd.	—	13	West. E. & M. Co. pfd.	220	209
General Electric	326	319¾			

BOSTON.

	May 6.	May 13.		May 6.	May 13.
American Tel. & Tel.	181½	178	Mexican Telephone	2½	2⅜
Cumberland Telephone	—	—	New Eng. Telephone.	150*	149*
Edison Elec. Illum.	—	—	Westinghouse Elec.	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd	—	—
General Electric pfd.	—	—			

PHILADELPHIA.

	May 6.	May 13.		May 6.	May 13.
American Railways	—	—	Phila. Traction	97½	97½
Elec. Storage Battery.	91½	85	Phila. Electric	5⅝	5¼
Elec. Storage Bat'y pfd.	91½	84½	Pa. Elec. Vehicle	—	—
Elec. Co. of America.	7⅜	—	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	May 6.	May 13.		May 6.	May 13.
Central Union Tel.	—	—	Northwestern Elevated	83	81
Chicago Edison	177	172½	Northwestern Tel. Co.	47	46
Chicago City Ry.	215	215	Union Traction	21	19½
Chicago Teleph. Co.	—	—	Union Traction pfd.	56	54
National Carbon	25½	25½	Yerkes	—	—

ST. LAWRENCE POWER PLANT SOLD.—Guthrie, Cravath & Henderson, of New York, representing the complainants in the foreclosure action brought by the Commercial Trust Company of New York and the Morristown Trust Company against the St. Lawrence Power Company, at Massena, N. Y., the Standard Trust Company, of New York, and the United States Mortgage and Trust Company, obtained a decree in foreclosure and sale from Judge Coxe in the United States Circuit Court, at Utica, N. Y., on May 14. James DeP. Lynch was appointed as master and he will sell the power plant at Massena in about six weeks. The judgment order provides for rejection of bids under $500,000. There was no opposition to ordering the sale of the property. The foreclosure suit was brought by the first and second mortgage bondholders as the result of the company's defaulting upon its bonds. A plan has been projected for a reorganization. It is understood that the sale of the property will not affect the big power scheme, which is all right from an engineering standpoint, but needs large customers.

NEW ORLEANS TRACTION.—The New York Security and Trust Company is syndicate manager of the consolidation of the street railways of New Orleans. The new company will have $10,000,000 fifty-year 4½ per cent. sinking-fund bonds, $10,000,000 4 per cent. cumulative preferred stock, and $30,000,000 common stock. Holders of New Orleans City Railroad preferred stock can sell for 112½ cash, the common for 35; New Orleans Carrollton Light and Power preferred stock at 105, and the common stock at 95; Orleans Railroad stock at 160; New Orleans Gas Light at 125; New Orleans Lighting stock at 60 and bonds at 110. The New Orleans Railway Company bonds can be sold at 105. All the securities, however, can be exchanged on more favorable terms into the securities of the Consolidated Company. Estimating the value of the new bonds at par, the preferred at 60, and the common stock at 15, the offer of exchange is about 11 per cent. preferable to the offer in cash.

DIVIDENDS.—Trustees of street railway illuminating properties paid a distribution of $1 per share on May 13 to holders of common shares of record May 9. The Niles-Bement-Pond Company has declared the regular quarterly dividend of 1½ per cent. on preferred, payable May 20. The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 1½ per cent., payable June 2. The Tampa Electric Company, of Tampa, Fla., has declared regular semi-annual dividend of $3 per share on the capital stock, payable May 15.

BOSTON EDISON STOCK.—The stockholders of the Edison Electric Illuminating Company, of Boston, at a special meeting, on May 14, voted to increase the capital stock by 16,500 shares, and authorized the directors to sell five parcels of real-estate owned by the company, and not needed in the business. The new issue will provide $3,300,000, and it is made to capitalize expenditures this year of $1,000,000, for extensions and improvements; to provide $500,000 for machinery, and to secure funds for the building of a new 75,000-hp station in South Boston.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has just completed an order for the equipment of the Edison Portland Cement Company's new plant at Stewartsville, N. J., with its motor starters throughout. Before placing the order for the starters the Edison Portland Cement Company conducted exhaustive competitive tests upon motor starters, and then, we are informed, placed the order for the entire equipment of motor starters with the Ward Leonard Electric Company. In view of Mr. Edison's familiarity with the requirements of electrical apparatus, the obtaining of this order is quite a testimonial to the quality of the Ward Leonard starters.

ELECTRIC COMPANY OF AMERICA.—A call is being issued for a special meeting of the Electric Company of America stockholders, to be held June 4, at 11 A. M., at Camden, N. J., to approve the proposed reduction in capital from $25,000,000 to $5,000,000. After this has been done, the directors will consummate the other features of the plan by calling a net assessment of $1 per share and crediting $1.50 on the stock, making the present $7.50 paid stock full paid $10.

SAN FRANCISCO.—The United Railways Investment Company, of San Francisco, has filed a certificate increasing its capital stock from $2,500 to $25,000,000. Of the capital stock $15,000,000 is to be 5 per cent. cumulative preferred and $10,000,000 common. Provision is made that the preferred stock may be retired after three years by the payment of its par value plus a premium of 10 per cent. and dividends.

WESTERN UNION IN BALTIMORE.—The Western Union Telegraph Company has acquired a controlling interest in the American District Telegraph Company in Baltimore. It is reported that a syndicate, in which the Western Union is largely interested, is planning a consolidation of the district telegraph companies in all of the large cities, which will include the American.

NORFOLK, VA., PROPERTIES.—It is stated that the details of a big street railway combination, involving $7,500,000, have been completed, and that the holdings of the Williams syndicate on the Norfolk Railway and Light Company are to pass into the hands of Messrs. Alexander Brown & Sons and Nelson Perrin, of Baltimore.

UNITED GAS IMPROVEMENT.—Stockholders of the United Gas Improvement Company, of Philadelphia, have approved the proposition to increase capital stock from 450,000 shares to 565,000 shares, the par value being $50.

COMMERCIAL PACIFIC CABLE.—The Commercial Pacific Cable Company has filed with the Secretary of State, at Albany, N. Y., a certificate of increase of its capital stock from $3,000,000 to $12,000,000.

NEW ENGLAND TELEPHONE STOCK INCREASE.—The stockholders of the New England Telephone and Telegraph Company have voted to increase the capital stock from $20,000,000 to $30,000,000.

NEW YORK TELEPHONE COMPANY.—At the annual meeting of the New York Telephone Company, held at the company's offices, 15 Dey Street, New York, on Tuesday, May 6, 1902, the following directors were elected: Union N. Bethell, John H. Cahill, Thomas F. Clark, Robert C. Clowry, Charles F. Cutler, Joseph P. Davis, Frederick P. Fish, George J. Gould, Edward J. Hall, James Merrihew, Charles Steele, John B. Van Every and William H. Woolverton.

UNION TRACTION OF PHILADELPHIA.—Union Traction stockholders have approved the lease of the property and the issue of $1,500,000 collateral trust bonds to refund floating debt.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a more cheerful tone in distributive trade during the week, owing to improved weather conditions. The situation in manufacturing generally is characterized by activity, the only important exception being in the woolen industry, which is interfered with by strikes. The unsettled anthracite coal situation also overhangs the Eastern trade situation, but the bituminous industry reports much activity. In the iron and steel trades the current demand still pushes them to the utmost tension to keep up. The feature in iron and steel is the scarcity of supplies of pig iron, and the strength of the demand for finished products, particularly structural materials. Some scattered lots of standard rails brought $31 per ton during the week, against the nominal price of $28. The mills at Pittsburg are reported to have orders six months ahead for structural material, the sales of which for the week were very heavy. Building, and all lines dependent thereon, are active despite the increased cost of labor and of builders' hardware and the higher level of wages. Railway earnings are very good in view of the somewhat adverse conditions in grain, cattle, etc. The gross earnings so far reported for April show a gain of 11.2 per cent. over the corresponding month last year. The Pacific Coast roads return a gain of 16 per cent.; the Grangers one of 15.8 per cent., and the Southern roads one of 13.7 per cent. The Central Western roads show an increase of 8.3 per cent., while the Trunk lines contribute a gain of 8.8 per cent. Copper was a little more active, a large business being reported for early and distant shipment. Prices show a slight improvement. Lake is quoted at 12@12½c.; electrolytic in cakes, wire-bars and ingots, 11⅝@11¾c.; casting stock, 11½@11⅝c. The business failures of the week, as reported by Bradstreet's, numbered 179, as against 174 the week previous, and 193 the same week last year.

GUANAJUATO POWER TRANSMISSION PLANT.—Some further information is just to hand regarding the Guanajuato Power and Electric Company, which, as already stated in these columns, was recently formed with a capital of $3,000,000 for the purpose of constructing a 12,000 hp plant and to convey electric energy by means of a high-voltage transmission line 125 miles long to the cities of Guanajuato, Leon and six smaller Mexican cities. In addition to Messrs. Coffin, Adams, Curtis, Peck and Bonwright, several other prominent Americans are interested in the venture. The list comprises John S. Bartlett, of Boston; D. O. Mills, of New York; William H. Crocker, of San Francisco; General William J. Palmer, of Mexican National railroad fame; George Foster Peabody; E. H. Rollins, of Boston; Cyrus H. McCormick, of Chicago, and Thomas Hine, of Colorado Springs. John Hays Hammond, the well-known South African mining expert, is also interested. Frederick W. Baker, president of the Venture Corporation of London, represents some English capital in the enterprise. The officers of the company are: President Thomas Hine; vice-president, John Hays Hammond; vice-president and treasurer, Leonard E. Curtis, who is one of the attorneys of William P. Bonwright & Co., the Denver bankers; secretary, Irving W. Bonwright, and assistant secretary and assistant treasurer, E. R. Coffin. Mr. Hine has just returned from Mexico, where he was accompanied by P. T. Hansom, of the designing department of the General Electric Company, and Frank E. Shephard, president of the Denver Engineering Works. The city of Guanajuato is the center of one of the most important mining regions in the Republic, but operations have not been very extensive, owing to the cost attached to steam power. The new enterprise is expected to cause the complete revival of the operations of every mine in the district, and means making possible the extraction of millions of tons of low-grade ore that heretofore would not permit of operation on account of expensive power. Mr. Hine has closed several large contracts for the supply of power to the mines. H. H. Filey, who was chief engineer in charge of the construction of the Mexican National Railroad, has been appointed superintendent of construction.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week just ended: Antwerp—9 pkgs. material, $418. Azores—1 pkg. material, $30. Amsterdam—27 pkgs. machinery, $449. British Possessions in Africa—25 pkgs. machinery, $1,729; 10 pkgs. material, $184; 5 pkgs. telephone material, $1,400. British Australia—36 pkgs. machinery, $2,250. British Guiana—9 pkgs. machinery, $1,899; 17 pkgs. material, $604. Brazil—7 pkgs. material, $212. Brussels—1 pkg. material, $10. Bristol—43 pkgs. machinery, $7,500. Bilboa—3 pkgs. material, $50. British East Indies—7 pkgs. material, $350; 12 pkgs. machinery, $1,005. British West Indies—56 pkgs. material, $2,218. Central America—45 pkgs. material, $3,821. Cuba—23 pkgs. material, $380; 1 pkg. machinery, $50. Chili—1 pkg. material, $70. China—10 pkgs. material, 135. Christiana—1 pkg. material, $45. Dutch West Indies—6 pkgs. material, $111. Dublin—2 pkgs. material, $100. Ecuador—9 pkgs. material, $199. Genoa—9 pkgs. material, $479. Glasgow—4 pkgs. material, $210. Hayti—3 pkgs. material, $84. Hull—2 pkgs. machinery, $90. Hamburg—10 pkgs. machinery, $850; 50 pkgs. material, $1,301. Havre—18 pkgs. machinery, $511; 5 pkgs. material, $96. Japan—127 pkgs. material, $10,203. Liverpool—226 pkgs. machinery, $17,319; 14 pkgs. material, $648. London—424 pkgs. machinery, $36,865; 155 pkgs. material, $5,006. Lisbon—20 pkgs. material, $1,124. Leeds—5 pkgs. material, $169. Mexico—159 pkgs. material, $2,297; 22 pkgs. machinery, $5,824. Newcastle—6 pkgs. material, $475. Philippines—88 pkgs. material, $7,725. Peru—17 pkgs. material, $1,131. Rotterdam—3 pkgs. material, $150; 7 pkgs. machinery, $855. Rome—87 pkgs. machinery, $5,000. Southampton—20 pkgs. material, $3,487; 4 pkgs. material, $130. Stockholm—1 pkg. machinery, $45. Turkey in Asia—3 pkgs. material, $92. U. S. Colombia—9 pkgs. material, $158.

ANOTHER MEXICAN WATER-POWER PROJECT.—In addition to the several large Mexican power transmission plants projected, with a view to supplying electric energy to the cities of Mexico, Guanajuato, Puebla, Toluca, etc., to which reference has already been made in the ELECTRICAL WORLD AND ENGINEER, the important city of Vera Cruz, it is anticipated, will shortly be supplied from a water-power plant, to be constructed 42 miles from that Mexican seaport. The initial equipment will be capable of developing from 10,000 hp to 15,00 hp. The energy is intended to be utilized for operating street railways and lighting in Vera Cruz, and for general purposes in some of the small towns in the vicinity. Francisco Hernandez has been granted the necessary concession.

THE CITY OF LOURENZO MARQUEZ, Portugese East Africa, will shortly have an electric traction system, the equipment, etc., for which, it is expected, will be purchased mostly in the United States. The contract has been awarded to the British Electrical engineering and contracting firm of Macartney, McElroy & Company, Havemeyer Building. Thomas Scott, chief engineer and general manager of the South Africa department of that concern, prepared the plans, etc. The concession for building and operating the road was originally granted to an American, J. C. A. Henderson. The Delagoa Bay Electric Tramways Company, Limited, has been incorporated for the purpose of carrying out the project. In the first instance it is proposed to construct about 12 miles of road.

THE A. G. SCHOONMAKER COMPANY, of 126 Liberty Street, New York, has received some of the largest orders that have been placed here of late for second-hand rebuilt electrical and other machinery. This company makes a specialty of hydraulic wheel presses for car shops, as well as other shop tools. Among the orders recently secured are: 22 trolley and trail cars, two 250-kw alternators, 18 pairs of traction trucks, two 120-kw alternators, 400 kw in transformers, a number of small motors, arc lamps, meters, repair jobs on generators, motors, cars, engines, etc., and two 150-ton wheel presses.

ELECTRIC POWER IN REVOLVER FACTORY.—The large revolver factory of Smith & Wesson, at Springfield, Mass., it is reported, will be operated by electric power provided the city council gives the firm permission to lay conduits through the streets for power transmission. D. B. Wesson, the head of the firm, has bought a valuable water power privilege at Barrets Junction, about 15 miles from Springfield. The power will be transmitted over a pole line the greater part of the distance.

CARS, ETC., FOR DURBAN.—The British electrical engineering firm of Macartney, McElroy & Company has secured a contract for some $50,000 worth of motor equipments, trucks, trolley wheels, overhead material, etc., for the Durban municipal road, South Africa. The contract will be filled in the United States. The J. G. Brill Company, of Philadelphia, recently obtained an order through the same British concern for eight cars for the Durban electric traction system.

HAWAIIAN CABLE.—It is stated from San Francisco that a landing place has been selected for the cable which John W. Mackay's Commercial Pacific Company is to lay shortly between San Francisco and Honolulu, close to the life-saving station, just north of Golden Gate Park. The terminus of the cable at this end will be in the offices of the Mackay Company, in the Hobart Building, on Market Street. Between this building and the beach landing place the cable will be buried in a trench or conduit. From the landing place mentioned the cable will pursue a southwesterly course to Honolulu. The total length of the cable will be about 2,100 miles. About $2,250,000 will represent the total cost. The actual work of laying the cable will begin next October. The construction of the great wire rope, or cable, is now going on at the mills at the rate of twenty miles a day. A steamer is already being fitted out for the purpose of laying the cable. The vessel will bring the cable from the mills in Great Britain, where it is being constructed, around Cape Horn to San Francisco, and proceed without delay with the work of laying it at the rate of six or seven knots an hour. The landing place at the other end will be about five miles from Honolulu. The line will be completed before Thanksgiving Day. General Manager Ward, speaking of the importance and significance of the new Pacific cable, said: "The company does not expect the San-Francisco-Honolulu cable to pay interest on the investment. The company aims to continue the cable on across the Pacific via Midway Island and Guam, to Manila and Japan. We are awaiting the issuance of the results of the Government steamer "Nero's" soundings between Honolulu and the Far East before going ahead with our work."

SAFETY CABLE ENTERPRISE.—An interesting pamphlet has been issued by the Safety Insulated Wire & Cable Company as to the proposed Trans-Pacific Cable, and raising the point whether it should be of American or foreign manufacture and whether it should not be under American control. The pamphlet, signed by L. F. Requa, president, and Ira W. Henry, chief engineer of the Cable department, says: "It is of vital importance to the United States that there should be established here, works suitable for the manufacture of ocean cables, so that when it is desired to renew existing American cables, or to lay new ones, either for commercial reasons or in time of war, all the facilities for doing this work in the best manner may be found within the United States. The company which we represent has already supplied and made cables for the United States Government, for use on the Atlantic, Gulf and Pacific Coasts. The Cuban war cable, laid and operated by the United States Government, was also made by this company, and there are over 1,300 nautical miles of submarine cable now laid and working in the Philippines, all of our manufacture, besides 250 miles about to be laid in the same waters. We are now making, for the Mexican Government, 472 miles of cable to connect Vera Cruz with Frontera and Campeche. Our company is prepared to undertake the manufacture of a Trans-Pacific cable."

GREENFIELD, MASS.—The stockholders of the Greenfield Electric Light and Power Company have voted to ask for permission to increase their stock from $30,000 to $100,000, and are ready to receive subscriptions for new stock, present stockholders having the first chance, but with so large an increase it is not probable that they will take it all. The plans of the company are not fully completed, but it has been decided to build a dam of concrete, 35 feet high, on which flashboards two feet high can be placed, giving a fall of 37 feet. The plan is to put in two generators, each directly connected onto the shaft of a pair of horizontal waterwheels, with sufficient power to generate from 1,000 to 1,200 hp, which is about four times the amount used. The cost of the new plant is estimated at $100,000, in addition to present investment.

UNITED TELEPHONE AND TELEGRAPH.—The management of the United Telephone and Telegraph Company gives the following figures as representing the assets and liabilities and profit and loss account of the company for the year ending March 31, 1902: Assets—Cost of original plants, $2,756,399; construction during year, $751,551; furniture and fixtures, $1,304; cash on hand, $23,885; total, $3,533,140. Liabilities—Capital stock, $1,617,387; mortgage bonds, $1,901,000; undivided profits, $14,752; total, $3,533,140. Profit and loss: Receipts—Telephone rentals, $182,596; toll line receipts, $3,015; other receipts, $2,469; total, $188,081. Expenses—Maintenance, $14,185; operation, $82,193; salary and office expenses, $8,935; interest on bonds and discounts, $6,814; surplus, $14,752; total, $188,081.

MACHINE TOOLS FOR LISBON TRAMWAYS.—The Companhia Carrie de Ferro de Lisbon (the Lisbon Electric Tramway Company, Limited, of Lisbon, Portugal), which concern is largely controlled by the Anglo-African house of Wernher, Beit and Company, and was built with American equipment, has placed a contract through the Morris Electric Company for a large lot of machine tools. The order calls for lathes, planers, drills, woodworking machinery, etc. Up to Tuesday, the Morris Company had not let any of the orders. It is stated that, owing to the great success of the Lisbon Electric traction system, which is the first electric road in Portugal, many of the leading provincial towns contemplate the adoption of electric motive power.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, has recently closed a contract with the Keystone Telephone Company, of Philadelphia, Pa., for a switchboard for their third district exchange. The switchboard will consist of seven sections, with an ultimate capacity of 3,000 lines, and a present equipment of 960 lines, 120 incoming and 120 outgoing trunk lines. Included in this contract are the necessary power apparatus, distributing frames, relay racks and the sneak-current and lightning-arrester equipment. The former is manufactured under one of the company's patents, and differs materially from former types, in that the heating-up process is not dependent upon the resistance of a coil of wire.

HAVANA CONTRACTS PENDING.—The Spanish-American Light and Power Company, Consolidated, is contemplating considerable extensions to its Havana plant. The company, of which Mr. T. J. Hayward, of Bartlett, Hayward & Company, 100 Broadway, New York City, is president, operates the only electrical plant in Havana outside that of the Havana Electric Railway Company. The contract for the requisite additional equipment, etc., will in all probability be given out direct from Cuba by R. Hermands Jimenez, the chief engineer of the company.

MM. F. ROUSSEL, of the Paris Municipal Council, F. Bienvenue, chief engineer of the Bureau of Bridges and Roads, also M. Locherer, one of the experts attached to the latter department, are now in the United States making a short inspection tour of electric traction systems. They are at present in Washington, D. C. According to present arrangements they will return to New York on Monday. While in this city they will be at the Holland House. These gentlemen return to France by "La Touraine," on May 22.

THE SPRAGUE ELECTRIC COMPANY has recently received an order from the Pennsylvania Steel Company for ten 5-ton electric trolley hoists, for use in the new bridge shop at Steelton, Pa. These hoists are of the new type of worm gear trolley hoists, manufactured by the Sprague Company. They combine great lifting capacity with remarkably light weight and unusual compactness. They are controlled from a cage and have a lifting speed of 20 feet per minute.

ARMATURE PRESS FOR BRITISH WESTINGHOUSE WORKS.—The British Westinghouse Electric and Manufacturing Company's plant, now being hastened to completion at Trafford Park, near Manchester, is to be equipped with a large armature press, which is intended to be used for shaping dynamos, etc. The machine, which has just left the shops of William Sellers & Company, of Philadelphia, weighs nearly 260 tons.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, which recently purchased the factory of the Strowger Automatic Telephone Exchange, with sole manufacturing and selling rights, under the Strowger patents, was last week apprised by a cable of the fact that the British Postal Department had authorized the installation of one of its automatic exchanges in the Post Office in London.

FIREPROOF CARS.—The Prussian Minister of Public Works, Herr von Thielen, has ordered experiments to be made with noncombustible passenger cars. These cars will have floors and walls chemically made fireproof, and seats stuffed with fireproofed cocoanut fibre, etc., and covered with asbestos. With electric light and heat, such cars ought to be very safe and comfortable.

STORAGE BATTERY FOR BERLIN, ONT.—Among the recent contracts secured by the Gould Storage Battery Company, of New York City, is one for the Berlin and Waterloo Street Railway Company, of Berlin, Ontario. It will consist of 255 cells with a 66-kw capacity and an allowance for 50 per cent. increase; together with regulating booster and switchboard.

CONDUIT CONTRACT.—Mr. G. M. Gest reports that the Cincinnati Gas and Electric Light Company has ordered 1,200,000 feet of American vitrified conduit duct, ranging from two ducts in the trench to 150. The latter has never been exceeded for mass, and requires a space 12 feet by 15.

AKRON ELECTRIC MANUFACTURING COMPANY, of Akron, O., has received contract for a new sheet steel mill plant at Niles, O., for the Surprise Iron and Steel Company, the generator to be run by a Brownell engine.

COAL FOR HAVANA ROAD.—The Havana Electric Railway Company has placed a contract with the Morris Electric Company, of 15 Cortlandt Street, for the supply of 30,000 tons of coal, which will be shipped from Philadelphia.

PLANT WANTED.—Mr. T. L. Smith, president of the Lighting Commission, Canandaigua, N. Y., is reported to be in the market for a plant of engines, boilers, dynamos, etc., to furnish 150 arc lights and 5,000 incandescents.

General News.

THE TELEPHONE.

SAN FRANCISCO, CAL.—Articles of incorporation of the Farallone Telegraph-Cable Company have been filed with the county clerk. It is proposed to establish a telegraph line from this city to a convenient point on the ocean shore near Point Lobos, and from that point a submarine cable extending to the Farrallone Islands. The capital stock of the company is placed at $75,000.

DOVER, DEL.—The Tontogany Mutual Telephone Company, of Tontogany, Ohio, has been incorporated under the Delaware laws to construct telephone lines in Wood County, Ohio; capital, $50,000.

BLUE RIDGE, GA.—The Blue Ridge Telephone Company has been incorporated, with a capital of $10,000, by J. H. Carter and others.

WAYNESVILLE, GA.—The Local Telephone Company of Waynesville expects to complete its connection with Asheville in the near future. The Bell company established long distance connections recently.

KNOXVILLE, ILL.—A franchise has been granted to the Gilson and Knoxville Telephone Company.

MARSHALL, ILL.—The Wabash Valley Telephone Company has increased its capital from $30,000 to $125,000.

GENESEO, ILL.—The Munson Telephone Company, capital, $500, has been incorporated by F. C. Swiger and others.

CHICAGO, ILL.—The Carbondale Telephone Company, of Carbondale, has been incorporated; capital, $5,000; incorporators: Joseph B. Bundy, Daniel B. Parkinson, and Daniel M. Parkinson.

ANGOLA, IND.—The Johnson Telephone Company will extend its line from Ashley to Waterloo.

CUMBERLAND, IND.—The Cumberland Telephone Company has incorporated with a capital stock of $10,000.

GAS CITY, IND.—The United Telephone Company has been granted a franchise to operate a system in this city.

MULBERRY, IND.—The Peoples' Co-operative Telephone Company of Mulberry has been granted a franchise for a town and rural system.

YEOMAN, IND.—A franchise for a telephone system in this town and the surrounding country has been granted to the Yeoman Co-operative Telephone Company.

INDIANAPOLIS, IND.—The Citizens Telephone Company (North division) has been incorporated to operate through Clay and Vego counties. The home office will probably be at Brazil.

INDIANAPOLIS, IND.—The Cumberland Telephone Company, of Marion county, has filed articles of incorporation. Capital $10,000. Joseph R. Ebaugh is president. The company will do a village and rural business.

INDIANAPOLIS, IND.—The Carrollton Telephone Company has filed articles of incorporation. The capital stock is $9,000. Louis J. Webber heads the board of directors. The exchange and home office will be located at Carrollton, Hancock county, Ind.

INDIANAPOLIS, IND.—The Lafontain Telephone Company, capital stock $5,000, has been incorporated to erect a plant at Lafontain and a rural system throughout Wabash county. Directors: T. H. Miller, John W. Harper, C. W. Stoner and L. B. Morris.

INDIANAPOLIS, IND.—Nearly $8,000,000 is invested in telephone property in this state, and the present season promises to be extraordinary in the development of existing plants and opening up of new fields. The New Telephone Company, of Marion, which was recently absorved by the United Telephone Co., has completed its buildings at Marion, and its business has extended beyond Company, has completed its building at Marion, and its business has extended beyond all expectations. The Citizens Telephone Company, of Columbus, has doubled its capacity in the past year. It will be recalled that the Merchants' Association at Columbus decided to discontinue the use of the Bell instruments after May 1, going on record as against two systems in one town. The exchange at Logansport is practically completed. The company now has over 1,000 contracts. The new exchange at Peru is about ready for operation. Much of the remarkable development in the telephone business is stated to be due to the independent telephone movement, and among those who have furthered such enterprises none deserves more credit than Hon. S. P. Sheerin, of Indianapolis, who is styled the "Father of Independent Telephony in Indiana."

EVANSVILLE, IND.—The revising committee has given out the full details of the proposed municipal ownership of the telephone system for this city. In the main it differs but little from the original scheme given out. Whatever changes are made are of a character to overcome legal objections. The plan is to issue preferred and common stock. The former is to bear 7 per cent. interest. It is proposed to obtain the money from the sale of this stock with which to build the plant. Of the common stock the city is given $197,500 as a compensation for a twenty-five years' franchise. It is the purpose to redeem the preferred stock with the earnings, and thus gradually and ultimately the city will own the system. The prices for telephones are placed at not less than $3, nor more than $4, a month for individual lines in business houses; $2 for individual lines in residences; $1.50 for two on a line; $1 for four on a line in residences. In case of party lines a new device will be used by which if one person on a line is using the telephone, all other parties are cut off. The wires are to be all hard drawn copper wires, and must be placed under ground in the fire limits. The matter is now in the council, and a royal fight is anticipated. The promoters and advocates admit that the scheme is not regarded as favorably as it was a few weeks ago. The local system is fighting the scheme hard.

DAVENPORT, IA.—The Iowa Telephone Company has been incorporated, with a capital of [illegible]

CLEAR CREEK, IA.—The farmers of this vicinity have decided to form a mutual telephone company.

MEDIAPOLIS, IA.—The Mutual Telephone Company of this place has incorporated, with H. Breder, president. Capital, $10,000.

WAYLAND, IA.—The Wayland Telephone Company has been incorporated with a capital of $3,000, by G. W. Hebel and others.

CHEROKEE, IA.—The Sioux Valley Telephone Company has incorporated, with a capital stock of $50,000. M. S. Harter is one of the directors.

BEATTIE, KANS.—The Farmers Mutual Telephone Company has been chartered, with a capital of $1,000.

SUMMERFIELD, KANS.—The Summerfield Mutual Telephone Company has incorporated with a capital of $1,000.

SHEPERDSVILLE, KY.—The Victoria Telephone Company has been incorporated by R. S. Hall and others.

NICHOLASVILLE, KY.—The Home Telephone Company is building a number of new toll lines in this vicinity.

LOUISVILLE, KY.—The Salt River Telephone Company has been incorporated in Bullitt county. Wood Ash is one of the incorporators.

LOUISVILLE, KY.—The Louisville Home Telephone Company has executed a mortgage to the American Trust & Savings Company, of Chicago, for $2,500,000, covering its entire property. The mortgage covers bonds to the same amount, of which $1,150,000 will be issued at once, and the balance when needed. The bonds bear 5 per cent. and are due July 1, 1922.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company's exchange increased during its first six months from 480 to 780 telephones in service, a gain of about 62 per cent. The half year's business shows net earnings (after charging depreciation) at the rate of 6 per cent. on the capital stock. The rates are low and the quality of service high. Private lines, unlimited service and the special features of the automatic system are enjoyed by all subscribers. The underground system, pole lines, building and switchboard have an ultimate capacity of 3,000 lines, and, therefore, a large part of the plant is not yet productive. Telephone competition is highly appreciated in Fall River.

GRAND RAPIDS, MICH.—The Citizens Telephone Company will erect a new exchange here.

IRONWOOD, MICH.—An independent telephone company has applied for a franchise, and the request will probably be granted.

HOLLAND, MICH.—The Zeeland and Hamilton lines of the Citizens Telephone Company will be rebuilt, and the service between Holland and these places greatly improved.

WATERLOO, MICH.—The Waterloo Rural Telephone Company has decided to reincorporate and increase its capital stock from $10,000 to $20,000. The company will build a line from Stockbridge to Howell.

ALBION, MICH.—The business men's committee has issued a public announcement to the effect that over 250 of the 300 subscribers necessary to start a telephone exchange upon a paying basis, have already been secured, and that as soon as the remaining number are secured they will feel that it is proper to go ahead with the organization of the company. The 300-mark is expected to be reached within a few days.

ST. PETER, MINN.—James Bennett proposes to extend his telephone line to Cleveland.

MAYWOOD, MO.—The Maywood Telephone Company has incorporated, with a capital stock of $5,000.

HUMPHREY, NEB.—The Humphrey Telephone Company will erect a line from Oldenbusch to this place.

WEEPING WATER, NEB.—The Plattsmouth Independent Telephone Company is constructing an exchange here.

LINCOLN, NEB.—The Duel Telephone Company, of Duel county, has been incorporated, with a capital of $2,000, by B. E. Fish and others.

CHATHAM, N. J.—A local telephone system, to be owned by the borough, is under consideration.

NEWARK, N. J.—The Warren Telephone Company is extending its lines through Hopatcong, Lopatcong and Greenwich townships.

SUSSEX, N. J.—The Farmers Union Telephone Company, of Sussex, N. J., has been incorporated; capital, $10,000. Incorporators: Warren D. Haggerty, William S. Vanderhoff, John D. Haggerty, Merritt L. Haggerty, Owen J. Little, Gabriel Lublum, Frank E. Armstrong, Charles A. Coykendall, Christopher P. Stanaback, Charles Ayers.

FRANKLINVILLE, N. Y.—Mr. Virgil Hayden will build an independent telephone line from Franklinville to Farmersville Center, Farmersville Station, Fairview and Sandusky, which will connect the Franklinville Telephone Company's lines with those of the Wyoming and Cattaragus Telephone Company at Arcade, all in New York State.

UTICA, N. Y.—The New Berlin Telephone Company has increased its capital stock from $3,000 to $10,000. The amended certificate allows it to extend its lines in six different counties, as follows: Chenango, Otsego, Delaware, Madison, Oneida, and Herkimer, and also to join other corporations. Private lines are to be connected along the line. Work on some of the proposed extensions has been started.

CORTLAND, N. Y.—Articles of incorporation for the Tioughnioga Telephone Company, with a capital stock of $30,000, have been filed at Albany. The new company is formed by Cortland capitalists to act in connection with the Cortland Home Telephone Company for the purpose of constructing toll lines through this and other counties to connect with the Home company lines in other cities. William Martin is president of the company.

ASHEVILLE, N. C.—The Asheville Independent Telephone Company has completed its long distance line to Hot Springs.

SANDUSKY, OHIO.—The Sandusky Telephone Company is now lighting its exchange with Nernst lamps.

STRYKER, OHIO.—The Stryker Telephone Company has been incorporated, with a capital of $10,000, to build a local independent telephone system.

MANTUA, OHIO.—The Mantua Telephone Company has commenced operations with 100 telephones, and others will be installed in the near future.

IRONTON, OHIO.—The system of the Lawrence Telephone Company at Ironton is to be thoroughly rebuilt, and a central energy exchange installed.

CHEATALL, OHIO.—The Acme Telephone Company, which is building a line through Cheatall, is securing a large number of farmers' subscriptions.

MENTOR, OHIO.—The Mentor Home Telephone Company is rapidly reaching the limit of its switchboard capacity. Improvements will be necessary before many months.

COOLVILLE, OHIO.—The Coolville Home Telephone Company is building a line to Belpre. A line will be strung across the Ohio River, giving connection with many points in West Virginia.

FINDLAY, OHIO.—The Findlay Home Telephone Company will spend about $50,000 in improving its system. The capacity of the plant will be almost doubled to take care of the rapidly growing business.

CINCINNATI, OHIO.—The Interstate Telephone Company, of Cincinnati, has been incorporated, with $20,000 capital stock, for the purpose of constructing a telephone line from Cincinnati to Hamilton.

CANTON, OHIO.—It seems probable that the local parties who propose to buy up the system of the Stark County Telephone Company will be successful, as good progress is being made in securing subscriptions for the new stock.

PUT-IN-BAY, OHIO.—John Holloway, of this place, is at the head of a company which will establish an exchange on the island. Connection with the main land will be effected through the cable which was laid last year. The Central Construction Company of Toledo will build the exchange.

BATAVIA, OHIO.—The Central Union Telephone Company is about to connect up every village in this county. Rates are $1 per month for farmers' lines, and a large number of these will be installed. This rate gives free county service and a 20 per cent. discount on toll business to Cincinnati.

TOLEDO, OHIO.—The success of the Toledo Home Telephone Company seems assured. Contracts for 6,043 subscribers have been secured, and the plant will be placed in operation about June 1, with 7,000 lines. The company has an authorized capital stock of $2,500,000, but has issued only $800,000. It has bonds outstanding of $800,000.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Telephone Company has increased its capital stock to $30,000, with a number of leading business men as stockholders. This step was made necessary for the remodeling of the plant. The officers are: G. W. Hale, president; Anna Osborn, vice president; Charles Juvinal, manager, and M. H. Brinkerhoff, secretary.

WELLSVILLE, OHIO.—The Pennsylvania Railway Company has submitted a proposition to both of the local telephone companies, with a view of installing an exchange in the round house and connecting the homes of all the engineers employed on that division, thus doing away with the service of call messengers.

CLEVELAND, OHIO.—H. D. Critchfield, who has had charge of all negotiations looking towards the sale of the Federal Telephone Company's properties, states that the report indicating that the company is about to dispose of the property of the United States Telephone Company is wholly without foundation. The United States long distance lines could not be sold without crippling the system, and there is no possibility of their being sold except as the Federal Company might be sold as an entirety, and the possibility of this step is now quite remote in view of the fact that negotiations are pending looking to the sale of several of the individual exchanges to home parties.

CLEVELAND, OHIO.—The deal for the sale of the Everett-Moore interests in the Federal Telephone properties at Columbus and Dayton has been consummated. Under the terms of the deal the syndicate, composed of Dayton and Columbus people, headed by H. A. Lanman, of Columbus, and John T. Barlow, of Dayton, secured the absolute ownership of the uncompleted Dayton plant and the control of the Columbus plant. The Dayton plant is understood to have sold for $90,000, while 2,200 shares out of the 5,650 shares of the Columbus stock owned by the Cleveland people are understood to have brought about $100,000 more. The deal gives the new parties the control of the Columbus plant in consideration of which they agreed to spend $300,000 in placing the system in first class order. A new sub-exchange will probably be erected to take care of between 2,500 and 3,000 subscribers, nearly 1,000 of which are already on the waiting list. The Dayton plant is to be completed at once and placed in first class condition. It is understood on good authority that the terms of the sale of the Columbus interests provided an option whereby the Everett-Moore syndicate may repurchase the stock at the sale figure, plus interest and minus dividends which the company is declaring.

MADILL, OKLA.—The Chickasha Telephone Company is asking for a franchise in this place.

SLATINGTON, PA.—The Citizens Telephone & Telegraph Company, capital $5,000, has been incorporated.

CANOVA, S. D.—The Canova Telephone Company has incorporated, with a capital of $2,000; E. C. Goeckle and others are the incorporators.

JACKSON, TENN.—The Jackson Telephone Company has organized, with A. D. Hay as president. The capital is $100,000.

MEMPHIS, TENN.—The Deer Creek Telephone Company, domiciled at Patmos, Yazoo county, has been incorporated to build a line of telephone from Luca to Rolling Fork; capital stock, $600. Incorporators are: H. G. Thornell, O. Thornell, James N. Screws, and others.

AUSTIN, TEX.—An amendment to the charter of the Farmers & Merchants Telephone Company of Henrietta, Tex., increasing its capital stock from $2,400 to $4,800 has been filed.

SPOKANE, WASH.—The Sunset Telephone Company will extend its lines to Lynden, Everson, Nooksack and Dumas.

SEATTLE, WASH.—The Northwest Telephone Company has been granted a franchise by the city council, and will begin work at once on the installation of a system here and at Everett.

MORGANTOWN, W. VA.—The People's Telephone Company has issued $10,000 worth of new stock, and will use the money in extending its lines.

CATLETTSBURG, W. VA.—The new independent telephone system has commenced operations, with 200 subscribers. The line to Huntington will be completed in a short time, giving through connection from Ironton, Ohio, to Huntington and Charleston, W. Va.

MILWAUKEE, WIS.—The Wisconsin Telephone Company is planning to place its wires underground in the sixth ward.

WATERTOWN, WIS.—The Wisconsin Telephone Company will expend about $10,000 in Watertown putting in new telephone lines, etc.

LEEDS, WIS.—The Leeds Farmers Telephone Company, with a capital of $5,000, has been incorporated by George Krondoke and others.

ORFORDVILLE, WIS.—The Orfordville Telephone Company has incorporated with a capital stock of $10,000, and will establish a system in Orfordville.

SANTIAGO, CHILI.—The Chilian Government is asking for tenders for the work of laying an ocean cable to the Straits of Magellan, starting from Talcahuano, Chili.

OTTAWA, ONT.—Replying to a question in the Dominion house of commons, the minister of agriculture stated that there are 113,294 miles of telephone lines in Canada. There are 55 telephone companies in the Dominion, of which 44 are in operation; 25 in the province of Quebec, 7 in Ontario, 6 in Nova Scotia, 5 in New Brunswick, 8 in British Columbia, 2 in the Northwest Territories, and 1 in Prince Edward Island. The Bell Telephone Company has 94,314 miles in operation in the provinces of Quebec, Ontario, Manitoba, and the Territories. It has no unissued stock.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The Nevada Power, Light & Water Company is spending $40,000 in rebuilding its system in Reno, Nev. An additional 400-kw. Westinghouse generator is to be installed.

SAN FRANCISCO, CAL.—Construction work is in progress at the new electric power station of the San Antonio Water Company, in the San Antonio canyon, California. Ontario, Pomona and other towns will be supplied with current. Two 500-hp. units will be installed at first.

SAN FRANCISCO, CAL.—The Mariposa Commercial & Mining Company has completed the electric transmission plant, which supplies power for its mine at Mt. Bullion, Mariposa county, Cal. A 600-hp. Westinghouse generator is operated by water power derived from the Merced River. The distance of transmission is 25 miles.

SAN FRANCISCO, CAL.—President John A. Britton, of the Oakland Gas, Light and Heat Company, is acting as consulting engineer for the United Gas & Electric Company, and is preparing specifications for the gas pipe line that is to be laid from San Jose to San Mateo.

SAN FRANCISCO, CAL.—As soon as the United Gas & Electric Company has completed the consolidation of the Electric Improvement Company, the San Jose Light & Power Company and the Consolidated Light & Power Company, it is said that the electric rates will be reduced. The rate in San Mateo and Santa Clara counties will be 10 cents per kilowatt hour, which is a reduction of from 30 to 50 per cent.

SAN FRANCISCO, CAL.—The Nooksack Falls Power Company recently closed a contract for its initial installation, through the Westinghouse Electric & Manufacturing Company's San Francisco office. There will be one 1500-kw. revolving field type generator, which will have a speed of 230 rpm. Current will be transmitted to Whatcom, Wash., a distance of about 45 miles. An electric railroad to be built in the Cascades mountains by the Bellingham Bay & B. C. Railroad Company will be operated from this plant. It is intended to install a second 1500-kw unit next year, and to extend power lines to Everett and other cities.

DOVER, DEL.—A certificate of incorporation has been issued to the Tonopah Water & Power Company, of Carson City, Nev., to furnish water and electric light plants and to do a general mining and milling business; capital, $1,500,000. Incorporators: Lewis H. Rogers and J. L. Yerington, Carson City; J. H. Daskell, Sandy Hill, N. Y.; J. F. Gardner, Brooklyn, N. Y.

ALBION, IDAHO.—An electric light plant has just been installed in Albion and is meeting with much success.

ALTON, ILL.—A 500-hp. electric plant is being installed by the Illinois Glass Company. The machinery will be operated by electric power.

PENDLETON, IND.—The city council has decided to install an electric light plant.

UNION CITY, IND.—The city council has accepted the new electric light plant erected by Messrs. Ulen & Parrott, of Indianapolis, for $48,000.

MOORE'S HILL, IND.—F. R. Philips is taking up the matter of constructing an electric light plant for this town. The prospects are that the plant will be built this spring.

PLYMOUTH, IND.—The Simons electric light plant of this place was entirely destroyed by fire. Six days after the fire the plant was rebuilt, and is now in full operation. Before the fire was hardly out plans were made, and machinery was ordered by telegraph.

ANDERSON, IND.—A schedule of lower prices for electric light went into effect here May 1. The new rate reduces the old figures about one-half. All the contracts are based on the meter system, and the price is now nine cents per kilowatt hour, and four and a half cents an hour for each incandescent lamp.

VAN HORN, IA.—Mr. J. A. Wicke has secured an electric light franchise in this place, and expects to have the plant in running order in sixty days.

GRINNELL, IA.—The Grinnell Electric Light Company has sold its plant to the Grinnell Electric & Heating Company, a new company which will thoroughly overhaul the plant and secure a new franchise from the town. The new company consists of Dick L. Benson, who will be vice-president and general manager; C. C. Jamison, of Muncie, Ind., president; Tasso A. Meyers, of Chicago, secretary; and F. W. Willson, of Muncie, Ind. The company has made a proposition to the town to pump water for $500 less per year than it is at present costing the town to run an independent steam plant. In addition to overhauling and rebuilding the electric light and steam heating plant and putting in a fuel water purification plant, an all day power and light service will be maintained.

OAKLAND, ME.—Contracts have been consummated by which the water power of the Messalonskee River at this place is to be improved. The Dunn Edge Tool Company and the Messalonskee Electric Company will construct the necessary power houses, etc. It is estimated that 1,000 horse power will be developed. Of this 400 horse power will be used by the Electric Company and 600 horse power by the Edge Tool Company.

HANNIBAL, MO.—The Canton Electric Company has brought suit in the United States Circuit Court to restrain the town of Canton, in Lewis county, Mo., from issuing bonds for $20,000 for a municipal electric lighting plant. The plaintiff was granted a franchise in 1891 for 20 years, and the town was to take a certain number of street lights at an agreed price. The affidavit alleges that the action of the city in establishing a plant is contrary to the franchise and the ordinances.

HOLLAND, MICH.—The council has voted to issue $55,000 bonds for the extension of the municipal water works and lighting plant. The improvements are to be made at once.

ALBANY, N. Y.—The Piermont Illuminating Company, Orange, Rockland County, has been incorporated; capital, $25,000. Directors: G. H. Sanford, Bridgeport, Conn.; E. F. Glover and F. W. Brecht, Brooklyn.

SYRACUSE, N. Y.—The Seneca River Power Company has purchased the Edison Illuminating Company of Baldwinsville, and will spend $40,000 in improving the plant. The company has been incorporated to operate in the towns of Baldwinsville, Solvay, Warner, Memphis, Camillus, Elbridge, Geddes, Lysander, Salina and Van Buren, Onondaga county, and Phoenix and Schroeppel, Oswego county. It is rumored that the Westinghouse Company is back of this purchase, and that that company will establish a power plant in Baldwinsville and buy the Syracuse, Lakeside & Baldwinsville Railway, and extend that road to Oswego. It is said that there is enough power to be obtained from the Seneca River to run the light plant and the railway.

CANTON, OHIO.—The Canton Gas & Electric Company is installing a new engine in its power house, and will increase its boiler capacity.

COLUMBUS GROVE, OHIO.—The council has passed an ordinance for the issue of $15,000 of bonds for the purpose of purchasing the municipal lighting plant.

WAPAKONETA, OHIO.—The annual report of the electric lighting plant indicates that during the past year the 79 arc lamps in service cost an average of $26.08 each.

COLUMBUS, OHIO.—Mr. Clak Doughty and others are engineering a proposition to build a theater and electric lighting plant. It is proposed to install a plant of 1,000 lights capacity.

COLUMBUS, OHIO.—Dr. Gladden has introduced a measure in the council providing for the issue of $175,000 worth of bonds for a new municipal lighting plant. Director Immel announces that work will start at once on the construction of the plant. The present contract with the Columbus Electric Light & Power Company expires Sept. 1, and as soon as the new plant can be completed, all the lights will be furnished by the city.

BAKER CITY, ORE.—The Baker City Gas Light & Electric Company, of Baker City, has been sold to capitalists represented by J. J. Henry, of Denver. The plant will be remodeled and its capacity increased.

SALEM, ORE.—The Tucker Power Company, which was recently incorporated in Salem, Oregon, with a capital stock of $75,000, will construct electric power plants for lighting, etc. The incorporators are B. B. Tucker, J. J. Crofut and others.

HARRISBURG, PA.—The Harrisburg Electric Light, Heat and Power Company is preparing to use Paxton creek water for power in place of the water power which it had from the Pennsylvania canal at Walnut and Ninth streets.

KNOXVILLE, TENN.—It is announced by the promoters of the Knoxville Power Company, among whom are R. W. Austin and Gen. J. T. Wilder, of this city, that work is to be begun during May on the dam across Little River, in Blount county, from which electrical power is to be generated. Beside the dam a railroad over twenty miles in length is to be constructed and an investment of between $2,000,000 and $3,000,000 made.

NASHVILLE, TENN.—The Cumberland Electric Light & Power Company will erect a new power station in this city, for which purpose it has recently bought a site adjoining the city plant. A fireproof building 110x300 feet will be erected. The equipment will include six batteries of boilers of 700-hp. each. A railway generating unit of 1600-kw. capacity, direct-connected to a 2,500-hp. Green-Wheelock cross-compound condensing engine will also be installed. The electric light load will be taken care of by a 1,250-kw generator driven by a 1,600-hp Green-Wheelock engine. The generating apparatus will be of the General Electric Company's make. The engine house will be spanned by a [illegible] of a running capacity of [illegible] tons.

AUSTIN, TEX.—The Sodemann Heat & Power Company, of St. Louis, Mo., with a capital stock of $25,000, was granted a permit to do business in Texas.

EAST TROY, WIS.—The city is considering the proposition of establishing an electric lighting plant. Engineers have made estimates of the probable cost.

MILWAUKEE, WIS.—The south side business men will ask the common council for an electric lighting franchise to cover a territory about a mile square.

MILWAUKEE, WIS.—The common council has passed a resolution favoring the erection of a municipal electric lighting plant, with a capacity of 2,500 arc lights, on Jones Island.

MONTREAL, CAN.—It is practically decided that electricity will be the chief motive power employed in the new work shops of the Canadian Pacific Railway at Montreal. The engineers estimate that the works will require from 800 to 1,000 horse power.

QUEBEC, CAN.—The Basilica of La Bonne Ste. Anne, in the province of Quebec, and famous for the wonderful cures which have been effected at its altars, will be one of the most brilliantly lighted churches in America. Nearly $20,000 is being spent in introducing into it over 1,500 electric lights, of which some 600 will be on and around the high altar alone.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Monterey & Pacific Grove street railway line has been purchased by J. M. Gardiner and associates, of Los Angeles, Cal. They intend to begin very soon the work of converting the road into an electric line. The same capitalists will also build an electric road from Santa Cruz to Capitola.

WILMINGTON, DEL.—The corporators of the Delaware Electric Traction Company, which proposes to build a trolley line through Kent county, have perfected organization. Senator J. Frank Allee was chosen president; Senator S. John Abbott, vice-president; Representative Thomas C. Moore, secretary; and Secretary of State Caleb R. Layton, treasurer. These officers, with Dr. Luther S. Conwell, of Camden, and Insurance Commissioner George W. Marshall are the directors of the company. A survey of the route from Smyrna to Milford, and from Smyrna to Woodland Beach was ordered. The line will be 35 miles long. The contract for its construction has been awarded to the Milford Construction Company, chartered recently in New Jersey. That concern will sublet contracts to parties in Baltimore and New York.

ROCK FALLS, ILL.—The end of the year 1902 will see all of the larger cities of Northern Illinois connected by electric railways, representing a cost of $3,000,000. The Rock River Valley Electric Railway will extend from Rock Falls to Rockford, 50 miles, passing through Sterling and Dixon. Another road is being planned from Dixon to DeKalb and from DeKalb to Sycamore. Plans are under way to build an electric road from Rockford to Janesville, Wis. The entire system will cover several hundred miles.

FRANKLIN, IND.—The commissioners have granted a franchise to the Indianapolis & Waverly Interurban railway through Johnson county to Waverly.

SHERIDAN, IND.—The commissioners have granted to H. E. Davenport and others, of this city, a right of way to build an electric railway from Sheridan to Carmel, a distance of eleven miles.

NEW CASTLE, IND.—A subsidy in aid of the New Castle & Pendleton Electric Railway was voted by the citizens of Henry Township, while the subsidy was defeated in Harrison Township adjoining.

RICHMOND, IND.—The Dayton & Richmond Traction Company has organized with William Ammon, Potsdam, Ohio, president; A. C. McDonald, Dayton, secretary, and H. G. Cress, Dayton, treasurer.

CORYDON, IND.—A movement is on foot backed by the Commercial Club of this city to build an electric line from New Albany to Leavenworth, by way of this place. H. B. Chilcote is president of the association having the undertaking in hand.

LAFAYETTE, IND.—At a recent meeting here of the directors of the Lafayette City Railway Company and George F. McCulloch, E. T. Griffiths and J. L. Jones, of Philadelphia, arrangements were made to merge interests and build a line to Logansport by way of Delphi.

ALBION, IDAHO.—A correspondent writes that there is an excellent opportunity for an electric railway between this place and the Oregon Short Line Railroad. In the vicinity are a large number of lead and silver mines, and it is believed that the district will become the greatest farming section of Idaho. There is plenty of water power in the immediate vicinity.

GARDINER, ME.—Maine electric railway builders are considering the plan of constructing a line between this city and Brunswick. This line would render it possible to travel entirely by trolley from Augusta to Biddeford, a distance of about 75 miles, the longest continuous run in the State.

LANSING, MICH.—The Mason & Oceana Railroad Company has increased its capital stock from $80,000 to $300,000.

NEWARK, N. J.—Architect Thomas Cressey is now busy with his plans for an extensive addition to the power house of the North Jersey Traction Company on River street. It will take fully a year to build the addition. The addition will be 100 by 225 feet in dimensions, and will comprise a boiler house and engine room. In the new boiler house there will be thirty-six boilers of 250-horse power each. In the engine room will be six large engines, thirty-eight feet high, and there will be space above them for a traveling crane. A large new brick stack will be built with a fifteen-foot flue. The stack will be 250 feet tall.

TROY, N. Y.—Fred Howe, of New York City, representing New York parties, is securing consent of property owners for the construction of an electric road from Port Kent to Keeseville, Ausable Forks, Jay, Upper Jay, Keene Center, Cascadeville and Lake Placid.

NEW YORK, N. Y.—The New York and North Shore Railway has been sold at auction to Mr. E. Clarence Miller. The price paid was $100,000 over and above the liabilities. The mortgage, it is stated, was held by the New York Security and Trust Company. The properties comprise the trolley line between Flushing and Jamaica and numerous franchises for trolley lines in the borough of Queens as far as Manhasset and Whitestone and other points. The sale included the tracks, franchises and rolling stock of the company.

WILMINGTON, N. C.—The work of converting the Seacoast Railway into a trolley line is expected to begin within two weeks and to be completed by August.

DAYTON, OHIO.—The Peoples' Railway Company is planning a number of improvements for its city system this summer.

MARION, OHIO.—The Mt. Gilead, Mt. Vernon & Western Railway Company has been granted a franchise in this town.

TROY, OHIO.—The bid of the Springfield & Western Railway for a line into the center of the town has been accepted.

COLUMBUS, OHIO.—The city has approved the plans for the construction of the Central Market Railway, and work is being pushed.

SOUTH CHARLESTON, OHIO.—The Dayton, Springfield & Urbana Railway has secured a franchise for its proposed branch line through this place.

MEDINA, OHIO.—The Medina Electric Power & Light Company is temporarily furnishing power for the southern end of the Cleveland & Southern Railway.

TROY, OHIO.—W. S. Thomas and R. J. Smith, of this place, are interested in an electric railway project in South Carolina. The road will connect Charleston with Summerville.

FINDLAY, OHIO.—Western capitalists are looking over the route from Findlay to Defiance with a view to building an electric railway to connect with the Findlay & Marion line.

PIQUA, OHIO.—Superintendent Bidwell, of the Miami Valley Electric Railway Company, states that a number of important improvements are to be made on the line this summer.

TOLEDO, OHIO.—The Arbuckle-Ryan Company, of Toledo, has secured a contract for the overhead work and the steam plant for a new line to be built from Flint to Grand Rapids, Mich.

MARION, OHIO.—It is stated that a deal has practically been effected whereby the Marion Electric Street Railway Company is to be absorbed by the new Findlay-Marion Company.

DAYTON, OHIO.—It is stated that a deal has practically been closed whereby the Miami Valley Railway, operating between Troy and Piqua, will be sold to the Winters-Clegg syndicate, owner of the Dayton & Troy Electric Railway.

CANTON, OHIO.—Motormen and conductors of the Canton-Massillon Railway have received an increase in pay. The new rate is 17 1-2 cents for new men and 20 cents after two years. The old scale was $1.65 per day for nine hours.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway Company has filed a mortgage on its property for $1,500,000 to secure an issue of bonds. The mortgage is in favor of the Continental Trust Company of New York.

CINCINNATI, OHIO.—The Interurban Terminal Company of Cincinnati has been incorporated with $500,000 capital stock by G. W. Scrugham, George H. Worthington, J. M. Kennedy, Lee H. Brooks, W. E. Hatton, C. H. Davis, and E. W. Mallon.

THE AUTOMOBILE.

INDIANAPOLIS AUTOMOBILE CLUB.—An automobile club has been organized at Indianapolis, Ind., with H. T. Hearsey as president.

MILE RECORD CONTEST.—The Automobile Club of America will hold its annual mile record contest on the South Shore Boulevard, Staten Island, N. Y., on May 31, at 11 a. m. Mr. A. C. Bostwick is chairman of the racing committee.

NEW INDUSTRIAL COMPANIES.

THE THOMPSON-BONNEY COMPANY, of Brooklyn Borough, New York, has been incorporated to manufacture electrical apparatus; capital, $30,000. Directors: C. A. Thompson and J. P. Bonney, Brooklyn; Frank Lippert, New York.

THE EMPIRE STATE ENGINEERING COMPANY, of New York, has been incorporated, with a capital of $500,000 to manufacture stationary and locomotive engines and motors. The directors are M. P. Marks, Albert G. Kalb, Harry J. Marks, Kenneth C. Kirtland, T. C. Press and Malcolm V. Ryan.

LEGAL.

THREE CENT FARE CASE.—The Indiana Supreme Court has held it valid and constitutional the law under which the charter and franchise of the Indianapolis Street Railway Company was granted. This practically declares invalid the 3 cent fare law of 1895. A Mr. Smith brought suit against the company for damages for being ejected from a car for refusing to pay more than three cents.

WESTERN ELECTRIC VS. KINLOCH.—A motion to stay the order for an injunction was argued last week in the United States Circuit Court, at St. Louis, in the case of the Western Electric Company against the Kinloch Telephone Company. The motion, however, was denied, but the defendant was given until May 19 to install new devices. The injunction was ordered some weeks ago to restrain the Kinloch Telephone Company from the use of a patented device on its switchboards.

IN FAVOR OF KEYSTONE COMPANY.—A Philadelphia despatch states that Judge Dallas has handed down an opinion in the United States Circuit Court refusing the motion of the Western Electric Company for a preliminary injunction to restrain the Keystone Telephone Company from making an alleged infringement of certain patented improvements in multiple switchboards for telephone exchanges, which the Western company claimed to own exclusively. In his decision the Judge refers to the previous case decided in the United States Court in Missouri, and says the construction of the patent is different and important additional evidence has been submitted.

STREET RAILWAY FRANCHISES.—The Wisconsin Supreme Court, in a recent opinion, decided that street railway franchises cannot be granted to individuals. This important interpretation of the statute was announced in an action brought against G. L. Clausen and P. F. Haynes to restrain them from building a street railway in Kenosha, after having received a franchise from the city council. It is the general opinion that franchises held by individuals will have to be transferred to corporations at once, and that the authority for such transfer will have to be secured from the grantors. A number of street railway franchises are now in the hands of individuals, and one of the roads affected by the decision is that about to be constructed from Madison to Janesville.

OBITUARY.

JOHN H. EMERICK, for many years general superintendent of the Postal Telegraph Company, at New York, died at his home in Brooklyn on the night of May 11, at the age of 57 years. When 17 years of age he entered the military service at Gen. McDowell's headquarters in Virginia in 1861, and served through the war as operator with the Army of the Potomac. In January, 1865, he was made chief operator of the Army of the James. He was one of the twelve military telegraphers who were presented with watches by Edwin M. Stanton.

FRANK R. COLVIN.—We regret to announce the sudden death at his residence, Roselle, N. J., last week of Mr. Frank R. Colvin, the telephone engineer and expert. He was only forty years of age, and had but just returned from a trip in apparent excellent health, but was subject to heart trouble. Mr. Colvin was a graduate from the U. S. Naval Academy, and a close personal friend of the late S. Dana Greene, whose class he was in. Shortly after leaving the naval service in which little opportunity offered before the development of the "new navy," Mr. Colvin became associated with Mr. F. J. Morrison and the old Baxter Electric Motor Company. He then entered the office of the *Electrical World*, and shortly after became business manager of the *Electrical Engineer*, when it was made into a weekly. He had always taken a deep interest, however, in the technical end of electrical work, and had been associated with some of the earliest electric lighting done in the navy. He now devoted much attention to telephony, took out some patents, and went into telephone manufacture for private exchange installations. His interests were acquired by the Western Electric Company, and he was retained by Barton & Brown, of Chicago, as an expert for special work in connection with Bell telephone infringement cases. Mr. Colvin was a man of marked ability, great insight into technical questions, and had an unusual grasp of the intricacies of telephone circuits. He leaves a widow. The funeral took place on Monday of this week. The services were strictly private, only those intimately acquainted with Mr. Colvin, or close business associates, being notified. Following the ceremony of the Episcopal Church, interment took place at the Elizabeth, N. J., cemetery. Among those present were Messrs. A. S. Salt, J. H. Barnard, F. Kortheuer, Joseph Wetzler, Harry S. Smith, John J. Carty, and A. C. Boughton, of *Electrical World and Engineer*.

DR. HENRY MORTON.—We note with deep regret the death of President Morton, of the Stevens Institute of Technology, long one of the foremost technical educators in this country. He was born in New York Dec. 11, 1836, and was the son of the Rev. Henry J. Morton, who for fifty-six years was rector of St. James's Episcopal Church, Philadelphia. He was graduated from the University of Pennsylvania in 1857, and after studying law abandoned the idea of practicing it, and devoted himself to the study of chemistry, physics and mechanics. He became an instructor in the Episcopal Academy of Philadelphia, where his lectures became so famous that he had to deliver an extra course for the public. In 1863 he was elected professor of chemistry in the Philadelphia Dental College, and in 1869 the new chair of chemistry was created for him at the University of Pennsylvania. In the same year he took part in the expedition sent out by the United States Nautical Almanac office to observe the total eclipse of the sun on Aug. 7, and in connection with these observations was the first to prove the true nature of the bright line on the sun's disk adjacent to the edge of the moon, which is seen in partial eclipse photographs. About this time Mr. Edwin A. Stevens left the endowment, out of which grew Stevens Institute. Prof. Morton was appointed president of the institution in 1870, and he entered upon the task of making the institution the first school whose exclusive object was to teach mechanical engineering as a profession. In 1880 he presented the trustees with a $10,000 workshop. In 1878 he was appointed to the United States Lighthouse Board by Secretary Sherman. He also enjoyed the position of being a leading scientific expert in this vicinity. During the early days of his presidency he devoted much of his time to original researches, with results of considerable scientific importance. He took a deep interest in electrical matters, and was retained as an expert in connection with many of the famous litigations and controversies of the past 25 years. He was a wide contributor to American and foreign scientific publications, and was also the author of many poems, mostly humorous. The funeral exercises, which were largely attended, took place on Tuesday, May 13, at Trinity Episcopal Church, Hoboken, of which he was senior warden.

PERSONAL.

DR. CARY T. HUTCHINSON [illegible] 71 Broadway to 56 Pine street, New York.

MR. ROBERT M'F. DOBLE, electrical engineer, etc., of San Francisco, has moved his offices to 314 Hayward Building in that city.

MESSRS. HOLTON AND REED, of the Manchester office of the British Thomson-Houston Company, Limited (controlled by the General Electric Company) are now visiting the United States.

MR. EDWARD F. SHELDON, for many years chief electrical engineer at the Hudson River State Hospital, at Poughkeepsie, N. Y., is now associated with M. F. L. Forest, electrical and mechanical engineer, Albany.

MR. A. L. RIKER, the pioneer inventor and engineer in the electric automobile and other fields, is reported to be perfecting a gasoline automobile for the Locomobile Company of America, hitherto known for its steam vehicles.

CAPT. G. O. SQUIER, of the U. S. Cableship "Burnside," who has been laying and repairing cable in the Philippines, writes that he is hopeful of reaching the United States some time this month, via Japan and Honolulu.

PREST. S. INSULL, of the Chicago Edison Co., with Messrs. Ferguson and Sargent, has been in New York City this week, with the object, it is said, of making contracts for a new plant. The Chicago lighting business is growing very rapidly.

MR. A. R. BLISS, treasurer and general manager of the New England Motor Company, of Lowell, Mass., has been in New York, and reports an excellent demand for the motors and generators of the company, new designs of which are being brought out.

MR. A. B. WEEKS has resigned his position as electrician with the Niagara Falls Power Company, to accept a position with the well-known Sherwin-Williams Company at Cleveland, Ohio. Mr. Weeks is well known to our readers as a contributor to these pages.

MR. R. M. BARWISE, who has had a good deal to do with the introduction of automobiles in this country, as the agent of different concerns, is now representing the Jandus and Buckeye Electric Companies in Philadelphia, with offices in the Real Estate Trust Building.

MR. M. R. HUTCHINSON, the electrical engineer, who has been devoting his time chiefly to the improvement of telephonic and microphonic apparatus for the deaf, sailed for England on the "Lucania" on Saturday. It is rumored that some important work awaits him on the other side.

MR. B. H. SCRANTON, president and general manager of the American Electric Heater Company, of Detroit, Mich., has been in the East lately. The concern is busily employed and is doing a variety of most interesting industrial work, possible only with the application of electric heat.

MR. DAVID SHANKS, of Handley & Shanks, electrical and general engineers, Birmingham, England, will be at the Waldorf-Astoria, New York City, on and after May 21, and would be glad while there to make appointments with manufacturers desirous of representation in Great Britain.

MR. GEORGE G. WARD, vice-president of the Commercial Cable Company, having but just returned from San Francisco, where he was busily engaged on preparatory work connected with laying the Commercial Pacific Cable, has now proceeded to England, sailing last Friday, with Mrs. Ward, on the "Celtic."

MR. GEORGE STANMORE, well known in electrical circles in New York City, has joined hands with a Mr. H. C. Wilson in starting the Steeplechase Hotel at Coney Island, on Surf avenue, near the famous Steeplechase Park. Mr. Stanmore proposes to pay special attention to automobile parties driving down to the Island.

MR. CHAS. EVELBAUER, representative of the Deutsche Waffen und Munitions Fabriken, who has been in Chicago making a thorough study of the Strowger automatic apparatus, manufactured by the Automatic Electric Company, has finished his work and leaves for Europe on May 15, to accept the position of manager of the telephone factory of the above-mentioned company.

MR. STEPHEN D. FIELD, the well-known electrical inventor and engineer, who has been engaged on electrical railway work for some years in Europe, with headquarters at Geneva, has just returned home, and is in residence at Stockbridge, accompanied by his wife and daughter. A great many old friends and admirers will meet him at the June Institute meeting at Great Barrington.

MR. A. S. LANGSDORF made an address on the evening of May 7, at the Engineers' Club, of St. Louis, Mo., on "Commercial Testing of Electrical Machinery." Mr. Langsdorf illustrated the tests made in factories of dynamos, motors, and transformers, with a view of obtaining a knowledge of the machines under a load before having them installed. The descriptions applied particularly to the tests made by the General Electric Company, at its plant in Schenectady, New York.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, accompanied by his wife, has sailed for Europe on the White Star Steamer "Celtic," for a tour of some months' duration. Dr. Wheeler has not only had a very busy year in connection with the company, but has given up a great deal of time and thought to affairs touching the proper care of the Latimer Clark library, which he gave so generously to the American Institute of Electrical Engineers.

MR. GEORGE F. PORTER, secretary of the National Electric Light Association, has, we regret to learn, found it imperative to hasten at once to the Pacific Coast in order to attend to work there in connection with the government Kerite cables now stretching to Alaska. He will thus be unable to attend the Cincinnati convention, but Past-president Cahoon has kindly volunteered his services in the emergency, and will at once take hold of affairs. Mr. Porter leaves immediately for the Pacific.

MR. CHARLES A. SPOFFORD, who has been connected with the Milwaukee Street Railway and several electric companies that are controlled by the North American Company, has been selected by Speyer & Co. to assist Mr. Yerkes in the management of the London underground railway system. He will take charge about June 1. The first work of the new company will be the electrical equipment of the subway system of the Metropolitan District Railway, which is now operated by steam.

MR. C. VANDEVENTER was tendered a farewell dinner recently by his office associates and friends at the Hotel Normandie, New York City. The occasion was Mr. Vandeventer's leaving the New York office of the Stanley Electric Mfg. Company to take the management of that company's Chicago office. Among those present were Dr. F. A. C. Perrine, president of the Stanley Company, Messrs. M. D. Barr, sales manager, John F. Kelly, consulting engineer, T. W. Kolman, J. G. Otis, B. J. Hough, C. E. Bibber, L. H. Hobbs, Ray D. Lillibridge, Ward Arnold and Z. V. Taylor.

MR. ALEX. HENDERSON, of the Sprague Electric Company, has kindly consented to act as master of transportation for the National Electric Light Association, in the absence of Mr. C. O. Baker, Jr., now in Europe. Mr. Henderson has been very busy during the past week meeting the wants as to transportation of those proposing to go by the special train on Sunday morning, and has taken all possible pains to circulate information and render everybody comfortable. His voluntary work at this juncture is very much appreciated by those who are going to Cincinnati to attend the Convention.

DR. F. A. C. PERRINE, president of the Stanley Electric Mfg. Company, on the evening of Friday, May 9, read a paper before the Boston Society of Arts at the Massachusetts Institute of Technology, on "Success in Long Distance Power Transmission." The special features of the paper were "the obstacles and difficulties met with in the engineering of the great transmission lines of California" and the details of their successful solving. On Saturday morning Dr. Perrine delivered an informal talk to the Senior Class in Electrical Engineering of the Massachusetts Institute of Technology, on "The Outlook in Electrical Engineering." The theme was the business prospects for young engineers. Dr. Perrine is to lead the discussion on "Protection of Long Distance Transmission Lines" at the Cincinnati convention next week.

MR. PAUL J. KRUESI, who for some time past has been connected with the management of the General Incandescent Arc Light Company, at their factory in New York City, has moved to Chattanooga, where he has become manager of the Sunlight Lava Manufacturing Company, a concern which is making electrical insulators and bushings, and lava work of every description. Chattanooga has become an active center in this branch of industry, and Mr. Kruesi's familiarity with electrical manufacture places him in a position of great advantage, as he is thoroughly conversant with the conditions which have to be met. It may be noted that this rising young manufacturer is a son of the late John Kruesi, of the General Electric works at Schenectady, long one of Mr. Edison's most intimate associates in the earlier days of the electrical arts.

MR. GEORGE A. DAMON, managing engineer of the Arnold Electric Power Station Company, of Chicago, was the guest of honor at a dinner of some of the younger graduates of the engineering courses of the University of Michigan, held at the Union Restaurant, Chicago, the evening of May 3. It is unnecessary to state in view of this event that Mr. Damon is one of the most popular engineers among the late graduates of his college to be found in Chicago, on account of his kindly interest in those just entering the profession. At the dinner he spoke on the subject of the engineer and the dollar, discussing whether the engineer should seek wealth or simply honor in his profession. Dr. Damon took the ground that there is no reason why an engineer should not seek both, and gave some figures on the income an engineer might expect to have at various stages in his career that were decidedly encouraging to the younger men.

MR. W. E. BAKER, until recently general superintendent of the Manhattan Railway Company, of New York, has decided to remain permanently in this city, and will now be associated with Mr. H. R. Bishop, Jr., under the firm name of W. E. Baker & Co., with offices at 170 Broadway. They will do a general electrical consulting and contracting business, but will be more closely associated with that branch which deals with electric railway engineering than any other. Mr. Baker's long experience in heavy electric railway work with the West End Railway Company, of Boston; the Intramural Railway at the World's Fair, at Chicago; the Metropolitan West Side Elevated Railroad, of Chicago, and the electrical equipment of the Manhattan Railway, in New York, places him in a prominent position in regard to this class of engineering. Mr. Bishop has been connected with the General Electric Company for a number of years and served as an officer in the 1st Regiment, U. S. V. Engineers, during the late Spanish-American war. He is the son of Heber R. Bishop, well known in financial circles.

Trade Notes.

THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, Ind., has increased its capital stock from $40,000 to $150,000.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, states regarding the "Howes" swiveling attachment plug, that its sales are rapidly increasing on this specialty.

C. W. HUNT COMPANY, of West New Brighton, S. I., have been calling special attention to their coal tubs for power plants of all kinds. They have been building such tubs for thirty years.

NEW AND SECOND HAND MACHINERY.—Wickes Brothers, Saginaw, Mich., have issued a monthly stock list of new and second-hand boilers, engines, machine tools, etc. The list is dated April 30.

ERRATUM.—The electrical ambulances at the new Lying-in-Hospital, New York City, described recently in these pages, are not equipped, as there stated, with Westinghouse motors, but with General Electric.

CONLEY ELECTRIC FURNACE.—We have an inquiry for the address of the Conley Electric Furnace Company, of New York, which controls the electric furnace recently patented and described in our issue of April 26.

FAN CATALOGUES.—Did you receive one of the new fan catalogues issued by the Electric Appliance Company, Chicago? This catalogue is complete and nicely gotten up and should be in the hands of every electrical buyer.

THE STANLEY ELECTRIC MFG. COMPANY has removed its New York offices to 29 Broadway, in order to acquire more room, which it could not obtain at the old place. The growth of the New York office force has been such as to render more room imperative.

CHAS. E. FELT & CO., 1156 Monadnock Block, Chicago, have recently opened an office for general electrical engineering; installations, power plants, etc., a field in which they have had fourteen years' experience. Mr. D. Avery Kimbark, consulting electrician, is associated with the concern.

GLAZE-FILLED INSULATORS.—The R. Thomas & Sons Company, East Liverpool, Ohio, has issued a booklet on Boch glaze-filled high tension insulators, giving general data on their construction, etc., as well as a review of patent litigation undertaken by the company to sustain its patents on these insulators.

MESSRS. HUBBARD, HALL & COMPANY, 213 West Fourth street, Cincinnati, Ohio, are sending out several leaflets describing and illustrating various electrical and other supplies and specialties handled by this firm. These include Columbia incandescent lamps, electric light guards, pay-out reels, etc.

STEAM HAMMERS.—Bement, Niles & Company, Philadelphia, Pa., have issued a handsome catalogue of their extensive line of steam hammers. These machines are very thoroughly described as to their construction and use, and illustrated by artistic halftone cuts, which show the different sizes and designs.

THE NEW ENGLAND MOTOR COMPANY reports brisk business for some time past. In order to meet the demand for its product, it is had to run its factory on overtime during the major part of the last six months. Among recent orders which it has booked are one of twenty 2-hp. motors to go to Chicago, and six special 50-hp. size 6-pole machines for the U. S. Navy.

THE ACME TIME SWITCH, manufactured by the Acme Switch Company, 458 Asylum street, Hartford, Ct., is described and illustrated in a pamphlet just issued by the company. This switch is designed to automatically control electric lighting current, and that it is satisfactorily fulfilling this purpose is evident from the large number in use by the principal central stations throughout the country. It is stated to be accurate, and it always acts on time.

JANDUS ELECTRIC FAN.—The Jandus Electric Company, 115 Broadway, New York, has issued a pamphlet describing its line of fans for the season of 1902. This type of fan is made for alternating and direct currents, and combines on one a desk fan, bracket fan, trunnion fan, and bracket-trunnion fan. All of the advantages of this useful machine are pointed out in clear language, and illustrations show its construction, compactness being one of the principal features.

O. K. SPECIALTY MFG. COMPANY, Garrettsville, Ohio, is placing on the market a line of specialties, including knife switches, time switches, tablet boards, terminal logs, enclosed fuse cut outs, plug cut outs, etc., all built to meet the underwriters' rules. These goods are understood to be meeting the needs of users, and the approval of electrical supply houses, lighting plants, etc. The company will be glad to receive inquiries with regard to its apparatus from reliable houses.

RIVETING MACHINE.—Mr. John T. Allen, 370 Gerard avenue, New York City, who manufactures a complete line of portable pneumatic riveting machines, pneumatic drilling machines, tool holders, etc., has just received an order from the Canadian General Electric Company for two jaw riveters having a 36-in. reach, 20-in. gap and 12-in. cylinder, capable of driving 1¼-in. rivets. Four of Mr. Allen's machines have been installed in the new plant of the Westinghouse Company, at Manchester, England.

PASS & SEYMOUR.—The Cincinnati office of Pass & Seymour, Inc., has been removed from 405 Union Trust Building to more suitable and commodious quarters at 234 West Fourth Street, Cincinnati, Ohio, where a full line and complete stock of P. & S. specialties are carried. A cordial invitation is extended to those attending the National Electric Light Association's Convention, to be held at the Grand Hotel, on May 20, 21 and 22, to visit the new quarters and make the office their headquarters during the convention.

INSULATING COMPOUNDS.—The Mica Insulator Company, 218 Water street, New York, is making a M. I. C. compound of black enamel, in four grades to suit all requirements. It is composed chiefly of linseed oil, Cuban asphaltum, and Para rubber, and is well adapted for coating armature coils, field magnets, electric wires, cables, arc lamps, etc. Reports of tests of these compounds are given in a pamphlet just issued by the company, which includes a sample of the compound applied to fabric. Several of the principal electric railway and electric light companies throughout the country are consumers of M. I. C. compound, a list of these concerns being given in the pamphlet, together with much other information on the general subject.

I. P. FRINK, New York, whose name and fame in the successful installation of all kinds of lighting fixtures, circulates around the globe, reports among recent export orders the shipment of large church reflectors to Brazil, Chatham, N. B., and Vancouver, B. C., Canada, Manila, Philippines, Moravian Mission, Bluefields, Nicaragua, C. A.; window reflectors to Birmingham, England, and to Mexico City, Mexico; and a general order for shades, special cluster reflectors, and window reflector to Cape Town, Africa. Mr. Frink carries a large line of electrical and other lighting specialties that might be profitably taken up and pushed in export fields, and any one interested in that direction will find much valuable data in the very complete catalogues which this firm sends out.

CROUSE-HINDS ELECTRIC COMPANY has removed from Union Trust Building to 234 West Fourth street, Cincinnati, where a new store is being opened. Owing to the constant increase in business, the former quarters have for some time been too small. The new quarters will be made a distributing point for Ohio, Southern Indiana, Kentucky, Tennessee, Mississippi and Alabama, which territory will be under this office, and a large stock of switches, panel boards, and "Syracuse" head lights will be carried in stock. The new store will be in charge of Mr. Charles M. Crofoot, the former manager, who will be assisted by a competent office force. Convention visitors will be welcome, and are invited to have their mail sent in "Crouse-Hinds'" care. A stenographer will be furnished anyone desiring the use of one.

THE NUNGESSER ELECTRIC BATTERY COMPANY of Cleveland, Ohio, has just commenced operations in its new factory building, which gives it nearly three times the capacity of the old plant. The new factory is 160x160 feet, and two stories high, being located on King street, facing the L. S. & M. S. Ry. tracks, giving the best of shipping facilities. A large amount of special machinery is being installed and within thirty days the factory will be running at full force, with a capacity of 250,000 cells per month. These figures give some idea of the enormous demand for these batteries, which are used very largely in telephone work. Heretofore the company has been wholly unable to take care of all orders offered, but with the increased facilities it will be enabled to handle almost any amount of business. The capital stock of the company is to be increased at the May meeting.

KELLOGG CATALOGUE.—The Kellogg Switchboard & Supply Company, Chicago, Ill., has just issued a general descriptive catalogue of its apparatus. In this catalogue is given much information concerning its line of telephone instruments, switchboards, and other apparatus, all of which are illustrated. At the back is a code list for use in connection with the cuts, and which gives a brief of the salient features, not only of the particular pieces of apparatus illustrated, but of its various modifications. Besides the illustrations of the many styles of apparatus manufactured by the Kellogg Company, are others showing the different departments of the company's factory, and of several important independent exchanges throughout the country equipped with Kellogg apparatus. Part of the catalogue is devoted to switchboards of all classes, which are very attractively illustrated. The line of these devices is a surprisingly extensive one. Every telephone manager will find much of interest to him in the contents of this catalogue.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 6, 1902.

(Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau-st., N. Y.)

711,983. RAILWAY SIGNALING AND SWITCHING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed June 7, 1898. An interlocking or controlling apparatus having means for preventing a lever changing its position in either direction before the track switch has made its complete movement.

711,140. ELECTRICAL ANNUNCIATOR; C. C. Blake, Brookline, Mass. App. filed Sept. 26, 1901. An electric magnet whose armature is adapted to operate a target in a colored fluid toward and from a transparent window, to be visible when in proximity to the window, and be concealed by the colored fluid when away from the window.

711,146. ELECTRIC COMBUSTION FURNACE; W. M. Carr, East St. Louis, Ill. App. filed March 3, 1902. (See Page 868.)

711,158. WIRELESS TELEGRAPH SYSTEM; C. D. Ehret, Washington, D. C. App. filed Dec. 3, 1901. Comprises a wireless telegraph receiver which is operated by the simultaneous reception of electromagnetic waves of different frequencies, the waves of different frequencies operating upon dissimilar wave-responsive devices, such devices being in local circuits by which are produced the signals.

711,162. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed Nov. 13, 1901. (See Page 868.)

711,177. ELECTRIC CALL SYSTEM; E. F. Huggins, Zanesville, Kansas. App. filed Apr. 12, 1901. Details.

711,181. JUNCTION OR USE BOX; M. H. Johnson, Utica, N. Y. App. filed Dec. 28, 1901. A removable tablet on which the electrical devices are mounted, is placed in a box in a manner permitting of ready access to the parts.

699,187. MEANS FOR CONNECTING DYNAMOS WITH TRUCKS OF RAILWAY CARS; P. Kennedy, Brooklyn, N. Y. App. filed Aug. 17, 1901. The dynamo is mounted in an overhanging frame from the truck, the supports running parallel to the belt which connects the dynamo pulley with the axle pulley.

699,193. DEVICE FOR CLEANING AND RUBBING COLLECTORS OF ELECTRIC MOTORS AND DYNAMO MACHINES; W. Kuppers, Berlin, Germany. App. filed Feb. 11, 1902. A block having a curved rubbing face conforming to the surface of the commutator and having a cavity into which the metallic particles are carried when ground off.

699,196. ELECTRIC ARC LAMP; A. Lees, New Bedford, Mass. App. filed Dec. 6, 1900. The lower carbon holder is supported by the wire net which protects the globe and current is carried through the net to the holder.

699,202. ELECTRIC GAS LIGHTER; A. J. Marschall, Little Falls, N. Y. App. filed Mar. 8, 1901. A battery casing and stem leading therefrom, at the end of which is a filament to be heated by the current for igniting gas.

699,205. ELECTRICAL TAP SOCKET; E. B. Meyrowitz, New York, N. Y. App. filed Aug. 27, 1901. A switch block is fixed transversely in the socket and is adapted to be forced inward on either side to project from the other side; the terminals of a branch circuit can be connected with either end of the block to place it in series or parallel with the main circuit when the connected end is forced inward.

699,208. VACUUM TUBE SIGN; H. M. Moore, Newark, N. J. App. filed Apr. 13, 1901. The improvements relate to an exciter to be used in connection with the tubular letters forming the sign.

699,215. ELECTRICAL OUTLET BOX; E. W. Muller, Brooklyn, N. Y. App. filed Mar. 11, 1902. An electrical outlet box having a receptacle-carrying part adjustable on the body of the box so as to shift the center of the receptacle.

699,218. ELECTRIC SWITCH OPERATING DEVICE; A. J. McCullough, Meadville, Pa. App. filed Mar. 29, 1901. The core of a solenoid is connected through a chain directly with the switch point, a spring serving to return the point after it has been moved by the solenoid.

699,225. ELECTRIC ARC LAMP; J. S. Nowotny, Madisonville, O. App. filed Mar. 19, 1896. Relates more particularly to the shape of the carbons, they being parallel throughout the portions which are to burn and offset from each other to accommodate the carbon holders above those portions.

699,232. METHOD OF TREATING BALLAST WIRES FOR ELECTRIC LAMPS; H. N. Potter, Pittsburg, Pa. App. filed July 14, 1900. To provide a ballast device, the temperature of which will increase uniformly throughout its length under the action of an electric current, the ballast is heated in the presence of a compound containing the material of which the ballast is composed, the temperature being raised to a point where a deposit of the said material will be made upon the ballast.

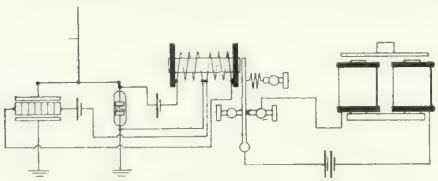
699,275. AUTOMATIC ANNUNCIATOR; J. A. Wotton, Atlanta, Ga. App. filed June 10, 1901. A solenoid provided with a divided core, one part being longer than the other, the shorter part connected with the resetting mechanism and the longer part adapted by its momentum when moved in the coil to actuate the shorter part to reset the annunciator.

699,294. APPARATUS FOR AERATING OR AGITATING LIQUIDS; Harold E. Dolphin, Cressington, near Liverpool, Eng. App. filed Jan. 17, 1902. An arrangement whereby a jet of water leading to a tank becomes commingled with air, the water and air together setting up a considerable agitation in the tank. In one arrangement a number of tanks have but one outlet for the overflow water, the surplus passing in sequence from one tank to another up to the final tank.

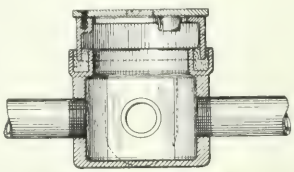
699,333. VESSEL FOR THE RECEPTION OF HIGH PRESSURE GASES; Albert Ludwig, Bernburg, Germany. App. filed Oct. 3, 1900. A gas-tight closing device for vessels or metals containing gases under high pressure, such for example as are used for the production of artificial diamonds.

699,364. TROLLEY STAND; C. G. Bleasdale, Detroit, Mich. App. filed Aug. 14, 1901. The rotative support of the trolley stand is inclosed by a suitable housing.

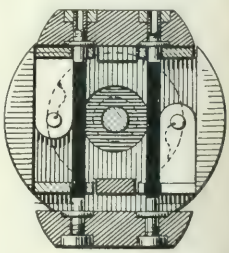
699,381. OUTLET BOX FOR ELECTRIC WIRES AND CONDUITS; J. M. G. Fullman, Pittsburg, Pa. App. filed May 16, 1901. A water-tight floor outlet box comprising a stationary box and a cap for the same adapted to be adjusted vertically with reference to the floor level, so as to be brought flush with the floor regardless of whether the box itself is accurately placed or not.



699,158. Wireless Telegraph System.



699,381. Outlet Box for Electric Wires and Conduits.



699,205. Electrical Tap Socket.

699,383. INSULATING COMPOSITION AND METHOD OF PRODUCING SAME; A. Gentzsch, Vienna, Austria-Hungary. App. filed Aug. 30, 1901. An insulating composition consisting of gum rubber or caoutchouc and a vegetable wax kneaded together under a mild heat which is increased gradually during the kneading operation.

699,388. DYNAMO; S. Hutchins, Manchester, Eng. App. filed Dec. 19, 1901. A field magnet movably mounted and adapted to follow the armature and means for maintaining a constant difference of speed between the armature and the field magnet.

699,412. DEVICE FOR OPERATING ELECTRIC LIGHTS IN RAILWAY CARRIAGES FROM THE GUARD'S VAN; E. J. Preston, Beckenham, and A. B. Gill, Blackheath Park, England. App. filed Dec. 8, 1899. A hand and automatic switching apparatus so arranged that by moving the hand switch once, various groups of lights on the car will be successively cut in and out.

699,413. STORAGE BATTERY; Jerome Redding, Boston, Mass. App. filed Aug. 5, 1901. Alternate indentations and protuberances are produced in sheets of lead foil by means of punching, the foil being practically reduced to a state of fine mesh. Strips of the foil are then coated with red lead or litharge, superposed and united in frames so as to form battery elements.

699,414. METHOD OF TREATING SOLUTIONS OF SALTS; C. J. Reed, Philadelphia, Pa. App. filed Aug. 1, 1901. (See Page 868.)

699,415. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed Aug. 1, 1901. (See Page 868.)

699,455. COMBINED HOSE AND ELECTRIC SIGNALING DEVICE; H. T. Cronk, New York, N. Y. App. filed Mar. 5, 1901. A hose having two wires embedded therein out of contact with each other, and contact-plates arranged on the inside and outside respectively of the hose and each connected with one of the said wires.

699,469. ELECTRIC COUPLING; T. C. James, Manistee, Mich. App. filed Aug. 28, 1901. An electric coupling comprising two sections, each divided into two chambers, contact devices arranged in the chambers, and contact devices carried by each section for closing a circuit when the sections of the [illegible]

699,483. ELECTRICAL APPARATUS; T. H. Brady, New Britain, Conn. App. filed July 20, 1901. When the meter is taken out, a sealed box is left in its place into which the ends of the conductors are passed and held to prevent tampering therewith.

699,492. PROCESS OF FORMING STORAGE BATTERY PLATES; Rufus N. Chamberlain, Depew, N. Y. App. filed Mar. 3, 1899. The plates are pickled, constituting the same as anodes in an electrolytic bath containing a pickling agent such as solution of nitric acid, and collecting on a cathode the lead which has been dissolved by the pickling solution. From the pickling bath the plates are removed to the forming bath, each plate being first the anode in such bath and receiving a coating of oxide, then being constituted the cathode in the same or similar bath, a fresh plate being then made the anode. The reduction of the oxidized coating on the first plate thus serving to diminish the amount of energy required to form a coating of oxide on the second plate. The electrolyte used for the forming plates is a dilute solution of acetic and sulphuric acids in water.

699,493. METHOD OF CLEANING SPONGY LEAD PLATES FOR STORAGE BATTERIES; R. N. Chamberlain, Depew, N. Y. App. filed Mar. 3, 1899. The process of cleansing a spongy lead plate from the active dissolving agent of an electrochemical forming-bath which consists in exposing said plate as a cathode in an electrolytic bath, such bath containing a solution relatively free from such active agent.

699,506. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, O. App. filed Dec. 28, 1901. Parallel plates carrying the fixed contacts on their outer faces are embraced by a U-shaped arm which is pivoted and carries the brushes on its respective legs which engage with the respective contacts.

699,566. AUTOMATIC STARTER FOR ELECTRIC MOTORS; J. E. Putnam, Rochester, N. Y. App. filed Sept. 8, 1900. The starting resistance is cut out by a centrifugal device driven by the motor.

699,574. TELEGRAPHIC DISTRIBUTION; H. A. Rowland, Baltimore, Md. App. filed July 24, 1901. A claim defines the invention as follows: The combination with two or more telegraph lines, of a repeating station located upon said lines and comprising the following elements, viz., a source of electricity from which said lines receive current, main line transmitting and receiving instruments, local transmitting and receiving current distributers operating in conjunction with said main line instruments and local circuit making and breaking devices operated by the receiving instruments of one line and automatically operating the transmitting instruments of another line.

699,575. TELEGRAPHIC PAGE PRINTER; H. A. Rowland, Baltimore, Md. App. filed July 24, 1901. The invention has reference especially to improvements upon the carriage shifting mechanism described in another application by this patentee.

699,582. SIGNAL APPARATUS; S. C. Shaffner, Mobile, Ala. App. filed Jan. 9, 1902. The street lighting system is combined with the telephone police signal system by means of certain switching apparatus, so that a policeman on beat can be signaled from the central office by sending a current over the telephone line which will operate a switch in a particular signal box to flash a light on the lighting circuit.

699,583. MEANS FOR AUTOMATIC CONTROL OF MOTOR VEHICLES; H. H. Sherk, Pasadena, Cal. App. filed Nov. 5, 1901. A plunger is operated by a movable seat to turn on the power when the seat is occupied, the invention relating more particularly to devices for regulating the action of the plunger to accomplish various functions.

699,590. ELECTRIC RAILWAY; A. A. Stolle, New York, N. Y. App. filed Oct. 22, 1901. Instead of running over crossings with the power turned off, the usual gap in the conductor at the crossing is automatically closed by the car, thus permitting the car to pass over under power.

699,618. RAIL BOND; A. H. Englund, Philadelphia, Pa. App. filed Mar. 3, 1902. A rail bond consisting of two heads united by a body formed in two divisions of unequal transverse dimensions, the purpose being to distribute the portions with respect to the spaces available between the fish plates and rail and still obtain the greatest carrying capacity.

699,619. COMBINATION DROP AND JACK FOR TELEPHONE SWITCH BOARDS; Henry M. Fisk, Wheaton, Ill. App. filed June 22, 1900.

699,630. METHOD OF RECORDING MESSAGES, SIGNALS, ETC.; P. O. Pedersen, Copenhagen, Denmark. App. filed Mar. 9, 1900. (See Page 866.)

699,633. ELECTRIC CUT-OFF SWITCH; L. W. Richardson, Dustin, Tenn. App. filed Oct. 10, 1901. A switch adapted to readily cut off a subscriber's telephone from the main wire during electric storms.

Electrical World and Engineer

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NEW YORK, SATURDAY, MAY 24, 1902.

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THE N. E. L. A. CONVENTION.

In a supplement to this issue are given abstracts of the remarkably full programme of papers read at the Convention of the National Electric Light Association held at Cincinnati this week, and also a condensed account of the proceedings. Owing to the holding of three sessions daily, the stenographic report of the meeting has been delayed, but the salient points of the discussion which occurred will be given in full in following issues, when also the more important subjects considered will receive editorial notice. One is safe in saying that the Cincinnati Convention has been the most successful in the history of the association, if it be judged only by the programme of papers. The merely perfunctory and commercial paper is conspicuous by its absence, and those to whom fell the task of selecting subjects and the writers, deserve the highest commendation for the excellent judgment displayed. With scarcely an exception, the papers treated of topics uppermost in the minds of central station men. The contributions on the subject of rates, free lamp renewals and long-distance transmission lines in particular form a contribution to the literature of these subjects of the utmost value To President Doherty and his associates we extend our congratulations on the gratifying result of their intelligent labor.

THE BUCKINGHAM TELEGRAPH PRINTER.

Few electrical inventions in these days have reached a point of practical utility with less of heralding than the Buckingham page printing telegraph system, which Mr. Maver describes in an article this week. The art of printing telegraphy is not a new one by any means; but, almost without exception, prior to Mr. Buckingham's work along this line, no great practical success had been reached in the attempts to produce a printing telegraph system operative at a high rate of speed on the longest circuits, and in which the messages would be printed as received on the ordinary telegraph blank. Hitherto, the commercially operated printing telegraph systems, like the Hughes, the Phelps and Baudot, have printed the received message on a continuous line on a paper tape, practically similar to that of the well-known "ticker" tape. It is of public knowledge that the large users of the telegraph in this country strenuously object to having telegrams delivered to them in this form, and to meet this objection the expedient of cutting up the strip in line lengths and pasting it on the telegraph blank has sometimes been resorted to, but not with marked success. It may be said, further, that the ordinary business man is to-day quite as averse to receiving telegrams in the operator's hand-writing, as he is to receive or transmit his ordinary correspondence in that shape, a fact which the telegraph companies have fully appreciated, and which they have endeavored to meet by encouraging the use of the typewriter by their operators.

These facts have doubtless contributed materially to the gradual disuse of such systems as the Phelps printing telegraph in this country, and have rendered it imperative that any improvement in the speed of printing telegraph systems must be accompanied by the reproduction of the transmitted message in typewritten page form. The system which Mr. Buckingham has evolved appears to meet this requirement in a simple and successful manner. The method of transmission employed in the Buckingham system is practically similar to that of the Wheatstone automatic telegraph, namely, the double or reversed current method, this having been found best adapted to rapid signalling on long lines. A speed of 200 messages per hour on one circuit between New York and Chicago, which is

attained by the Buckingham printer, is of greater importance than might at first appear, when it is considered that a circuit of similar length operated as a Morse duplex probably does not carry over 60 average messages per hour. The advantages that such a printing system possesses over the Wheatstone or chemical automatic system is obvious when we consider that while the former prints the message for delivery simultaneously with its reception, the tape of the latter must first be translated and typewritten. Another merit of this latter system is that any errors can be detected and corrected almost immediately, while errors on the Wheatstone or chemical systems are not usually detected until the tape reaches the copyist, thus frequently delaying the translation and delivery of the messages.

MANUAL VS. MACHINE TELEGRAPHY.

In another column we print a letter from Mr. J. C. Barclay, electrical engineer of the Western Union Telegraph Company, in which issue is taken with those who would accuse the Western Union of being wedded to antiquated telegraphic methods. As one who is an acknowledged master of the art of telegraphy, from the key to the broad problems involved in a great system handling 66,000,000 messages annually through 23,000 offices, Mr. Barclay is ideally fitted to speak on the subject. His unqualified verdict in favor of manual over automatic telegraphy, except for emergency service, is entitled, therefore, to the highest respect, even though it may appear to be at variance with the great modern tendency to replace as far as possible the manual operative by the machine. It may be answered, however, that the comparison which weighs so strongly against automatic or machine telegraphy is based upon conditions of service which favor manual telegraphy and militate against its modern rival. In other words, the conditions of telegraphy to-day differ little from those of 50 years ago—it remains an urgency service, at least during day hours. If one wishes to send a message at one hour that may as well be delivered some hours later, the message is in theory—if not in practice—on the same footing as one which demands the most rapid haste. As a consequence of this lack of differentiation, an office must be organized to dispose of all business promptly as received, and it is contended that such an organization implies manual telegraphy. But many will, we believe, agree with us in the opinion that if the telegraph service of this country were to be reorganized by the partisans of automatic telegraphy, with power to proceed untrammeled by the traditions of the past, they would by no means meet with the overwhelming defeat that partisans of the old system might consider inevitable. Or, to state the case in another manner, if the birth of telegraphy had been delayed 40 or 50 years, one does not venture much in saying that its evolution would be along entirely different lines than in the past—and, furthermore, that these lines would be fixed by the exigencies of automatic or machine telegraphy.

THE SYNCHRONOUS MOTOR.

In his article on synchronous motor calculation, printed in last week's issue, Mr. F. G. Baum has done practical men a particularly good turn. The average electrician who has to deal with synchronous motors in his daily work is likely to be rusty, to put it midly, on the algebra of complex quantities, and yet he wants to solve ordinary problems in synchronous motor working rather frequently. To those who find themselves in such a position graphical methods appeal strongly. They permit of rapid approximate solutions of many rather difficult problems, and often have the additional advantage that their constructions lead, for particular values of the quantities concerned, to rather easy attainment of rigorous results by the aid of plane trigonometry alone. Mr. Baum's diagrams and equations enable the ordinary computations of synchronous motor practice to be performed with celerity and ample accuracy for practical quantities. In the purely mathematical discussion of these matters, one often forgets a very essential qualifications that separate rigorous theory from ordinary practice. We refer to the general fact that in the every-day problems of power transmission the quantities usually assumed as constants are really variables which cannot be expressed as linear or even quadratic functions of anything whatever.

For example, cos ϕ, one of the commonest factors in ordinary computations regarding alternating currents, is in any practical plant a variable of the most annoying character. One can obtain by exact computation a series of results which will be true of particular instantaneous values of the power factor, but broadly it cannot be regarded as physically constant within five per cent. or so for any ordinary period of time. Consequently, the precision of ordinary graphical methods is amply sufficient to represent the facts. In figuring the over-excitation proper for a synchronous motor, for example, the best that can be done is to approximate it for an average condition, and this can be done, as Mr. Baum has shown, with great facility. The value of simplified methods—short-cuts, as it were—to the busy man is very great, and the more of them one has at his finger tips the better. All that one asks is that the methods should lead to results of the same order of precision as the available data. If the methods are exact, it is so much clear gain, but there is such a thing as putting a hundred-dollar harness on a ten-dollar horse. Of course, one can overdo graphical methods, just as one can torture algebra into doing work fit only for the calculus; but Mr. Baum has kept well clear of intricate and troublesome constructions, and has managed to put a subject, generally considered altogether troublesome, into a very straightforward and practical form.

THUNDERSTORMS IN THE UNITED STATES.

The annual report of the Weather Bureau for 1901 contains, as usual, some very interesting information and data. When it is remembered that about 1,500 skilled observers and nearly 200 stations have contributed to the collection of the observations from which the data are compiled, it is no wonder that the results are of interest. In this report the number of days in which thunderstorms were reported in 1901 are tabulated with respect to the particular Weather Bureau stations and the months of the year. In frequency of recurrence at individual stations, Florida leads with 70 thunderstorm days in the year, a frequency which finds an equal only in the mountain districts of Georgia and the Carolinas. The frequency diminishes in all directions from Florida, if this mountain region be omitted, and becomes reduced to about ten days per annum near Nova Scotia, and about four days per annum on the sea level of the Pacific coast. The average for the entire United States is about 30.4, of which rather more than one-half occur in the three months, June, July and August.

The number of thunderstorm days per year follow, in a general way, the annual rainfall. That is to say, in Florida, Georgia and the Carolinas, where the annual rainfall is heaviest, the thunderstorms recorded at individual stations are also most frequent; and as a very rough rule, one thunderstorm accompanies each inch of rainfall. Notable exceptions to the rule occur, however, in more northern latitudes—namely, toward Nova Scotia on the Atlantic, and toward Vancouver on the Pacific, where the rainfall apears to accumulate without concomitant thunderstorms. It may be, perhaps, that in sunny climes rain and atmospheric electrical disturbances go hand in hand; whereas in more temperate regions the rain falls without marked atmospheric electrical disturbance. As regards danger to electric transmission lines from atmospheric electricity, this is sometimes found in mountainous regions in the absence of thunderstorms. In Colorado, for example, it is frequently reported that atmospheric discharges through transmission lines occur with a clear sky.

Powerful atmospheric electrical displays are reported to have recently been manifested over the active volcanoes of the West India Islands, and similar phenomena have been reported in connection with volcanic eruptions in the past. It seems likely that the principle of the development of the electric energy in these cases is the friction between the rapidly uprushing matter and the walls of the crater or eruptive shaft. In other words, it seems likely that the principle of operation is that of the hydro-electric machine, in which the friction of gaseous steam passing through a nozzle or jet gives rise to powerful electric phenomena. Moreover, wherever the cloud of upheaved gas over the volcanoe undergoes condensation of any kind, by coming into contact with the relatively cold surrounding air, electric accumulation of potential is to be expected. With spherical particles charged to a given initial voltage, the capacity is as their radius. When these particles coalesce by condensation or aggregation, still remaining spherical for simplicity of conception, the charge increases with the mass of the resulting particles or degree of aggregation, while the capacity increases only as the radius or cube root of the mass. Since the potential is equal to the charge divided by the capacity, the potential must rise as the square of the mass, or of the degree of aggregation. Thus, when the initial particles, charged to say 1,000 volts, are welded, or aggregated by close condensation, into masses of ten times the initial radius, the capacity of each mass has increased ten times, the charge one thousand times, and the potential one hundred times, or to 100,000 volts. In this way it is easy to understand how the condensation of feebly potential gaseous particles of steam in the atmosphere may produce drops of rain high in air, of many millions of volts potential; and also that the chilling of the gases belched from the crater of an active volcano may give rise to similar phenomena.

METERS AND METERING.

The electric meter, like the gas meter, has to endure its share of popular obloquy, but it has nevertheless come to be an indispensable part of the equipment of every well ordered station. Contrary to the generally received opinion, meters when in error are much more likely to run too slow than too fast, so that it is the station that should worry rather than the consumer. The introduction of alternating systems of distribution has greatly complicated the metering situation by reason of the difference between the real and the apparent energy; and in spite of all the study which has been given the matter, no adequate solution of the difficulty has as yet been advanced. In a certain way, the matter is allied to the question of capacity charge on systems in general, but it is not necessarily treated in the same manner. The fact is that too much attention has been given to the theory of metering and too little to the practice. The principal desire of the consumer is to get reliable electric light and power and to get it at a low price. He cares not a rap for the philosophy of the matter, so long as his bills are moderate; nor on the other hand, do the stockholders of the electric supply company care much for the methods employed so long as the dividends are regular. Experience has shown that upon the whole all hands are better satisfied by a metering system than by special contracts,, and hence practice has steadily tended toward metering. But experience has not yet shown the best method of defining charges, or even that there is any best method of general applicability. As we have many times pointed out, electric supply is a business which has definite relations with the public as a whole as well as with its consumers as private persons, and hence the ability of a supply company to adopt arbitrary methods of charging is contingent in the last resort upon public toleration.

Broadly, the policy of a standard rate with discounts based on quantity of product used has worked well in most stations of moderate size, particularly in those operating no day or power circuits. But these, once a large majority, are steadily decreasing in number, and with the initiation of power and other day circuits the trouble begins. The particular form which it takes depends on the character of the station, but the fundamental desire of every manager is to make his load curve as nearly a straight line as is possible. All sorts of schemes based upon metering systems or special contracts have been devised to further this end, but the great stumbling block in the way is the fact that most people want electric lights at a particular time of the day, and at no other time. It is of little use to offer a man cut rates for lighting at hours when he does not want it, or to discourage the use of lights at the peak of the load when they are needed. One can make small changes in this way, but not large ones. The thing really effective is to study the local market with the greatest care with a view of developing demands of a favorable kind. The great desideratum is a large use of electricity during the twenty hours between 8 P. M. and 4 P. M., or in large cities between midnight and 4 P. M., and this no mere cut rate scheme seems able to attain. In some isolated cases motor service terminating at 4 P. M. or 5 P. M. might be arranged for, but more than discounts are necessary to prevent the accumulation of a peak. If the storage battery were adroitly applied it would probably do more to steady the load conditions than any other one influence. It makes little practical difference in the results whether discounts for hours outside the peak are made automatically by the meter or semi-automatically by the book-keeper. Even a carefully applied contract system could yield good results in the general way of regulating the load, and taking account when necessary of unusual demands for capacity. Extreme refinements are not necessary for this end.

But alternating apparatus of low power factors presents a different problem. Here is a capacity demand that pulls away at the station all the time and does not tend to even itself up, as the aggregate of casual demands for capacity may. Induction motors or arc lamps with power factors of .7 or less have introduced a new and serious problem into station accounting. Meters which register merely the real energy consumption of such apparatus do not adequately evaluate their demands upon the station, and the question might well be raised whether a recording current meter would not give a fairer basis of charging for this class of service. The propriety of making some charge for the current output actually required hardly admits of debate, whatever view may be taken of the desirability of a capacity charge as such. Ordinary meters, too, make no difference between a customer who runs a small and steady load of fairly good power factor, and a customer who demands the same number of watt-hours monthly at a very bad power factor. In stations of moderate size the manager is frequently able to exercise some control over the character and size of the motors installed on his circuit, and should do so as far as possible; but no one has yet devised any simple and practicable means of dealing with the general problem. A combination of flat rate and meter rate can be successfully applied to motor service, but it is not so easy to work for arcs, which however are less troublesome and do not need so much study of the conditions. Using simple wattmeters, probably the simplest scheme is to base the rates for motor service on a certain assumed power factor so that while the real watts are measured, the apparent watts will upon the average determine the price paid. This is, of course, basing the business on general averages, a procedure which may or may not be philosophically correct, but which is in constant and necessary use in many commercial operations. An electrical supply station is a business enterprise, run for profit and not to demonstrate abstract theories, and so long as it meets public requirements has a wide range of freedom. To our notion, simplicity in its relations with its customers is an important matter, and almost any simple system of charging is better than a complicated one which tempts customers to demand inconvenient modifications.

Pennsylvania Railroad Ends Western Union Contract.

[illegible] from the Philadelphia headquarters of the Pennsylvania Railroad that the company had given notice to the Western Union Telegraph Company that the present agreements under which the latter operates lines over the right of way of the railroad would terminate at the end of six months from June 1, 1902. These contracts—one for the lines east of Pittsburg, and the other for those west of Pittsburg—terminated by limitation in September, 1901, and February of the same year, respectively. Provision was made in the contracts for their continuance upon the same terms until they were either renewed or six months' notice was given by either company of its desire to terminate the agreements. The decision to give the required notice was reached by the Pennsylvania Railroad directors at their meeting last week. When the contract for the lines east of Pittsburg expired last September, reports were current that the Pennsylvania would not renew it because of the aggressive move made by the Goulds to enter Pittsburg with the Wabash system.

The notice by the Pennsylvania to sever the contract means that, after almost a year's effort to get the Western Union to make certain concessions, without satisfactory results, the directors had decided to place themselves in the position of using the company's own line or of entering into a contract with some other telegraph company on a more advantageous basis. This would not necessarily exclude the Western Union from entering into a new contract within the next six months, but the action of the directors gave the railroad officials a free hand either to conduct the company's telegraph business themselves or to enter into a contract with some other company. Should the Pennsylvania Railroad determine to embark into the telegraph business on its own account, it would be in a good position to do so. It already has the nucleus of an extended telegraph system along its line. The operation of its train service was conducted entirely over its own lines. Failing to come to terms with the railroad company for a new contract, the Western Union will have to secure rights of way along highways, construct new lines, and secure new buildings for offices. Western Union stock quotations have been very weak on the announcement.

Governmental Supervision and Municipal Ownership in Great Britain.

About a year ago we referred, editorially, to a paper read by Mr. W. L. Madgen before the British Institution of Electrical Engineers, which set forth the manner in which electrical development in Great Britain has been hampered by governmental regulations and municipal obstruction. Following the reading of the paper, the Institution appointed a committee of 16 of its most prominent members, with Mr. Madgen as chairman, to report on what steps should be taken to assist the electrical industry in connection with the matters dealt with in Mr. Madgen's paper.

After eleven meetings, and the hearing of the views of a number of gentlemen, representing various shades of opinion on the subject, the following resolutions have been reported as embodying the views and recommendations of the committee in respect to the matters referred to it:

1. That, notwithstanding that our countrymen have been among the first in inventive genius in electrical science, its development in the United Kingdom is in a backward condition, as compared with other countries, in respect of practical application to the industrial and social requirements of the nation.

2. That the cause of such backwardness is largely due to the conditions under which the electrical industry has been carried on in this country, and especially to the restrictive character of the legislation governing the initiation and development of electric power and traction undertakings, and the powers of obstruction granted to local authorities.

3. That local boundaries have usually no reference whatever to the needs of the community in regard to electric supply and traction; that the selection of suitable areas should be dealt with on the basis of economic principles and industrial demands; and that this has been found to apply also to gas, water, and sanitary engineering.

4. That the development of electric power and traction undertakings offers the most favorable means of relieving congested centers, and of thus contributing towards the settlement of the housing question.

5. That it is expedient in the national interests that the Electric Lighting Acts 1882-8, the Tramways Act 1870, and the Standing Orders relating to special acts for tramways should be amended in so far as they enable local authorities to veto or delay the carrying out of electric supply and traction projects of which the utility can be shown; and that effect should be given to the recommendations of the Joint Select Committee of Parliament 1898 on "Electrical Energy —Generating Stations and Supply."

6. That excessive time is occupied and expense incurred in obtaining authority to carry out electrical undertakings, and that important and growing industries are thereby checked.

7. That while this committee fully recognizes the ability of the technical officials of the Government departments concerned, it is of opinion that the staffs of those departments, as at present existing, are wholly inadequate having regard to the great industrial interests involved; that it is essential that these departments should be put into a position enabling them to keep in touch with all developments in engineering matters, both in this country and abroad, and that a sufficient sum should be provided annually by the Government to enable them to employ and pay a proper staff for such purposes.

8. That the adjustment of departmental regulations to engineering development should not be delayed until the industrial interests concerned are seriously hampered, and that, with a view to preventing any such delay, the Institution of Electrical Engineers should be willing to take part in revising such regulations from time to time.

9. That this committee recommends that the institution should memorialize the Prime Minister to receive a deputation for the purpose of urging the removal of the present disabilities and restrictions which prevent electrical engineering from making the progress that the national interests demand, and attaining at least the same level as in America, Germany and other industrial countries.

In a communication accompanying the resolutions, the committee reported that the witnesses, while taking divers views of subsidiary questions, were practically unanimous in their conviction that electrical enterprise has not attained that stage of industrial development in Great Britain which might fairly have been expected, having regard to the many favorable natural conditions, and having regard also to the achievements of British capital, labor and inventive genius in so many other branches of the mechanical arts. In considering the comparative development which might have been reached in this country, the committee had in view, not only the extent of the plant employed, but also the source of its design and manufacture. As leading indicative cases, the committee drew attention to the foreign equipment of the Central London Railway, the undisputed competition of American and Continental firms for the electrification of the Metropolitan District Railway, and the large orders executed abroad for the Dublin, Glasgow, Manchester and numerous other corporations. The committee found that the essential difference between the electrical industry as it exists in the United Kingdom and as it exists abroad is largely due to the exceptional legislative enactments, official regulations, and powers of local authorities existing in that country. Thus British electrical engineers, capitalists and others concerned have been hampered by enactments and rules which other governments have regarded as either unnecessary or opposed to public interests.

Under these conditions it has been possible for numerous local authorities to prevent any electrical supply whatever being provided within the area of their jurisdiction; and comprehensive traction schemes have been blocked, or only carried out at great unnecessary expense, owing to the opposition of one or two of the local authorities concerned. A joint select committee of the two Houses of Parliament, appointed so long ago as in 1898, reported that the law should be amended in so far as it gives local authorities the power of veto; but no steps have been taken to give effect to this recommendation. The committee considered that the acts restricting the electrical industry should be revised in order that there may be that development which is necessary to the commercial progress of the nation.

Besides the legislative enactments governing the projection, duration, expropriation, etc., of electrical undertakings, the committee considered that the Government departments should be put into such a position financially as would enable them to keep more in touch with the progress of science so as to prevent them from continuing to enforce regulations which unduly impede engineering development.

The Bergen County, N. J., Lighting System.

By W. J. Jones.

THE lighting system of Hackensack and Bergen County, which is entirely a suburban district, has been completely changed during the past few years. In 1897 the plant at Hackensack was equipped as follows: Two 12½-kw and two 30-kw, direct-current generators; two 60-kw, 125-cycle, alternating-current generators, and a 32-light arc machine. During 1898 the above was changed to a two-phase plant, using one 50-kw and one 150-kw, belted generators, and one 350-kw, direct-coupled generator.

At this time the plant furnished current for street lighting, commercial lighting and power to three towns around Hackensack. In 1899 the electric lighting companies of Rutherford, Ridgewood and Englewood were brought under control of the Hackensack Company, and plans were made to operate these from the plant located at Hackensack. The old plants were abandoned and substations were fitted up in their stead, each of which handle the street and commercial lighting over a territory allotted to them.

The lines for the eastern section of the territory are cabled under the Hackensack River. Okonite and Standard Underground Cable Company submarine cables are used. Where the lines enter and leave the river, cable houses have been erected and supplied with cable switchboards, and extra cables are laid. With suitable plugs a damaged cable can be cut out and a new one connected in a very little time. These cable boards not only serve in the above capacity, but make it very convenient when testing for grounds on any one wire or circuit. The transmission line to Ridgewood is eleven miles, to Rutherford six miles, and to Englewood seven miles.

In 1898 the company lighted four towns, while to-day it is supplying current for street lighting, commercial lighting and power to thirty-eight municipalities, which comprise about fifty different towns and boroughs, covering a territory of about 160 square miles, with about 900 miles of wire and 9,000 poles. These towns have a total of about 2,500 series incandescent street lamps, and 125 series enclosed alternating-current arc lamps; 750 of the incandescent street lamps are of 25 cp, and about 1,750 are of 32 cp.

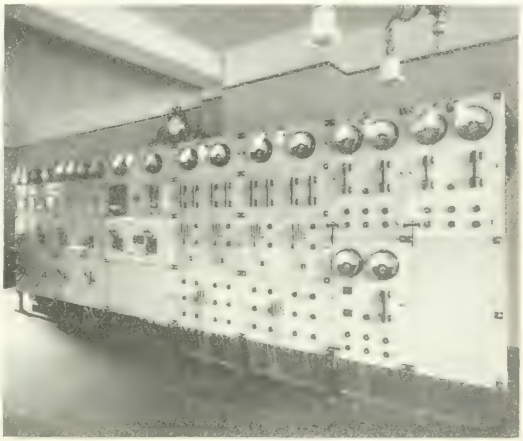


FIG. 2.—SUBSTATION BOARD, HACKENSACK.

The switchboard at Hackensack controls 22 series incandescent circuits and two arc circuits, and is also equipped with feeder regulators for each commercial circuit, and transmission line.

The Rutherford substation has 17 series incandescent circuits, and

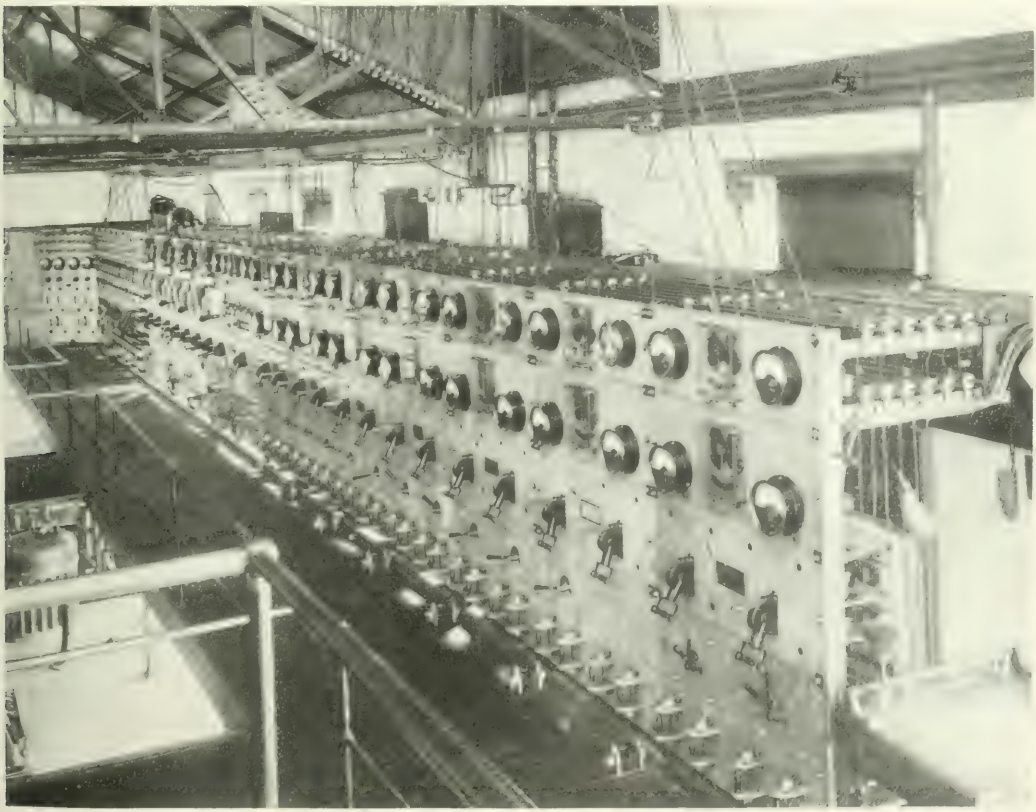


FIG. 1.—MAIN SWITCHBOARD, HACKENSACK.

one arc circuit. Ridgewood has five series incandescent circuits. Englewood has 60 arc lamps and about 320 series incandescent lamps.

The plant at Hackensack is now equipped with one 150-kw, belted, two 350-kw and one 825-kw Stanley two-phase generators, operating at 2,500 volts, and direct connected to McIntosh & Seymour vertical cross-compound, condensing engines. Blake single acting and compound jet condensers are used. The boiler room is equipped with four 300-hp Stirling water-tube boilers, and five 72 in. x 16 in. horizontal return-tubular boilers.

In suburban towns with many shade trees and scattered residences, as found throughout Bergen County, the subject of street lighting and the kind of light to adopt has been and is still quite a problem, but the incandescent lamp seems to be the one most desired, and gives a better distribution of light for a given amount of money. The amount of money appropriated for street lighting very often determines the kind of light and the type of lamp to be used. There are a number of methods of operating incandescent lamps for street lighting. A few places have adopted the system of using a multiple lamp on secondary mains run from large transformers suitably located, but the common practice is to have a series system. Following are a few of the series methods:

Shunt-box system, using a multiple lamp with a shunt-box in parallel; series system, using series lamps with film cut-out in base of lamp; series system, using multiple lamp, with lamp as shunt, and film cut-out in fixture; series system, using multiple lamp with film cut-out in socket.

With a series system using multiple lamp and cut-out in socket, the amount of current for each circuit or series of lamps may be regulated by a bank board, with a number of lamps to be cut in or out by hand, as required, to keep the current constant; by regulators operated by hand, or automatic reactive coils requiring little or no attention. By using either of these and a socket with a film cut-out, a multiple lamp can be used with a saving in cost of renewals of over 50 per cent. over the regular series lamp.

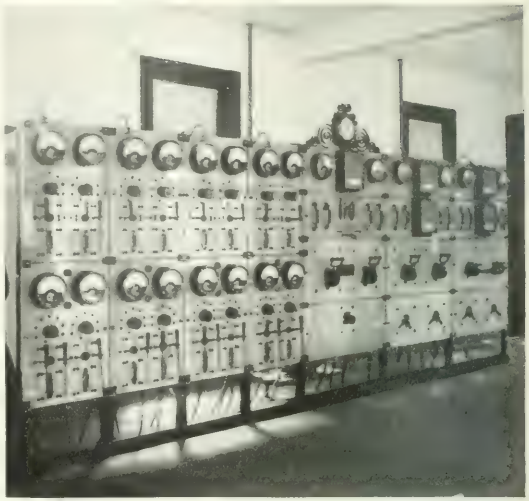


FIG. 4.—SUBSTATION SWITCHBOARD, RIDGEWOOD AND RUTHERFORD.

Some plants have each circuit or series carried back to the plant. Others run out a set of street circuit primary mains, and tap each circuit across; all of the regulating is done at the plant on the mains only, and shunt boxes or shunt lamps used for the regulation of each individual circuit.

The shunt box is quite expensive, not only in first cost, but in loss of energy while in circuit and loss due to burnouts, especially on circuits operated on 2,000 volts, especially from the effects of lightning.

To be able to control the regulation on each circuit as it is done in series arc lighting, each circuit should be run to the plant or substation and be provided with some type of regulator there.

Most of the series incandescent circuits of this company are run on a common-wire system. This common wire is of white insulation and covers a territory of from three to six circuits. Each circuit is tapped to it near the lamp farthest from the plant, and run back through a series of from 45 to 50 lamps of 32-cp, 50 volts each, using a bankboard at the plant to regulate each circuit. The common wire simplifies outside construction, as only seven wires instead of 12 are required for each set of six circuits.

About a year ago three hundred 32-cp, 50-volt lamps were installed in a section of the territory using G. E. reactive coils on 6,000 volts; about 100 lamps are in each circuit, thus leaving a little margin in each circuit for future increase of business.

The voltage of the street system in this section, both arc and incandescent, is 6,000, three-phase, stepped up from 2,400 volt, two-phase. By using reactive coils, switchboard construction is very much simplified, and the regulation on the circuits is the best that can be obtained; this, of course, increasing the life of the lamps and keeping down the cost of renewals and repairs.

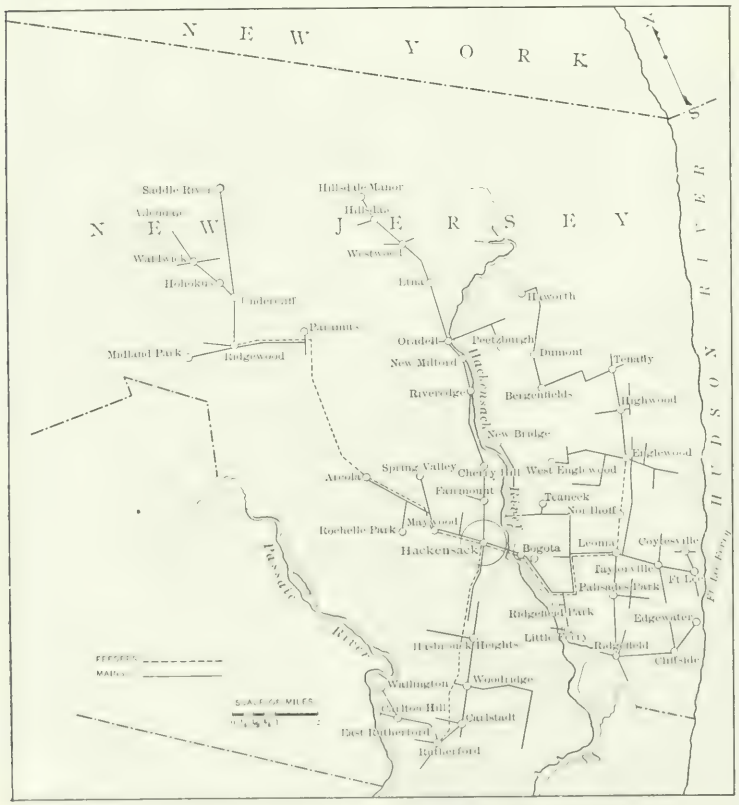


FIG. 3.—MAP OF TERRITORY COVERED BY BERGEN COUNTY LIGHTING SYSTEM.

The multiple lamp appeals to the average council and citizen much more than the series type of lamp, as the multiple lamp is somewhat longer and has a long filament, while the series lamp is very short,

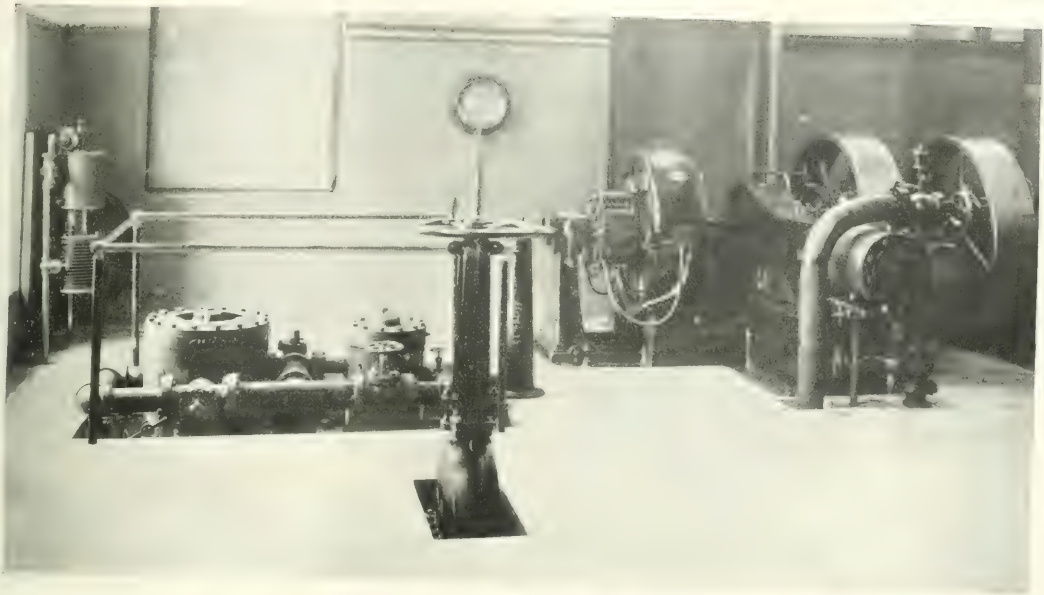


Fig. 5.—Exciter and Condenser, Hackensack.

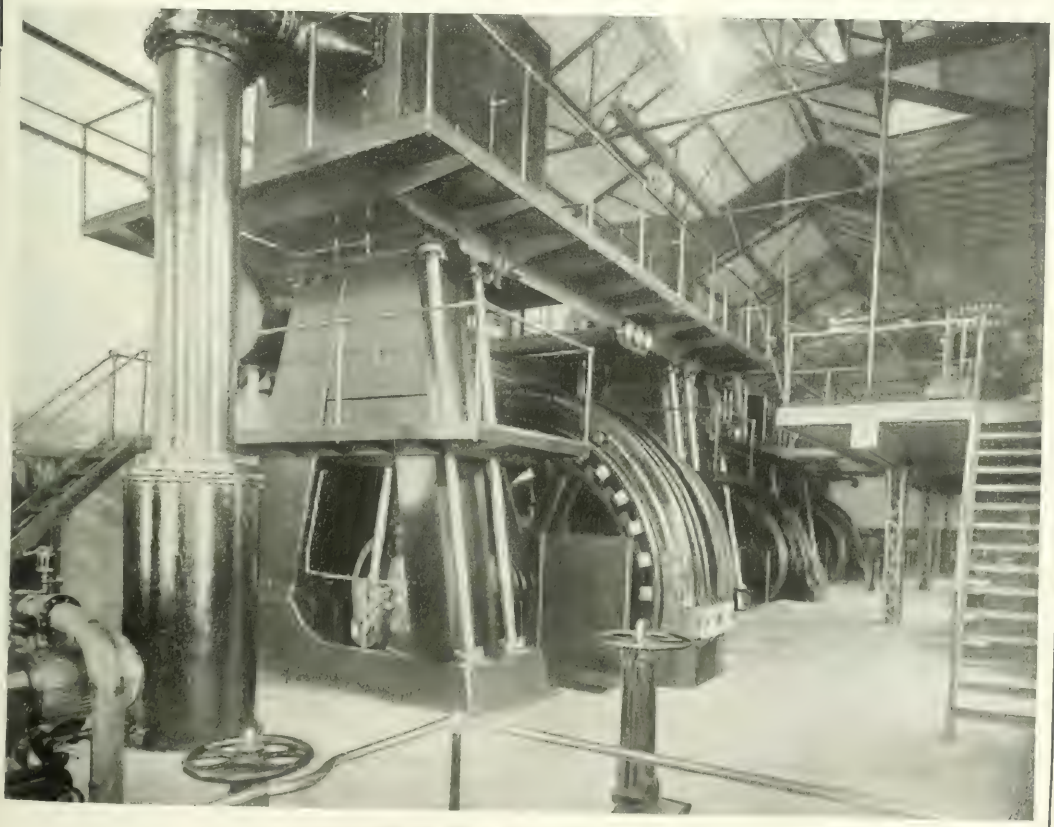


Fig. 6.—Engine Room, Hackensack.

and the cost is about double that of the multiple lamp. Throughout our entire system each lamp is numbered and a record is kept of the number of renewals for each lamp per year.

A record chart is kept, with fifty lamps to a chart, with the date of each change for the entire year. These charts are uniform and will last indefinitely. From these a list is given each inspector every week, with the number of lamps to be changed. Each lamp is renewed six times a year, barring burnouts and breakage. With about 4,000 lighting hours per year, this will give an average of about 656 hours per lamp. This gives the lighted district a very uniform light, as the lamps changed each week are not taken from any one street.

A weekly report is made by each inspector of the lamps and the length of time out. To these are added the station reports of circuits out and a rebate allowed pro rata for the same, to each town or municipality. This method is found to save a number of complaints from councils and town authorities, for when they know such a record is kept of their street lights and they get a rebate for lamps out, bills are more easily passed and are paid promptly.

The Buckingham Long-Distance Page-Printing Telegraph.

BY WILLIAM MAVER, JR.

FROM the days of Wheatstone, House and Hughes, almost to the present time, printing-telegraph systems have depended primarily for success upon the uniformity of revolution of a cylinder or wheel at a transmitting station with a revolving type wheel at a receiving station.

Thus if, as in Fig. 1, two wheels of equal size, having at their peripheries type letters of the alphabet, similarly arranged, are

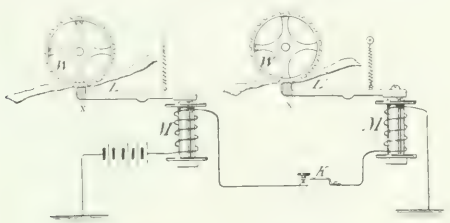


FIG. 1.—ILLUSTRATING SYNCHRONISM.

caused to rotate at equal rates of speed, it is evident that if they have started together, with a given letter on each opposite a given point, each wheel will continue to present a similar letter at that point. If, then, the wheels are suddenly stopped, and at the same time the circuit of the magnets be closed, their armatures will be attracted and the upper ends of the levers will strike against the paper strips provided, impressing thereon whatever letter may at the time be opposite thereto. It is, however, a difficult matter to obtain a uniform rotation of two such wheels, especially when they are rotated at a high rate of speed, unless their rate of rotation is controlled by some master wheel or transmitter.

In printing-telegraph systems such as are used in the well-known "ticker" service, the type wheel of the tickers in the various offices are placed under control of a transmitter, which operates them by a positive, or "step-by-step," movement.

This "step-by-step" movement is produced by a transmitter which sends out pulsations of current, generally of alternate polarity, to which a polarized magnet at the receiving station is responsive. The pulsations thus originated cause the armature of the polarized magnet to oscillate from side to side, and as it does so it operates an escapement, which, in turn, permits an escape-wheel to rotate one-half tooth, or "step," for each half-oscillation; that is, one step for each pulsation of current. If, then, there are, say, sixteen teeth on the escape-wheel, thirty-two pulsations of current will cause it to turn one complete revolution. In practice, a type-wheel having, say, thirty-two letters and other characters on its periphery is placed on the escape-wheel shaft, and hence thirty-two steps of the escape-wheel will effect one revolution of the type-wheel.

In "step-by-step" systems the transmitter is usually designed to transmit, automatically, the number of pulsations requisite to bring any desired letter on a distant type-wheel opposite a given point by the depression of a corresponding key of a keyboard at the transmitting end of the circuit. The printing is usually done by a "press-magnet" in the same circuit as the polarized magnet. The press-magnet is so constructed that it will not respond to the rapid reversals of polarity that actuate the more sensitive polarized magnets, but when a steady current of either polarity flows, one end of the armature lever of the press-magnet is raised against the type-wheel, impressing on the paper the letter which is at that instant in the printing position.

In other printing-telegraph systems, such as the Phelps in this country and the Hughes in Europe, the uniform rotation of the transmitter and type-wheel is maintained by a nearly synchronous rotation of the motors at each end of the circuit, and, in addition, by a device which corrects any slight tendency to variation from the given rate of rotation. A keyboard transmitter is also generally used on these systems.

In these systems it is evident that a considerable loss of time ensues, from the fact that frequently it is necessary to rotate the type-wheel the greater part of a revolution in order to print one letter. Thus, if the letter A follows B in a given word, it will require 31 pulsations of current to print A. If R follows C, 15 pulsations will be necessary. This is nearly equal to 15 pulsations for each letter, and for the space between words as well, and hence conduces to a comparatively low rate of speed, perhaps an average of 30 to 40 words per minute; the message being printed as received on a paper strip, which is not an agreeable form for delivery to the public; in fact, large users of the telegraph frequently specify that messages shall not be delivered to them in strip form. When also it happens that the transmitting cylinder and a printer on these step-by-step systems get out of unison, as it is termed, it is necessary to let the transmitter run free for two or three revolutions, until a unison device which holds the ticker at a unison or zero point is actuated, this frequently requiring sixty or more pulsations of current in the step-by-step systems. In the synchronous systems it is frequently necessary to allow the apparatus to run free for several minutes to obtain unison. Also, it is well known that a high degree of skill is required on the part of the operator of the Phelps and similar keyboards to secure the best results.

The Buckingham long-distance page printer is the successful outcome of the efforts of the inventor, Mr. Charles L. Buckingham, of New York, ably assisted by Mr. E. Germann, to produce a rapid printing-telegraph system adapted to operate on the longest circuits and to avoid the paper strip and other objectionable features of previous printing-telegraph systems. The success of these efforts is attested by the fact that this system has been in daily operation on some of the longest circuits of the Western Union Telegraph Company for nearly four years, transmitting 100 messages per hour between New York and Chicago in each direction, simultaneously on one wire, and printing the messages as received on the regulation telegraph blank, or on large sheets if desired.

It is evident that to obtain these results it was necessary to diminish largely the number of pulsations required for the transmission of letters and spaces below that requisite on the ordinary printing-telegraph. As a first step toward this desideratum, the Buckingham printer employs four very small octagonal type-wheels mounted side by side on one shaft, on the periphery of each of which wheels are placed eight letters and other characters, thirty-two in all. The shaft on which this combined type-wheel is mounted is so disposed that by an ingenious arrangement of five levers it may be given both a lateral and a rotary motion such that any one of the thirty-two characters on the type-wheel may be placed before a given point for printing by five pulsations of current—that is, two and one-half alternations of polarity from the transmitting station. It may also be noted here that the Buckingham receiving apparatus is so arranged that a succession of five short pulsations must always bring the escape-wheel of the receiving apparatus to the unison position, in a manner to be explained subsequently.

For the actual printing of the letter the pulsation required to produce the space between letters and words in the Morse and Wheatstone systems is utilized. Hence the selection and printing of any character are brought about in the Buckingham system by a cycle of six pulses of current in all—that is, three alternations of polarity. These pulses are, however, of varying length, akin in this respect to the Morse alphabet. For example, the letter A will be selected by a dash and two dots, B by a dot, space, dash, space, dot [illegible], the space, as in the Wheatstone system, being made by

a negative current; and since it is known that a succession of five short and long pulses can be arranged in thirty-two different ways, a different combination is readily obtained for the twenty-six letters of the English alphabet and six other characters.

These combinations form what is termed the Buckingham alphabet or code, given herewith:

A — . .	I . . —	Q — — —	Y — . —
B . — . .	K — — —	R	Z
C —	J . —	S	&
D — . .	L	T	Comma (,)
E . — .	M. — —	U . . —	Period (.) — — — .
F — . —	N. — .	V	Question (?)
G . . —	O	W	Dash (—)
H . — —	P . — —	X . . —	Space (blank)

Inasmuch as the prolonged negative or positive pulse of this alphabet, like that of the dash of the Wheatstone-Morse alphabet, is equal to three short pulses (that is, as the dash is to the dot), the letters that occur most frequently in the English language are, in the Buckingham alphabet, allotted the combinations which contain the least number of prolonged impulses.

In the feature of preparing the messages for transmission, and in the actual transmission of the messages, the Buckingham system is almost identical with the Wheatstone automatic system. Consequently, the messages are prepared for transmission by being perforated in a double row on a paper strip, which is then passed through the Wheatstone transmitter, and if the Wheatstone receiver were employed at the receiving end the messages would be recorded on the paper strip as dots, dashes and spaces, differing from the Wheatstone records only as the Buckingham alphabet differs from the Morse alphabet.

The Wheatstone transmitter is shown in Fig. 2. It is said that Wheatstone obtained his idea for this instrument from the Jacquard

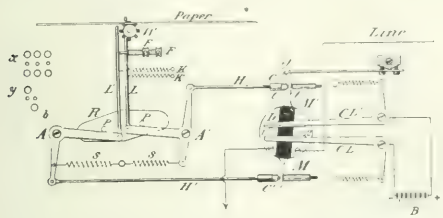


FIG. 2.—THEORY OF WHEATSTONE AUTOMATIC TRANSMITTER.

loom, which in its operation it somewhat resembles. It is seen that the perforated paper is caused to pass above two vertical rods, which receive a tendency to rise vertically by the springs shown, but are limited in their motion by pins on a rocking beam, which, during the operation of the apparatus, is rocked by suitable machinery, and thus, with the rods, presents the appearance of an inverted walking beam, one rod rising with the rocking beam and the other being depressed alternately. When the holes in the paper come immediately above the rods, the latter pass through them and complete a full phase. Hence, if there are a succession of holes in each edge of the paper strip, the rods will make complete excursions, and in that case the levers attached to the lower ends of the vertical rods will operate a pole-reversing device which will send out a succession of short positive and negative currents to the line. When, however, the holes in the paper come at suitably designed intervals, so that at times a rod in rising comes in contact with the paper, it is thereby prevented from rising further with the rocking beams, and thus at that time a prolonged pulse of one or other polarity goes to the line, since at that time the levers of the pole-changers do not alter position, and by suitably arranging the holes in the paper short and long pulses of current may be transmitted in any desired order.

The transmission of the six pulses of alternating polarity thus arbitrarily arranged for each character of the Buckingham alphabet results in the operation of a Wheatstone polarized relay in the main line at the receiving end of the system, which relay by its armature controls a local circuit in which are a governing relay, a unison magnet and an escapement magnet, which latter imparts, by means of an escapement, a step-by-step motion to a "sunflower" or distributor of peculiar construction, to such purpose that, with the co-operation of the governing relay, and depending on the duration of the incoming pulses and the order of their arrival, one or more selecting relays are operated, and these, in turn, cause the operation of the type-moving levers which bring a desired letter on the type-wheel to the printing position.

The Buckingham printer is thus a positive or "step-by-step" system in which an escape-wheel, and with it the sunflower, is caused by a cycle of six pulses of current, one or more of which are prolonged, to undergo a cycle of six steps for each letter or character printed. The term prolonged pulse is a relative term, as will be understood if it is considered that when the system is operating at the rate of 100 words per minute the length of a prolonged pulse is about the one-fortieth part of a second.

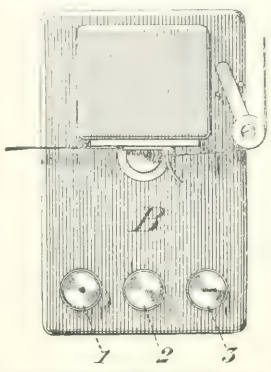


FIG. 3.—WHEATSTONE PERFORATOR.

Before further considering the receiving apparatus, the manner of preparing messages for transmission by the Buckingham system will be described.

First it may be noted that the ordinary method of preparing messages for transmission by the Wheatstone system is a somewhat tedious and arduous process. The apparatus consists essentially of a set of five metal punches, each moving within a close-fitting case, Fig. 3, and which, by suitable mechanism, may be pressed outwardly beyond the case a short distance. The paper to be perforated is caused to pass close to the edges of the punches, Fig. 4. The inner ends of the punches are adjacent to three rods or levers, which connect with three keys or discs, 1, 2, 3, the dot, space and dash keys, respectively. These keys are placed in a position convenient for the operator, who depresses them by means of a rubber-tipped mallet in each hand. Depressing the dot key perforates three vertical holes in the paper, two large and one small. Depressing the dash key perforates four holes, two small central holes, and two large holes at an angle with each other. Depressing the space key perforates a central hole only. The act of depressing a key also causes the paper to be fed by a small star wheel meshing in the central holes. The rate at which a Wheatstone puncher can prepare messages is from twenty to forty words per minute.

One of the important features of the Buckingham system is that it dispenses with this mallet method of punching messages, in which every element of a letter has to be punched separately by the operator, and, instead, it employs a method in which all the elements of a given letter are perforated by the depression of one key on a keyboard corresponding to that of the Remington keyboard, and by means of which messages can be prepared at a speed which is only limited by the capacity of the operator to manipulate the keyboard.

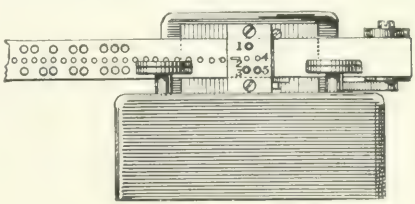


FIG. 4.—WHEATSTONE PERFORATOR.

some data relative to which will be given towards the end of this article.

This keyboard perforator is shown in the accompanying illustrations, Figs. 5, 5a, the operation of which may be described in general terms as follows: Under the levers of the keys a number of fine piano wires are stretched, at right angles to the key levers, at intervals of about ¼ of an inch. These wires are secured at the left end, while at the right end each wire is attached to a crank lever which controls a circuit in which is an electromagnet. There are in all twenty-five of these wires, sixteen of which through

their crank levers control an equal number of punching magnets, and nine of which control nine paper-feed magnets. The key-levers are provided with inverted stirrups on their under edges, the actual number and placing of which is different for each letter, and when a given key lever is depressed these stirrups engage with certain of the piano wires, which latter operate the crank levers with which they are connected and close the circuits of their respective electromagnets. Hence a given key will always operate the same electromagnet.

The punches in the apparatus are sixteen in number, of the same diameter as those used in the Wheatstone puncher, and are placed in two rows, eight in each row, one series of which perforates the necessary upper holes in the paper, the other series the lower holes in the paper. There is thus an upper and a lower row of punches, the upper row being caused to punch the paper from one side, the lower row from the opposite side. Behind each punch there is placed a crank lever, one for each punch, so arranged that it may be operated by the armature of a certain one of the punching magnets, which latter are compactly arranged in a vertical row under the punches for that purpose, as may be partially seen in the illustration. It then follows that when a given key is depressed it will close a certain six of the circuits containing punch magnets, which, in turn, will operate the punches connected therewith, thereby perforating three upper and three lower holes in the exact order required for the transmission of the letter represented by the key so depressed.

At nearly the same instant the hammer end of the armature lever of a magnet termed the "knock-down" magnet has been placed above that pin which is now raised at the fixed stop. When the operator removes his finger from the key, allowing it to ascend, the circuits of the punch magnets and feed magnets are opened, the

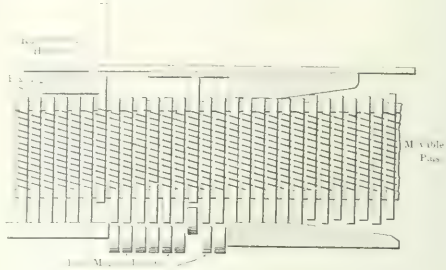
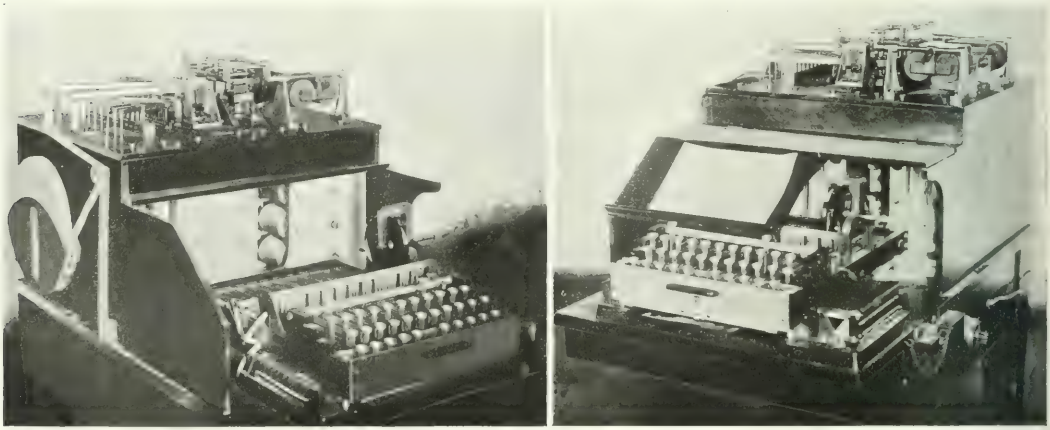


FIG. 6.—THEORY OF PERFORATOR PAPER FEED DEVICE.

punches are withdrawn from the paper, and, nearly simultaneously, the hammer of the knock-down magnet hits the pin under it, depressing it below the fixed stop, whereupon the feed-wheel quickly turns, drawing with it the paper strip, until the pin last raised arrives at the fixed stop, when the wheel is again halted and the apparatus



FIGS. 5 AND 5A.—BUCKINGHAM KEY-BOARD PERFORATOR, FROM OPPOSITE SIDES.

It should be noted that the small central holes in the paper strip are prepared in advance by a separate machine at a very high rate of speed.

Inasmuch as the letters of the Buckingham alphabet, like those of the Morse alphabet, are of variable length, it is evident that a variable paper feed device must be employed in this punching apparatus. This device is outlined in Fig. 6. It consists of a drum-shaped wheel, 1.6 inches in diameter, on the periphery of which are placed small teeth of the proper size and so spaced as to mesh into the central holes of the perforated paper. This wheel is carried on a vertical shaft driven by a motor-wound barrel spring.

This variable feed action is automatically brought about in a very simple manner. There are arranged vertically around the edge of the feed-wheel (Fig. 6) a number of movable pins, frictionally held in any position by close-fitting spiral springs. These pins normally project below, but may be raised above the upper surface of the feed-wheel. Normally, also, some one of these movable pins is always thus raised, and while so raised it engages with a fixed stop placed above the wheel, whereby the wheel's rotation is stopped. When a key-lever is depressed one of the feed magnets referred to is operated, and through its armature lever it drives up another of the movable pins which is distant from the fixed stop a space equal to the length of the letter represented by the key so depressed. Simultaneously with the raising of the latter pin the proper punching magnets have also been actuated and have punched the paper. is ready for the punching of another letter. When the punched paper strip passes the feed-wheel it enters a curved chute (seen in the photograph of the perforator), which strips it from the teeth of the feed-wheel, and it is then ready to be "run" through the Wheatstone transmitter.

In the operation of this keyboard perforator the operator depresses the keys precisely as in the case of the ordinary typewriter, depressing a space key once for the space between the words. To prevent the operator over-running a line, an escape-wheel, termed an indicator, is provided, which is rotated step by step with each key depressed. At the zero point of this wheel, which corresponds with the end of a line, there is a slot into which a pawl drops and locks the apparatus. To unlock it the operator depresses a line space key, which at one operation throws the pawl out of the slot and punches a line space. On the periphery of the indicator, which is plainly seen at the right of the keyboard, is a white mark, which comes into view as the end of the line is approached, giving the operator visual warning to that effect. Provision is also made whereby when a message, or any part of it, ends in the middle of a line the operator may manually turn a knob on the axle of the indicator, which brings it at once to the zero or locked position, ready for the beginning of a new line.

The Buckingham page printer is shown in front and rear view in the illustrations, Figs. 7, 8. To avoid the delay that would necessarily follow the attempt to move a paper carriage in the man-

ner of the ordinary typewriter and page-printing telegraph systems, Mr. Buckingham employs a novel device. The telegraph blanks are arranged in the form of a tube, which is placed loosely over a fixed tubular support. A row of small holes is perforated in advance along the margin of the blank, and the teeth of a small star-wheel mesh into these holes. This star-wheel is carried on the inner side of an annular toothed wheel supported on roller bearings, and which may be seen in Figs. 8, 8*a*. Gearing operated by a motor-wound clock spring gives this wheel a tendency to rotate, but under the control of the printer escapement it acquires a step-by-step movement around the tubular support. There are seventy-four teeth on this ring (sufficient to carry it once around), which correspond with the number of letters and spaces on one line of a telegraph blank. Near the zero point of the escape-wheel several of its teeth are omitted for a purpose presently to be mentioned. While a message is being printed, letter by letter, this annular ring, and with it the star-wheel, is moved step by step around the supporting tube, the star-wheel being held in one axial position by the engagement of its teeth in three circumferential grooves on the supporting tube (Fig. 9), until, at the end of a revolution, the paper is almost at the place of beginning. Since certain of the star-wheel teeth are meshed with the perforations in the paper tube, the latter will obviously be carried around the fixed tubular support, step by step, and thus as printing goes on a new surface is regularly fed beneath the type-wheel. This wheel is visible in Fig. 7, in which a section of the tube has been removed for purposes of illustration.

entrance of the inclined grooves the escape-wheel, from which several teeth are omitted, jumps a corresponding distance, and with it the annular ring, with the result that the annular ring simultaneously moves a distance equal to several short steps, and the paper is advanced a line, with but one step of the escape-wheel; in other words, with but one pulse of current.

Figs. 10, 11, 12, 13 show details of the receiving, unison and

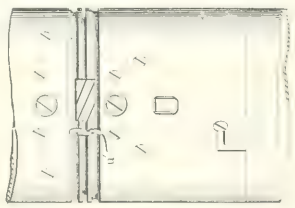
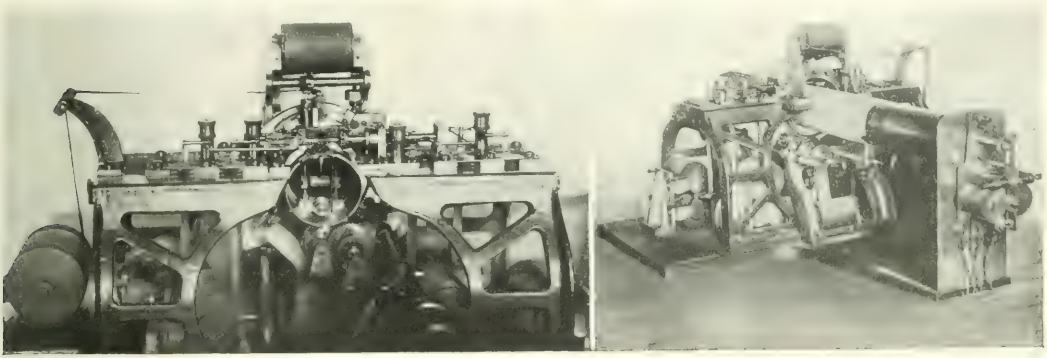


FIG. 9.—SUPPORTING TUBE.

printing apparatus. The main-line polarized relay and the apparatus which it directly controls are shown in Fig. 10. Its armature controls two branch circuits, in which are the sunflower escapement magnet, a unison magnet and a governing relay. These have each two coils reversely wound, and in the case of the escapement magnet the effect is to oscillate its armature from side to side in common with the armature of the main-line relay. The unison



FIGS. 7 AND 8.—FRONT AND REAR VIEWS OF BUCKINGHAM PRINTER.

It will be seen that the circumferential grooves on the tube turn off at an angle, or incline, at a point (Fig. 9) which corresponds with the end of a line on the paper sheet or tube. When the star-wheel in its course passes through these inclines it must turn on

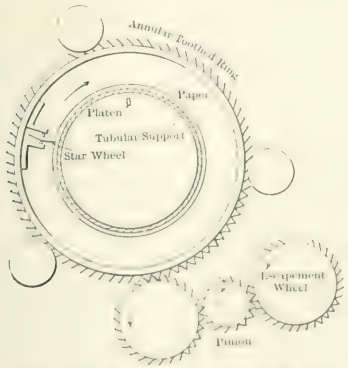


FIG. 8A.—END VIEW OF ANNULAR RING PAPER FEED GEARING.

its axis, causing its teeth to mesh with new perforations in the paper, and advancing the paper thereby the distance of one line along its support. At the time when the star-wheel arrives at the

magnet is polaried, and its coils are so connected that a current through one of its coils corresponding to a negative current on the main line tends to assist the induced magnetism which a current in the other coil (corresponding to a positive current on the main line) opposes the induced magnetism of the magnet. The adjustment of the retractile spring of the magnet is such that its armature will not be attracted by short pulsations of either polarity, nor by prolonged positive pulses, but it will be attracted by prolonged negative currents. The result of this is that when short and long positive and short negative currents are coming over the main line the hook on the end of the armature of the unison magnet is always in the path of the teeth of the unison wheel on the same shaft as the escape wheel, but when a long negative pulse is received the armature is attracted, and the hook is withdrawn from the path of the teeth. The space between any two of the teeth on the unison wheel is equal to the space between any three of the teeth on the escape-wheel. Six pulses of current will move the escape-wheel a distance of three teeth. Hence six pulses will also move the unison wheel a distance equal to that between two of its teeth. Therefore so long as the escape-wheel is in unison with the received pulses of the latter, the hook will always be drawn out of the path of the teeth, since each letter of the Buckingham alphabet is followed by a long negative pulse, and if at any time the apparatus should get out of unison, it is seen that in this way five short pulses will hold it at the unison or zero point, as previously stated.

The teeth of the unison wheel also perform another important

office. There are six circuit-closing levers pivoted as shown, of which five are on one metal support; the sixth is insulated therefrom. The arrangement of these levers relative to the teeth is such that when the unison wheel moves a distance equal to the space between two of its teeth these levers close their respective circuits at 1, 2, 3, 4, 5, 6 in quick succession, beginning at 1. In other words, each cycle of six pulses, whether of long or short duration, will bring about a consecutive closing of the circuits controlled by these levers for a purpose presently to be mentioned. Of course, a long

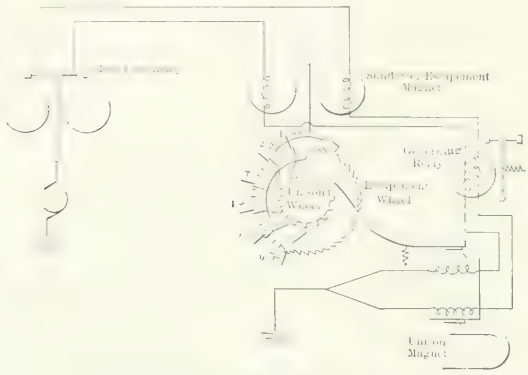
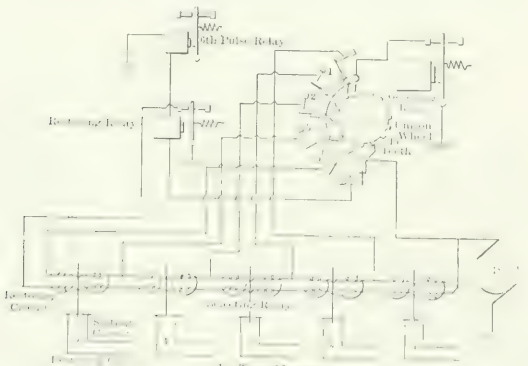


FIG. 10.—DIAGRAM OF RECEIVING APPARATUS.

pulse will cause a circuit closer to dwell longer on its contact than a short pulse.

The retractile spring of the governing relay is so adjusted that its armature will not respond to short pulses of current, but will respond to prolonged pulses of either polarity. This feature is utilized in connection with the circuit closers of the distributor, or sunflower, and certain relays, termed selecting relays, of which there are five, shown in Fig. 11. These relays, known as Nos. 1, 2, 3, 4, 5, also have two coils, reversely wound. The circuit from one of the coils of each relay is connected to the correspondingly numbered contact post of the sunflower, but this circuit, it may be seen, can only be fully completed when the armature of the governing relay is attracted. Each of the selecting relays, by its armature, controls an electromagnet, which latter, by its armature, mechanically moves a lever that is connected with the type-wheel moving devices. These are termed the type-wheel magnets.

Whenever, in the course of the incoming six pulses that repre-



sent and print a character, one or more of the pulses are prolonged, there will, of course, also be a prolonged pulse or pulses in the local circuit of the governing relay, which will attract its armature, as in Fig. 11. Assume, for example, it is the first pulse. At this moment circuit-closing lever 1 is on a tooth of the unison wheel, and its circuit is closed at the contact post 1. Hence, at this instant (the governing relay also being closed) the circuit of No. 1 selecting relay is completed, and being thereby actuated by current from dynamo D, throws its armature to the right, operating a type-magnet No. 1. This magnet, by its armature levers, will move the type-wheel into a position for printing the letter A, and if there be no other prolonged pulses in the cycle up to the sixth pulse that letter will be printed by the sixth pulse. Had the third and fifth pulse of the cycle also been prolonged, the third and fifth selecting relays would have been operated, with the result that the letter K would have been printed.

The sixth circuit-closing lever is the last to act (it may be said to be the first and last, for it rests normally against its contact point, but it leaves it at practically the instant that No. 1 makes its contact). This lever, when closed, energizes two relays, one of which, the sixth pulse relay, operates the press-magnet, the feed-magnet, an ink-ribbon magnet and a dogging magnet; the other is the restoring or resetting relay, which closes the restoring circuit through the selecting relays and type-wheel magnets, and thus resets those instruments to normal position after the selection and printing of a letter. It need not be said that these operations

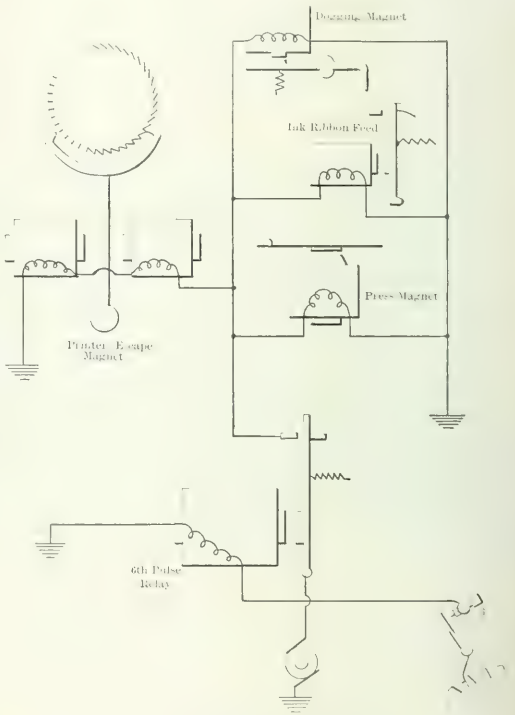


FIG. 12.—DIAGRAM OF PRINTING CIRCUITS.

follow each other very quickly. It is obvious that the apparatus operated by the sixth pulse relay must operate before the restoring apparatus performs its part. This is ensured by giving the armature lever of the restoring relay a longer distance to travel before it makes its contact, and also by suitable adjustment of the retractile springs of the armatures.

The circuit connections of the instruments operated by and in connection with the sixth pulse relay are outlined in Fig. 12.

The ink-ribbon feed magnet actuates a step-by-step ratchet and pawl device which moves the inking ribbon under the type-wheel. The dogging magnet plays an important part in steadying the type-wheel during the process of printing. This it does by means of a small cylinder on the same shaft as the type-wheel on the surface of which cylinders thirty-two small holes are arranged to correspond with the characters on the type-wheel. When the dogging magnet is operated, which will be after a desired letter is approximately in the printing position, its armature drives a dog or pin into one of the holes, thereby adjusting and locking the type wheel

in a given position until the printing is effected, whereupon it is released. The printer escapement magnet operates or controls the train of gearing, which results in feeding the paper around and along its support, as already explained.

The manner in which the type-wheel is brought into any one of the thirty-two possible positions, considered aside from the alphabet, is perhaps the most unique of the numerous novel features of the Buckingham printer.

The electromechanism for this purpose is schematically outlined in Fig. 13. It is also visible in the accompanying photograph. The type-wheel is securely mounted with the dogging cylinder on a horizontal shaft. This shaft receives an endwise motion from the horizontal levers on the left, and a rotary motion from those on the right. In shop phrase, these horizontal levers are termed whiffletrees. The vertical arms 4, 5, connected with type-lever magnets 4, 5, move the horizontal levers which give the endwise motion to the type-wheel. The arms 1, 2, 3 move the right-hand levers which impart by suitable intervening mechanism the rotary motion to the type-wheel. The whiffletrees are connected by suitable links and pins to their respective arms, and are so pivoted and interlinked that a movement of arm 5, for example, to the right will move the type-wheel (whose shaft is attached by a swivel connection to the left-hand levers) a distance equal to the width of

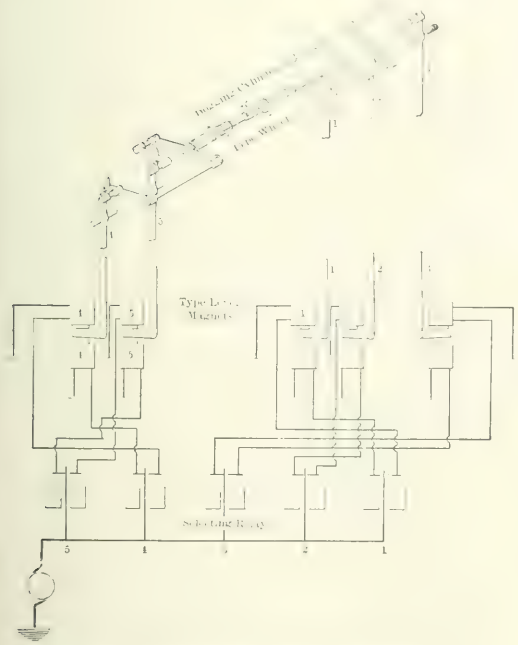


FIG. 13.—TYPE WHEEL MOVING MECHANISM.

one of the type-wheel rings to the left. When arm 4 only is moved, it shoves the type-wheel shaft lengthwise a distance of two rings of the type-wheel to the right. When both arms are moved, the type-wheel is moved a distance equal to one ring to the right. As in the normal position of the type-wheel the second ring from the right is in the printing position, it is clear either of the other three rings may be brought into a printing position by the single and combined effects of two endwise adjusting arms.

The lengthwise or reciprocal movements of the right-hand levers impart a rotary motion to the type-wheel shaft by the intermediary of a spiral slot in a sleeve through which a pin attached to a rod *R* projects. This rod is connected by a link to the right-hand whiffletrees. The type-wheel shaft enters the left end of the same sleeve, in which it moves freely lengthwise. A pin on this shaft projects through a straight slot in such manner that when the sleeve rotates in either direction the pin compels the type-wheel shaft to turn with it. The rotating levers are so adjusted that arm 1, when moved alone to the left by its magnet, will turn the type-wheel as a whole one-half of a revolution in the direction of the arrow shown at the shaft. Arm 2, when moved alone to the right, turns the type-wheel two-eighths of a revolution in an opposite direction. Arm 3, moved alone to the right, turns the type-wheel one-eighth of a revolution in the same direction as arm 2. Arms 2 and 3, acting together, jointly turn the type-wheel three-eighths of a revolution in a direction opposite to the arrow, while arms 1 and 2, acting together, but oppositely, will turn the type-wheel two-eighths of a revolution in the direction of the arrow; and by these means any one of the characters on the type-wheel may be placed in the position for printing with a maximum of five prolonged pulses apart from the final prolonged negative pulse for printing and restoring the apparatus to normal after printing.

The press-magnet is seen at the rear end of the tubular support. Its armature lever is connected with the printing platen by means of a rod attached to a crank lever, the platen being arranged within the tube and driving the paper against the type-wheel through an opening in the tube.

As already noted, the method of transmitting messages by the Buckingham system is identical with that of the Wheatstone automatic telegraph system.

The speed of the operators in preparing messages by the Buckingham keyboard perforating machine for transmission by the Buckingham system has increased with the increased skill of the operators, and is now not less than eighty words per minute. This rate of speed, it may be said, is greater than that at which the most expert operator of a typewriter could transcribe the same messages on ordinary page copy by the Remington or other typewriter. This is due to the fact that the operator of the Buckingham keyboard perforator has practically no sheets to change, the paper strip coming in rolls sufficient for 100 messages. Furthermore, the extent of depression of the key levers of this machine is less in point of distance traveled than the levers of the ordinary typewriter, and it is easier to operate, since it has practically no friction to overcome and no work to do other than to close the circuits of the punching and feed magnets. All the business transmitted by the Buckingham system is prepared by this key-board perforator, and it may be added that two-thirds of all the business transmitted over the regular Wheatstone automatic circuits from the New York office is also prepared by this keyboard perforator, it being understood that it is only a question of arranging the proper combination of stirrups under the key levers to adapt this keyboard perforator to any dot and dash alphabet; the piano wires, feed and punch magnets remaining unchanged.

In the operation of receiving messages by this system an attendant places the telegraph blank in its tubular form over its support, until it meshes with the star-wheel, as stated, to facilitate which a slot at right angles to the circumferential grooves is provided (*a*, Fig. 9).

The reception of message then proceeds. At the end of the first line, which contains the number, originating station and date of the message, also at the end of the address and at the end of the message, a blank space is provided in the perforated strip at the transmitting end. At these intervals the attendant operates a manual device and advances the paper one line. At all other times the line space movement is automatic. When the message is completed the attendant opens up the paper tube by running a knife [illegible] message is practically ready for delivery.

An expert attendant quickly detects any imperfect signals, such as might be caused by wire trouble of any kind, by a break in the rhythm of the working of the receiving apparatus, and in the event of any appearance of error he signals to the transmitting operator accordingly. In this way incipient errors due to line and instrument troubles are detected with practically the same facility as on the regular Morse circuits.

The rate at which messages are regularly transmitted between New York and Chicago by the Buckingham printing-telegraph on a duplex circuit is about 100 average messages in each direction, or 200 messages per hour on one wire. The length of this circuit is 974 miles, but the ordinary Wheatstone repeaters are inserted at Buffalo, which is 444 miles from New York and 532 miles from Chicago. The wires used are the ordinary overhead copper wires of the company, measuring from 3 to 5.5 ohms per mile, and the

system is, of course, operated under all prevailing conditions of capacity, self-induction and inductance effects from other lines to which the contiguous circuits may be subjected.

On several occasions the system has been worked at full capacity, to test its accuracy of transmission and reception. The matter transmitted on these occasions consisted of ordinary newspaper press reports, and was received on sheets of foolscap. On one occasion, from Chicago to New York, 2,429 works were transmitted in 23 minutes 54 seconds. On another, 6073 words were sent and received in 60 minutes and 13 seconds. On still another occasion 9126 words were sent in 91 minutes and 18 seconds, all without an error in the printed copy. This is at an average rate of 100 words per minute. These figures include the time lost in changing the sheets, which, at the date of the tests, required six seconds for each change. By an improvement in the apparatus this time has been reduced to one second. It is estimated that over 1,500,000 messages have been transmitted by this system since its introduction upon the lines in question.

In conclusion the writer begs to acknowledge his many obligations to Mr. Buckingham for facilities afforded him in gathering data concerning this interesting system for publication in detail in the author's work, *American Telegraphy*, considerable of which data, it may be said, has been drawn upon in the preparation of this article, which is the first consecutive description of the Buckingham printer that has thus far been given to the public.

A Polyphase Motor System for Traction Purposes.

At the annual meeting of the American Institute of Electrical Engineers, held May 20, two papers were read relating to polyphase electric traction. One paper was communicated by Mr. Ernst Danielson, of Westeras, Sweden, and the other was read by Mr. Carl L. De Muralt, of Zurich, Switzerland. The latter paper, an abstract of which will appear in the following issue, gives an account of all the more important polyphase electric railways that have been installed in Europe.

The paper by Mr. Danielson deals with an arrangement of polyphase motors, which makes it possible to obtain economically four different speeds by means of only two such motors. The object of this arrangement is to do away with some of the difficulties now experienced in applying induction motors to railway work.

As is well known the concatenated control of two induction motors consists in connecting the secondary circuit of one to the primary of the other, mechanical connection being arranged so as to make the moving parts of both motors always run at the same speed. In this way a combination is obtained giving a speed corresponding to half of the regular speed of each motor. The torque of each motor will be the same when used single or in concatenated connection. This means that the output of the concatenated combination is only half of the output of the motors operating independently.

If instead of using two similar motors, two motors of different speeds (*i. e.*, with a different number of poles) are combined in concatenated connection, a speed is obtained which corresponds to a number of poles equal to the sum of both motors. Assume a combination of a 6-pole and a 4-pole motor and a frequency of 50 cycles per second; then three different speeds are possible, viz.: the speed of the 4-pole motor alone (the 6-pole motor running idle), or 1,500 r. p. m. (minus slip); the 6-pole motor speed, or 1,000 r. p. m., and the combination speed, or 600 r. p. m. If both motors are of the same horse-power, say, for instance, 50-hp, the combination gives also 50-hp. By means of this arrangement there is thus a motor capacity of 50 hp at three different speeds, 1,500, 1,000 and 600 r. p. m.

But it is possible to go still further. When connecting in concatenation there is a possibility of making the connection either so that the torque of both motors works in the same direction, or by crossing the leads combining the secondary of the first motor with the primary of the second, to get a resultant torque which is the difference between those of the two motors. This arrangement may be called a differential concatenated connection. In order to see the result of this, assume two motors, one with 10 poles and one with four poles, both of the same output, say 50 hp each, the rotors being mounted on the same shaft. (Fig. 1.) If now the source of current be connected to the stator of the 4-pole motor, and the rotor winding of the same motor be connected to the rotor winding of the 10-pole motor in such a way that the magnetic field in both rotors will revolve in the same direction relatively to their cores—then the torques of both motors will be opposite to each other.

As both motors have the same output, then if the torque of the 4-pole motor be called unity, that of the 10-pole motor will be 2.5; accordingly the resulting torque in this case will be $2.5 - 1 = 1.5$, and acting in the same direction as that of the 10-pole motor. As

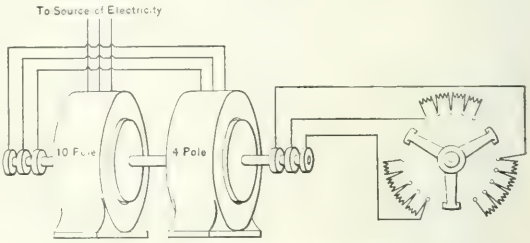


FIG. 1.—TWO ROTORS ON ONE SHAFT.

the system begins to move, the frequency in the circuit belonging to the rotors increases, whereas the frequency in the stator of the 10-pole motor decreases. Started in the regular way by inserting resistance in the last secondary and gradually cutting it out, the speed comes up until the frequency in the stator winding of the 10-pole motor approaches zero, which will happen when the speed is 1,000 r. p. m. (the frequency being 50 cycles per second); that is to say we have obtained a motor running at 1,000 revolutions, and with a torque which is represented by 1.5; the torque of a 1,500 revolution motor (4-pole) of 50 hp being unity. Accordingly, the horse-power of this arrangement is still 50.

By means of this combination of two motors we can thus obtain the same output under following conditions: (1) The 4-pole motor alone, the 10-pole running idle with a speed of 1,500 r. p. m. (2) Differential concatenation speed, or 1,000 r. p. m. (3) 10-pole motor alone, the 4-pole motor running idle, or a speed of 600 r. p. m. (4) Regular or direct concatenation of speed of 428 r. p. m. These torques and speeds are graphically represented in Fig. 2, which gives the torque for any of the speeds with regular full load current on a 20-hp motor. The lag, of course, is considerably greater in the con-

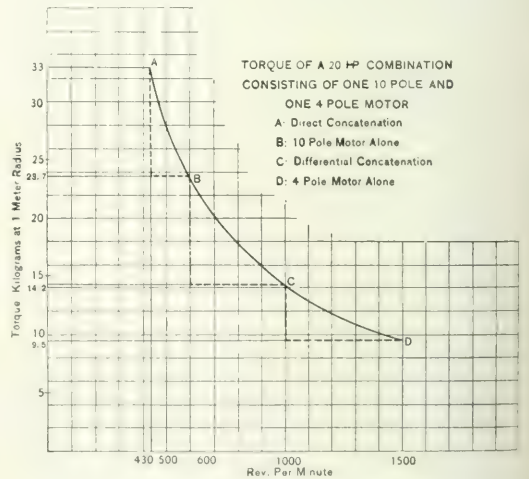


FIG. 2.—TORQUE AND SPEED OF 200-HP MOTOR.

catenated connection—direct or differential—than with one motor alone.

Fig. 3 shows a small motor built on these principles and which is intended for running tool machinery in a workshop. It is designed with a 10 poles of large diameter on one side and 4 poles on the other side. It accordingly gives the speeds 428, 600, 1000, 1,500.

Obviously, if gearing of some kind be used, the motors need not have different numbers of poles. For instance, if both motors are identical and are geared to the same shaft so that one gives a speed

.617 that of the other, then the speeds which are obtainable form a geometrical series, the ratio of which is 0.617; that is to say, it is possible to obtain four different speeds each of which is 0.617 of the one which is next higher.

Referring to the fact first brought forth by Mr. Steinmetz, that a system of two equal induction motors in concatenated connection

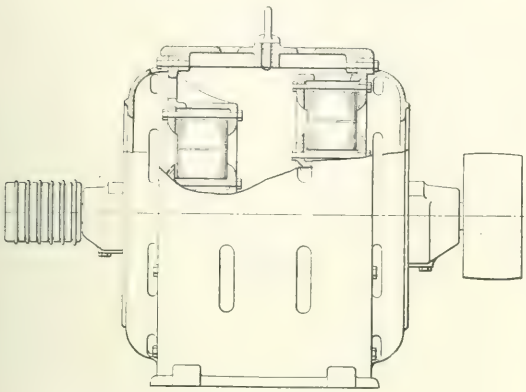


FIG. 3.—DIAGRAM OF SMALL MOTOR.

can operate at two different speeds, Mr. Danielson says that in this case there is no risk of obtaining the secondary speed instead of the one desired, for the reason that the latter speed is always lower than the secondary speed.

Among the advantages given for this system as applied to electric traction work is the possibility of using economically four different speeds. When running over a road with considerable grade, the motors can work at different torques, corresponding to the different speeds, and still have the same input, which is not the case with the series motor; moreover, it is possible over almost the entire range to increase the torque above the normal if that should be considered desirable—for instance, in order to make up for lost time. This is shown graphically in Fig. 4, which shows a curve of torque and speed

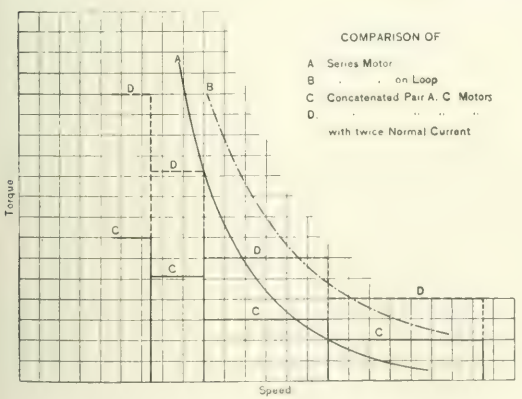


FIG. 4.—CURVE OF TORQUE AND SPEED OF SERIES MOTOR.

for a series motor and for a combination of polyphase motors. While the direct-current motor cannot at higher speeds develop torque above the curve, the induction motors can momentarily develop anything up to the dotted line.

In using this system the work of the motorman will consist merely in handling the controller so as to keep the current at a certain normal value, not only when accelerating, but also when running. As to economy, the accompanying table gives a comparison of the different systems with respect to input, the motors starting up to full speed and braking down, electrically, as far as possible.

RELATIVE AMOUNT OF ENERGY CONSUMED.

	Accelerating only		Accelerating and Electrically Braking.	
	Without gearing.	With gearing.	Without gearing.	With gearing.
D. C. Motor, resistance entirely cut out at ½ full speed	1.33	1.4	1.33	1.4
D. C. Motor, resistance entirely cut out at full speed	1.4	1.48	1.4	1.48
A. C. Motor, simple	2.17	2.29	2.17	2.29
A. C. Motors regular concatenated connection	1.68	1.77	1.36	1.47
A. C. Motors, three speeds: 0.4: 0.67 1	1.5	1.58	1.17	1.27
A. C. Motors, four speeds: 0.285: 0.4: 0.67 1	1.45	1.52	1.15	1.24

Mr. Danielson says that, admitting the polyphase motor as a rule is fully as efficient as the series direct-current motor, it may be considered that when working on an even road the difference in energy consumption will be negligible; it would then appear that by using the four-speed arrangement of concatenated connection, it will be possible to get a more economical method of working electric roads than by means of the direct-current system with series motor. Considering at the same time that for greater distances the electric energy has to be generated as alternating current and then transformed into direct in converter stations, whereas with polyphase motors on the cars simple transformers can be used, giving a difference in loss of at least 5 per cent. to 7 per cent. in favor of the alternating-current motors, the comparison comes out still more in favor of these. Another advantage is that there is no need for high voltage in the rotating parts of the motors; the rotor windings can be arranged for any desired voltage, thus giving the designer full liberty to choose this so as to get the most convenient winding.

As to any difficulty introduced by making one of the motors of 2.5 times the torque of the other, the author replies that the best solution probably in many cases will be to connect in concatenation one motor with two or three others in parallel—for instance, with a locomotive with four axles, have three of the motors of a slower running type than the fourth, and of a current-carrying capacity something like one-third of the latter. The same arrangement could be used for an ordinary double track car with four motors. For cars with only two axles the best arrangement will probably be with only three speed connection, and then there will be very little difficulty—the difference in torque of the two motors not being so considerable.

The discussion of the two papers read was opened by President Steinmetz, who briefly abstracted Mr. Danielson's paper, and said, in closing, that he considered it a very fair comparison of the relative merits of alternating and direct currents for railway work. He then called upon Mr. C. O. Mailloux to open the discussion.

Mr. Mailloux stated that although upon returning from Europe a few years ago he had been completely saturated with the alternating-current idea, he had since become demagnetized and now considered there were too many limitations in the possibilities of high acceleration in alternating-current railway motors to make them practical for ordinary service. He pointed out that in Mr. De Muralt's paper the accelerations were only from one-half mile per hour, per second, to three-quarters mile per hour, per second, which rates are very much under the requirements of passenger service in this country. He thought, however, that the alternating-current motor would find its place when long roads operating under essentially steam railroad conditions commenced to be electrified. In the present state of the art, he believed, passenger service dictated the use of direct-current motors. He called attention to the importance of Mr. Danielson's paper, as indicating the possibilities of better control than is now obtained by ordinary arrangements of alternating-current equipments. On account of the weight increasing so rapidly with increased power, and the necessity for having much larger motors for accelerating than are required for running, he thought, with present designs, it would be economically possible to obtain high acceleration only by the use of special gearing with changeable ratio between motor shaft and driving axle.

Mr. Steinmetz continued the discussion by commenting on the power used on the Swiss roads. Comparing it with the consumption of an ordinary American interurban car, it appears very small. While the tests showed that the motors could be slightly overloaded, he thought that not enough margin was left. Ordinary requirements demand that a motor car should be able to push a disabled car in front

of it, involving an overload of over 100 per cent. As the motors could not be run above synchronism, the old trouble of the cable roads in not being able to make up time was again present. As power was returned to the line only when motors were running above their nominal speed, it would be dangerous to attempt it with passenger cars designed for 40 miles per hour, although much saving may be effected in this way with slow speed freight trains.

The discussion was continued by Messrs. Stott, Hammer, Walcott, Henshaw and others. In replying to numerous questions that had been asked, Mr. De Muralt said that there had been no trouble from short-circuiting on three-phase, 10,000-volt trolley lines when placed one above the other. An arc had never started as the contact device was good and the current low. It was necessary to have the substations near together on heavy-duty lines alone. The lighting arresters used had given no trouble as far as he knew. The distance between the top of cars and trolley wires where the bow trolleys were used made little difference, but best results were obtained when the trolley was nearly vertical. The rollers had variable lengths of life, some lasting much longer than others. It is no trouble to renew a roller, and the old one is recast with slight loss of material. The tubes are made of softer metal than the trolley wire, and so take most of the wear. The use of the iron rails as one leg produces no unbalancing of the three-phase circuits. It is probably prevented by the high frequency used. He thought the ability to make up time did not belong entirely to direct-current motors. Where loss of time occurs from too long or frequent stops, it generally is accompanied by an overload of passengers. Under such conditions the alternating-current motor may make better time than an overloaded direct-current motor. He thought acceleration a matter of motor capacity. An acceleration of 1½ miles per hour, per second, have been obtained, and he thought motors could be designed for even greater accelerations.

Recent Developments in Electrochemistry.

By Clinton Paul Townsend.

Mr. Edison has stated that so far as regards capacity per unit of weight, the most effective combination, in an alkaline solution, is finely divided iron against nickel or cobalt oxide, both mixed with foliated graphite. This statement lends interest to

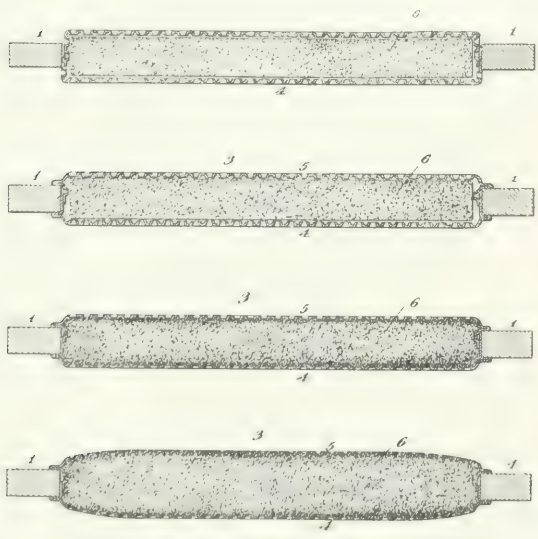


FIG. 4.—[illegible] BATTERY.

his current patent disclosing an economical method for the production of the iron in suitable physical state. As will be recalled, the method patented a year ago depended upon the electrolytic oxidation of ferrous sulphide in potassium hydrate, and subsequent reduction of the oxide formed; according to the present disclosure, sheets of the [illegible] are subjected to quick oxidation in a muffle and the scale at once detached and ground to pass through a 200-mesh sieve. This scale oxide is mixed with one-fourth its weight of foliated graphite, packed in the pockets of the plate, and electrolytically reduced.

In another patent Mr. Edison describes in detail the construction of the plates. These are of the now familiar form, comprising a light framework of nickel-plated steel, the active mass being retained in perforated pockets, also of plated steel, secured in the apertures, and the upper bar of the grid increasing in cross section toward the connecting lug in conformity to the rate of discharge from the pockets. The changes undergone during forming are well shown in the accompanying figures, in which the grid is indicated at 1, the perforated pockets at 3, and the active mass at 6. Opposite plates 4, 5, enclosing the active mass, are set in position in the grid, as indicated in Fig. 1. A compression of the ends crimps the pockets over the grid, as shown in Fig. 2. Upon immersion in the alkaline electrolyte the active mass increases somewhat in bulk, bringing it, as shown in Fig. 3, into close contact with the pockets; and upon forming a further increase in bulk occurs, distending the pocket walls, as shown in Fig. 4. Thereafter the elasticity of the steel walls is relied upon to maintain a close contact through the changes of bulk undergone during successive charges and discharges.

OXYCHLORIDES.

Mr. George Jones Atkins, of London, England, patents the device illustrated in Fig. 5, comprising a vessel *a* lined with carbon blocks

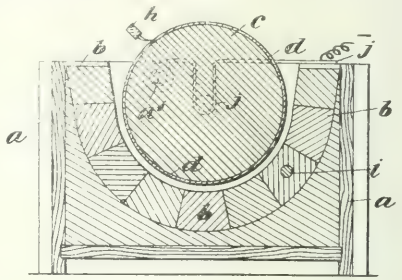


FIG. 5.—CHLORINE ELECTROLYSIS.

b and supporting a revoluble cylinder *c* of wood covered with a sheet *d* of lead. The carbon blocks and the sheet-lead cylinder constitute anode and cathode respectively, the electrical connections being indicated at *i j*. Sodium chloride solution is introduced at a^1, and passing through the annular space between the electrodes overflows at the opposite end of the bath. A scraper *h*, bearing on the revolving cylinder, mechanically depolarizes the cathode. A solution of sodium chloride flowing through the vat is decomposed by a current of less than four volts, yielding a mixture of chloride, hypochlorite and chlorate, which in the presence of acid may be used for the slow liberation of chlorine, for the treatment of ores or other purposes. Save for the single feature of the direction of flow of the electrolyte, the apparatus is identical with that patented many years ago by Hermite for the electrolytic production of bleach liquor.

ELECTRIC FURNACE.

A patent issued in the name of the late Dr. de Chalmot covers the furnace employed by him for his well-known researches on the metallic silicides. The furnace comprises the usual carbon-lined, cast-iron pot *A*, formed in two sections, *a*, *b*, with an intermediate flange *c*, *g*, and provided with the tap *d* and vent *e*. This pot forms one electrode, the other being the carbon *B* depending through the cover. The distinctive features are the sectional construction of the cover *m*, m^1, clearly shown in the figure (page 911), with independent water conduits to each section; the stuffing-box *E*, to prevent access of air to the heated carbon; and a shunt *s* from the electrode to the cover, whereby these portions of the furnace are maintained at the same potential. This is an important feature, since an accidental arc to the water-cooled cover would destroy it. A line of insulation *l* prevents short circuiting between the cover and the pot.

FUSED BATH ELECTROLYSIS.

Messrs. Roepper & Scholl, of Philadelphia, describe apparatus for the electrolysis of fused baths in general, the essential feature being the provision of a fusion chamber adjoining the electrolytic cell.

this chamber and the cell communicating at their lower portions. The purposes are to utilize gases of combustion for bringing the salts into fusion and to provide means for free communication between the general body of fused salt and the particular portion undergoing electrolysis. The details of the electrolytic cell have been carefully worked out, the several parts being water cooled and

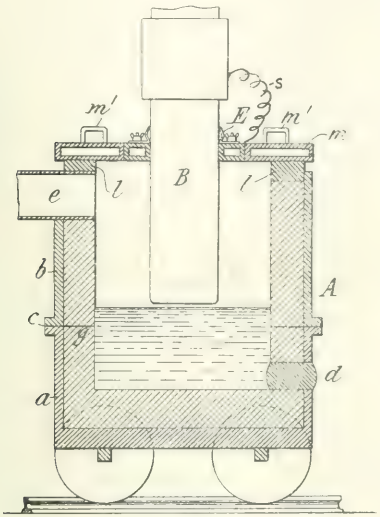


FIG. 6.—DE CHALMOT'S ELECTROLYTIC ENVELOPE.

readily replaceable, and the principle of protection by a chilled layer of electrolyte being freely applied.

REDUCTION OF ORES.

Mr. Frederic H. Long, of Chicago, has heretofore patented a "converter," wherein a stream of ore pulp is continously circulated past the anodes and over the horizontal diaphragm of an electrolytic cell, the cathode compartment comprising a chamber beneath the diaphragm. He finds that in operation the resistance rises owing to the accumulation of gas below the diaphragm and bases his present patent upon the simple expedient of providing a suitable vent pipe at the proper point. Carmichael long ago found the same difficulty and solved it in the same way.

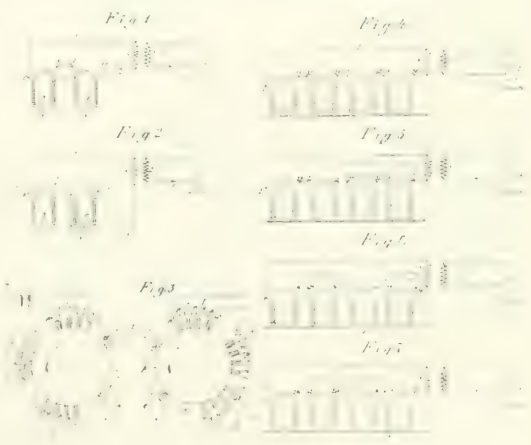
Multiplexing the Telegraphone.

A patent just issued to Peder Oluf Pedersen, of Copenhagen, covers a method of using the Poulsen telegraphone in such a way as to record a number of messages on a single steel strip and to reproduce each message without interference from the other. With this improvement in the Poulsen invention, it is obvious that the size of the drum or the length of the wire or ribbon used therein may be materially lessened, so that a long speech or a number of speeches or signals may be stored upon a comparatively short or small magnetic body.

The essence of the invention is the use of two or more recording magnets, the connections of which are varied for each message, with a corresponding variation in the combined action of the magnets on the recording strip. To reproduce each message the connections of the magnets must be adjusted to the same combination that was used in impressing it. In the drawings, Figs. 1 and 2 show how two messages may be recorded on and reproduced from the same portions of two adjacent steel strips. Fig. 3 is a diagram showing how several messages may be simultaneously transmitted over a single line by means of the telegraphone; and Figs. 4 to 7 illustrate the methods of connecting four electromagnets in different ways to fix four different messages on the same strip. In Figs. 1 and 2, *a* and *b* are two separate steel ribbons drawn past the poles of magnets 7 and 10 connected in series with the secondary 4 of the telephone circuit. By means of plugs 6, 8, 9 and 11 the connections of the magnets in the circuit may be varied. A message spoken into the transmitter 2 will be recorded magnetically on the strips *a* and *b*, and may be reproduced on substituting a receiver for coil 4, according to the well-known action of the telegraphone.

By changing the connections of the magnets, as shown in Fig 2, the polarity of one is reversed and in this state of the magnets the original message cannot be reproduced, because each magnetic condition in one of the strips *a* and *b* will be equal to the corresponding condition in the other, and as they oppose each other in the magnets there will be no current in the circuit and silence in the receiver; but while the magnets are thus connected it is possible to fix on *a* and *b* an entirely new message, which will not in any way obliterate the first message, and which can be reproduced while the connections remain the same and will not prevent the reproduction of the first message when the connections of the magnets are changed back to the conditions shown in Fig. 1. It is not necessary to use separate recording strips for each magnet, as the desired results can be obtained by using a single strip, it being necessary only that the magnets shall act at different parts of the strip. In using a drum carrying a spirally-wound steel wire, the magnets should be arranged to bear on two different convolutions of the spiral.

Figs. 4 to 7 show the extension of the method to four magnets, the connections of which can be varied, as indicated, to permit the recording and reproduction of four separate messages on the same strip. Fig. 3 shows the application of the same principle of varying combinations of magnets to the simultaneous transmission of several messages along the same wire. It is assumed that three messages are to be simultaneously transmitted along the line 21. At the transmitting end is a steel disk *i*, and at the receiving end a similar steel disk *k*; in working both are simultaneously rotated. Each station has three local circuits, *I*, *II*, *III*, each having four electromagnets connected in different combinations, the combinations of the different circuits at each end corresponding with each other; that is, the magnets of each circuit *I* are connected in the same manner, and so on. The circuit 21 is connected at each end to an electromagnet, 20 and 22, facing the corresponding disk. With the apparatus equipped thus in operation, the magnetism created in the disk *i* by the three different sets of magnets acting simultaneously thereon



PEDERSEN'S MESSAGE RECORDER.

will affect the magnet 20 and send impulses over the circuit 21, which will be received by 22 and impressed upon the disk *K*.

Those impulses which were created by the circuit *I* at the transmitting end will be picked up and delivered to the receiver in the circuit *I* at the receiving end, and in like manner the receiving circuits *II* and *III* will select the messages delivered through the circuits *II* and *III* at the transmitting station. After the disk has passed all the recording and receiving magnets it passes an obliterating magnet p^1, which cleans off the record so that it may be presented to the recording magnets in condition to receive a new portion of the message.

New Telephone Patents.

The issue of the Patent Office, of May 13, contains little of interest to telephone men, there being but two patents directly bearing on telephony. The first is due to Mr. Frank B. Cook, of Chicago, and covers a polarized bell of somewhat novel design. Mr. Cook entitles his invention, a "polarized electromagnetic apparatus," and does not wish to confine its application to bells, though a polarized bell is what he specifically describes. The general design of the bell is somewhat similar to that of the drop patented by the same inventor a short time ago, the magnet being enclosed in a split casing between the opposed ends of which the armature is pivoted. The magnetic casing surrounding the magnet core besides providing a sensitive magnet gives the magnet a high impedance, and also serves as a protection against fire by enclosing the coil in a fire-proof sheath.

Referring to Fig. 1, A and A^2 are the permanent magnets attached to the frame D^3 by the bracket D^2 and supporting the two parts B and B^2 of the magnetic shell or casing of the electromagnet D by means of the screws a a. The core D^4 of the electromagnet is connected to the two parts of the shell B and B^2, so that the core, the shell and the armature form a nearly complete magnetic circuit. The ring armature H is pivoted as shown at b, and encircles the electromagnet D. The armature is, therefore, disposed between the ends of the two parts B and B^2 of the shell, so that the polarized ends thereof act directly upon the armature. The usual bell-hammer J is attached to the armature.

With an alternating current the ends of the two parts of the shell are of different polarities, and a combined push and pull is brought to bear upon the armature. The ends of the permanent magnet, also brought to bear upon the armature H, are of the same relative polarity, thus permanently polarizing the armature with one magnetic polarity.

The upper sketch, to the right in the illustration, shows an attachment to be used when a straight current is employed, which is capable of ready attachment to or detachment from the bell. It consists of a prolongation or extension piece, K, of the armature, a bracket, K^2, removably held on the permanent magnets by the screws a a, having a holding arm K^3, a spring K^4 and an adjusting screw K^5 for the spring. This device is capable of ready removal, and can be reversed in position as desired to exert an opposite pull on the armature when a current of opposite polarity is used.

The inventor claims that as the lines of force of the magnet poles

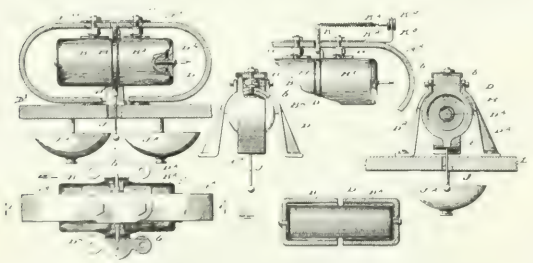


FIG. 1.—COOK'S POLARIZED ELECTROMAGNETIC APPARATUS.

of the shell act directly upon the armature, the arrangement is such as to produce a more sensitive action of the armature, while the inclosing of the magnet coil in a magnetic shell gives a high impedance without the use of excessively long cores.

Mr. George E. Goodhead, of Winchester, Illinois, patents a telephone circuit for party-lines, the object of which is to provide means to prevent intermediate stations from listening in. The device embodies the use of an auxiliary switch, more or less controlled by the receiver switch hook, and is one of the many arrangements of circuits and apparatus that go through the Patent Office, but seldom reach the field of practical application. Fig. 2 sufficiently illustrates the idea. An auxiliary switch consists of contact plates 4 and 5, between which and adapted to engage with either is plate 6, mounted on block 7 of insulating material, and moved by rod 8, having the slotted end 9, in which the receiver hook works. The parts of the switch are also shown in detail, as well as the slotted end of the rod, the rod [illegible] that it may be moved by hand. The line wire 9 comes from central, and is continued on to the next station by wire 11, wire 12 being a common return; or rather, the stations are connected in series with a branch to the common return. Moving the receiver off the hook 3 cuts off the wire 11, and moving the push-rod 8 upward cuts off line 9 from the station and connects

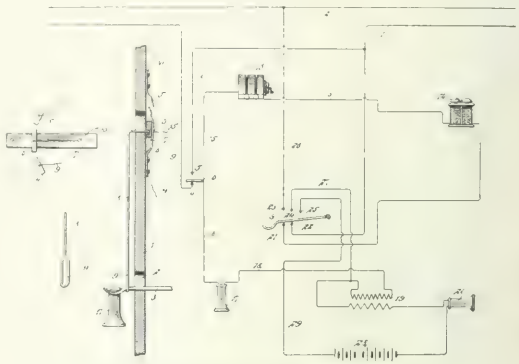


FIG. 2.—GOODHEAD'S TELEPHONE CIRCUIT.

line 11 by means of wire 10. Upon replacing receiver 17, the rod 8 will be drawn down, thus automatically restoring the circuit. An intermediate telephone attempting to listen in cuts out the station on the side away from the central by breaking the connection between wires 9 and 11 at contacts 21 and 22.

CURRENT NEWS AND NOTES.

AUTOMOBILE CHARGING STATIONS.—Stations for charging automobiles using the "Exide" battery have been opened in New York, at 148 West Eighteenth Street; Philadelphia, at 250 North Broad Street; Buffalo, at 200 Pearl Street; Chicago, at 264 Michigan Avenue. Similar stations will shortly be established in a number of other cities.

FRENCH SUBMARINE BOATS.—A cable dispatch from Paris says: M. Goubet, the inventor of a submarine vessel, who is not an officer, disgusted over the tactics of the regular officers of the navy, who through their alleged jealousy caused him all sorts of trouble, has sold his invention to an English private company, specially organized to build the vessel. Goubet received $100,000 in cash, retaining a third interest of the future profits. The company will build indiscriminately for governments or private persons.

A. A. A. S.—The preliminary announcement of the meeting of the American Association for the Advancement of Science, to be held at Pittsburg from June 28 to July 3, fills 50 pages of an octavo pamphlet, just issued. Full information is given concerning railroad rates, and a list is printed of the names of all of the officials for the Pittsburg meeting and of the local committee, the latter comprising several hundred names. Some pages are devoted to information concerning the hotels and boarding houses of Pittsburg, and the arrangements made for the places of meeting of the various sections of the association and of the affiliated scientific societies. A guide to Pittsburg occupies ten pages, in which information is given concerning the various places of interest, with directions as to transportation to the same. Arrangements have been made whereby representatives of the press may have full facilities for reporting the meeting. The importance of properly reporting the meetings of the association is dwelt upon by the secretary, and members are urgently requested to bring to the meeting duplicate type-written abstracts, or reports, stating the main features or facts contained in the papers. With the admirable arrangements that have been made for the meetings of the association and the entertainment of the visitors, and with the facilities that will be accorded newspaper men, the Pittsburg meeting of the Association promises to be one of the most successful—perhaps the most successful—in the history of the association.

DIGEST OF PATENTS.—Mr. Jas. T. Allen, well known as an authority on electrical patents, is engaged on the preparation of a digest of telephone patents from the earliest patent to December, 1901, and on similar digests of electric lighting patents, automobile patents, and air and gas engine patents.

ELECTRICAL ENTERPRISES IN WALES.—The U. S. Consul at Cardiff, Wales, reports that much interest is being taken in what promises to be the most gigantic enterprise in the principality—the South Wales Electrical Distribution Company, which is building a large generating station at Pontypridd. The station, when completed, will generate no less than 70,000 horse-power, and no one unit will be smaller than 3,000 indicated hp. At present, five combined sets of triple-expansion engines and generators, together with 24 water-tube boilers, and all the necessary auxiliary machinery, switchboards, mains, etc., are being provided for, and will be at work within 12 months from the present time. Three-phase currents will be generated at 12,000 volts.

FROGS AND TELEGRAPHS.—Something new in the relations between "galvanic" telegraphs and frogs is reported as follows: One of the great enemies of the overland telegraph line in central Australia is the common green frog. In order to save the insulators from being broken by the lightning they are provided with wire "droppers" leading round them at a little distance, to conduct on to the iron pole in case of need. The frogs climb the poles and find the insulators cool and pleasant to their bodies, and fancy that the "dropper" is put there to furnish them with a back seat. After a nap they yawn and stretch out a leg until it touches the pole—result, sudden death of the frog, and as the body continues to conduct the current to earth we have a paragraph in the papers to the effect that "in consequence of an interruption to the lines, probably caused by a cyclonic disturbance in the interior, we are unable to present our readers with the usual cables from England."

BIRKELAND ELECTRIC CANNON.—A cable dispatch from Berlin, of May 17, says: It is announced that the trials of the electromagnetic cannon, invented by Prof. Birkeland, of Christiania, has been so successful that a German firm has offered to purchase the system. The proposal will be placed before a company which has been formed at Christiania for the development and improvement of the invention. In the meantime, arrangements are on foot to test the power of the gun to fire a projectile of two tons a distance of 12½ miles, which the inventor asserts it can do. The Norwegian company, however, has not been able to raise the £7,500 necessary to carry on the test. The Norwegian experts are confident that this cannon will effect a revolution equal to that caused by the invention of gunpowder. According to Prof. Birkeland's calculations, the firing capacity of a cannon increases with the length of the barrel. A gun with a barrel of 32 feet 10 inches could fire a two-ton projectile 93 miles, which would enable the French to bombard London from Calais. A longer barrel ought to be able to hit the moon. It would be interesting to have the Professor's calculations as to the kilowatt capacity required for his gun, and the amount of material for electromagnetic storage.

SAFETY ELECTRIC RAILWAY SYSTEM.—Five patents issued May 13, to Charles J. Kintner, relate to arrangements having for their object to prevent front or rear-end collisions between electric cars operated on a sectional conductor system. The essential feature of the system patented lies in connecting each sectional conductor to the earth or return circuit through a releasing and signalling circuit running to the distant ends of the two adjoining sectional conductors. The application of this principle makes it possible to avoid either front or rear-end collisions, to avoid accidents at turnbridges, at sidings, at crossings at other roads, whether electrical or common roadways, and a number of other essential dangers. One of the patents relates to means for using metal terminals for connecting the sectional conductors to, and disconnecting them from, the current feeder or main without arcing, and the placing of such terminals in relatively close position to each other. The sectional conductors are by this system locked into connection with the current feeder as a car enters a section and remain locked until the car either advances and passes out at the other end of the section, or runs backward with reversed trolley to the distant end of the sectional conductor it has just left.

TELEPHONE RECEIVER FOR WIRELESS TELEGRAPHY.—The name of "coherer telephone" has been given to a wireless telegraph receiver by the inventor, Thomas Tomasina, of Geneva, Switzerland. There is a coherer in connection with the diaphragm of a telephone receiver, the terminals of the coherer being connected, respectively, to the antennæ and to ground. These terminals also serve to connect a relay circuit. When the relay circuit is closed through the coherer by the Hertzian rays passing through the same from the antennæ to ground, the second circuit is closed in turn by the relay to operate the recording apparatus and energize the diaphragm magnet, thus producing a sound, and at the same time decohering the material of the coherer. The sound produced by the receiving instrument is stated to be sufficiently loud to be heard distinctly without placing the instrument to the ear, and hence in use it is not necessary to remove the instrument from its support. The iron diaphragm of the ordinary telephone receiver is covered on one face with a sheet of insulating material, such as paper, on which is fixed, by means of a second sheet of paper, a plate of insulating material having an opening, which forms a recess in which the cohering powder is lodged. A sheet of mica closes this recess and allows the cohering powder to be observed. The movement of the diaphragm of the electromagnet gives the necessary mechanical decohering motion to the powder.

ANNUAL MEETING OF THE A. I. E. E.—The Nineteenth Annual meeting of the American Institute of Electrical Engineers was held at New York on Tuesday, May 20th, president Steinmetz in the chair, 75 members and guests being present, and 149 members represented by proxy. The annual reports of the Board of Directors and the Treasurer were presented, showing a net gain in membership of 239 during the year, and an increase of $14,844.48 in net assets, the total assets on May 1st being $30,220.24, of which $1,885.17 is in cash, and $16,285 in government bonds (market value). The president appointed Mr. Townsend Wolcott, Col. Samuel Reber and Mr. W. C. Andrews a committee on proxies. Chairman W. J. Hammer of the committee on tellers reported the election by ballot of the nominees of the Board of Directors of officers for the ensuing year as follows: President, Charles F. Scott. Vice-Presidents, C. O. Mailloux, Bion J. Arnold, Schuyler S. Wheeler. Managers, Townsend Wolcott, Gano S. Dunn, E. H. Mullin and Charles A. Terry. Treasurer, George A. Hamilton. Secretary, Ralph W. Pope. Under the Constitution the following officers hold over: Vice-Presidents, Dr. Michael I. Pupin, Dr. Samuel Sheldon and George F. Sever. Managers, John J. Carty, W. S. Barstow, Ralph D. Mershon, Calvin W. Rice, John W. Leib, Jr., W. E. Goldsborough and Col. Samuel Reber. Mr. Carl L. deMuralt then read a paper on "Some Notes on European Traction with Three-Phase Alternating Currents," which was fully illustrated by lantern slides. An abstract of this paper will appear later in these columns. A paper by Mr. Ernst Danielson on "A Novel Combination of Polyphase Motors for Traction Purposes," in the absence of the author, was read by the president. An abstract of this paper and the following discussion is printed elsewhere in this issue. At the meeting of the Board of Directors in the afternoon 34 associate members were elected.

LETTERS TO THE EDITORS.

The Telegraph of To-day.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to Prof. Pupin's criticism of the Western Union Telegraph Company for its alleged slowness in adopting new methods, I am constrained to say that the professor displays a wonderful lack of knowledge of the telegraph, which is perhaps not surprising in view of the fact that the gentleman has presumably had no practical experience whatever in this field. For the benefit of those who read Prof. Pupin's criticism and are unfamiliar with the practical workings of the telegraph, I take pleasure in making reply to the criticism from a practical standpoint.

At the time when Prof. Morse erected his first wire between Washington and Baltimore, a distance of 41 miles, under adverse circumstances, and over which he sent his first message, he did not realize that he had invented the best, quickest and cheapest system of telegraphy that has been introduced up to the present time. It is true that this first message was reproduced embossed on paper, by means of what was then known as the receiving register. This

until the young American with his quick ear for music learned to receive messages by sound; the old registers have long since become obsolete, and with nimble fingers, messages are now transmitted over the wires not only a distance of 41 miles, but thousands of miles, as rapidly as the receiver can write them on a type-writer, and as distinctly and simple as *A, B, C*—I may say more distinctly than the letters and figures can be talked over the telephone lines, for there is no similarity between the Morse characters forming the letters *B* and *V* and other letters, which letters are so confusing when transmitted over the telephone.

Since the telegraph was invented, the improvements in the apparatus have kept apace with the demands of the American people, and to-day, according to the admissions of experts who have been sent here by all the foreign countries to investigate our systems, the telegraph systems in America are years in advance of those of most all other nations. This is evident in the improved apparatus, namely, the multiplex systems, automatic repeaters, switchboards, copper line wires, insulation and conductivity, motor-dynamos, storage batteries, etc. To illustrate the quickness of this wonderful system, it is not uncommon for a broker to file his message in New York, Boston, Chicago, Philadelphia or other cities in the United States, and to have the same transmitted to his broker on the floor of one of the exchanges, the order filled, and to have received the reply notifying him that it had been executed, within the short space of 55 seconds. Messages of this description are not only transmitted between Chicago and New York, a distance of 984 miles, but the same is true of the direct working wires of this company between San Francisco and New York, a distance of 3300 miles. The American people have been educated up to this quick service, which, as I have said before, is the most rapid that has been introduced up to the present time.

Prof. Pupin referred particularly to the automatic rapid system of telegraphy, and in order to compare one of these systems with the former, it will be necessary to explain the *modus operandi* necessary to transmit and receive a message. I may say that one of the most rapid systems was given a practical test by the writer over the Western Union lines between New York and Chicago within the past two years, and in point of working satisfactorily it was an absolute failure, and not adaptable to use in this country on account of its slowness. In the system referred to, the message when handed into the office of the telegraph company is placed before an employé known as a "puncher," who perforates the message on a strip of paper, which consumes more time than would be required by an expert operator to transmit it from New York to San Francisco by the Morse system. The message is afterwards run through what is known as a Wheatstone transmitter; simultaneously a receiver is in operation at the distant end of the line, consisting of a cylinder containing sensitized paper. After the message has been reproduced on this paper, it is necessary to carry it into a dark room, where it is developed in the same manner that a photographer develops his negative. It is next placed in the hands of an employé known as a "copyist." The message is then copied on a type-writer, which again consumes more time than it would require an expert telegrapher to receive the message transmitted by the Morse system.

If an error is discovered in the message as received on the sensitized paper, which frequently occurs, it is not possible to correct it at the time it is being received, as would be the case if telegraphed by the Morse system, and much time is consumed in making such corrections.

A number of automatic systems have been tested by the telegraph companies of this country, but up to the present time every one of them has been found lacking, except for emergency service. They are not only slower than the Morse system, but more expensive to operate. A corps of expert electricians is constantly in our employ experimenting with new devices and testing automatic and machine telegraphic systems, with a view to securing something better than the Morse. While some of the automatics will transmit very rapidly, the time wasted in preparing the message for transmission and recopying makes the service slower and more expensive than the Morse.

To show the growth of the Western Union Telegraph Company, in 1867 it operated 46,000 miles of poles and cables, 85,000 miles of wire, and handled 5,000,000 messages with 2,000 offices. In 1901 it operated 194,000 miles of poles and cables, 673,000 miles of wire, and handled 66,000,000 messages with 23,000 offices. The greatest length of one continuous circuit operated by this company is from [illegible] circuit operated by the telephone company is from New York to Omaha, 1,466 miles.

[illegible] N. Y. J. C. BARCLAY.

Electrical Engineer Western Union Telegraph Company.

The Right of Inventors to Encouragement.

To the Editors of the Electrical World and Engineer:

Sirs.—Referring to the editorial in your issue of May 10th, on the "Western Union Shakeup," I commend to prayerful consideration the remark of Prof. Pupin, "that anyone who offers them an improvement is treated like a book agent," as text for a short sermon on unprogressiveness by manufacturers in general, and especially by governments. The treatment of inventors by government officials is a well-known scandal since the days of Dickens and "Little Dorrit." In the forty years since that work was written, governmental methods (and some manufacturers' methods) have changed but little. I speak with knowledge when I say that the attitude of the United States officials is one of intolerance and obstruction. A common stock phrase among the officers to whom less fortunate inventors are referred is, "Oh, send him an inventor's letter!" It is unusual for any inquiry whatever to be made. This was the experience of those controlling the art of wireless telegraphy as commercially applied; has been the experience of many persons who have made improvements in marine engines, and has been the experience of every man who has invented an improvement in fire-arms, big or little; and to the shame of our government be it said, inventors have been robbed, absolutely without recourse.

To cite a concrete instance, the well-known Krag-Jorgensen gun is but a minor and unimportant modification of a weapon invented by an American, and patented by him. In the opinion of many experts, the modification was not an improvement; but, waiving this, the United States have appropriated the patented construction, and, although retaining from the purchase price a portion nominally for the purpose of guarding against claims for infringement (showing that the officers of the government were aware of the facts), no part of it has ever reached the true inventor, or is likely to do so, there being no jurisdiction in any court to try such a case, and no officer of the government having moral courage enough to demand that the contractors shall compensate the patentee. This is but one instance of many.

Dr. Conan Doyle's recent experience with the British war office, of which he complains so bitterly in the London *Times*, is but another. He had, as he thought, invented a distinct improvement in sights for firearms; if anything could possibly be needed in the British service in South Africa it was that, but upon his offer to submit it to the War Office the answer was that the office "would not trouble him in the matter." As he said, it might amount to nothing, or it might be revolutionary, but the War Office would not even inquire.

Substantially all of the progress in the mechanic arts of all kinds has been effected by persons not in government employ. Of the persons employed by the government very few are competent by education or actual ability to pass upon the value of improvements, and those few have but little, if anything, to do with the subject. This is the attitude also of some manufacturers; but is not the case with those who have attained the greatest eminence in their respective lines. To cite the case of only one large corporation, with the affairs of which I am familiar: Its entire force is constantly upon the lookout for every improvement which can be made, and it maintains a large staff of experts for the sole purpose of looking over improvements made by others which are applicable to its work, and purchasing them, either outright or the permission to employ them. Hundreds of thousands of dollars are spent in this way every year, and I betray no secret when I say that its inventors are all from two to five years ahead of present demands in the art, and constantly seeking to anticipate and provide for the demands of the new arts, and in many cases by so doing practically creating those arts.

If the American manufacturers are to get and keep the world's markets, they must of necessity resort to the improvements constantly devised by American inventors. An inventor is no longer a sporadic genius, but a hard-working business man, applying his efforts and intelligence to definite problems; in most cases a technologist, a graduate of the highest schools, versed in literature and

languages as well [illegible] ticular art to which his invention relates; in many cases better qualified to pass on its value than those who have occasion to adopt it. He is entitled, no matter how visionary his plans may appear, to a fair hearing, to an opportunity to explain fully the merits of his device or process, and to have it tested on a proper scale before a decision is reached. T. J. JOHNSON.

NEW YORK CITY.

[While agreeing in the main with Mr. Johnson in his position, it should be pointed out that as a great majority of inventions do not advance beyond the stage of patent issue—often owing to lack of commercial availability, even when the invention possesses intrinsic merit in conception—there is some reason for the attitude of the business man and government official toward the inventer.—EDS.]

Synchronous Reactance.

SIRS.—I have just read Mr. Behrend's letter in your issue of May 10, criticizing my article on "Synchronous Reactance," which appeared in your issue of April 26, in which he says, "it seems surprising that at this late season novelty can be claimed by Mr. Baum for discovering the discrepancy between calculation and observation in using the short-circuit current for determining the drop in alternators." I beg to say that I made no claim of discovering anything. I am aware, and have been for some years, that the short-circuit current does not give us the true reactance. In fact, no experiment is needed to prove this, and it may be considered as having been discovered at the time of the discovery of the variable reluctance of iron.

STANFORD UNIVERSITY, CALIF. F. G. BAUM.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Railway and Tramway Motors.—[illegible] in which he discusses some statements made by Carus-Wilson in the discussion of Swinburne's recent paper, as has been noticed in the Digest. He corrects an incorrect statement of Carus-Wilson concerning the motor used in the test on the Liverpool Overhead. He gives in a diagram the characteristic curves of this motor. At 100 hp this motor requires 162 amp., and delivers a torque of 1,780 lbs. This is at the rate of 11 lbs. per ampere. At half-load, or 50 hp, the motor requires 83 amp., and delivers a torque of 600 lbs., or 7.22 lbs. per ampere. The torque per ampere varies between half load and full load in the ratio of 100 to 152, and not in the ratio of 100 to 110, as Carus-Wilson had stated. The value of this ratio increases as the rating of the motor is decreased. For example, under some conditions of rating, this motor might be styled a 50-hp motor. Under such conditions the value of the torque per ampere varies about as 100 to 165. The original motors built by the large electrical companies were very much underrated; this explains to some degree why we find now a decrease of this ratio. Carus-Wilson desires to increase the value of the torques at full load and at overload, *i. e.*, to make more of a load in the torque curve. This change will entail a diminution of speed for these loads: it will make the speed curve straighter. There are objections to this proposition. In order to insure sparkless commutation at full load and all overloads, it is necessary that the magnetic density must be brought to saturation in the pole face, the teeth, or the armature body; to make this effective it is necessary to cause a considerable bend in the speed curve. The type of motor made by the Steel Motor Co. has this carried to such an extent that practically the only point to be considered in connection with overload is the heating effect. Sparking at any overload seems unknown. This freedom from sparking is obtained at the expense of very heavy starting current. The same effect of sparkless commutation might be obtained by winding the armature so that it will not be so heavily loaded. This means that the iron sections must be increased, and that a motor of larger capacity must be bought. The dead weight carried by the cars must therefore be increased. A further advantage of early saturation of some part of the magnetic circuit is that we thus obtain a more constant speed and have more of the advantages of a shunt-wound motor—namely, constant speed at varying loads. This is especially advantageous on roads operated under steam railroad conditions, where a schedule speed must be adhered to under all conditions of traffic.—Lond. *Elec.*, April 25.

Armature Reaction of an Alternator.—ARNOLD.—A long communication, illustrated by diagrams. In the armature winding of an alternator, an e.m.f. is induced at no load, which depends only upon the exciting current. When the generator is loaded, the armature current produces an alternating magnetic field which reacts upon the armature winding, induces currents in the exciter circuit and eddy currents in the solid metal parts. All these actions may be called armature reaction, while the inducing action of the armature field upon the armature winding is simply self-induction. The voltage at the terminals of the generator decreases at load, if the excitation remains unchanged. In general, the e.m.f. induced by the field is no sine wave, and therefore a graphical addition of the vectors of the e.m.fs. is incorrect. Moreover, the effective resistance and the effective reactance of the armature winding are not constant; the latter depends largely upon the saturation of the magnet cores and teeth and varies during one period. If one wants to apply graphical methods, one must be satisfied with approximate results. The effective resistance depends upon the ohmic resistance, eddy currents in the pole shoes and variation of the reactance. He then distinguishes the different fluxes which determine the self-induction, and gives diagrams in which the different e.m.fs. are properly combined. He shows how, by different authors, either one or the other determining factor is overlooked. He gives a diagram from a book by himself and La Cour, as also the formulas for determining the various values in the diagram. He then discusses the following point: When the machine is loaded and the demagnetizing ampere windings weaken the field, there is a smaller saturation in the magnet cores and yoke; the magnetic reluctance is thereby diminished, and as the ampere windings of the exciting coils have remained constant, the field leakage is increased; but this increase is not great and is often exaggerated. He shows that in the worst case the leakage coefficient can become 6 or 7 per cent. greater than at no load; in most cases, however, the increase is insignificant.—*Elek. Zeit.*, March 20.

[illegible] ROTHERT.—Further contributions to the discussion on the subject which has recently been going on in the correspondence column of this journal. Rezelmann replies to a criticism of Bauch. Corsepius agrees with Rothert that the dependency of the leakage flux upon the armature current is of importance; he gives some general notes on the leakage flux and on armature reaction.—*Elek. Zeit.*, March 13.—Bauch makes some remarks on diagrams for this matter, and discusses at length a suspiciously high leakage coefficient found by Rothert.—*Elek. Zeit.*, March 20.—Rothert claims the priority of the diagram for himself, and corrects a numerical error.—*Elek. Zeit.*, April 17.

Induction Motor.—ZIEHL.—A detailed illustrated description of construction and tests of a 10-hp, 190-volt, 50-periods, three-phase induction motor of the Schwartzkopff Co.—*Elek. Zeit.*, March 20.

[illegible]

Small Water-Power Transmission Plant.—HARDESTY.—An illustrated description of a small water-power electric transmsision plant

for local lighting service in Utah County, Utah; this is considered as a good example of what could be done in utilizing the natural fall of many mountain streams in the West for the benefit of neighboring settlements. There is at present installed a 250-kw, 60-cycle, 6,600-volt, three-phase generator. The current is transmitted to a sub-station, five miles distant, where the voltage is reduced to 2,000. From there the current is transmitted to different places for lighting and power, 115 and 200 being the voltages used, respectively, for these purposes. The hydraulic installation is described in detail.—*Eng. News*, April 17.

REFERENCES.

Alternating-Current Transmission.—STURDEVANT.—A reprint in full of an illustrated paper read before the Cleveland Electric Club. He first gives a general graphical review of the phenomena taking place in alternating-current circuits, and then makes an application to a simple numerical case of power transmission. No use is made of higher mathematics.—*West. Elec.*, April 19, 26, May 8.

Boilers.—The whole issue, of more than 100 pages, consists of a profusely illustrated description of American stationary boilers and furnaces, and feed water heaters.—*The Eng.*, April 15.

Electrical Equipment of a Shipyard.—A long and well-illustrated description of the electric power distribution and application in the shipbuilding plant of the Fore River Ship & Engine Co., at Quincy, Mass. Direct current at 240 volts is used for all purposes.—*Elec. Rev.*, April 26.

Automatic Feed Water Purifier.—An illustrated description of an automatic water purifying apparatus for use in power stations where the water is not adapted to boiler feeding.—*St. R'y Jour.*, May 3, and Int. Ed., May.

TRACTION.

Train Resistance.—DAVIS.—The writer is one of the engineers of the General Electric Company, and conducted a series of tests to determine the train resistance at high speeds. These tests were made near Buffalo. He divides the resistance into three parts, viz.: First, friction of the axles and journals, which has been found to be independent of the speed; second, rail friction, which is assumed to be directly proportionate with the speed; and third, wind resistance, which varies with the square of the speed. He then submits a formula embodying these features. The tests referred to were made with a 37-ton electric freight locomotive, geared to a speed of 88 to 100 km per hour at average line voltage. The train was made up of a locomotive, baggage car and three standard passenger coaches, weighing on an average 26 tons each without load. The track was absolutely straight, with practically no grades, and was in good condition. The motors had previously been tested at the factory to determine the journal friction and gear friction. The inertia of the revolving elements, such as the armatures, gears and wheels, were calculated, and an allowance made therefor. At the time of the tests there was practically no wind. It was found that the addition of each car to the train increased the effective cross-section by approximately 10 per cent. Sample curves are given, which had been obtained with trains of different lengths. After these were run, a wooden shield was mounted on the front end of the locomotive, hinged at the lower end, and fitted with a system of levers and an adjustable spring balance to register the pressure. The writer then considers the effect of a rounded end on the car, similar to that of the vestibule on the ordinary high-speed electric car, and gives curves for a 25-ton, 35-ton and 45-ton car respectively. The constants in the formulæ are calculated, and are given in the three final formulæ in the paper.—*St. R'y Jour.*, May 3, and Int. Ed., May.

LUNDIE, DODD, BELL, WILLE.—Articles in which Davis' paper is critically discussed. Lundie criticises the method by which Davis determines some factors in his formula, and calls attention to the fact that he does not consider any other factors in the train except weight, area and speed; further, that details of Davis' tests should be given. He then mentions his own formula, in which resistance in pounds per ton varies as the first power of the speed, which gives correct results on all trains up to 48 km. per hour.—Dodd believes that a formula which would be correct, even to within 10 or 15 per cent., would be of great use, but thinks that the power could be calculated from the curves of the motors. He deplores the fact that the author did not give some data of the tests to which he refers, as confirming the correctness of the formula, and believes that the formula will not be correct at high speed, on account of the high value which has been assigned to one coefficient. He cites one or two tests which he had made which gave lower results than those from the Davis formula. He then compares Davis' results with those obtained by the Siemens & Halske Co. in their preliminary experiments on the equipment of the Berlin-Zossen road, by whirling a flat board or fan at the end of a long arm at various speeds. While the experimenters admit that their method was approximate only, the results are important, because if it is true that there is a difference of 400 per cent. depending upon the shape of the ends, it would affect the whole character of the Davis formula, and would require a somewhat higher value for two of his coefficients. With a 96-ton car with a front area of 9.36 square meters and a speed of 200 km. per hour, Davis' formula would give a power consumption of 2620 hp, whereas the Zossen experimenters estimated on only 950 hp.—Bell says that the equations of Davis call for about double the power found necessary in the most recent investigations, and so demand very critical examination. He shows in detail that Davis' formula does not agree with the results of others. He believes these conditions are due to errors in the method employed by Davis in making tests which were by the coasting method. This he looks upon with distrust, owing to the involved way in which the losses in the motor and gearing enter the results. He believes that a better method would consist in towing trains of various lengths and weights by means of a long wire cable and a dynomometer. This cable would have to be supported by light trucks at one or more intermediate points. This would also be a better method than that of determining the head air pressure employed by Mr. Davis, which was that of a front shield. This latter is open to the serious objection that the center of pressure is not easy to locate. If a head shield is used, it would be better to pivot it along one vertical edge rather than along the lower edge, or better to arrange it to slip bodily backward on anti-friction rollers.—Wille says it would be unfair to compare Davis' results with those obtained on steam roads, as the conditions are totally different. The chief difference is that the electrically driven trains are of lighter units than those propelled by steam. It is therefore reasonable to expect that he should obtain a higher value than that usually accepted by steam railroad engineers. When trains are operated at short headway, and it is necessary to accelerate them to high rates of speed in a short distance, the resistance due to acceleration is so large as to completely mask the frictional train resistance. When these facts are considered, the formulæ check the one derived by the Baldwin Locomotive Works very closely.—There is also a separate editorial discussion of the subject. Davis' formulæ are based on experimental runs made on the Buffalo & Lockport road; they are the first to be made on a modern electric road at high speed and under approximately service conditions. The results indicate about double the total train resistance found by other experimenters, and revert more nearly to early values obtained upon steam roads. These formulæ, however, are not accepted by the contributors who have reviewed Davis' article, and attention is called to the fact that the discrepancy between the results reported by Davis and those of other recent experimenters is so great as to require careful attention and revision. It is suggested that the entire subject be reconsidered, and that experiments be made which will not depend upon the same conditions as those upon which Davis' results were figured. Consideration of these papers leads to the inquiry whether a train, like a steamship, has certain critical speeds at which driving becomes relatively easy, and others at which increase of speed can only be obtained by a large additional power consumption. —*St. R'y Jour.*, May 3, and Int. Ed., May.

Electric Boats.—FLAMM.—An account of a series of experiments made first with two small electric model boats of 1.6 meters length and different form. The resistance and the behavior of the boats was studied at various speeds; the resistance was separated into wave-making and frictional resistance; the influence of speed and form upon the waves was studied. The result of these preliminary trials with the two models was the adoption of a model slightly differing from either for constructing a large boat, which is 16 meters long, 2.50 meters in width and 0.8 meter depth amidships, with a displacement of 17.20 cubic meters. The weight of the motor, accumulator, switches and conductors is 11,049 kilograms, or, for 60 hp, about 185 kilograms per motor horse-power; this is greatly in excess of that required for steam or internal combustion motors. At a speed of 10 knots the power required was 59.30 hp, at 7.70 knots 18.10 hp, and at 4.90 knots 5.30 hp. "At the speed of 10 knots

the radius of action was 30 sea miles, while at 4.90 knots this was extended to 220 sea miles."—*Schiffbau*; abstracted in *Eng. Mag.*, May.

Electrolysis Due to Stray Currents.—MOERS.—A communication in which he describes some experiments. It is known that the direction of the current changes in the pipes. To investigate what influence this may have upon the electrolysis, he placed four equal lead pipes into two cases, two into each. Each was filled with the same wet material. The one pair was always supplied with current of the same direction, while for the other pair the direction was changed from day to day. After three weeks the pipes were examined. One pipe, which had always been positive, had lost 155 grams. In the other case the loss of the two pipes together was only 90 grams. The danger of electrolysis due to stray currents from tramway rails can therefore be diminished by changing the direction of the current in the traction system at regular intervals.—*Elek. Zeit.*, March 27.

Car Wiring.—An illustrated note on a departure in car wiring. In a car having twenty lamps, the lamps are arranged in groups of four in multiple, instead of having five lamps in series. The advantage of this arrangement is that in case a lamp burns out, only one light goes out instead of five. This is particularly desirable when the headlight is on the circuit.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

REFERENCES.

Block Signals.—KOHLFUERST.—After giving an illustrated description of the system of block signals used at the terminals of single track portions of the Buffalo-Lake Erie road, which in other parts has double track, he suggests modification of the system.—*Elek. Zeit.*, March 20.

Thirty-two Thousand Volt Transmission Line in Indiana.—An article on the system of the new traction company of Indiana, which is operating about 250 km. of track, power being transmitted at 14,000 volts. The company is planning an extension of about 150 km., and for this will transmit power at 32,000 volts. There will be three substations, one of which will be 96 km. from the power station.—*St. R'y Jour., Int. Ed.*, May.

Street Railway Accounting.—The beginning of a new department, conducted by Calderwood. There is an article, by Calderwood, on the modern accountant; a second article with the title: "From the Conductor to the Bank," and an article, by Mackay, on the creation of reserve funds.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Mains Department of a Direct Current Station.—MOORE.—An abstract of a paper read before the Newcastle section of the (Brit.) Inst. Elec. Eng. The type of mains to be adopted was first discussed, the points raised being the liability to short-circuit or earth, repairs, alternation to any section, first cost, and life. The various systems were criticized, no one apparently filling all his requirements. Short circuits in distributors of large sections may be burned out by reason of the energy available, but the feeders present a vulnerable point in the system. The taking of positive, middle and negative feeders to one point was debated, it being possible to obtain better pressure distribution by separating the poles by a distance of some hundred yards. Meters are preferably tested from some steady source of energy, such as a special battery, rather than from the supply mains. He considers that the maximum demand and discount systems should not be used on the same system of supply, and that meter rents would become more acceptable to the consumer if a nominal charge were made. The cost of mains and their laying was illustrated by diagrams.—Lond. *Elec.*, May 2.

[illegible]

Power Plant of Factory.—RICE.—An illustrated description of the power plant of the Otis Elevator Company, at Yonkers, N. Y. For lighting and power purposes the 220-volt, three-phase, three-wire system is used. For testing, electromotive forces of 110, 220, 330, 440 and 550 volts can be obtained by series connection of various circuits.—*The Eng.*, May 1

WIRES, WIRING AND CONDUITS.

Cost of Cables.—COHN.—An article referring to the formula often given for the cost of a line as the product of the length in meters and a factor A + B Q, where Q is the cross-section in square millimeters, and A and B are numerical values. He has calculated the latter values for different types of cables from the price lists of the manufacturers. The results are given in a table. It is restricted to cables to be buried in earth. When he plotted the curves for the cost as a function of the cross-section, he found that the above formula is valid only for cross-sections greater than 25 square millimeters; for smaller cross-sections B increases and A decreases. For voltages higher than 3,000, the above equation is valid only for cross-sections between 50 and 70 square millimeters.—*Elek Zeit.*, March 27.

ELECTRO-PHYSICS AND MAGNETISM

Oscillation of Ions.—DAVIS.—An article in which he describes how Cremieu's failure to produce motion in a charged plate by means of an oscillating magnetic field, has led him to the idea of substituting for the charged plate a body capable of carrying an enormously greater charge in proportion to its mass, viz., the ion itself. He produces a "ring-discharge" in a tube surrounded by a coil conveying a Tesla discharge. In this arrangement no electrodes are used. The ions are set into an oscillatory motion along circular arcs concentric with the coil, the negative electrons exerting a greater effect in the way of collisions and ionisation than the positive ions, on account of their superior speed. He mounts a set of four vanes on a needle parallel to the axis of the coil. The vanes are convex on one side and concave on the other. It is practically a miniature anemometer, which rotates in the direction of the convex side of the vanes, whatever the direction of the impinging electrons may be.—*Phys. Zeit.*, April 1; abstracted in Lond. *Elec.*, April 18.

Oscillatory Charging Currents.—ANDRIESSEN.—A description of some interesting experiments. A condenser may be discharged by an oscillatory spark, and similarly it may be charged by introducing a spark-gap which produces oscillation. He has made the following experiment. The secondary of a transformer is connected to a circuit containing a condenser, an incandescent lamp and a spark-gap. He first short-circuited the spark-gap and brought the transformer up to 6,000 effective volts at 50 periods, then the charging current was not strong enough to make the lamp glow. The spark-gap was then opened to 0.5 mm; then the lamp glows, even with only 2,100 volts. He explains this result by the increased quantity of electricity which passes the lamp, owing to the charging current of the condenser being of an oscillatory character. This may be of practical importance for a wattless introduction of capacity whenever the object is to get rid of noxious inductive phase displacement. It also accounts for the superiority of oil insulation, as against air insulation, since the latter leads to the appearance of oscillating sparks which are damped out in the former.—*Ann. der Physik*, No. 4; abstracted in Lond. *Elec.*, April 25.

Large Electromagnets.—THORNTON.—The first parts of a very long illustrated mathematical paper, read before the Newcastle section of the (British) Institute of Electrical Engineering, on the distribution of magnetic flux in large electromagnets. He describes a method of measuring the flux at any point of the magnet circuit and its variation with the magnetizing currents or the time. The essential part of the method consists in observing a prolonged induced voltage in a secondary exploring coil when the current in a primary is made or short-circuited. He gives details of the tests on a 50-kw dynamo with 16-in. diameter magnet cores. The maximum leakage coefficient is found and shown to vary with the load, decreasing as the load increases. Tables are given of the relative and absolute flux through several sections of the magnetic circuit. The effect of hunting in the engine and of irregular turning moment is observed by variations of the magnetization of the machine. The curves are analyzed and compared with the theory. The initial rate of change of permeability at "make" and "short-circuit" is found, and its effect on the shape of the curves discussed. The initial throw is shown to be independent of the material of the core. A powerful recording ammeter is described. Tests were also made with three generators, and the leakages at several parts of their circuits at no load examined. A new method is given of determining the permeability of large iron cores. An investigation of the change of permeability with time shows slipping of the molecules at saturation, as indicated by Ewing's theory of magnetism, but not hitherto observed. Heaviside's formulæ for the decay of induction in cores are applied to a machine, and a satisfactory agreement is found.—Lond. *Elec. Eng.*, April 11, 18.

Cathode Rays in a Magnetic Field.—PELLAT.—An investigation of the problem of the solid tubes of magnetic force traced out by cathode and canal rays under certain conditions. In strong fields the cathode

rays follow the tubes of force. He believes that there is some agent at work which makes the corpuscles run along the lines of force, and that this agent is of the nature of a friction across the lines of force. —*Comptes Rendus*, March 24; abstracted in Lond. *Elec.*, April 18.

Lightning.—An illustrated discussion of the question whether lightning is oscillatory. An account is given of experiments made by Walter, who photographed lightning flashes by means of a rotating camera. A lightning flash then appears to consist of a series of several successive discharges, the time intervals between them being very unequal. The discharge of a lightning flash appears to be not oscillatory, but intermittent and undirectional. In almost all cases when a discharge takes place between a cloud and the earth, the cloud is positive to the earth.—Lond. *Elec. Rev.*, April 18.

[illegible] —An account of a continuation of his studies of Hertzian waves emitted by lightning flashes over enormous distances. The waves arriving from a great distance are practically horizontal. When, on the other hand, the storm is in sight, or at all events not further off than 200 miles, the waves are more vertical than horizontal.—*Comptes Rendus*, March 10; abstracted in Lond. *Elec.*, April 18.

Cathode Drop and Current Strength.—Stark.—The normal cathode drop of potential in the case of the glow current is independent of the pressure of the gas and of the current strength. The law of the abnormal cathode drop is less determined; both Schmidt and Skinner declare it to vary in a linear and positive manner with the current strength. The present author maintains, on the other hand, that the true relation is indicated by a curved line.—*Phys. Zeit.*, April 1; abstracted in Lond. *Elec.*, April 25.

REFERENCE.

[illegible] illustrated description of a mechanical model for demonstrating the fundamental terms of the theory of alternating currents, such as direction of current and e. m. f., maximum values, mean value, period, phase and phase difference, etc.—*Elek. Zeit.*, March 20.

Electro-Chemistry and Batteries.

Barium.—Stansfield.—A paper read before the Manchester Lit. & Phil. Soc., giving "a preliminary note on the preparation of barium." After a discussion of the method of distillation of amalgam and the method for preparing zinc alloys, he describes experiments with the Goldschmidt process, whereby oxides are reduced by means of finely divided aluminum mixed with them in an intimate manner, and in which the heat of the reaction, being very large, is generally sufficient to fuse even the alumina formed. The experiments were carried out under reduced pressure, crucibles of Veitsch magnesite being used. In the earlier experiments the charge consisted of barium peroxide and aluminum. It was afterwards found to be more satisfactory to use nothing but the peroxide and aluminum. The experiments seem to indicate that the reaction is reversible, and that it cannot be used to obtain pure barium, but only an alloy of barium with aluminum containing up to about 60 per cent. barium. —*The Elec-Chem. & Met.*, March.

Copper Refining.—The introduction of magnesium into molten copper, with a view of getting rid of the various impurities (like oxygen, sulphur, carbon, etc.) is difficult and even dangerous. According to Froment, the Aluminum and Magnesium Plant Hemetiagen has recently patented the manufacture of an alloy of Mg. and Cn., 50 grams of which are said to be sufficient for the refining of 100 kilos. of copper. The alloy contains equal parts of Mg. and Cn.; it melts at 450° C. This material is of a greyish-red color and fairly brittle; specific gravity = 2.97.—*L'Electrochemie*, v. 7, 2; abstracted in *The Elec.-Chem. & Met.*, March.

Mond's Process for the Electrodeposition of Zinc.—An illustrated description of this process, which is said to give coherent metallic deposits of zinc of any desired thickness by subjecting the metal to a constant rubbing action under pressure while it is being deposited, by precipitating the zinc from its solutions in acids or alkalies upon revolving cylinders, and arranging several of these cylinders so as to touch one another in an electrolytic bath. These cylinders are provided with shafts moving in bearings, which are mounted so that they can slide, and pressure is applied to all or several of these cylinders by means of weights, springs, levers, or other mechanical devices which press the cylinders against each other, and at the same time allow them to move further apart as the thickness of the zinc deposited upon them increases. The cylinders may be made alternately of slightly different diameters, so that the same points on their circumferences do not come in contact until after many revolutions. In order to facilitate the removal of the deposited zinc, the cylinders are covered with a little graphite or paraffin, or any other substance which prevents the deposited zinc from adhering to the metal of the cylinder.—*The Elec.-Chem. and Met.*, March.

REFERENCES.

Aluminum.—Langley.—An abstract of a recent lecture held at Sibley College. The problem which had to be solved as basis of the present industry was to find a solvent which dissolves large quantities of aluminum oxide and at the same time requires a higher e. m. f. of decomposition than aluminum oxide; this solvent is cryolite. The general arrangement of the electrolytic process is described.—*Sibley Jour.*, April.

Max Accumulator.—An illustrated description of this French lead storage battery, which has been noticed before in the Digest. *Sc. Am. Sup.*, April 19.

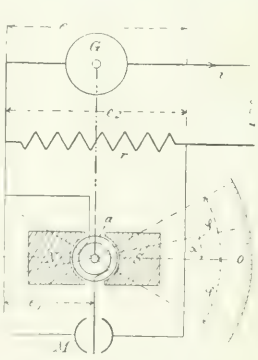
Electric Furnaces.—Blount.—The first part of an illustrated reprint in full of his paper, recently abstracted in the Digest.—*Sc. Am. Sup.*, May 3.

Alkalinity of Blood.—Henri.—An article on the theory of electrolytic dissociation and its application to the measurement of the alkalinity of blood.—*Rev. Gen. des Sc.*, April 15.

Diffusion of Electrolytes.—Thovert.—A description of some experiments on diffusion phenomena of electrolytes, and their explanation by the electrolytic dissociation theory.—*Comptes Rendus*, April 14; abstracted in Lond. *Elec.*, May 2.

Units, Measurements and Instruments.

Application of the Electrometer to Alternating Currents.—Hohage.—An article describing a method of applying the electrometer to alternating currents, for measuring power, current, and phase difference. The connections are shown in the adjoining diagram: G is an alternator, r a known resistance, which does not need to be non-inductive, M is the electrometer. Between its needle and one pair of quadrants an auxilary e. m. f., equal to e^1 is connected, while the other pair of quadrants is connected to the terminal of the resistance r. If the voltage e^2 at the terminals of the resistance r is small compared with e^1, then the reading of the electrometers is proportional to $e^1 e^2 \cos(e^1 e^2)$. To produce e^1, the auxiliary e. m. f. there is mounted on the axle of the generator an alternating-current armature a, provided with many thin windings. The field magnets $N\ S$ can be moved around the axle of the armature. If they are in the position O, then e_1, which is induced in the armature, may reach its maximum value at the same moment when the e of the generator is a maximum. If, however, we turn the magnets through an angle c, then e_1 in the auxiliary armature lags behind e by the same angle. The reading of the electrometer reaches a maximum, when e_1 is in phase with e_2. When e_2 is in phase with e, *i.e.*, when the load and the resistance r are non-inductive, the maximum reading is obtained in the position O. If, however, the phase difference c exists between e_2 and e, the reading in the position O gives $e_2 \cos c$, and in order to get e_2, we must use an auxiliary e. m. f. like e_1, displaced by c against e. This phase displacement can be obtained by turning the field magnets through the angle c. When then the angle of phase (*i.e.*) has the known value a, then the instantaneous phase difference is $c + a$, and can be read directly after $N\ S$ has been turned, until the reading of the electrometer is a maximum. At the same time the maximum reading gives a measure of the total current. When $N\ S$ is placed into the position given by the angle a, the electrometer gives the watt current, while for the angle $a + 90$ degrees it gives the wattless current.—*Elek. Zeit.*, April 24.



DIAGRAMS OF CONNECTIONS.

[illegible] Oscillations. Zennec. A description of a method of studying the damping of rapid electric oscillations by

means of a Braun cathode-ray tube. The trace of such oscillations on the luminescent screen consists of a line of beads or bright patches extending on both sides of a bright center, and becoming fainter and wider apart the further they are away from the zero or middle position. These beads, he points out, are the turning points of successive oscillations. They become visible owing to the reduced velocity, and, consequently, to the greater illuminating power of the oscillating cathode rays at those points. Hence the distances between the beads and the zero position mark the successive amplitudes of the oscillations. When a large number of discharges take place in short succession under the same conditions, the beads appear stationary, and may be photographed. At all events they furnish a delicate test for the regularity of the discharge, and show the influence of inductance, resistance and spark potential. He reproduces photographs obtained with a frequency of over a million per second, and some 600 discharges per second, the deflection being either magnetic or electric.—*Ann. d. Phys.*, No. 4; abstracted in Lond. *Elec.*, April 25.

Mechanical Break for Induction Coils.—TURNER.—A (Brit.) Phys. Soc. paper, describing a mechanical break for induction coils. It consists of two metallic rollers with their axes parallel and kept in contact by a spring. One of the rollers has a cam attached to its spindle, and can be made to rotate by means of a small electric motor. Once in each revolution the cam separates the rollers, thus making the break, and at the same time causing the second roller, which rides loose upon its axis, to turn about one-eighth of a revolution. As soon as the cam has passed, the rollers are brought into contact by the spring, and the next break occurs at a different place. The break is placed in a box containing alcohol or petroleum. The noise which the break makes when working is an objection. Noble exhibited a similar break.—Lond. *Elec.*, May 2.

REFERENCE.

Testing Voltmeters.—LAWS AND COOLIDGE.—An illustrated description of an apparatus used at the Mass. Inst. of Tech., for the rapid comparison of voltmeters with a standard instrument.—*Tech. Quart.*, March.

TELEGRAPHY TELEPHONY AND SIGNALS.

Submarine Telephone Cables with Increased Self-Induction.—KRARUP.—An article in which he refers to experiments made by Breisig with a telephone cable in which an open spiral of band iron was wound around the copper core; an increase of the self-induction by 57 per cent. had thereby been obtained over that of the cable without iron, and Breisig believed he had thus obtained the maximum possible limit of self-induction. The present author refers to older experiments of Hughes, who had found that an iron cover gave a much greater self-induction when the transverse cross-section of the iron was a complete closed ring (from similar results Hughes had drawn conclusions which were directly opposite than those drawn at present, because he thought that self-induction was undesirable in telegraph cables). He, therefore, suggests using a closed ferromagnetic cover; this is best obtained by a tightly-wound layer of soft iron wire. He made measurements of the self-induction of single and double conductor lines and cables of such construction. The results are given in a table; the following are quite interesting: While in a cable without iron or with a common iron cover, the self-induction is greater for single conductors than for double conductors, the reverse holds good for cables with iron cover around each core. The increase of the self-induction due to the iron is then twice as much for double conductors than for single conductors. The self-induction due to the iron cover increases in a greater proportion than the iron weight, when the magnetic circuit is more nearly closed. The fine, tightly-wound wire with great permeability is far superior to the band iron. He advocates the use of a thin layer of varnish between the copper conductor and the iron wire. He thinks there would be no great risk in constructing a submarine cable of this construction. (He does not seem to have included a cable in which the iron is applied in the form of two spirals of flat bands, wound in opposite directions, thereby reducing the magnetic air-gap very greatly compared with what it would be with cylindrical iron wires, even though they are of small diameter).—*Elek. Zeit.*, April 17.

REFERENCE.

Scientific Basis of Spark Telegraphy.—SLABY.—An illustrated English translation in abstract, of his German paper on the theoretical foundations of wireless telegraphy recently noticed in the Digest.—Lond. *Elec.*, April 25, May 2.

MISCELLANEOUS.

REFERENCES.

British Institution.—The London journals announce that the president elect of the (Brit.) Inst. Elec. Eng. for the next year is James Swinburne. His biography, with portrait, is given in Lond. *Elec. Trans.*, May 1.

Model of Contracts.—A reprint of the "form of model general conditions" proposed by a committee of the (Brit.) Inst. Elec. Eng., for use in connection with electrical engineering contracts; with editorial notes.—Lond. *Elec.*, April 25.

New Books.

RECHERCHES EXPERIMENTALES SUR LES SPECTRES D'ETINCELLES. By G. A. Hemsalech. Paris: A. Hermann. 138 pages, illustrated. Price, 6 francs.

This little volume contains the results of a research upon the modifications introduced into the spectra of condenser spark-discharges between metallic electrodes, by the insertion of inductance into the discharging circuit.

The work is divided into two parts. The first part occupies but twenty pages, and refers to the extinguishing effect of induced magnetism and eddy currents in self-induction coils upon the oscillations accompanying an electric condenser discharge. Photographs taken of such discharges on a film bound to the surface of a rapidly rotating pulley show that whereas in a simple discharging circuit without any iron core in the coil included, about 20 visible pictures of successive diminishing sparks could be obtained at a single discharge; yet on introducing a small iron core into the coil, the number of visible pictures reduced to 5. This result, while interesting as recorded, was, of course, to be expected.

The second and more important part is devoted to the result of a photographic study of the spectrum of the discharging spark, under the presence and absence of a coreless inductance coil in the circuit. The results are very interesting. They appear mainly to depend upon the change in the temperature of the spark under the variation of electric conditions due to inductance. The spectra of fourteen metals are studied successively. It seems that inductance diminishes the spectra of zinc, cadmium, magnesium, tin, lead, bismuth, copper and silver, by tending to reduce the temperature of their spark discharge; while the spectra of iron, nickel, cobalt and manganese are reinforced by the presence of inductance, owing perhaps to an elevation in the spark temperature.

The research has evidently absorbed a large amount of experimental work, and must have demanded considerable experimental skill. It goes to show the complexity of the phenomena comprised in an electric spark discharge, and the importance of specifying the precise electric conditions under which such discharges may occur, in order that the results may be comparable. The research concludes, very fittingly, with a résumé and series of conclusions. The volume is unique in being dedicated to two different scientists (Lippmann and Schuster).

WOERTERBUCH DER ELEKTROTECHNIK. Deutsch-Franzoesisch-Englisch. Paul Blaschke. 1 Theil. Leipzig. S. Hirzel. 1901. Cloth. [illegible]

This is the first volume of a series of three polyglot vocabularies intended for electrical engineers. It contains the German terms with their French and English equivalents, while the other two will contain the French and the English respectively with their corresponding equivalents.

While it is not possible for a reviewer to say that it is very complete, a comparison with another well-known and earlier polyglot vocabulary published in Paris, shows that it contains many more electrical terms, chiefly the composite words; moreover, it gives the gender of the words, which is not done in the other dictionary referred to. It therefore is more complete than the best other dictionary of its kind known to the reviewer. Comparing it in number of words with an English dictionary of electrical terms, however,

shows that either many terms are missing, or else, and more probably, that the German language contains fewer electrical terms than the English.

The English terms are not always the best, nor are they always correct, which shows that they have not been revised by a good English authority. But for English speaking readers, the fault is not serious; it is to be hoped, however, that when the English volume is prepared it will be thoroughly revised by a native American or Englishman who is also familiar with the German and French terms.

Besides the electrical terms it includes many that are not in any sense electrical. The idea probably was that electrical engineers use them also, but this excuse for including them also applies to thousands of other technical terms, and it seems therefore somewhat inconsistent to enter the non-electrical field at all without making it a complete technical vocabulary including all branches of technology. However, an excess of words is not an objection as a deficiency would be, and as the book is low priced, one does not feel that one is paying for what one does not want.

While the author's preference for the use of the almost international term hydrogen in German in place of the older and senseless term *Wasserstoff* (as oxygen is just as important a constituent of water as hydrogen is), is, in the reviewer's opinion, a very sensible conclusion and one which should be encouraged, yet he goes too far when he omits the word *Wasserstoff* entirely, as it is often found in German literature. We notice also that the word Gauss is omitted entirely.

Typographically the book is very creditably arranged. The leading word is printed in bold, plain and clear type, which greatly facilitates finding it quickly. Placing the appendix of about a hundred overlooked words at the beginning instead of at the end, as usual, is to be commended as it is then less likely to be overlooked.

As a third of a polyglot vocabulary of electrical terms, the book can be highly recommended and is probably the best of its kind. With a few unimportant exceptions, the work seems to have been very well done. Typographically it leaves little or nothing to be desired.

A Manual of Physical Measurements. By John O. Reed, Ph. D., and Karl E. Guthe, Ph. D. Ann Arbor, Mich.: George Wahr. 185 pages, 86 illustrations. Price, $1.50.

This is a laboratory manual pure and simple for the use of college students in their earlier laboratory work, and a very excellent specimen of its kind. In the preface the authors state: "A manual equally suited to all laboratories has not been, and probably will not be written. Each laboratory reflects in greater or less degree the individual trend of the man who stands at its head. . . . Hence it happens that one laboratory is largely devoted to the study of the phenomena of light, another to those of electricity, a third to those of elasticity. . . . The moral of all this is that the practices and traditions of each laboratory are best conserved by a text representative of its own methods, and if no better reason should be found perhaps this may serve to explain the appearance of this another laboratory manual." From the above it will be seen that the limitations of such a treatise have been fully realized.

The introductory chapter, containing remarks on measurements in general, is most terse and pointed, and if the student will digest it fully and has its importance firmly impressed on his mind, he will have an excellent foundation to start from. That "the ability to use delicate apparatus without injuring or destroying it is an important part of a liberal education" is too little appreciated.

The University of Michigan, for the students of which college the volume is written, very evidently comes under the head of those having laboratories largely devoted to the study of electricity, sixty-seven pages being devoted to measurement in this branch of physics, as against six for sound, fifteen for heat, and twenty-two for optics; physical measurements, however, very naturally coming in for a good share of attention.

A review of the electrical section would probably not interest the profession at large, particularly as its contents are hardly novel from an engineering standpoint. Anyone engaged in teaching marksmanship to the young idea can, however, read it to advantage, and many will doubtless find it a desirable volume to place in the students' hands.

If the reader will use his head at all, the abrupt little "Why?" [illegible] frequently follows a cautionary remark, or a direction, will cause him to do some thinking that will be very good training.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Extra meeting, 220 West Fifty-seventh Street, New York, May 28; annual convention, Great Barrington, Mass., June 18-21, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Pennsylvania State Street Railway Association. Next meeting, October, 1902.

A New Series Enclosed Arc Lamp.

A recent type of long-burning series differential enclosed arc lamp is being introduced by the Fort Wayne Electric Works, for which a number of special features are claimed. The general appearance of the lamp is shown in Fig. 1. The cap or top of the case from which the lamp is suspended and which supports the mechanism of the lamp, is of cast iron, which prevents any distortion of the parts in case the lamp should be roughly handled. The cylindrical part of the case is made of heavy copper sheeting with one soldered lapped joint. It is held in place by a bayonet catch, and is weather proof and designed to withstand the roughest usage. The mechanism is of the differential type and is extremely simple in construction. When the lamp is in operation the armature is practically in a horizontal position, directly beneath the series and shunt magnets. This makes a magnetic floating suspension for the armature, and reduces friction to a minimum.

The series shunt coils are wound on independent cores and held in place by one large screw, which can be easily removed with an ordinary screw-driver. These coils are so proportioned that they have considerable radiating surface per watt of energy expended in them and operate at low temperature. All connections that carry current are made with copper clips and fastened by two screws. These screws enter into cast-brass lugs, which are mounted in a position where they are readily accessible. The loosening of one of these screws breaks five connections, and the loosening of the other breaks three connections.

The adjustment coil, by means of which the voltage at the arc is regulated on circuits of different voltage, is wound on a form consisting of a brass tube covered with asbestos and mounted on a cylindrical wood core. This rigid construction prevents the wire from becoming loose and allows the coil to be readily removed from the lamp by loosening the clip screw at the top and bottom of the core.

The cut-out is unique in design, and is so constructed as not to get out of order. It is composed of three stationary parts and one moving part. A brass cylinder traveling in a vertical direction makes and breaks contact with the stationary terminals in such a manner as to bring the arc always on the same contact. The various parts of the cut-out can be readily removed in a few seconds.

In the outer globe holder, provision has been made for the expansion of the globe when heated by the arc. The globe is clamped in place in the holder by thumb-screw clips, with specially designed springs that fit the curvature of the globe and will not permit the clamping screw to exert sufficient pressure to crack the globe. The globe holder is held in position directly beneath the radiator by a bayonet catch similar to that holding the cylindrical case, and has attached to it a chain from which it is suspended while the lamp is being trimmed. The assembled globe holder may be removed entirely by simply lifting the chain and hook from a lug cast on the side of the radiator.

The lamp is equipped with a corrugated cast iron radiator, which

rapidly dissipates the heat arising from the arc and prevents its entrance to the mechanism chamber, thus insuring an extremely low operating temperature in the lamp. The radiator is designed to permanently protect all parts of the lamp located beneath it from moisture, snow and dirt, and all parts located above it from the heat of the arc.

The clutch is what is known as the three-jaw ring clutch, and is extremely simple in construction. On the top and in the center of the main clutch casting is mounted a small copper ring with three inwardly projecting jaws. Only these three jaws come in contact with the carbons. This arrangement allows the use of carbons differing slightly from the standard size specified to be used with the lamp. The small ring containing the three jaws can be replaced by the removal of one screw. The clutch is so designed that it is impossible to insert any part in any but the right position.

The upper carbon holder is combined with the trolley which carries current to the upper carbon, and consists of a phosphor-bronze vertical split holder, insuring even distribution of pressure on the part of the carbon covered by its jaws. The lower end of the solid piece of brass on which these jaws are mounted projects downward between the jaws, and serves as a stop for the upper carbon and prevents its entrance into the holder beyond the correct position. No steel springs are used in the construction of the holder, and should it become damaged it can be easily replaced by the removal of two screws. The trolley of the lamp is made from a solid piece of brass with circular grooves milled therein at angles 120 degrees apart. These grooves contain semi-circular contact springs which protrude above the grooves and make edge-wise contact with the carbon tube. The planes of these edges are at right angles to lines passing through the center of the body of the trolley. This form of construction prevents corrosion and accumulation of dust and dirt between the surfaces of the trolley springs and the carbon tube.



FIG. 1 AND 2.—SERIES ENCLOSED ARC LAMP.

In trimming the lamp the carbon is automatically centered, and the surface of the contacts between the trolley spring and the carbon tube is automatically cleaned. In the top of the carbon tube is a nut, on the lower surface of which is a projection which enters the center opening in the top of the body of the trolley or carbon holder, thus always centering the carbon without any special effort on the part of the attendant.

The adjustment of the length of the arc is accomplished by the adjusting coil in shunt with the series magnet coil. On loosening one screw the adjusting clamp may be lowered or raised, increasing or decreasing the amount of current passing through the series coil, thus causing it to operate at a longer or shorter arc as may be desired.

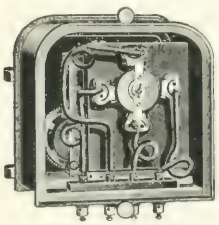
The gas cap is made of two parts, thoroughly insulated from each other, so that there is no difference of potential on its top. This is an important point, as a gas cap constructed so that there is a difference of potential on the top sooner or later causes trouble on account of short-circuit created by the collection of dust and dirt. The opening in the gas cap through which the upper carbon passes is provided with a copper bushing, easily removed should it become damaged.

The binding posts are of ample proportion and are provided with porcelain petticoat insulators and a rubber insulating washer, which makes the joints water-tight. They are further provided with set screws for clamping the wires in a vertical position, so as to make a strong mechanical as well as a good electrical connection.

One of the features of this lamp is the ease with which it can be dismantled should repairs become necessary. By the removal of five screws, two brass spring cotters and a clamping nut on the bottom of the clamping tube, the entire bottom part of the lamp below the radiator can be removed from the carbon tube, leaving only in connection therewith the armature, the shunt and series coils with their castings, and the cast-iron top. The magnets, armature and casting upon which they are mounted can be easily removed from the carbon tube by removing the cast iron cap, two spring cotters and four screws. The cast-iron top can be removed by simply taking off the binding posts. The trolley and carbon combined can be released by removing the cast-iron top and taking off one nut. By the removal of the outer globe and the cylindrical case all sides of the mechanism are exposed. In fact, the lamp has been so designed that any part of it is rendered accessible by a few moments' work. All the nuts in the lamp are made the same size, a fact that will be appreciated by the repair man.

Acme Time Switch.

In the accompanying illustration is shown a partial view of the mechanism of the Acme time switch, manufactured by the Acme Switch Company, 438 Asylum Street, Hartford, Conn., and designed for the automatic control of electric lighting circuits. This switch, which is of the snap type, can be used on any direct or alternating-current circuit up to 250 volts, and gives a quick break. It is made in two sizes, viz.: 15 amperes double-pole and 25 amperes double-pole, each being provided with an eight-day clock movement.



ACME SWITCH.

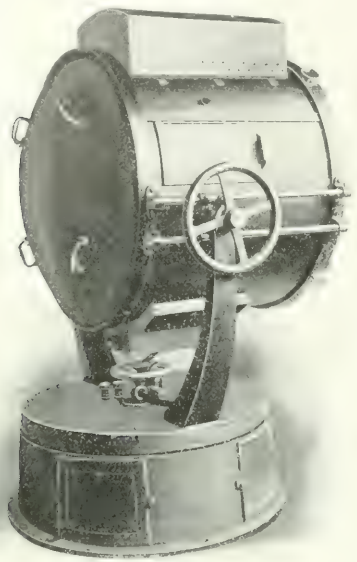
Another style of switch is of the single-pole rotary type, especially designed for outdoor work where a central station wishes to control one or two arc lights. The clock movement of this switch is stated to be able to withstand the variations of heat and cold. It is made in two styles of the same size as the snap switch above described. The instruments are compact in design and are encased in a substantial metallic waterproof box. The binding posts are located outside of the box, thus permitting the placing of the instrument in position without having to expose the mechanism. One of the chief merits of this switch, it is stated, is its prompt action at the proper time.

Naval Projector.

The cut on next page shows a projector of the naval type recently built by Chas. J. Bogue, 213 Centre Street, New York, the apparatus being constructed entirely of iron. The cylinder has an outside diameter of 34 inches and is provided with longitudinal rods passing through the trunnions, which allow the cylinder to be shifted on the

bearings to insure a perfect balance at all times, the hand wheel being used to lock the cylinder in any desired position. The supporting arms are bolted to the turntable, which moves on a series of steel balls; the balance is so exact that a slight touch is sufficient to move the heavy upper parts in any direction required. A half turn of the wheel on top of the platform locks the searchlight as required.

The cable leads through the base and is connected with a commu-



NAVAL SEARCHLIGHT.

tator set on the top of the base, and a corresponding commutator on the underside of the turntable, from which latter the wires run to the lamp. This forms a perfect contact for the heavy current used. The mirror is of the Mangin type, and is 30 inches in diameter, with a focal length of about 17 inches.

The lamp is automatic with a hand-feed attachment, and is trimmed with carbons 1¼-in. diameter positive and 1-in. diameter negative. The rheostat with regulating switch is adjusted to pass 100 amperes when the voltage of the circuit on which the light operates is 230 volts. The net weight of the apparatus complete, with the rheostat, is 1,050 lbs., and the shipping weight, 2,100 lbs. This projector was recently shipped to South America.

Holly Gravity Return System.

Mr. C. S. Wilson, chief engineer of the 4½ Street power station of the United States Electric Lighting Company at Washington, D. C., has made a very favorable report upon the performance of the "Steam Loop and Holly Gravity Return System" in the plant under his charge. The plant contains six boilers, aggregating 1,600 horse-power, four tandem-compound condensing engines and two single-cylinder non-condensing engines. The four tandem engines are directly connected to railway generators and two single engines to lighting generators. The six engines have a maximum capacity of 3,000 horse-power.

The engines were all equipped with separators, and the separators with traps, and the traps all discharged in the sewer. Now all of the condensation from the high-pressure drips goes to the boilers. Referring to his experience with the system, Mr. Wilson says that he is safe in asserting that it has made a saving of .2 of a pound of coal per kilowatt-hour, which would mean a saving of from 1

Among the advantages of the Holly system is, first of all, that it effects a considerable saving in the water of condensation, of entrainment and primage, with the heat contained. The return is usually made at from 250 to 400 degrees, according to the pressure carried, while the best of feed-water heaters furnish water at not more than 200 to 210 degrees. Another advantage is in preventing the loss of steam that is blown to waste in clearing pipes from water, and the numerous wastes from open or leaky drips. Moreover, by returning pure water to boilers, and by concentrating this return in one or two boilers at a time, loosening the scale, the system frequently furnishes the entire feed water for one boiler in a battery of twelve. Accidents due to water in cylinders are prevented, and uniform temperature is preserved in pipes over nights and Sundays, thus obviating difficulties due to expansion and contraction. This arrangement, in addition, enables engines, especially at the end of long lines, to start promptly and safely, and it reduces the amount of cylinder oil removed by the washing action of the water. It is effective also in maintaining higher temperature in jackets, driers, etc., by reason of better circulation, and in reducing the amount of attention necessary to the steam pipe and its drainage, as it affords a comprehensive drainage system, operating continuously, and supplanting all devices requiring attention, manipulation or repair.

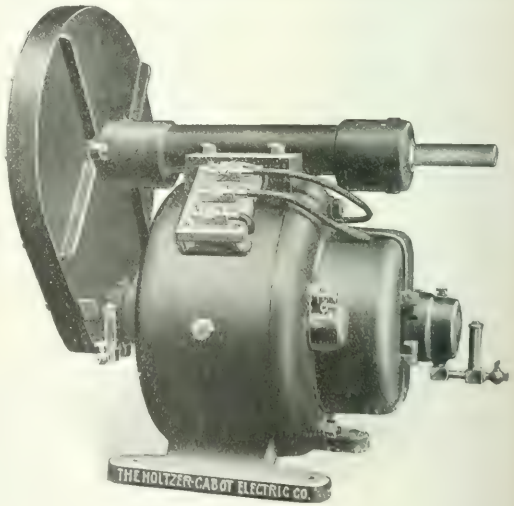
This system has been installed in a large number of central station and industrial plants by Westinghouse, Church, Kerr & Co.

Back-Geared Motors.

The accompanying cut shows a 1-hp back-geared motor, one of a line being manufactured by The Holtzer-Cabot Electric Company, of Boston, Mass. These motors are made in the usual sizes from one-sixth up to 20 hp. They are bipolar up to 3 hp. and above that multipolar.

The poles are laminations of soft steel, which fit into curved seats in the field ring. The motor is made both in the semi-enclosed and completely enclosed form.

The heavy casting which holds the gear shaft is bolted to the body of the motor and is entirely separate from the end cases, so that either the gear rigging or armature may be removed without interfering with each other. The alignment of the gear shaft is quite independent of the end cases, so that the motor may be run in any position by simply turning the end cases through a portion of a



revolution, in order to keep the oil rings in proper position. Self-oiling and self-aligning bearings are used.

The brush ring is held in a machine seat in the front end case, a construction which provides ample adjustment for the brushes, and [illegible] makes the commutator and brushes quite easy of access. The doors are hinged on the front bearing. It is claimed that these motors show an unusually low heat loss for machines of this type. They have been found to meet the rigid requirements of the United States Navy, being used extensively for navy-yard and ship-board work.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was obtainable with comparative freedom, the closing rates being 5 per cent. for 30 to 60 days; 4½@5 per cent. for three, four, five and six months. In the stock market speculation was very dull and depressed owing to the coal strike. Early in the week there was some firmness, but toward the end prices fell off and the volume of business decreased to very small proportions, the absence of commission business being a noticeable feature. The anthracite coal stocks were naturally objects of much attention, and when the announcement was made that the strike of the miners would be continued there was heavy selling. The industrial specialties were for the most part dull. The steel stocks were well supported, but not particularly active. Amalgamated copper was more active and advanced from 66⅝ to 69 on the increased exports and the advance in the price of copper. Trading in other prominent industrials was on a limited scale. Electric stocks and tractions were weak, all, without exception, closing at figures lower than those last quoted. General Electric lost 6 points, closing at 315, and Westinghouse common 8, the last quotation being 208. The 1st pfd. closed at 218, which is a net loss of 1½. In the traction list, Brooklyn Rapid Tran. closed at 64¾, a net loss of 1⅛ points, and Metropolitan at 146¾, a drop of 2¼ points. Weakness also prevailed in the telegraph and telephone list, Am. Tel. and Tel. closing at 180, a net loss of 1½; Western Union 89¼, a loss of 2½, and Am. Tel. and Cable 91⅝, a net loss of ⅜. American Dist. Tel. closed at 40, which quotation is ¼ point above the last. In Boston the week closed dull and uninteresting. Following are the closing quotations of May 20:

NEW YORK

	May 13.	May 20.		May 13.	May 20.
American Tel & Cable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
American Tel & Tel	178½	177	Hudson River Tel	[illegible]	[illegible]
American Dist. Tel....	38½	38	Metropolitan St Ry	147	148
Brooklyn Rapid Transit	[illegible]	[illegible]	N Y Elec Veh Trans	[illegible]	[illegible]
Commercial Cable	[illegible]	[illegible]	N Y & N J Tel	[illegible]	[illegible]
Electric Boat	34	[illegible]	N Y & N J Tel	[illegible]	100
Electric Boat pfd.....	48	48	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n	—	3	Western Union Tel	[illegible]	[illegible]
Electric Vehicle	[illegible]	[illegible]	West. E. & M. Co.	[illegible]	[illegible]
Electric Vehicle pfd	13	11	West. E. & M. Co. pfd..209		—
General Electric	321½	315			

BOSTON.

	May 13.	May 20.		May 13.	May 20.
American Tel & Tel	178	[illegible]	Mexican Tel Power	[illegible]	[illegible]
Cumberland Telephone	[illegible]	[illegible]	N E Tel & Tel	[illegible]	[illegible]
Edison Elec. Illum	[illegible]	[illegible]	Westinghouse Elec	[illegible]	[illegible]
Edison Telephone	[illegible]	[illegible]	Westinghouse Elec. pfd	[illegible]	[illegible]
General Electric pfd....	—	315			

PHILADELPHIA.

	May 13.	May 20.		May 13.	May 20.
American Railways	[illegible]	[illegible]	Phila Traction	[illegible]	[illegible]
Elec Storage Battery	82	82	Phila Electric	[illegible]	[illegible]
Elec Storage Batty pfd	82	82	Phila Elec Vehicle	—	—
Elec. Co. of America...	—	7⅞	Pa. Elec. Vehicle pfd...	—	4

CHICAGO.

	May 13.	May 20.		May 13.	May 20.
Central Union Tel	[illegible]	[illegible]	Chicago Edison	[illegible]	[illegible]
Chicago Edison	[illegible]	[illegible]	Chicago Edison	[illegible]	[illegible]
Chicago City Ry	[illegible]	[illegible]	Chicago Edison	[illegible]	[illegible]
Chicago Telephone Co	[illegible]	[illegible]	Chicago Edison pfd	[illegible]	[illegible]
Central Union	[illegible]	[illegible]	Weber	[illegible]	[illegible]

MANHATTAN TRANSIT COMPANY.—With regard to the affairs of the Manhattan Transit Company recently formed to cooperate with the General Carriage Company, the *Wall Street Journal* has the following data as to what the versatile Mr. J. H. Hoadley proposes to do: A new corporation—the Manhattan Transit Co.—will take over all the assets of the old corporation, and also the old Gambrinus brewery at Forty-second Street and Second Avenue, which Mr. Hoadley purchased from Mr. Morgan about five months ago, and has since stocked with several hundred vehicles of all kinds, including 200 vehicles purchased from the New England Electric Vehicle Company at a very small price. In this factory a carpenter shop, machine shop, electric battery room, charging room, repairing room, carriage trimming department and wheel shop have been fitted up, and several hundred workmen are now engaged in putting into order the abandoned electric vehicles which Mr. Hoadley has been for some months picking up, feeling sure that he had a revolution in the power industry. Mr. Hoadley says that he can charge these electric vehicles through fuel oil, and the Diesel engine at two mills per kilowatt hour, while the present charge in New York for electric current is twelve cents per kilowatt hour. Mr. Hoadley [illegible] rates of charging electric batteries. He is also turning out steam trucks, in the development of which he has spent $600,000. He claims that in this line he has produced a steam engine of sixteen pieces without a bolt or a screw, and that he will be turning out five steam trucks a week by the first of September.

MANHATTAN RAILWAY.—It is reported that earnings for the current quarter will show about as large an increase as was shown for the quarter ended March 31. It is asserted very positively that the increase in business is the result of the very satisfactory service maintained rather than of the torn-up condition of certain streets forcing business away from the surface cars. The secret of the gain is believed to be the fact that trains are kept running with strict regularity, absolutely on schedule time. Formerly it took trains, say 20 minutes to run from Chatham Square to South Ferry. Now the run is made in less than half the time, and the same is true of approaches to all terminals where trains had been allowed to obstruct one another. The result of such obstruction in the past was that every day trains had to be withdrawn on account of the difficulty of getting them away on schedule time. Now anything of this kind is unknown. Every train provided for on the time sheet runs its full number of trips and runs them exactly on schedule time. Some recent days, when traffic conditions were perfectly normal, have shown a total number of passengers carried which came comparatively near the high record figures of 1893. The extension of electric operation to the Fordham Extension is expected to result in a considerable increase in business in the Bronx, and it is predicted that with all lines in electrical operation the company is likely to do a business of 1,000,000 passengers per day.

DENVER TROLLEY FINANCING.—A circular has been sent out to the stockholders of Denver City Tramway, signed by the president of the company and three large stockholders, stating that 78 per cent. of the stock had been turned in to Denver & Northwestern. Under this plan stockholders may take cash par value for the stock turned in before June 2, or they may take for every $500 of stock an equal amount of thirty-year 5 per cent. first and collateral mortgage bonds and $125 of stock of Denver & Northwestern. By this plan, Denver & Northwestern constitutes itself a holding company, issuing $6,000,000 bonds to take up the $5,000,000 stock of Denver City Tramway. This stock is the only security behind these bonds and the dividends on this stock are the source from which the 5 per cent. interest on the bonds must be drawn. The stock has been paying 4 per cent., and has been said to be able to pay 6 per cent. This latter dividend would just pay the interest on the bonds. The assets of Denver & Northwestern outside of these dividends consists of four miles of road running to a coal field, and a prospective local coal delivery trade in the city of Denver. This is expected to do away with the retailers and middlemen by supplying the wants of the town by direct delivery from the mines to the consumer. A vigorous resistance is looked for on the part of the retail trade. The total capital stock of Denver & Northwestern is $6,000,000 exclusive of the bonds.

LONDON TUBES.—As to underground railway developments in London, a cable dispatch of May 17 says: The Morgans are much satisfied with the decision of the House of Lords' committee granting them the right to construct a "tube" railroad from Hammersmith to Tottenham, about fourteen miles, passing through the heart of the City, via Piccadilly. The committee's decision now goes to Parliament for confirmation. The only applications refused Mr. Morgan were facilities to build two small lines at either end of the present terminal, which are already connected with over 100 miles of street-car track. Charles T. Yerkes has also been successful. But the English authorities believed that his proposed "corkscrew" line, from Charing Cross to Piccadilly, was not feasible. Hence the refusal to allow its construction. Mr. Yerkes now has a circle on both sides of London, while Mr. Morgan runs in the center and to the north.

CHICAGO LIGHTING.—In connection with the recent announcement of a community of ownership between the Peoples Gas Light and Coke Company and the Northwestern Gas Light and Coke Company of Evanston, there is believed to be a $100,000,000 combination in process of formation, embracing the principal gas and possibly electric lighting plants in Chicago and neighborhood. It is said that the purpose of the company is to effect a virtual consolidation of the Northwestern Gas Company of Evanston and the Peoria Gas and Electric Light Company, the Highland Park Electric lighting plant, the Blue Island and Cicero gas plants.

GENERAL CARRIAGE.—Details of the plan by which the Manhattan Transit Company, incorporated at Albany last week with a capital stock of $10,000,000 in shares of $20 par value, will effect the reorganization of the General Carriage Company, have been made public. The stockholders of the General Carriage Company of New Jersey have the privilege of depositing their stock with the Atlantic Trust Company, accompanied by a cash payment of $2 a share. In exchange they will receive for each share of stock deposited one share of the stock of the Manhattan Transit Company. The company is also to issue $800,000 of fifty year 4 per cent. bonds. It is to acquire besides the $400,000 raised by the assessment on the General Carriage stock, the real estate, subject to mortgage, at Forty-seventh Street and Second Avenue; the capital stock of the carriage company covering the franchises of that company; 150 automobile vehicles, and the exclusive right for the State of New York for the use of the auto trucks manufactured by the International Power Company. It will be remembered that the company gave notice recently of its ownership of a number of the patents of R. M. Hunter. This was at the time the stock made its sensational slump.

NEW ORLEANS CONSOLIDATION.—Plans have now been completed for the merging under the name of the New Orleans Railways Company of all the electric railways, gas and electric light companies of New Orleans, La. The companies absorbed are the New Orleans City Railroad, New Orleans and Carrollton Railroad, Light and Power Company, Orleans Railroad Company, New Orleans Gas Light Company, New Orleans Lighting Company, and the New Orleans Railways Company. The new concern is being capitalized as follows: Fifty year 4½ per cent. sinking fund gold bonds, $40,000,000, of which $20,000,000 is being issued now to acquire existing securities; $7,154,000 is reserved for future extensions and improvements, and the remainder is reserved to retire existing bonds as they mature or are exchanged; 4 per cent. cumulative preferred stock, $10,000,000; common stock, $30,000,000. The syndicate is being organized under the management of the New York Security and Trust Company to underwrite the exchange of the securities. The participation syndicate subscribers receive for each $1,000 subscribed, in addition to a commission, $769.23 in 4½ per cent. bonds, $384.51 in preferred stock, and $769.23 in common stock.

CONSOLIDATION OF OHIO RAILWAYS.—The final steps have been taken for the consolidation of the Southern Ohio Traction Company, the Cincinnati Northwestern Railway Company, the Miamisburg and Germantown Traction Company, and the Hamilton and Lindenwald Electric Transit Company. The consolidated company will be known as the Cincinnati, Dayton and Toledo Traction Company. The capital stock is $5,000,000 and bonds of like amount will be issued, of which $2,300,000 will be retained in the treasury to retire underlying bonds. There will be issued to retire the Southern Ohio Traction stock, $1,200,000, and there will be retained in the treasury, for future extensions, consolidations, etc., $1,500,000.

BANNER ELECTRIC COMPANY.—At a meeting of the stockholders of the Banner Electric Company, of Youngstown, O., held at their offices on May 12, it was decided to increase the capital stock of the company from $35,000 to $50,000. This action was made necessary on account of the rapidly increasing business of the company, thus necessitating the enlarging of its plant and equipment. The Banner Electric Company has been in operation since November 1. The officers of the company are: J. Evans Lippincott, president; Thos. Carr, vice-president; O. U. Cassaday, treasurer; N. L. Norris, secretary and general manager; F. C. Kirchner, superintendent.

FESSENDEN WIRELESS TELEGRAPH COMPANY.—It is reported from Pittsburg that Prof. Reginald A. Fessenden, who has been conducting experiments in wireless telegraphy in behalf of the United States government, has completed arrangements for the organization of a $5,000,000 company to develop his system. It is also stated that Prof. Fessenden has arranged to fulfil a number of contracts of importance. He and his associates will shortly take up the work of installing transatlantic stations, connecting, in one instance, the United States with France.

WEST END STREET RAILWAY.—Stockholders of the West End Street Railway Company, at a special meeting, on May 21, voted to authorize the directors to issue $300,000 4 per cent. 15-year bonds, dated August 1, 1900, to repay the Boston Elevated the amount advanced by it to pay the principal of the $300,000 Highland Street Railway 5 per cent. bonds which matured May 1, 1902. Stockholders also authorize the directors to issue additional bonds from time to times as may be required by the terms of the lease to the Boston Elevated.

GENERAL ELECTRIC BOARD.—At the annual meeting of the General Electric Company, held at Schnectady, N. Y., on May 15, the following board of directors was re-elected for the coming year: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., Frederick P. Fish, George P. Gardner, Eugene Griffin, Henry L. Higginson, J. Pierpoint Morgan, J. P. Ord, Charles Steele, Robert Treat Paine, 2d, and George Peabody. About 185,000 shares of stock were represented at the meeting.

GRAND RAPIDS ELECTRIC LIGHTING PROPERTIES.—A syndicate of Cincinnati, Chicago and Grand Rapids capitalists has purchased the properties of the Edison Electric and Grand Rapids Electric Light and Power Companies, of Grand Rapids, Mich. The capital is $1,000,000, and $610,000 in bonds is being issued.

REDUCING CAPITAL STOCK.—The International Bell Telephone Company, Limited, of New York City, of which Charles J. Bell, S. D. Babcock, Charlton T. Lewis, Fred M. Thieriot and D. H. S. Randall are directors, has certified to the Secretary of State that its capital has been reduced from $500,000 to $250,000.

GENERAL ELECTRIC.—It is stated that the subject of capital readjustment will be taken up by the directors some time next month. A stock dividend of 66⅔ per cent. will call for the distribution of $16,761,000 of new stock of the issue of $19,757,800 recently authorized by stockholders.

DIVIDEND.—The Philadelphia Electric Company has declared a dividend of 15 cents, payable June 16.

Commercial Intelligence.

THE WEEK IN TRADE.—Among the conditions governing trade, Bradstreet's points out that there is a lack of uniformity, which explains irregularity in advices from different sections. The preeminent feature, however, is the favorable character of nearly all crop advices. The shadow overhanging Eastern trade in the shape of a general anthracite coal strike has deepened with the formal suspension of work and the strike announcement. The industrial outlook, aside from the anthracite trouble, and the possibilities of this disturbance, if extended, involving some branches of the iron and steel trades, is, on the whole, no more unsettled than might be expected in a time of more than ordinary prosperity. Reports of railroad earnings for the first week of May indicate a gain in excess of 8 per cent. Activity continues in nearly all kinds of building materials, despite the largest production of pig iron on record, at the rate of 18,000,000 tons a year. Bessemer pig is advancing, the increase for the six months being $6 per ton. Sales of Southern iron are also reported at advanced figures. Large structural orders have been placed for 1903. The business failures during the week, as reported by *Bradstreet's*, aggregated 190, as against 179 the week previous, and 192 the same week last year. The copper market is very firm, the manufacturers in this country being very busy. It is reported that a number of large producers have sold their products for the near future, and it is believed that buyers have not yet filled their entire requirements. Prices are somewhat improved, Lake being quoted at 12⅛@12¼c., electrolytic in cakes, wire bars and ingots at 11¾@11⅞c., cathodes and casting stock at 11½@11⅝c.

SHAW CRANES FOR SUBWAY POWER STATION.—The Shaw Electric Crane Company, of Muskegon, Mich., has just secured a substantial contract for cranes, which are intended to be installed in the New York rapid transit subway power station, to be erected on Eleventh Avenue between Fifty-eighth and Fifty-ninth Streets. The contract calls for a crane of 60-tons capacity together with two 50-ton trolleys, for a span of 75 feet. The height of the hoist will be 80 feet. This outfit will be operated by a 175-hp motor of Shaw make. A 25-ton crane, together with a 5-ton auxiliary hoist, has also been requisitioned for. This machine will be driven by a 60-hp Shaw motor. Both of these cranes will be run on the same track. The value of the contract is close on $25,000.

THE GOUDEY-McLEAN COMPANY, of 88 Maiden Lane, New York, which concern acts as foreign sales managers for a number of electrical firms throughout the country, has just been forwarded by its Scottish branch—the Scottish Goudey-McLean Company, Limited, of Glasgow—a number of orders for motors, ranging from 5-hp to 10-hp each. These motors will be built by the Browning Manufacturing Company, of Milwaukee, Wis., and the Milwaukee Electric Company. Some of them are intended to be installed in Glasgow newspaper offices. Legendré Fréres, of Paris, which concern represents the Goudey-McLean people in France, have also sent in a fair sized contract for motors.

NEW ZEALAND CONTRACTS PENDING.—The Auckland (New Zealand) city council has retained Noyes Brothers, of Sydney, to act as consulting engineers respecting the electric lighting of the city of Auckland. It is also proposed to operate the cranes on the wharves by electricity. The municipality of Wellington will shortly let contracts for the construction of an electric traction system.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended May 10: Antwerp—37 pkgs. material, $2,519. Argentine Republic—8 pkgs. material, $1,442; 1 pkg. machinery, $670. Amsterdam—1 pkg. machinery, $91. Alicante—1 pkg. material, $25. Bradford—9 pkgs. machinery, $700. Brazil—22 pkgs. machinery, $1,161; 82 pkgs. material, $3,223. Barcelona—5 pkgs. machinery, $284. British East Indies—41 pkgs. material, $978; 7 pkgs. machinery, $752. British Possessions in Africa—1 pkg. material, $100. British Australia—4 pkgs. material, $346. British West Indies—25 pkgs. machinery, $295. Cuba—153 pkgs. material, $9,518. Charkow—4 pkgs. machinery, $350. Central America—95 pkgs. material, $674; 51 pkgs. machinery, $8,742. Copenhagen—1 pkg. material, $105. Christiana—1 pkg. machinery, $75. Ecuador—9 pkgs. material, $204. Genoa—25 pkgs. material, $500. Glasgow—9 pkgs. material, $167; 11 pkgs. machinery, $1,080. Havre—9 pkgs. material, $350. Hayti—4 pkgs. material, $47. Hong Kong—4 pkgs. material, $2,687. Hamburg—5 pkgs. machinery, $607; 21 pkgs. material, $2,411. Hull—4 pkgs. material, $90. Japan—4 pkgs. material, $55. London—80 pkgs. material, $5,720. Liverpool—149 pkgs. machinery, $13,321; 22 pkgs. material, $1,217. Leeds—1 pkg. material, $20. Manchester—556 pkgs. machinery, $99,264. Milan—27 pkgs. material, $588. Mexico—4 pkgs. material, $104. Naples—1 pkg. material, $50. New Castle—1 pkg. material, $19; 8 pkgs. machinery, $1,976. New Zealand—2 pkgs. machinery, $86. Nova Scotia—19 pkgs. material, $278. Peru—18 pkgs. material, $872. Philippines—5 pkgs. machinery, $342. Rotterdam—5 pkgs. machinery, $120. Rome—59 pkgs. machinery, $10,000. U. S. Colombia—8 pkgs. material, $151. Venezuela—53 pkgs. material, $710.

LIGHTING EQUIPMENT FOR PHILIPPINE CRUISERS.—The fifteen cruisers which are now undergoing construction in Chinese and Japanese shipbuilding yards for coasting and inter-island service in the Philippines, are to be each equipped with 10-kw marine-type lighting sets and 18-inch searchlights. The General Electric Company has secured the contract, which is valued at nearly $40,000. The duplex pumping equipments of these vessels are to be supplied by the Laidlaw-Dunn-Gordon end of the International Pump Company. These contracts have been placed by F. W. Horne, of Yokohama, the pioneer handler of American machinery in the Far East, who is now in the United States for the purpose of placing contracts aggregating nearly a quarter of a million dollars, for various electrical equipments, machine tools, etc. The contract for the wiring for the cruisers has not yet been let. This item will represent an expenditure of about $10,000. Mr. Horne has also some interesting orders to place for equipment needed in several of the Japanese arsenals. He is making his headquarters at the offices of W. J. Kingsland, in the Curtis Building, 35 South William Street. Uptown he can be found at the Hotel Manhattan.

WESTINGHOUSE EQUIPMENT FOR NEW AUSTRALIAN ROAD.—The Australasian electrical engineering and contracting firm of Noyes Brothers, which concern represents the Westinghouse interests in the Antipodes, has secured the contract for the equipment of Adelaide electric traction system. The lines will be about 66 miles in length. The value of the contract is over $3,500,000. Under the measure passed by the South Australian House of Parliament, 42 miles of electric traction must be in operation within three years. The existing horse tramways, owned by various companies, are to be acquired at a cost of between $1,750,000 and $2,000,000. The new Adelaide system will be built and operated, for a certain period, by a private enterprise, differing in this respect from the Sydney system, which is being constructed and worked by the New South Wales Government. Fourteen years after construction the municipality of Adelaide has the right to acquire the projected road at valuation, and in 55 years the lines are to become the property of the local authorities free of cost.

MASSENA POWER.—It is announced that the Pittsburg Reduction Company has secured 100 acres of land at Massena, N. Y., and will at once erect five large factories to cover at least fifteen acres of its land. The company will manufacture aluminium principally, and will employ from five to six hundred men steadily the year round. This company has plants at Niagara Falls, Shawinigan Falls, Quebec and Pittsburg. The Massena factories will be one of their main plants on account of the cheap shipping facilities both by water and rail and the abundant electrical power available at a low cost. The cost of this plant will involve an expenditure of over $1,000,000. The buildings will be inclosed by Fall, and the works in operation by April of next year.

WATER-POWER PLANT FOR COSTA RICA MINES.—The Abangarez Gold Fields of Costa Rica, an Anglo-American concern, in which Mr. Minor C. Keith, vice-president of the United Fruit Company, is largely interested, has placed contracts for a water-power plant to operate its mines in Central America. Hitherto work has been carried on by means of steam power. The water-power plant is to have an initial capacity of 300-hp, which is expected to be largely added to in the near future. The electrical portion of the contract has been undertaken by the General Electric Company. The water-wheel equipments will be furnished by the Pelton Water Wheel Company. The Pelton Company has also secured an order for 1½ miles of pipe.

ORDERS FOR AUTOS.—The Vehicle Equipment Company, of Brooklyn, has been compelled to enlarge its plant, and for that reason has acquired a portion of the old De Dion plant, adjoining the Nassau car stables, Thirty-seventh Street and Thirteenth Avenue, now occupied by the former concern. The Rainier Company, of 393 Broadway, agents of the Vehicle Equipment Company, have just sold, among others, a 5-ton electric truck, with electric hoisting apparatus, to the Niles-Bement-Pond Company, in Liberty Street; a 4-ton truck to the John Simmons Company, at 110 Centre Street, and an electric delivery wagon to Schonniger Bros., the milliners.

DIESEL ENGINE.—At a meeting of the directors of the American Diesel Engine Company, Hugo Reisinger resigned as secretary and treasurer, and Edwin S. Cramp, vice-president of the Cramp Ship Building and Engine Company, of Philadelphia, was elected a director. President Busch has visited the works of the International Power Company, at Providence, where the Diesel engines are being manufactured, and is said to be very much pleased with the new engines which are being built with all the improvements put on by the International Power Company. The International Power Company holds the manufacturing right for Diesel engines in the United States, Canada, Great Britain and all her colonies.

STEEL FOR SYDNEY POWER STATION.—Milliken Brothers, New York, are about to make shipment, through R. W. Cameron & Company, New York, the American agents of the New South Wales Government, of some 700 tons of structural material, which will be used for an extension to the central power station of the Sydney City and Suburban Tramways. It will be recalled that the General Electric Company was awarded the contract for the initial equipment of the power house, etc., valued at nearly $800,000. Further important contracts will be awarded shortly.

ELECTRIC POWER IN ELECTROTYPERS.—Electrotypers and photo-engravers have been quick to see the advantages of electrically-driven machines, and are installing electric motors in their plants as rapidly as occasion permits. One of the most recent plants to be thus equipped is that of the United States Playing Card Company, Cincinnati, O., where all the electrotyping and photo-engraving machines are operated by the Sprague Electric Company's motors.

ELECTRICAL PLANT FOR QUEENSLAND RAILWAY SHOPS.—The Queensland Government's new railway shops at Ipswich, are to be installed with a complete electrical plant, for the purpose of operating machine tools, etc. The plant will consist of three 250-hp Westinghouse engines and two-phase generators, switchboard, steam piping, pumps and several motors for driving the machines.

MEXICAN POWER HOUSE CONTRACTS.—The Riter-Conley Manufacturing Company, of Pittsburg, Pa., has secured the contract for the extension of the boiler and engine house of the Mexican Tramways Company, Limited, City of Mexico. The same concern has also received the contract for the erection of the power plant of the Compania de Penoles, at Mapina, Mexico.

MR. A. K. BAYLOR, formerly connected with the railway department of the British Thomson-Houston ompany, Limited, and now interested in the British Electric Car Company, is at present on a visit to the United States. He may be found at his New York office in the Bowling Green Building, or at the Hotel Albemarle.

THE VALLEY SUGAR COMPANY, which is building a beet sugar plant at Carrollton, Mich., will have an electric plant, consisting of two engines built by the Ball Engine Company, Erie, Pa., direct connected to Crocker-Wheeler generators.

A PRISON LIGHTING PLANT.—Warden George Deyo of Clinton Prison, Dannemora, will purchase a 100-kw. alternating current plant for lighting Clinton prison. Mr. Robert Elliott is electrical engineer of the prison.

LORAIN RAILS FOR ENGLISH ROAD.—The Lorain Steel Company has secured a contract for track material for the electric traction system about to be constructed by the Corporation of Reading, England.

MEXICO ROAD TO BE EXTENDED.—The electric system at Puebla, Mexico, which is controlled by the Mexican Tramways Company, Limited, City of Mexico, is to be extended.

General News.

THE TELEPHONE.

SAFFORD, ARIZ.—The Gila Valley Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-

LOS ANGELES, CALIF.—The New Home Telephone Company, of Los Angeles, has 6,000 subscribers. It has just received 210,000 feet of conduit cable, which will be laid as fast as conduits are built.

DENVER, COLO.—The Colorado Bell Telephone Company is preparing to duplicate enough of its Denver-Cheyenne service to make a more complete and extended service between Denver and Salt Lake City.

GUNTERSVILLE, FLA.—J. C. Drake will construct a telephone system from this place to Joppa.

HENRY, ILL.—The Hopewell Telephone Company has petitioned for a franchise in this place.

TOULON, ILL.—The Stark County Telephone Company has increased its capital stock from $5,000 to $6,000.

MACOMB, ILL.—The Illinois Western Telephone Company has increased its capital stock from $60,000 to $200,000.

CHICAGO, ILL.—The Flanagan & Dana Telephone Company, of Flanagan, capital $980, has been incorporated by Henry P. Thompson, George Crawford, Milton M. Bane.

RODNEY, IA.—The Monona Telephone Company will build a line from this place to Ticonia.

EAST MOLINE, IA.—The Crescent Telephone Company is building a line from Osborn to this place.

HEDRICK, IA.—The Hedrick Telephone Company's franchise has been granted. The company will now greatly enlarge its system.

SPENCER, IA.—A special election will be held soon to decide upon the granting of a franchise to the Clay County Telephone Company.

DAVENPORT, IA.—There is a probability that the Iowa Telephone Company will build a line from this city to Plainview and Marysville.

RED OAK, IA.—The Red Oak Mutual Telephone Company has incorporated, with a capital stock of $10,000. William Cozal is president.

CEDAR RAPIDS, IA.—The Farmers' Telephone Company, of Cushing, Woodbury county, has filed articles of incorporation. Its capital stock is $6,000.

CEDAR FALLS, IA.—The Rapid Transit Company is installing a telephone system on its interurban cars running between this city and Waterloo and that city and Denver.

MILTON, IA.—The Milton Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a 150-line magneto self-restoring drop switchboard.

MARSHALLTOWN, IA.—The Marshall Telephone Company, of this city, has executed a mortgage of $20,000 in order to provide for extensive improvements to the system, including a new switchboard and the laying of underground cables.

MUSCATINE, IA.—The American Telephone & Telegraph Company has, within the past six weeks, secured franchises in the following-named places: Wapello, Burlington, Ft. Madison and Keokuk, Ia., and La Grange, Hannibal, Bowling Green, Troy and St. Charles, Mo. A franchise for this city will probably be granted to the same company.

GAYLORD, MICH.—The Otsego Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company for a 200-line self-restoring drop switchboard.

WADENA, MINN.—The Iron Range Electric Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 200-line self-restoring drop board.

PATMOS, MISS.—The Deer Creek Telephone Company has incorporated, with a capital of $600. H. G. Thornell and others are interested.

GREAT FALLS, MONT.—The Rocky Mountain Bell Telephone Company will at once start construction on a new line from Great Falls to Fort Benoi.

RENO, NEV.—The Sunset Telegraph & Telephone Company is endeavoring to obtain 300 more subscribers for the Reno exchange, in which case a new exchange will be put in and the express system installed. The company will at once start extending to a number of other Nevada towns.

EAST AURORA, N. Y.—The Haines Telephone Company has been incorporated, with a capital stock of $20,000.

AMSTERDAM, N. Y.—The Hudson River Telephone Company contemplates erecting an exchange building here soon.

TROY, N. Y.—The New Lebanon Farm Telephone Company, of Otsego county, has been incorporated. The capital stock is $5,000.

the name of Great Western Telephone Company, with a capital of $100,000.

BERLIN, OHIO.—The Berlin Telephone Company of Holmes County has increased its capital stock from $1,350 to $4,500 to provide for improvements.

DEFIANCE, OHIO.—C. R. White, D. Lieberthal, John Titus and others of Defiance have secured a franchise for an independent telephone system in Ashland.

FLUSHING, OHIO.—The Flushing Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop board.

MANSFIELD, OHIO.—A lively fight is on between the Central Union Telephone Company and the Mansfield Telephone Company, which has recently commenced operations.

KENTON, OHIO.—The Kenton Telephone Company is installing an addition to its switchboard to take care of numerous new subscribers. A number of new rural lines is being built.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has 470 telephones in operation and orders which will bring it over the 500 mark. A switchboard addition has been ordered.

ALLIANCE, OHIO.—The physicians of Alliance have signed an agreement to discontinue the use of Bell telephones after June 1. It is understood they will subscribe for the new independent service.

CHILLICOTHE, OHIO.—The Chillicothe Home Telephone Company is installing considerable cable work and a new switchboard and will build a number of farmers' lines. At present it has over 1000 subscribers.

TOLEDO, OHIO.—Spitzer & Company have acquired a large financial interest in the Toledo Home Telephone Company and Gen. C. M. Spitzer has been chosen a director in the place of C. F. Chapman, who recently resigned.

SEBRING, OHIO.—The Central Union Telephone Company is installing a local exchange, and will furnish business lines at $2 and residence lines at $1 per month. Free service is given to Alliance and surrounding towns.

LORAIN, OHIO.—The Lorain Telephone Company has placed a contract with Arthur W. Hoge for a switchboard of 4,000 drops. New conduits will be laid and additional telephones purchased. The improvements will cost about $65,000.

NAPOLEON, OHIO.—After a fight of more than a year, the Central Union Telephone Company has been refused a franchise in Napoleon by the Probate Court, on the ground that more telephone wires on the street would be a serious obstacle in case of fire.

COLUMBUS GROVE, OHIO.—The Putnam Telephone Company is making important improvements at Columbus Grove, Continental and Pandora. The new switchboard for Columbus Grove is being built by the Columbia Telephone Manufacturing Company of Ottawa, Ohio.

DEFIANCE, OHIO.—The Northwestern Telephone Company has elected these officers: H. B. Tenzer, president; William Geiger, vice-president; W. W. Wood, secretary, and W. G. Lehman, treasurer. The annual report shows a gain of over 200 subscribers for the year. The company is planning extensive improvements to its system.

HASKINS, OHIO.—The Haskins Mutual Telephone Company has organized as follows: F. A. Robertson, president; J. A. Bowers, vice-president; E. C. Thornton, secretary-treasurer; Wm. Mohr, general manager. The above with E. C. Thornton, John Schurtzburg and Fred Dauer are directors. The exchange will shortly be placed in operation and connection will be made with Bowling Green, Weston, and other points.

AKRON, OHIO.—Manager Laubach of the Akron People's Telephone Company states that it now has over 3,000 telephones connected up in Summit county. The increase amounts to 50 per cent in the past six months and 100 per cent in the past year. The company is planning to build several sub-exchanges in the southern portion of the county and will cover the territory thoroughly with farmers' lines.

EAST LIVERPOOL, OHIO.—The telephone operators in the exchange of the Columbiana County Telephone Company struck for an increase in pay a few days ago. They demanded an increase from $20 per month to $1 per day. The girls finally returned to work on the following scale: Toll operators, $1 per day; three oldest operators, $25 per month; other operators, $20 and $21; overtime, 10 cents an hour, and each operator to be given a ten-days' vacation with full pay.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Company held its annual meeting a few days ago and elected directors as follows: F. L. Beam, H. C. Devin, P. S. Kelser, B. L. McElroy, W. P. Bogardus, A. R. Sipe and B. D. Herron. During the past year the company has spent $8000 in improvements and it is contemplating a large amount of work for this summer. A new exchange will be installed at Centerburg with equipment for 100 subscribers. Over 800 telephones are now in operation in the county.

CIRCLEVILLE, OHIO.—The Circleville Citizens' Telephone Company was organized a year ago and commenced business in September with 35 subscribers connected. At present the company has in actual operation 596 telephones divided among three exchanges as follows: Circleville 418; Ashville, 99 and Williamsport 79. The company has over 100 miles of toll line reaching twenty-four towns. An order has been placed for an additional switchboard and new lines are to be built to Yellow Bud, East Ringgold, Commercial Point and Matville. A number of farmers' lines are to be built.

JOHNSTOWN, PA.—The Johnstown Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop board.

DALLAS, PA.—The Centre Moreland Telephone Company has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop switchboard.

the Wheatstone Bridge Telephone Company, with a capital of $500,000, and

NASHVILLE, TENN.—The Cumberland Telephone Company, of Nashville, Tenn., has bought the Carroll County Telephone Company, with lines and exchanges in McKenzie, Hollow Rock, and other points.

BEAUMONT, TEX.—The Beaumont & Northwestern Telephone Company has increased its stock from $10,000 to $20,000.

HENRIETTA, TEX.—The Farmers' & Merchants' Telephone Company has increased its capital stock from $2,400 to $4,800.

HERNDON, VA.—E. L. Detwiler has closed a contract with the Kellogg Switchboard & Supply Company for a 100-line self-restoring drop board.

SALT LAKE CITY, UTAH.—The Gila Valley Telephone Company of Arizona will at once extend its lines. The company will build from Tombstone to Pearce, Turquoise, Cochise and Willcox, and from that point to Solomonville and Safford. The Globe Telephone Company of Arizona will build across the San Carlos Indian reservation to connect with the lines of the Gila Valley Company at Fort Thomas.

RICHMOND, VA.—The Street Committee has adopted an ordinance granting the Richmond Telephone Co., of Richmond, two years in which to place its wires under ground. The officers of the company asked for ten years.

ST. ALBANS, VT.—The Franklin County Telephone Company opened its exchange in St. Albans, Vt., February, 1900, with 100 subscribers. Today it has 500. Its business has steadily increased.

SPRAGUE, WASH.—A farmers' telephone company has been organized here to put in a system of country telephones in Whitman, Spokane, Adams and Lincoln counties. It is estimated that 100 miles of wire will be strung. The line will connect with the Inland Telephone Company.

ELECTRIC LIGHT AND POWER.

MARION, ALA.—The Marion Light & Power Company has been granted a forty-year franchise for an electric plant. T. D. Kemp, Selma, Ala., is secretary and manager.

PRESCOTT, ARIZ.—The Prescott Electric Company is expending $20,000 in the improvement of its electric lighting.

SAN FRANCISCO, CALIF.—The W. B. Brown Company has purchased a controlling interest in the North Bloomfield Mining Company, of Nevada county, Cal. Mr. M. B. Bourn is the president of the San Francisco Gas & Electric Company. It is considered more than probable that an electric generating plant will be installed for the transmission of electric power to San Francisco. The Bourn syndicate is also negotiating for the property of the Eureka Lakes Company, the owners of French Lake, fifty miles of ditches, canals, and valuable hydraulic ground at Columbia Hill and other points. The control of 10,000 inches of water is involved.

DENVER, COLO.—The new town of Custer, Colo., will at once install an electric light plant in connection with its water system.

CRIPPLE CREEK, COLO.—John P. Kerin has been granted a franchise by the City Council for electric lighting, power and heating.

BOULDER, COLO.—The two electric light and power companies are again cutting rates. Efforts at a consolidation have failed, and lights are being offered to citizens at 50 cents per month per ten-room house. The fight between the companies is being watched with interest, and citizens are taking lights of the company which offers them the cheaper.

JACKSONVILLE, FLA.—The Madison Electric Power Company, with $7,500 capital, has been incorporated by C. H. Smith, John C. Dial and M. D. Smith.

POCATELLO, IDAHO.—E. E. Calvin, George H. Olmstead and R. C. Sneed, Pocatello, have asked for an electric light and street railway franchise.

BOISE, IDAHO.—The Farmers' Grain Company, of Boise, recently incorporated, will build a power plant to operate its tramways. The company will also operate a telephone system from Nez Perces to surrounding towns.

BOSTON, MASS.—It is announced that the recent sale of the Plant Investment Company's trolley lines and electric light plant at Jacksonville, Fla., was to the Stone & Webster interests of this city. The companies comprised in this purchase will be united in a single corporation, and a considerable sum will be expended in developing properties.

TAUNTON, MASS.—It has been practically decided that Taunton is to have a new municipal lighting plant at an expense of $175,000, the Common Council and the majority of the board of aldermen being in favor of the plan. It is proposed to erect the new plant at Weir Village, on the Taunton River, and to use a portion of the power in conjunction with the pumping station of the new sewer system. Work will be begun at once on the new [illegible]

ST. LOUIS, MO. [illegible] pany, it offering to do the work for $21,217. There were six other bidders: J. Monk, $21,350; Buehler-Cooney Construction Company, $22,305; Schilling & Sall, $23,250; R. W. Monson Company, $25,000; Carroll Contracting Co., [illegible] switchboard at the electricity building to the eastern end of the lagoons. It will have numerous branches conducting light and power circuits to all parts of the grounds.

LEBANON, OHIO.—The village of Lebanon will make improvements to its municipal lighting plant at an expense of $6,000.

FREMONT, OHIO.—The Home Light & Power Company has applied to the Council for a franchise [illegible]

TOLEDO, OHIO.—The Toledo Railway & Terminal Company will install an electrical plant for power and lighting in its new shops here.

CHILLICOTHE, OHIO.—The Chillicothe Electric Light & Power Company has ordered an automobile, to be used in the work of renewing carbons in arc lamps.

ELYRIA, OHIO.—The Elyria Gas & Electric Light Company has given bond for $5000 to guarantee the construction of the lighting and heating plant. Contracts for equipment are to be closed in the near future.

DOYLESTOWN, OHIO.—The project of building a lighting plant has fallen through, and the $10,000 raised by bond issue will be returned to the bond buyers. Failure to secure an electric railway caused the change in plans.

COLUMBUS, OHIO.—The City Council has purchased a site for a new municipal lighting plant, which will be equipped in duplicate, and have a capacity of 4,000 lamps. Machinery for 1,900 lamps will be installed at the start.

NAVARRE, OHIO.—Proposals will be received until June 5 by Will H. Sahl, corporation clerk, for the construction and operation of an electric lighting system, with not less than 30 arc lamps for a term of ten years. A franchise will be given to a new company.

LIMA, OHIO.—The Lima Electric Light & Railway Company has let contracts for the erection and equipment of its new power house. The building will be 100x125 feet. A 500-hp. generating set will be installed for lighting service, and a 600-hp. set for the railway service. About 800-hp. will be added to the boiler capacity. The improvements will cost about $800,000, and the structure will be ready about October 1.

OKLAHOMA CITY, OKLA.—Denver men, formerly connected with the Denver Gas & Electric Company, have secured one of the largest municipal contracts ever given in the Southwest. A. H. Brauch, formerly manager of the company, has been elected president of the Oklahoma City Gas & Electric Company, which will construct an electric light plant to light Oklahoma City and to furnish power for a street railway system, which will be built by St. Louis capitalists. Harry C. Nelson will be superintendent of the construction of the new plant.

ASTORIA, ORE.—The Astoria Electric Company will soon have a new power building, and will add a large boiler, engine and generator.

PORTLAND, ORE.—The Portland General Electric Company is increasing the capacity of its electric power plant in Portland by installing four 750-hp. generators.

CAMDEN, S. C.—The building of the Camden Electric Light, Water and Ice Company and two warehouses were totally destroyed by fire recently. The loss of the company is about $40,000, with no insurance.

MEMPHIS, TENN.—The Memphis Light and Power Company has been sold for a sum very nearly approaching one million dollars. The plant was bought in merely as an investment.

NASHVILLE, TENN.—The Cumberland Electric Light and Power Company, of Nashville, Tenn., has recently purchased ground and let the contract for a new electric light and power plant to cost $300,000.

LOGAN, UTAH.—Representatives of the Hercules Light & Power Company, of Logan, are in Soda Springs, Idaho, looking over the ground for a site for the new electric light plant.

SALT LAKE CITY, UTAH.—The O'Meara-Lynch Mining Company, of Utah, will install an electric power plant at its mine to run air compressors and furnish light for the mine.

BEAVER CITY, UTAH.—The City Council has granted a franchise to E. A. Hodges to install and operate an electric lighting system. The cost of the plant will be about $10,000.

SALT LAKE CITY, UTAH.—The Big Spring Electric Company, of Fountain Green, Sanpete county, Utah, has been incorporated; capital, $25,000. George Carter is president, A. J. Aagard, Jr., secretary and treasurer.

SALT LAKE CITY, UTAH.—Preliminary work on the new electric light plant at Ephraim, Utah, has started. As soon as this is done bids will be wanted for machinery and equipment. Mr. Hutchins, Ephraim, Utah, has charge of the work.

SALT LAKE CITY, UTAH.—The Brigham City (Utah) Electric Light & Power Company will build a new power plant, using the waters of the Box Elder Canyon. The plant will be located between the mouth of the canyon and Mantua, where a fall of 500 feet is available.

SALT LAKE CITY, UTAH.—Senator Clark will equip his Ophir (Utah) mine with electric power. A plant will be installed of sufficient capacity to operate the concentrating plant, light the mine and otherwise supply power. The new plant will have a capacity of about 300 horse-power.

PROVIDENCE, R. I.—Officials of the United Gas Improvement Company are negotiating to secure possession of the principal street railways and the electric lighting and gas plants of Providence. The companies being negotiated for are the Union Traction, the Narragansett Electric Lighting and the Providence Gas companies. The amount involved in the deal is $16,000,000.

[illegible] Rapids Hydraulic & Land Company contracts with the Shawinigan Water & Power Company for the distribution of its power throughout the island and city of Montreal. The arrangement is not an amalgamation of the companies, and does not affect the management of either, according to the statement of the officials. It is simply a contract which gives the Lachine Company right to call for a practically unlimited amount of power.

TOLUCA, MEXICO.—The work of constructing the great power plant of the Toluca Electric Light and Power Company near Tenancingo, Mexico, is making good progress. The machinery for the plant has just arrived at Toluca. It was purchased in New York City and weighs 6,000 tons. R. C. Bateman and M. T. Thompson, of the City of Mexico, have secured the contract for building the canal by which the water will be conducted from the San Pedro River to the plant. The company has secured contracts to supply electric lights and power to twelve towns situated in that region.

CITY OF MEXICO, MEX.—The annual meeting of the Compania Electrica e Irrigadora de Hidalgo, a Mexican corporation, was held recently in the City of Mexico. The report of President Thomas Braniff was presented. It showed the following receipts: From electric power contracts, $22,924.86;

irrigation contracts, $62,146.31; lighting the city of Pachuca, $47,587.55. Total receipts, $132, 658.72. The disbursements, ordinary and extraordinary, amounted to $130,794.96. The board of directors reported that the plant of the company is in first class condition and that it is expected that it will be able to pay a fair dividend this year. Captain Pord Porfirio Diaz, Jr., son of President Diaz, and Mr. Constantine Noreiga were elected auditors for the current year.

THE ELECTRIC RAILWAY.

WILLIAMS, ARIZ.—The Williams & Cataract Canyon Railroad Company, recently incorporated by A. L. Hall, A. B. Coit and others of 71 Broadway, New York City, will construct in addition to a railway, telegraph and telephone lines and an electric power plant. The capital stock of the company is $3,000,000 and the power will be transmitted to Williams.

JERSEY CITY, N. J.—The North Jacksonville Street Railway, Town & Improvement Company has been incorporated here; capital, $150,000. Incorporators—R. R. Robinson, F. D. Robba, George E. Ross, J. L. Muse, William H. Young, F. P. Pratt, Frank P. McDermott.

COLUMBUS, OHIO.—The Chamberlain bill, authorizing street railways to consolidate with artificial and natural gas companies, has become a law.

LIMA, OHIO.—The council has granted a franchise to the Lima, Delphos, VanWert & Fort Wayne Traction Company, enabling it to reach the center of the city without operating over the tracks of the Lima Electric Railway & Light Company, as had been planned originally.

CLEVELAND, OHIO.—It is reported that owing to an alleged hitch between Senator Hanna and officials of the Cleveland Electric Railway Company regarding the division of stock, the proposed consolidation of the Cleveland systems has been declared off indefinitely.

COLUMBUS, OHIO.—The Columbus Railway Company has awarded a contract for an 1800-hp. engine and generator, and for a large traveling crane. A new steel roof is to be placed on the power house, and the cost of the contemplated improvements will be about $100,000.

NEW PHILADELPHIA, OHIO.—J. C. Welty, representing Tucker, Anthony & Company, Boston, who are building the line from Massillon to New Philadelphia, has deposited $1,000 cash and $5,000 bond with the county commissioners to insure the completion of the line by November.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate announces that it has secured the entire right of way for the proposed line from Wellington to Mansfield, which will be known as the Cleveland, Ashland & Mansfield Railway. The link will complete a through line from Bucyrus to Cleveland.

NORWALK, OHIO.—The Norwalk, Ashland & Southern Railway Company and the Mansfield, Greenwich & Norwalk Railway Company have both applied to the county commissioners for a franchise to build on the Wooster pike; the former to New London, and the latter to Jennings Corners and thence to Greenwich.

CLEVELAND, OHIO.—W. M. Bicknell, formerly of Cleveland, has been made general manager of the Aurora, Elgin & Chicago Traction Company. E. R. Gilbert, general manager of the Chicago Electric Traction Company, will succeed W. M. Bicknell as general manager of the Miami & Erie Canal Transportation Company.

CLEVELAND, OHIO.—The Western Ohio Railway Company has recently placed contracts with the C. & G. Cooper Company and the Westinghouse Electric & Manufacturing Company for generating sets to increase the capacity of the St. Marys power station from 800-kw to 2,300-kw. Stirling boilers of sufficient size for the new plant are being installed. The power station will have a maximum capacity of 3,800-kw.

CLEVELAND, OHIO.—J. E. Latimer and J. W. Holcomb have closed the option secured some time ago on the Cleveland, Painesville & Ashtabula Railway. The purchasers announce that construction work will start at once, a contract for building the line having been placed with the Electric Construction Company of this city. The power house has already been started, but the equipment has not yet been purchased. A $75,000 steel bridge will be required to cross the Grand River at Painesville.

YOUNGSTOWN, OHIO.—The Havana & Jainanitas Railway Company of this place has been incorporated at Dover, Del., with $1,000,000 capital stock. W. H. Park, Harry G. Hamilton, Myron A. Morris, J. N. Thompson and others of Youngstown are interested in the project, which contemplates the building of an electric railway from Havana to Jainanitas, Cuba, a distance of nine miles. The interested parties are identified with the Penhale-Devitt syndicate. W. H. Park and J. D. Milligan have left for Cuba. The latter will be in charge of the construction of the road.

PETERBORO, ONT.—The electric street railway of Peterboro, which has not been operated for the past three years, has been sold to a Detroit syndicate.

WEST CHESTER, PA.—The West Chester street railway has been sold to the Tennis Traction Company of Philadelphia. The Tennis company will proceed to complete the line between here and Downington, and will extend it to Parkesburg this summer. The company will also construct a line from Lenape to Unionville and Kennett Square.

SPARTA, WIS.—Capitalists have obtained a franchise from the city council to construct an electric railway. They also propose to extend the line to Melrose. The road will be about 25 miles in length.

GUADALAJARA, MEXICO.—The Compania Industrial, of the city of Guadalajara, which owns the electrical power obtained from the great waterfalls of Juanacatlan, near that city, is about to commence the construction of a new system of tramways in Guadalajara. The lines will traverse several of the principal streets of Guadalajara and will touch at several of the principal manufacturing establishments located in the suburbs. The old street railway system in Guadalajara is still operated by mules. The net receipts of this company, [illegible] for the year [illegible] were $[illegible]. It owns 14 kilometers of streets

THE AUTOMOBILE.

THE EADS BRIDGE AUTOMOBILES at St. Louis, Mo., are now daily averaging about 3,000 passengers. Eighteen electric vehicles are in operation and two steam propelled machines will be tried as an experiment shortly.

AUTOMOBILES IN CHICAGO PARKS.—The South Park Commissioners of Chicago have passed a rule forbidding the use of the South parks and boulevards to automobiles leaving a trail of vapor or offensive odors or making excessive noise. There is some uncertainty as to just where the line will be drawn, but the action was directed chiefly at racing machines. Electric vehicles are safely out from under both the letter and the spirit of the rule.

NEW INDUSTRIAL COMPANIES.

THE SMITH STORAGE BATTERY COMPANY, Binghamton, N. Y., has been incorporated, with a capital of $100,000. Directors—T. J. Coster, M. O. Smith and A. C. Rahe, Binghamton.

THE AMERICAN LIGHT AND FIXTURE CO., St. Louis, Mo., has been incorporated with a capital stock of $4,000, all paid. The incorporators are W. J. Hughes, W. T. Thorn, Orlando Hinz and others.

THE METROPOLITAN SWITCHBOARD COMPANY has been incorporated in New Jersey; capital, $25,000. Incorporators—Thomas J. Murphy, George A. Annable, William C. Jones and John S. Adams.

THE POWELL ENGINEER'S SUPPLY CO. with a capital stock of $5,000, has been incorporated at St. Louis, Mo. Among the shareholders are John H. Workman, Charles H. Tentenberg, Edwin E. Francis, Wright N. Powell and H. Price Simsons.

THE DAVIES-SHERMAN MACHINERY & ELECTRIC COMPANY has been organized at Tacoma, Wash., with a capital of $5,000, to do general construction work and manufacture fixtures, switches, etc. This company is a reorganization of the M. C. Davies Machinery and Electric Company. Mr. Marcus C. Davies is president.

OBITUARY.



THE LATE C. E. STUMP.

MR. C. E. STUMP. It is with deep pain and regret that we record the death from liver complaint, after a short illness at his residence in Flushing, L. I., of Mr. Clarence E. Stump, at the early age of 45. The deceased was born in Cincinnati in January, 1857, and began his journalistic career with the *Daily Herald* of that city. He put in a year at civil engineering but resumed journalism, and on arriving in New York became one of the founders of the *Daily Hotel Reporter* of which he was editor and manager for five years. Early in 1883 he became associated with the old *Operator and Electrical World* and continued as business manager of the *Electrical World* until 1891, seeing the journal grow in size and importance and doing very much by his personal influence to make it a power in the electrical field. He had many brilliant opportunities of advancement in the industry itself, but preferred to stand by the paper he had helped to create. He was now offered the vice presidency of the company issuing the *Street Railway Journal*, and having had a warm interest with numerous friendships in that rapidly growing branch of the art, he decided to make a change. In 1893 he considered that the time was ripe for a weekly street railway paper, and essayed the publication of the *Street Railway Gazette* in Chicago. He struck the distress of the hard times, however, and removed the offices to New York in 1894. A little later the paper was bought and absorbed by the *Electrical World*. Early in 1896 Mr. Stump became publisher of *City Government*, now the *Municipal Engineer*, and with this he continued until 1899. An old friend, Mr. Louis Klopsch, of the *Christian Herald*, had been urging him for some time to take charge of his vast publishing department in New York City, and as this gave Mr. Stump an opportunity to indulge his always strong mechanical tastes as well as exercise his great executive ability as a publisher, he consented, selling out his interests in all other publications. In this employ he remained up to the time of his death. Mr. Stump took an active and prominent part in the development of many early electrical institutions and enterprises, giving his time and money and influence freely in aid of friends and to worthy causes. He was also a Mason and rose to the highest degrees and honors in the craft. His position threw him into personal relationships with the leaders in electrical science and art, and on both sides of the Atlantic are many of the foremost men who held him in high esteem and regard. He was also a life-member of the International Association of Municipal Electricians and took a leading part in its organization. Of affable manners, too easy natured for his own best interests or those of others at all times, a hard worker, and unexcelled in his own lines of endeavor, Mr. Stump made an enviable record, and won a host of admirers [illegible] will always cherish his memory with tenderness and affection. Masonic funeral services were conducted on Sunday afternoon, Mr. F. H. Scherer, Past Grand Master of the State of New York officiating, Anglo-Saxon Lodge, of which Mr. Stump was a past-master, attending in a body. The interment took place at Cypress Hills Cemetery, Brooklyn, on Monday morning. The deceased leaves a widow, but no children.

MR. MAX DIETRICH, former secretary of the Empire Carbon Works, St. Louis, Mo., died on April 2 at the residence in that city of his son-in-law, George Beck, president of the Empire Company. He was secretary of the company until two years ago, when he resigned on account of ill health. The cause of Mr. Dietrich's death was pneumonia.

PERSONAL.

PROF. ARVID REUTERDAHL, of Providence, R. I., made a visit to New York last week.

DR. LOUIS DUNCAN has been appointed head of the department of Electrical Engineering at the Massachusetts Institute of Technology.

MR. C. A. SPOFFORD, well known in electrical circles has, it is said, gone to London to join the staff of Mr. Yerkes in the management of the underground electric railway properties.

MR. W. E. SIMPSON, president of the Goshen & Indiana Traction Co., has left for Europe in furtherance of plans for the early construction of an interurban railway from Goshen to Angola.

GEN. E. B. FOWLER.—A bronze statue has been unveiled in Brooklyn, Fort Greene, of Gen. E. B. Fowler, the war commander of the Fourteenth Regiment, who was afterwards prominent in the management of the Commercial Cable up to the time of his death.

MR. C. S. POWELL, Cleveland district representative for the Westinghouse Electric & Manufacturing Company, will leave New York about June 4 for a two months' pleasure trip to Europe. He will devote considerable time to studying the power plants in the cities he visits.

MR. EDWARD E. GOUDEY, formerly foreign manager for the Wagner Electric Company, and now Secretary of the Goudey-McLean Company, New York, who has been abroad since last October in the interest of his company, will return by the Atlantic transport liner "Minnehaha," due to arrive in New York, June 7.

MR. HORACE E. ANDREWS, president of the Cleveland Electric Railway Company, gave a luncheon a few days ago to the retiring general manager of the company, Ira A. McCormack, at the Euclid Club, Cleveland, Ohio, and had as guests a number of prominent visiting steam railway men. Mr. McCormack goes to New York to become division superintendent of the New York Central.

MR. CHARLES H. ERWIN has been appointed superintendent of the Western Union Telegraph Company, with headquarters at New York, in place of Mr. Walter C. Humstone, who recently resigned. Mr. Erwin was Mr. Humstone's assistant, and is therefore, through his familiarity with all the details, thoroughly qualified to fill the new position. His territory embraces New York City, including 250 branch offices, and 1,500 offices in the States of New York, Pennsylvania, New Jersey, Massachusetts, Connecticut and Vermont.

Trade Notes.

REMOVAL.—The Metropolitan Telephone & Electric Company has moved to 610 Wilson Ave., Chicago.

THE ELECTRIC FURNACE COMPANY has removed its offices from 52 William St. to 180 Broadway, New York.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that an appreciative public is not letting it forget that it is headquarters for Packard incandescent lamps. The orders for last month have broken the record.

THE REUTERDAHL ELECTRIC CO., Providence, R. I., has opened a New York office at 72 Trinity Place, in charge of Mr. Horace M. Williams. Mr. Williams has had an extensive experience in and around New York City in representing other lines of trade and is thoroughly acquainted. The Reuterdahl cell, it is stated, has given much satisfaction to its users.

MR. RAY D. LILLIBRIDGE, the well-known trade press and advertising expert, who represents Stanley, Link Belt, Otis Elevator, and other interests, has now had confided to his skill for securing profitable publicity the press business of the famous Cazanove, "Vin Monarque" champagne, one of the best-known French wines. The '93 brut brand will be pushed in this country.

COMMUTATOR BARS.—The Sterion Copper, Brass & Bronze Co., of 65 and 67 N. Ashland avenue, Chicago, is putting on the market a line of copper commutator bars from less than a half ounce each up to 16 ounces each and over. These bars are made to specific order or can be had in the standard shapes and sizes. The Company also makes switch blades, splicing sleeves and other electric copper details.

REFRIGERATION AND COLD STORAGE.—The H. W. Johns-Manville Company, New York, has issued a pamphlet on refrigerating and cold storage by the use of Keystone hair insulator. This insulator, it is stated, insures the maintenance of even temperatures with the lowest first cost for equipment, boilers, compressors, and piping. It possesses many advantages which are all pointed out in the pamphlet.

NEW YORK TELEPHONE CO. has distributed an extremely handsome and striking pamphlet on telephone service in New York city, with special reference to hotels and apartment houses. The cover and decorations are what we esume should be styled "impressionistic" and "art nouveau," in grays and greens, mauves and sombre tints, while the illustrations are excellent and the text admirable, pertinent and persuasive. The company is doing a large business in this field now and expects a very rapid increase.

FIRE-DETECTING WIRE.—The wide scope of the uses of Montauk fire-detecting wire and its various advantages are pointed out in a booklet just issued by the Montauk Fire-Detecting Wire Company, of New York. The system is briefly described and an understanding of its operation is materially advanced by the aid of diagrams. The advantages and importance of this system are obvious to those who have investigated it, and it is assuring to know that the system has been approved by the New York Board of Fire Underwriters.

C. K. HILL, Pittsburg, Pa., has recently moved into his new building, corner Liberty Ave. and Seventh St. The new quarters are most attractive in appearance, conveniently arranged and offer every facility for promptly satisfying the demands of the most exacting customer. The first floor is occupied by the principal salesroom, in the rear of which is the packing room. On the second floor are the offices and a spacious showroom. The third floor is given over to manufacturing. In the basement is a complete lighting plant, as well as facilities for storing heavy goods and reserve stock.

THE DOUBLEDAY-HILL ELECTRIC CO. Pittsburg, Pa., has recently installed a uniform filing system throughout the different departments of its business. As a result it is in better shape than ever to fill orders promptly and accurately. Invoices are invariably sent on the same day on which the goods are shipped. The company reports excellent prospects for a record breaking fan business this year. It is well prepared to meet this demand, having recently received four carloads of Emerson fans and two carloads of fans of other makes. The repairing and winding department which this company established several months ago is meeting with success beyond all expectations. This rapid growth has necessitated additional machinery recently and the employment of additional skilled workmen.

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, has just issued one of the most complete telephone catalogues that has ever been produced. It is a volume of very nearly 200 pages, handsomely bound, and devoted exclusively to telephone apparatus and telephone line and construction material. There is nothing pertaining to the operation, maintenance or equipment of telephones lines and exchanges, which is not shown in this catalogue. It illustrates a large number of new and up-to-date devices which have never been in a catalogue before. This is the first catalogue, it is said, which has ever been issued which covers the complete requirements of a telephone line and exchange. It should certainly be a very valuable book to any one interested in telephone line and construction material. This company claims that it is now carrying probably the largest stock of telephone line and construction material in the United States, and states that it is prepared to furnish promptly from St. Louis stock anything illustrated in this catalogue. A copy of the catalogue will be mailed on application.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 13, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

699,640. TROLLEY HEAD OR WHEEL; G. Aye, Kittanning, Pa. App. filed Sept. 28, 1901. The wire runs through a triangular space formed by the rims of three wheels and is thereby confined to the trolley; ice-scrapers are also a feature.

699,643. CONTROLLING ATTACHMENT FOR TROLLEY POLES; R. J. Barry, Westboro, Canada. App. filed Dec. 10, 1901. The pole is prevented from rising beyond the wire by a link attached to the roof of the car by a spring which opposes the spring on the trolley arm.

699,647. SAFETY FUSE FOR ELECTRIC CIRCUITS; D. G. Black, Brooklyn, N. Y. App. filed Jan. 3, 1902. Two wire-terminals under spring tension are connected together by a small globule of fusible metal.

699,651. ELECTRIC HEATER; M. C. Bing, Chicago, Ill. App. filed Oct. 19, 1901. The heating resistance is wound around a tube which is perforated and air is forced through the pipe to create a circulation through the resistances.

699,654. ELECTRIC FURNACE; C. [illegible], Providence, R. I., assignor to [illegible], Providence, R. I. App. filed July 2, 1898. (See page 930.)

699,658. STORAGE BATTERY; H. J. Cogswell, Hartford, Conn. App. filed Oct. 26, 1899. A pencil or core of lead is formed along its length with abutments between which are disposed at short intervals a series of annular flanges between which the active material is located.

699,660. POLARIZED ELECTROMAGNET APPARATUS; F. B. Cook, Chicago, Ill. App. filed Aug. 29, 1899. (See page 912.)

699,676. TELEPHONE CIRCUIT; G. E. Goodhead, Winchester, Ill. App. filed June 11, 1900. (See page 930.)

699,677. MEDICAL BATTERY; F. Greer, Chicago, Ill. App. filed Sept. [illegible]. (See page 930.)

699,713. PLASTIC COMPOUND AND THE METHOD OF MANUFACTURE THEREOF, SAME; E. M. Rudd, Newark, N. J. App. filed Sept. 9, 1901. An insulating compound consisting of varnish residue, peat and [illegible].

699,714. HEADLIGHT FOR MOTOR CARS; C. Reuter, Cleveland, O. App. filed Feb. 11, 1901. The lamp feeds when the circuit is broken and [illegible] covered with insulation at intervals to interrupt the current to the lamp.

699,734. ELECTRIC GENERATOR; J. M. Wilson, Battle Creek, Mich. App. filed Apr. [illegible]. A [illegible] driven thereby for supplying the bicycle lamp.

699,744. TROLLEY WHEEL; G. E. Chapman, G. L. Ensign and J. M. Weir, Cleveland, O. App. filed July 16, 1901. The contact device between the wheel and the harp has both tangential and lateral connection with the wheel.

699,761. INSULATOR; H. F. Kretzer, St. Louis, Mo. App. filed Jan. 27, 1902. A knob having a seat for a lightning rod and suitable grooves for a binding [illegible].

699,764. SYSTEM OF ARMATURE WINDING FOR ELECTRIC MOTORS; T. J. Murphy, Montreal, Canada. App. filed Oct. 17, 1901. Details.

699,787. ELECTRIC RAILWAY SYSTEM; G. L. Campbell, Nyack, N. Y. App. filed Aug. 23, 1901. A system in which a trolley in a closed conduit is moved along by the attraction of a magnet carried by the car and this invention provides for the insertion of non-magnetic plates and walls at crossings to prevent interference with the action of the trolley.

699,841. ELECTRIC SIGNAL DEVICE; T. J. Hoover, Carlinville, Ill. App. filed Sept. 20, 1901. An automatic switch is arranged to close the circuit containing a semaphore whenever a draw-bridge is open or a portion of the track destroyed.

699,851. APPARATUS FOR FUSED BATH ELECTROLYSIS; C. W. Roepper and G. P. Scholl, Philadelphia, Pa. App. filed Aug. 29, 1898, renewed Oct. 15, 1901. (See page 910.)

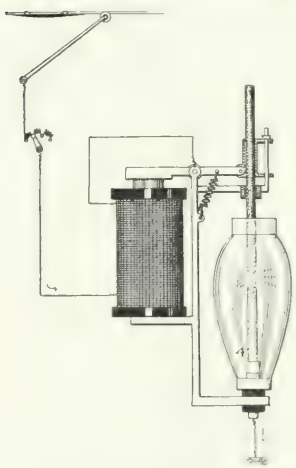
699,863. DEMAGNETIZER; G. Boettger, Milwaukee, Wis. App. filed March 24, 1902. A switch for rapidly reversing the magnetism of a solenoid consisting of two plates having alternating teeth in line with each other, over which the circuit terminals travel.

699,899. ELECTRIC METER; G. A. Scheeffer, Peoria, Ill. App. filed Jan. 10, 1900. An oscillating meter having means for effecting a reverse movement of the oscillating element when it has been rotated by the normal torque of the meter to a predetermined point in its oscillation, the means for effecting the reverse movement of the oscillating member counteracting the torque.

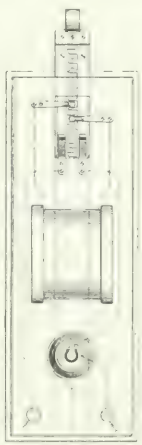
699,902. RAIL BOND CONSTRUCTION; E. G. Thomas, Cambridge, Mass. App. filed Nov. 1, 1901. A rail bond consisting of a flexible strip bent laterally between its ends and thereby adapted to be passed through an opening in one or both of the rails to be joined, and to be attached at each end to one of the rails.

699,907. ELECTROLYTIC APPARATUS FOR MANUFACTURING CERTAIN SALTS SUITABLE FOR THE SUBSEQUENT PRODUCTION OF CHLORINE; G. J. Atkins, London, Eng. App. filed Aug. 17, 1901. (See page 910.)

699,914. CEILING BLOCK; C. W. [illegible]. App. filed Aug. 19, 1901. Details.



699,714. Headlight for [illegible].



[illegible].

699,927. TROLLEY; P. McCullough, Tuebrook, Liverpool, Eng. App. filed June 24, 1901. An arrangement which enables the trolley head to separate from the pole without injury to the conducting wire when an exceptional pull is applied, such as is the case when the head gets entangled.

699,951. ELECTRIC CONTROLLER; J. C. Henry, Denver, Colo. App. filed April 1, 1901. The method of operating a pair of electric motors, which consists in connecting the armatures in series relation and the fields in shunt relation thereto, changing the combined machine to parallel and then speeding up by placing the fields of both motors in series.

[illegible]. CIRCUIT CONTROLLER; [illegible]. App. filed [illegible]. Details.

[illegible]. ELECTRICAL CONVERTER; [illegible]. App. filed [illegible]. Details.

[illegible]. CONDUCTOR FOR ELECTRIC RAILWAYS; [illegible]. App. filed [illegible]. Details.

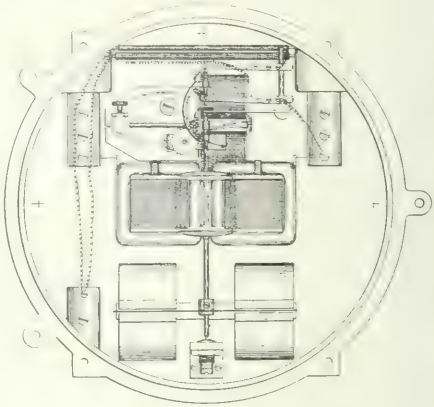
I. L. Thompson, Morristown, N. J. App. filed Aug 8, 1901. A system

[illegible],027. BURGLAR ALARM FOR SAFES; I. J. Emory, Waverly, O. App. filed Dec. 16, 1901. An inclosed space in front of a safe, has a movable floor by which an alarm circuit is closed by the weight of a person on the floor.

[illegible],037. REPEATER FOR TELEGRAPH LINES; J. W. Gray, Fowler, Ind. App. filed Nov. 22, 1901. Details.

[illegible],052. ELECTRIC MOTOR CAR OR LOCOMOTIVE; C. DeKando, Budapest, Austria-Hungary. App. filed April 13, 1901. To make high-tension currents safe for use on tram cars, all of the conductors and parts which carry current, are encased in metal tubes which are grounded.

[illegible],079. POTENTIAL REGULATOR; R. A. Philip, Seattle, Wash. App. filed Nov. 5, 1901. This invention is for the purpose of modifying the voltage returned to the station by a group of pilot wires in such a way that, instead of representing the potential at some particular point, the voltage indicated is proportionate to the average potential at a number of points of the system; this reduces the liability of the general potential of the system being injuriously affected by local disturbances.



699,899.—Electric Meter.

[illegible],107. MANUFACTURE OF ELECTRIC CABLES; J. H. West, Berlin, Germany. App. filed Sept. 21, 1901. To obtain the lowest static capacity in the cables, they are strung upon a helix of insulating material such as paper, being seated in notches in the helix and thereby separated by air spaces.

[illegible],111. ELECTRICAL MEASURING INSTRUMENT; V. Arcioni, Spoleta, Italy. App. filed July 25, 1901. A counter-balancing device for equalizing the action of the current on the movable part of the instrument.

[illegible],126. SYSTEM OF ELECTRIC RAILWAYS OF THE SECTIONAL TYPE OF CONDUCTORS OR RAILS; C. J. Kintner, New York, N. Y. App. filed Dec. 2, 1901. Utilizing a part of the working current taken from a live section over which a car is passing, to prevent any circuit connection between a sectional conductor immediately in the rear of the live section and the current feeder, until the car has passed out of the section on which it is located.

[illegible],127. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed May 6, 1901. This invention contemplates lowering the current flow through the terminals of a switch at the time that the corresponding sectional conductor is disconnected from the current feeder, to such an extent as to avoid injurious arcing.

[illegible],128. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed May 6, 1901. A safety system in which cars are automatically prevented from approaching each other to a certain distance and in which draw-bridges are prevented from opening after a car has approached within a certain distance of it.

[illegible],129. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed May 6, 1901. Signals are arranged to be operated coincidently with the energizing and de-energizing of the sections of a third rail, to thereby indicate to motormen the position of cars with respect to the sections.

[illegible],130. ELECTRIC RAILWAY; C. J. Kintner, New York, N. Y. App. filed Dec. 5, 1900. A safety system wherein the current to the sections immediately ahead and behind a car is controlled and co-operating signals likewise operated. The invention also relates to the manual control of current to the sections.

[illegible],134. TROLLEY; M. P. Crehan, Pittsburg, Pa. App. filed Oct. 25, 1901. The trolley wheel is spring-mounted at the end of the pole.

[illegible]. ELECTRIC GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed March 5, 1901. (See page 910.)

[illegible]. ELECTRIC GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed March 5, 1901. (See page 910.)

[illegible],160. DENTAL MALLET; J. W. Thatcher, San Francisco, Cal. App. filed Jan. 25, 1902. A reciprocating drill which is set in motion by pressure of the drill point against the filling of the tooth.

[illegible],161. TELEPHONIC RECEIVER FOR WIRELESS SIGNAL APPARATUS; T. Tommasina, Geneva, Switzerland. App. filed May 24, 1900. [illegible].

Twenty-fifth Convention of the National Electric Light Association.

THE twenty-fifth convention of the National Electric Light Association was called to order at the Grand Hotel, Cincinnati, 10:20 A. M., May 20, 1902, by President H. L. Doherty. Gen. . Hickenlooper, president of the Cincinnati Gas and Electric Company, welcomed the convention to Cincinnati in the name of the city's hief executive, who was absent from the city. He spoke of Cincinati's importance as a manufacturing center. Out of half a million eople, 200,000 are engaged directly in manufacturing. In referring the large factories, the growing importance of the Bullock Electical Manufacturing Company in the electrical field was enlarged n with no little eloquence and local pride, and in concluding, the ish was expressed for a most profitable convention.

Past Pres. Fred Nicholls, of Toronto, Canada, responded to the ddress of welcome in behalf of the Association. He said that the ssociation had never assembled in any city where so great and varied ntertainment was promised. He extended a cordial vote of thanks the name of the body.

President Doherty then made a few preliminary announcements. Owing to the length of the programme, he urged the necessity of eeting on time. He also urged a general response to questions in ie question box. Fully 80 per cent. of the members he considered pable of giving advice on some special topics, and their contribuons were especially needed for answering question-box inquiries. e then delivered the president's address, and inaugural utterances this kind have rarely been given that contained more in the way of ofitable suggestion, both for the industry and the association.

PRESIDENTIAL ADDRESS.

President Doherty called attention to the healthy financial ndition of the Association, and pointed out how its method preparing a programme had been varied by eliminating ig papers on technical subjects in favor of short written practical scussions and of replies to "Question Box" inquiries and topics. e recommended that the Association elect not only a president ch year, but an editor to report progress made in methods and paratus, with as many sub-reporters as the work might demand. e also directed attention to some of the topics to be treated, d noted as to steam turbines that a manufacturer recently gave bid on one for direct connection to an alternator with a steam arantee about equal to 10 pounds per indicated horse-power below reciprocating engines they now had. The province of the sociation he defined as the study of such matters, to assist ntral station managers, and he placed its sphere midway between t of the American Institute of Electrical Engineers and those the smaller local Associations, the managers in which could not ord participation in the work of the national body. He believed affiliating with and building up these smaller organizations, t as on the other hand he advocated co-operation with the titute, particularly in such matters as the adoption of the metric tem, which he discussed very favorably.

With regard to relations with the manufacturers, Mr. Doherty de some strong remarks, but said that on the whole "we want assistance of all of the manufacturing companies, and we can p considerable benefit from their co-operation. In the long run, on some points especially, our interests are absolutely identical yet some manufacturers, by a short-sighted business policy, to gain small profit for themselves at great expense to the ntral station industry and the retardation of central station deopment by cultivating competitive conditions."

s to municipal ownership, Mr. Doherty remarked very shrewdly the efforts of its advocates were productive of the very thing most wished to avoid, namely, the formation of large syndis for the control of the private properties, which were able s to protect themselves against raids of all kinds. He advocated k by the Association and by individual members against the rement, and recalled the effort made to bring the League of erican Municipalities to time in making an investigation of a number of municipal plants. If this could not be forced, possibly the American Economic Society, whose members came largely from academic professors and had a sincere but unpractical view of the subject, might be induced to join with them in such an investigation. The fact remained that 90 per cent. of the municipal plants were rank failures, and it only remained to demonstrate the true conditions.

As to the development of the electric lighting business, Mr. Doherty made some striking and pertinent remarks, saying:

We have not yet reached the commercial age, and I predict that within five years our Association will almost lose sight of engineering matters in their eagerness to increase their sales. Our earnings through economy of operation have well defined limits, but the possibilities of increasing our earnings by developing our market have a much wider range. About 70 per cent. of all of our expenses are not influenced by the output of our station, and are only partially influenced by the capacity of our station. We sell only from 10 per cent. to 30 per cent. of the amount of current we are capable of generating, and our plants therefore lie practically idle about 70 per cent. to 90 per cent. of the time. It is not possible to acquire a daily uniform load, but we can greatly influence the load factor of our stations by the class of business that we encourage. We want that class of business which demands the least investment, and which yields the greatest consumption. I think we must lessen the difference between our operating costs and selling price.

It is possible to make the greatest returns to the capital invested when the income per kw is nearly at a minimum. I believe our business today might be considered as of a retail nature compared with what it will be a few years hence. I see no reason why central station companies should not furnish every bit of power used in any town regardless of size of installation. One power house can be run more economically and with less aggregate capacity than several, and we must content ourselves with a smaller margin of profit per kw, our future profit being represented by a greater degree of economy resulting from a central station operation versus isolated station operation. One central station with which I am acquainted supplies eleven-fourteenths of all the power used in the town in which it is situated. The officers of that company are laboring with the other three-fourteenths, with strong prospects of acquiring the greater portion of it. Another central station with which I am acquainted did not make any appreciable gain in output for ten years, although they had a large increase in connected load and a slight increase in earnings. The whole condition resulted from the rates of charging in vogue. Their rates were so high, and so inequitable to users of light for long hours, that each year they were losing a portion of their connected capacity by the installation of isolated plants; but the natural growth of their town and business was giving them an increase in connected capacity of nearly three times that lost by isolated lighting, although from the standpoint of consumption their three new connected lamps did no more than compensate for the one lamp lost by isolated lighting. The investment for this station had gradually crept up until it represented an investment of $16 per lamp connected. Their connected load was 630 lamps, or their equivalent, per 1,000 inhabitants. During the past year they have inaugurated a different policy, and their connected load has been materially increased without a corresponding increase in capital investment, and their investment now represents $12 per lamp wired up, and they have 917 lamps per 1,000 inhabitants. I predict that they will have in another year 1,500 lamps wired up per 1,000 inhabitants, which will represent an investment charge of $8 per lamp wired up. Previously they were compelled to make $1.60 per lamp profit, over and above operating expenses, in order to take care of interest and depreciation. Now if they brought their investment down to $8 per lamp wired up, they would only be required to make 80 cents above operating expenses to cover interest and depreciation.

Line, meter and transformer efficiency have often been so low in alternating-current stations that the stations were paid for but

from 35 per cent. to 65 per cent. of the current sent out, and even then the cost of lost current in alternating stations was not as great as the additional interest charge in direct-current stations. Core loss in transformers and interest can be considered as charges of an identical nature. Assume that you are using individual transformers for each house, and are installing transformers' capacity equal to 100 per cent. of your connected load. We will assume that, with a transformer installation of this magnitude, your iron loss is 2 per cent. of its rated capacity. Now 2 per cent. does not look high, but it must not be forgotten that your 2 per cent. is 2 per cent. loss of current at full load, and 100 per cent. loss of current at no load. With a 2 per cent. transformer loss, your aggregate loss is approximately 10 kw per lamp per year. Your average sales per lamp per year in the average Western station, covering both the residence and business districts, will be in the neighborhood of 18 to 20 kw. This average will represent lamps using from less than 1 kw per lamp per year to 400 kw per lamp per year. With an installation which averages one kilowatt per lamp per year, you must send from the station ten kilowatts for loss in the transformer and one kilowatt to be sold. If you are selling current at 20 cents per kilowatt-hour, you are getting for the one kilowatt sold 20 cents, but for the 11 kw sent from the station you are getting but 1 8-10 cents per kilowatt-hour. As you increase your sales per lamp per year, assuming that your selling price remains constant, your income per kilowatt generated increases very rapidly.

It is simply absurd to ever expect to properly develop business as long as charges are made only on the basis of current consumed, and what I have stated about the transformer loss is true also of the investment expenses, which would be encountered if a direct-current station were used. If we must spend a dollar for interest, or spend a dollar for current to be lost in a transformer, we are no better off in one case than in the other. Personally, I believe I would prefer to spend a dollar for core loss in transformers, as we have better opportunities of reducing this expense than an interest expense. If every small consumer was made to pay all of the costs which he occasions, we could sell current at a much lower rate. At a much lower rate we can considerably increase our sales, and can probably keep up the development of our market by reductions in the selling price without impairing the percentage return on the money invested. As we reduce the price of current we may expect a lavish use of it for sign and decorative lighting. We may also expect a great acceleration in the standard of illumination, which is already constantly increasing.

Mr. Doherty then remarked that the question of forcing distributing lines under ground is being agitated all over the country, and that they were largely responsible for the dislike the public has for pole lines. It is possible to have overhead work which is neat and unobtrusive, and yet almost every central station in the country has unsightly, unpainted poles, with an irregular network of badly strung conductors, representing three or four times the number of wires needed for conduction of current. In the event of a feeder wire becoming too small, it has become the custom to string other feeders in parallel. He urged the use only of long, straight cedar poles, painted a color to harmonize with their surroundings, but said they must pay more attention to underground work. With the consent of the executive committee, he would offer a gold medal, suitably inscribed, for the best paper on underground construction.

In closing, Mr. Doherty returned to the work of the association, and suggested that it have a Wrinkle Department, an Advertising Department, a Department of Decorative Lighting, a Department of Sign Lighting and a Department of Office Methods and Accounting, with committees on Steam Results, Thefts of Current, Methods of Collection, etc. In conclusion, he remarked:

I think we should extend an invitation each year to the professors of electrical engineering in all the colleges throughout the country, and address a letter to the faculties of the universities, calling their attention to the fact that by having the professors of electrical engineering attend our conventions they can keep in closer touch with central station work, and be able to more intelligently conduct the course of studies for those students who expect to take up central station work. Each year I have occasion to employ a number of young college graduates. They come to me sadly lacking in certain respects, particularly in their lack of knowledge of the laws of heat and thermodynamics, or else they are unable to apply whatever they know regarding this subject. They also seem to be incapable of thinking of expenses as anything but operating expenses, without regard to fixed expenses, such as interest, taxes, etc., and even if they do take these fixed expenses into their calculations, they do not seem to comprehend how large an item of expense they may be if a plant can only be operated for a small portion of the time, while these expenses go on constantly, 24 hours per day and 365 days in the year. It would also be greatly desirable if they could have some knowledge of accounting, but I do not know that it is practicable to give them a proper insight into this branch of our business during their college course.

At the close of this address of President Doherty, which was listened to with much interest and applauded vigorously, Mr. Nichols, of Toronto, moved that the secretary appoint a committee to consider means of best carrying out the numerous important suggestions made by Mr. Doherty, as he considered that after so many good ideas had been put forward, something should be done towards carrying them out. The secretary appointed Mr. Perkins, of Youngstown, O.; Mr. R. S. Kelsch, of Montreal, and Mr. C. E. Hewitt, of Elkhart, Ind.

The president then announced that the association would go into executive session for the remainder of the morning, as there were matters of vital importance to consider.

At the executive session, Tuesday morning, retiring Secretary Porter was given a vote of thanks, and Lieut. James Blake Cahoon was formally appointed secretary.

Tuesday afternoon at 2:20, when the meeting was called to order. L. A. Ferguson named a committee on revision of the constitution and by-laws, according to action taken at executive session in the morning. The committee named was: C. L. Edgar, of Boston; Fred. Nicholls, of Toronto, and C. E. Hay, of Springfield, Ill.

The president announced that a visit to the Bullock Electric Manufacturing Company's works would be made Wednesday afternoon leaving the hotel at 4 P. M.

W. E. Moore, of Augusta, Ga., then read his paper on the subject "Does it Pay to Creosote Wooden Poles for Electric Line Work?"

A number of questions were asked Mr. Moore regarding the process which his company is using. Dr. F. A. C. Perrine spoke of the methods of treating railroad ties, as described in U. S. agricultural reports and practiced on the Southern Pacific Railroad, as being somewhat different from that described by Mr. Moore. Some of the operations Mr. Moore described had been found detrimental. A temperature of 300 degrees or over was too high. The rapid drawing out of sap made explosions, which checked the wood. In answer to inquiry as to the government publications on the subject, a member said that "Metal Railroad Ties," issued by the department of agriculture and some other publications given in the bulletin of publications of that department were worthy of recommendation. Pres. Doherty said that a lime water bath neutralized the acid on creosoted treated poles so that they could be handled with more comfort.

Then followed a lengthy discussion on "What Efficiency Lamp Should Be Used, and How May this Efficiency Be Determined for any Particular Station?" Written discussions were submitted by Messrs. H. L. Doherty, S. E. Doane, L. G. Van Ness, F. W. Willcox and Converse D. Marsh.

Following this was a lengthy and somewhat animated discussion over President Doherty's position that for most central stations a 16-cp lamp taking 4 watts per cp is more economical to the central station and consumer than a 3.1 watt lamp; it being assumed that the central station furnishes free renewals, and that the price of current per kw-hour to the consumer be reduced so as to make the price to him the same per cp-hour as with a high efficiency lamp. Mr. Doherty maintained that the cost of lamp renewals for the high efficiency lamp more than compensated for the additional cost of energy for the low efficiency. Other members did not by any means agree with this, but it finally simmered down to the question of how much the additional electrical energy would cost in each particular plant, and hence became a problem for each member to figure on for himself. The discussion was useful, as it set members thinking seriously along this line of better service.

The vigorous and business like policy of President Doherty in conducting affairs of the association was shown by the holding of sessions not only all day but evenings as well. Owing to the heat it was pretty severe, however, on the delegates. Tuesday evening the session was opened by the paper of Irvin Butterworth on "What is the Best Method of Caring for Consumers' Complaints." This was followed by a short discussion.

J. P. Crowley then presented his discussion on "What Change

Should be Made in the Plan of Uniform Accounting," submitted at last convention. "Loose Leaf Ledgers" were then taken up in four brief written discussions submitted by G. E. Tripp, H. H. Fairbanks, Geo. W. Davenport, and Charles R. Price. Answers to questions in the question box took up the remainder of the term until 10:45 p. m., when the convention adjourned.

WEDNESDAY'S SESSIONS.

Wednesday morning at 10:15 the session was opened with the discussions of B. A. Behrend and C. F. Scott, on "Three-Phase *vs.* Two-Phase for City Distribution." Although this was intended for a debate, the two gentlemen substantially agreed that in the main for large plants three-phase, four-wire distribution was most desirable, while for small plants in some cases two-phase distribution might be best.

The president announced as committee on memorials, E. H. Davis, F. E. Smith and W. E. Moore. On nominations, the committee appointed was Jas. I. Ayer and H. H. Fairbanks. An addition to the committee on dues was made by the president, consisting of Messrs. Edgar, Hay and Nicholls.

The remainder of the morning was taken up with answers to questions filed in the "question box." In connection with one of these, Capt. Brophy, as chairman of the committee on wiring rules, called attention to the proposed rule of the underwriters canceling the insurance on any building which had within 75 feet of it an alternating-current circuit with more than 3,500 volts between wires. He said that his committee had opposed the rule, and had pointed out its inconsistency when 8,000 volt direct-current arc circuits are, and always have been, permitted. He also called attention to the great amount of money already invested in circuits of the kind, which the rule practically forbids. Mr. Abbott, of the Chicago Edison Company, showed that under such a rule the whole insurance in the city of Chicago could consistently be cancelled. His company had 3,800-volt circuits on over 50 miles of street, and these crossed other lines of various kinds covering the whole city and vicinity. A committee was appointed to draw up resolutions regarding the proposed rule.

Wednesday afternoon at 2:15 the answers to questions were taken up for a few moments, and then the Third Progress Report of the Committee for the Investigation of the Photometric Values of Arc Lamps was read.

Prof. W. E. Goldsborough then took the floor to extend to the Association in the name of the directors of the Louisiana Purchase Exposition, an invitation to hold its 1904 convention on the exposition grounds at St. Louis. As director of electrical exhibits at that exposition, he also asked the co-operation of members of the association in making the Louisiana Purchase Exposition memorable, electrically. On motion of Mr. Jas. I. Ayer, it was unanimously voted to hold the 1904 convention at St. Louis.

The subject of Protection of Long-Distance Transmission Lines was next taken up. Dr. F. A. C. Perrine first read a communication on the subject, followed by P. M. Lincoln. Communications on the same subject were read by title from Chas. H. Baker, L. Denis and Henry J. Gille.

In regard to the advisability of putting up barbed wire along a line for protection against static discharges and lightning, Mr. Lincoln said that on the Niagara Falls transmission line barbed wire had been taken down several years ago, because it had made more trouble than it had prevented, but that it was not unlikely that it would be put up again in more substantial shape. Dr. Perrine favored the use of barbed wire, but said it should be special quality and not ordinary telegraph fence wire. He considered barbed better than bare wire.

The convention then adjourned at 4 P. M., to take a special train given by the B. & O. to the Bullock Electric Manufacturing Company's works, at Norwood.

Wednesday evening the convention went into executive session and elected the following officers: F. A. Ferguson, of Chicago, president; R. L. Edgar, of Boston, first vice-president; E. H. Davis, of Williamsport, Pa., second vice-president; executive committee members, to serve three years, S. T. Dunham, of Hartford, Conn.; P. G. Gossler, of Montreal, Can.; H. D. Hartman, of Philadelphia, Pa.; executive committee members, to serve two years, J. H. Perkins, of Youngstown, O.; C. F. Hewitt, of Elkhart, Ind.; executive committee members, to serve one year, Arthur Williams, of New York; Lieut. Jas. Mike Cahoon, of New York, secretary and treasurer; Miss Harriett Billings, of New York, assistant secretary and treasurer.

A new scale of membership fees was also adopted, to take effect July 1, 1903, as follows: Initiation fees for all companies, $25; annual dues for companies in towns of 20,000 or less population, $10 a year; for companies in towns of 20,000 to 300,000 population, $25 a year; for companies in towns of over 300,000 population, $50 a year.

The convention after transacting this business went into open session. Russell Spaulding read a paper on "Display Lighting, Signs and Decorations," and this was followed by the paper of E. J. McAllister, on "The Possibilities of Sign and Decorative Lighting." This closed the programme of the second day.

THURSDAY'S SESSION.

The session was opened by a discussion on the Nernst lamp, after which committee reports were considered. Mr. Frank A. Wolff, of the National Bureau of Standards, delivered an address outlining the policy of that bureau with respect to electrical standardization. After a discussion on rates and transmission lines, in which President Doherty and Dr. Ferrine took leading parts, the session adjourned. At the afternoon session the subject of steam turbines was discussed, and Messrs. Ferguson, Wallis, Patterson, Scovil, Phillips and Dow continued the discussion on rates. Resolutions were adopted commending the administration of President Doherty, and thanking the local entertainment committee and the Bullock Company for courtesies extended. Upon report of a committee, the meeting approved the suggestions in President Doherty's address, including securing the services of a progress editor, affiliation with other associations, a prize paper, endorsement of the metric system, a wrinkle department editor, reports on sign and decorative lighting, office methods and accounting. The closing papers were on "Hot Water *vs.* Steam Heating," read by Messrs. Porter, Korst, Maunsell and McGee. A resolution was adopted protesting against the 3,500-volt limit proposed by the underwriters with respect to street lines. The treasurer's report showed a balance of $6,000. After fixing on Chicago as the place of meeting of the convention next May, the convention adjourned.

LIST OF CENTRAL STATION DELEGATES.

There was an unusually good muster of central station men present, who gave evidence of their zeal and earnestness by attending three sessions a day steadily in all the fierce heat of the week, in a room whose acoustic and ventilating properties were not of the highest efficiency. The list up to the time when our collection of names closed on Wednesday night was as follows:

DENVER GAS & ELEC. CO.—H. L. Doherty, L. G. Van Ness.

CINCINNATI GAS & ELEC. CO.—A. Hickenlooper, H. C. Hutchison, G. Hafer, C. E. Jones, H. R. Hooper, J. E. Minn, A. J. Pfiester, A. R. Duncan, H. Ayers, E. A. Gast, W. J. Dean, W. J. James, W. E. Beaty, H. K. Prudden, R. R. Woolley.

MONTREAL, CAN.—Lachine Rapids Hyd. & Land Co., W. W. Walbank, R. S. Kelsch.

NEWTON, MASS.—Newton & Watertown Gas Co. W. E. Holmes.

BELLOWS FALLS, VT.—Fall Mt. Elec. Lt. & Power Co. H. Bottomley.

PAWTUCKET, R. I.—Pawtucket Gas & Elec. Co. Orin Smith, Jr., H. A. Peirce.

HACKENSACK, N. J.—Gas & Elec. Co. of Bergen Co. W. J. Jones.

PORTSMOUTH, N. H.—U. S. Navy Yard. T. F. Flannigan.

HAMMONTON, N. J.—Elec. Lt. & Power Co. S. L. Pancoast, Jr.

WOBURN, MASS.—Woburn Light, Heat & Power Co. L. R. Wallis.

COLUMBUS, O.—Col. Edison Co. W. S. Barstow, A. W. Field.

TRENTON, N. J.—South Jersey Gas Elec. Traction Co. F. P. Lupke.

WATERVILLE, ME.—W. & Fairfield R'y & Light Co. R. J. Patterson, G. K. Boutelle.

PLAINFIELD, N. J.—Plainfield Gas & Elec. Co. W. A. McClurg.

PHILADELPHIA, PA.—Brush Elec. Lt. Co. A. J. DeCamp, J. D. Israel. Southern Elec. Lt. Co. A. H. Manwaring, W. P. Conover.

OTTAWA, CAN.—Ottawa Elec. Co. A. A. Dion, J. Murphy.

DERBY, CONN.—Derby Gas Co. R. E. Wyant.

NEWARK, N. J.—United Elec. Lt. Co. J. J. Gaffney, W. W. Titzell.

MARLBOROUGH, MASS.—Marl. Elec. Co. F. O. Barnes.

PLYMOUTH, MASS.—Plymouth Elec. Light Co. E. P. Rowell.

HARTFORD, CONN.—Hartford Elec. Co. R. W. Rollins.

COVINGTON, KY.—Union Lt., Ht., & Pr. Co. E. Darrow, J. C. Ernst, W. Barnum, W. E. Washburn.

ELMIRA, N. Y.—Elm. Water, Light & R.R. Co. A. E. Walden.

THOMPSONVILLE, CONN.—Enfield Elec. Lt. & Pr. Co. E. H. Tarr.

NEW BEDFORD, MASS.—N. B. Edison Co. C. R. Price, C. H. Gifford.

LITTLE ROCK, ARK.—L. R. Edison Co. J. A. Trawied.
WORCESTER, MASS.—Wor. Elec. Lt. Co. H. H. Fairbanks.
MOBILE, ALA.—Mob. Lt. & R.R. Co. J. H. Wilson.
RICHMOND, VA.—Rich. Pass. Ry. Co.—E. W. Trafford, H. W. Trafford.
PANA, ILL.—Pana Elec. Lt. Co. A. C. Thuelby.
HAMILTON, O.—Ham. Elec. Lt. Co. H. S. Rodgers.
BELLEVUE, O.—Bell. Lt. & Pr. Co. C. M. Lewis.
ELKHART ELEC. CO.—Elk. Elec. Co. C. F. Hewith.
BOSTON, MASS.—Boston Edison Co. C. L. Edgar, L. Stieringer, W. Brophy, L. L. Elden, S. H. Lurer, S. Hosmer.
DETROIT, MICH.—Penin. Elec. Lt. Co. E. S. Phillips.
NEW YORK CITY.—N. Y. Edison Co. N. F. Brady, A. Williams.
BROOKLYN, N. Y.—Brooklyn Edison Co. E. A. Leslie.
AUGUSTA, GA.—Aug. Ry. & Elec. Co. W. E. Moore.
COVINGTON, KY.—C. N. & C. St. Ry. Co. W. W. Tripp.
YOUNGSTOWN, O.—Youngs. Gas & Elec. Co. J. H. Perkins.
CONNEAUT, O.—Municipal Plant. W. E. Fownes.
TOLEDO. O.—Tol. Ry. & Lt. Co. E. J. Bechtel.
SAN ANTONIO, TEX.—S. A. Gas & Elec. Co. G. H. Cushman.
SOUTH BEND, IND.—South Bend Elec. Co. F. A. Bryan.
LONDON, ONT.—London Elec. Co. C. B. Hunt.
YORK, PA.—York Edison Co. J. F. Dusman.
PORT HURON, MICH.—P. H. Lt. & Pr. Co. J. E. Davidson.
TOPEKA, KAN.—Top. Edison Co. C. R. Maunsell, J. P. Guswald.
CHICAGO, ILL.—Chic. Edison Co. S. Insull, L. A. Ferguson, F. Sargent, W. L. Abbott, P. Junkersfeld, J. E. Gilchrist.
MUSCATINE, IA.—Citizens Ry. & Lt. Co. H. T. Fiske.
ABERDEEN, MISS.—Ab. Elec. Lt. Plant. J. F. Endulin.
RED OAK, IA.—R. O. Elec. Co. D. F. McGee
MONMOUTH, ILL.—Mon. Edison Co. R. Ferris.
PORT CLINTON, O.—P. C. Elec. Lt. & Pr. Co. H. C. Taylor.
PEORIA, ILL.—P. Gas & Elec. Co. R. S. Wallace, P. A. Bertrand.
ANACONDA, MONT.—Anac. Copper Mining Co.'s Plant. H. Mc. Nalta.
SPRINGFIELD, ILL.— Spg. Elec. Lt. & Pr. Co. A. V. Schroeder, G. E. Hay.
CAMBRIDGE, MASS.—Cam. Elec. Lt. Co. W. R. Eaton.
HILLSBORO, ILL.—Hill Elec. Lt. & Pr. Co. J. J. Frey.
EDWARDSVILLE, ILL.—Ed. Elec. Lt. & Pr. Co. C. A. Vallette.
CLINTON, ILL.—Clinton Gas Co. W. H. Odwine.
SOMERVILLE, MASS.—Som. Elec. Lt. Co. F. E. Smith.
OMAHA, NEB.—New Om. Thomson-Houston Co. W. J. McManigal, R. A. McLaughlin.
GREENFIELD, O.—Municipal Plant. L. F. Hengle.
JANESVILLE, WIS.—Jan. Elec. Co. P. H. Korst.
MONTREAL, CAN.—Mon. Lt., Ht. & Pr. Co. P. G. Gossler.
EVANSVILLE, IND.—Ev. Gas & Elec. Co. J. W. Gillette.
ATLANTA, GA.—At. Gas & Elec. Co. F. M. Laxton, J. G. Rossman.
MADISON, WIS.—Mad. Gas & Elec. Co. C. H. Williams.
LINCOLN, NEB.—Lin. Gas & Elec. Co. H. H. Scott.
CLEVELAND, O.—Clev. Elec. Ill. Co. M. E. Turner.
WASHINGTON, D. C.—U. S. Elec. Lt. Co. E. S. Marlow, L. E. Sinclair, H. W. Fuller.
GREENVILLE, O.—Green. Elec. Lt. & Pr. Co. D. L. Gaskill.
WEST CHESTER, PA.—W. C. Edison Co. J. E. Pyle.
LOUISVILLE, KY.—Louis. City Ltg. Co. A. M. Worthington.
LAMBERTVILLE, N. J.—Hunterdon Elec. Co. W. S. Newman.
ALBERT LEA, MINN.—A. L. Light & Pr. Co. B. J. Shockley.
JOLIET, ILL.—Econ. Lt. & Pr. Co. J. R. H. Staley.
CINCINNATI, O.—City Elec. Dept. S. H. Weissleder, E. A. Sarran. Cincinnati Traction Co., J. E. Marshall.
WILLIAMSPORT, PA.—Lycoming Elec. Co. E. F. McCabe, E. H. Davis.
SAVANNAH, GA.—Sav. Elec. Co. C. B. Kidder.
SIOUX CITY, IA.—S. C. Gas & Elec. Co. C. C. Gartland.
LEXINGTON, KY.—Lex. Ry. Co. T. D. Murray, R. E. Hunt, J. P. McKeever.
KNOXVILLE, TENN.—Knox. Elec. Lt. & Pr. Co. H. M. Moses.
HASTINGS, ENGLAND.—Corporation Plant. L. Andrews.
CHATTANOOGA, TENN.—Chat. Lt. & Pr. Co. B. T. Burt.
MARYSVILLE, O.—Mary. Lt. & Water Co. H. M. Jones.
GLOVERSVILLE, N. Y.—Fulton Co. Gas & Elec. Co. J. C. De Long.
CONNERSVILLE, IND.—Gen. Gas, Elec. Lt. & Pr. Co. F. Lewis, G. C. Floub.
MT. VERNON, N. Y.—Westchester Lighting Co. J. T. Cowling.
AURORA, IND.—Au. Gas & Elec. Co. F. C. Smith.
ST. LOUIS, MO.—Laclede Gas Co. W. Gallaher.
CEDAR RAPIDS, IA.—C. R. Elec. Lt. & Pr. Co. I. B. Smith.
DETROIT, MICH.—Det. United Ry. J. R. Bibbins.
JOHNSTOWN, PA.—John. Lt., Ht. & Pr. Co. A. Weis.
CHILLICOTHE, O.—Chill. Elec. Ry., Lt. & Pr. Co. L. C. Laube.
TERRE HAUTE, IND.—Terre Haute Elec. Co. C. T. Mordock, J. P. Clark.
MACON, MO.—N. W. Elec., Ht. & Pr. Co. T. W. V. Blees.
BRAZIL, IND.—Terra Haute Elec. Co. E. C. Deal.
CANON CITY, COLO.—Colo. Elec. Power Co. N. T. Wilcox.
ST. PAUL, MINN.—St. P. Gas Light Co. A. Washrop.
GALION, O.—Elec. Light Plant. H. C. Dye.
LIMA, O.—Lima Elec. Ry. & Lt. Co. J. A. Bendun.
VINCENNES, IND.—Vin. Elec. Lt. & Pr. Co. H. W. Frund.
SPRINGFIELD, O.—Spg. Lt. & Pr. Co. J. H. Miller, J. D. Rodgers.
BATESVILLE, IND.—Bates Elec. Lt. Co. J. A. Hillenbrand.
COLORADO SPRINGS, COL.—Col. Spg. Elec. Co. G. B. Tripp.

Names registered after the compilation of the above list will be noted in our next issue.

Abstracts of Papers.

The programme of the Cincinnati meeting comprised almost a score of subjects, not including several formal reports of committees. Owing to the fact that in many cases two or more persons contributed to the discussion of a subject, the total number of writers aggregated more than two score.

Arc and incandescent lamps were represented by three papers, and two papers dealt with sign and decorative lighting. In this classification should also come what was perhaps the most valuable contribution to the proceedings of the Convention—the third progress report of the committee for investigating the photometric value of arc lamps.

LAMP EFFICIENCY.

On the subject, "What efficiency Lamp Should be Used, and How May This Efficiency be Determined For Any Particular Station," five papers were contributed—namely, by Messrs. Doherty, Doane, Van Ness, Willcox and Marsh. Mr. Doherty considered that the efficiency of the incandescent lamp, assuming that 16-cp lamps are used, should be placed at that point where the cost to the central station for the supply of current just balances the cost of lamp renewals; and that when this point has been determined for a 16-cp lamp, then lamps of other ratings should have an efficiency that would bring the cost of lamp renewals to the same point per kw-hour consumed. In other words, when lamp renewals for lamps of a given efficiency cost more than it would cost the central station to supply additional current to yield the same amount of light from a lamp of lower efficiency, they should adopt this lower efficiency lamp. The paper by Mr. Doherty formed the basis of a discussion of the subject by Messrs Doane, Van Ness, Willcox and Marsh.

Mr. Doane agreed with the opinion put forth by Mr. Doherty, and gave a table comparing the economy of using lamps of several efficiencies. If, for example, the ultimate life of a 4-watt lamp is represented by 375, that of a 3.5-watt lamp is 210, and that of a 3.1-watt lamp is 130. That is to say, it is as economical to use a 3.1-watt lamp for 130 hours as it is to use a 4-watt lamp for 375 hours. Mr. L. G. Van Ness considered that the life of 16-cp lamps on perfect regulation is 420 hours for 3.1-watt lamps; 750 hours for 3.5-watt lamps and 1,500 hours for 4-watt lamps; and that lamps should be changed periodically by the company, the changes being made at such intervals that lamps burned until midnight will not exceed the normal life. On this basis the most desirable efficiency of lamps will then be determined by five factors, namely, the average regulation of the circuit; the generating costs that are strictly proportional to the output; investment per kw-capacity of the station; the average consumption per lamp per year and the charge per kw-hour to consumer. Each of these points was taken up and discussed in detail, and the conclusion arrived at that the best way to answer the question propounded in the title of the discussion is to face the situation squarely and each figure it out for himself. Mr. Van Ness showed how the different factors may be determined and correlated.

Mr. Francis W. Willcox discussed the question under a number of heads as follows: definition of the term, "best efficiency;" the cost of lighting; useful life and lamp cost for the different efficiencies of the 16-cp lamp; is the operating cost the basis? how may net

earnings be increased; the efficiency giving minimum cost to consumers; the case stated; the question of regulation; the effect on rates; how lamp renewal costs may be offset; the cost of other units than 16-cp; the 8-cp lamp; the lowest units for economy and the ease of sign lamps. The general conclusions of Mr. Willcox are as follows: 1. The best available economy in central station service for the 16-cp is 3.1 per candle. The 2.75-watt lamp is the most desirable for average rates in use. 2. The 3.1-watt lamp can be used to advantage even when the voltage is kept 4 per cent. high, with fluctuations going still higher. 3. No central station, therefore, which supplies current by meter should use lamps of lower economy than 3.1-watts. 4. The best economy in smaller candle-power units is that which keeps the cost of renewals per kw-hour about the same as the 16-cp costs. This basis gives a 3.6-watt per candle economy, or better, for 8 and 10-cp lamps. 5. As very low candle-power units are used chiefly for sign lighting, they can be more liberally treated than the basis of the foregoing paragraph demands. An economy of 4 watts per candle-power is desirable for 4 and 5-cp units, this being reduced to 5 watts per candle-power for three and two candle-power lamps owing to the extreme tenuity of filament used in the same.

Mr. Converse D. Marsh considered as a double fallacy the argument that low economy lamps are preferable to high economy lamps because finer regulation is required for the latter. The best possible regulation should be provided regardless of the lamp efficiency. Central station men should bring the regulation up to the best practicable point with a view to best satisfy the consumers. It will then not be necessary to waste energy on 4-watt lamps. The central stations which have advocated high economy in incandescent lamps have been, with rare exceptions, those that have done a large volume of incandescent lighting and have paid handsome dividends. Mr. Marsh considers that from a strictly engineering standpoint it would seem a simple matter for the members of the National Electric Light Association to arrive at a proper conclusion if a table were given them, fixed factors being entered and blanks left for the variables, which each manager could insert for himself. Business policy, however, should be ever kept in mind in considering the technical branch of central station operation. Mr. Marsh said that a good incandescent lamp is to-day sold for but slightly more than the cost of a lamp chimney, though the former goes through over 50 mechanical, chemical and electrical operations, some of them requiring the highest technical skill. One of the prime factors in producing this condition has been the employment of 3.1-watt lamps on a large scale, the increased output having aided the lamp maker in reducing his cost of manufacture.

FREE LAMP RENEWALS

On the subject, "Are Free Lamp Renewals Desirable?" discussions were contributed by Messrs. English, Smith, Little and Green. Mr. Jas. English said that the companies he has been managing have after some experimenting adopted the plan of free renewals, and have found it beneficial and wise. Experience in renewing lamps demonstrated that some definite system should be employed, based upon the following desiderata: First, lamps should be renewed often enough to insure the maintenance of a good candle-power during the service, or a limitation in the fall of candle-power; second, the renewals should be made in such a manner as to cause no annoyance to users; third, renewals should be made often enough to obviate practically the necessity for customers calling for new lamps to replace those burned out; fourth, the system should be one that would effect the desired end in the most economical manner to the company. Mr. Smith said that his companies had adopted the principle that all lamps on circuits should be changed once in 400 hours. All lamps removed are sorted by a photometer and those put again into stock that measured 16 candle-power. Every lamp on the main is changed four times per year, usually in February, May, August and November, it having been found that this results in very few lamps being used over 400 hours. 40 per cent. of the lamps removed are found to measure 16 candle-power and are sent out again. The experience of ten years demonstrated that all the lamps in service are at least 4-cp, and not at any time more than 2 candle-power below the initial candle-power. The cost to the company of this method is at least no greater than that of the ordinary method of making free renewals; the general effect on business had been excellent.

Mr. F. Elwood said that for a number of years his customers bought all their lamps, either from the company at cost, or elsewhere as they saw fit. The experience with this system was very unsatisfactory and finally the company adopted the system of free renewals. As an example of the advantage of free renewals, a customer using a dim lamp of, say, 12-cp is paying for, say, 37-watts. If given a new lamp and consuming, say, 50-watts, he will be satisfied with the light and willing to pay for the additional current. The central station will thus soon get back the cost of the lamp in increased revenue. New lamps are not given in exchange for broken ones. While Mr. Smith has not adopted the method of sending men to replace lamps, he confesses that a systematic inspection of all lamps on circuits would be a very good thing. All the lamps returned are photometered, and those giving 14 candle-power are used again near the center of distribution, where the voltage is a little higher. Mr. Smith does not believe in furnishing free the first installation of lamps, except in residences, for the reason that in a great many instances the return per lamp will be very small, and he considers that the cost of the first lamps will not keep away any desirable customer.

Mr. F. W. Little said that the question of free lamp renewals had been but lately considered by the Peoria Gas & Electric Company. At present, however, it is considering the plan of selling lamps at cost and charging a nominal price for renewals when customers turn in burned out lamps originally obtained from the station. He considers that this will insure the use of first-class lamps on the circuits and the freer use of current owing to the lower cost of the lamps, without entirely cutting off the revenue from lamp sales. If results indicate that the step is unprofitable, the loss will not be as serious as free renewals, if furnished; while if results indicate that further reduction in the price of lamps will be advantageous, the company will be in a favorable position to make it.

Mr. W. J. Green said that from 1888 to 1893 his company furnished free lamp renewals. In 1892, however, it became evident that the net earnings were not keeping proper pace with the growth of the plant and the increased investment, and two reforms were then resorted to; one was the adoption of a minimum charge proportional to the maximum burning lamps; the other the discontinuance of free lamp renewals. These changes were soon followed by the adoption of a two-rate system in connection with a minimum charge, so that the consumers upon whom the heavier cost of lamp renewals fell were many times compensated for such expense, by the lower cost of service. Mr. Green gave several reasons for continuing the present system. One is the extraordinary one that the check which it gives to growth of business resulting from charging for lamp renewals is desirable, in view of strong competition with gas and difficulty in providing for increased capacities owing to manufacturing delays and engineering problems. Another reason is lack of facilities at present to carry a supply of lamps and conveniently serve consumers to lamps from the office. Still other reasons are avoidance of extra time required on the part of the management, and extra cost for labor, lamps and for storage room; and the benefit to supply houses of supplying lamps, which insures their good will.

220-VOLT LAMPS

Mr. Fred W. C. Bailey read a paper of considerable length entitled, "Performance of Present 220-Volt Lamps," giving results of lengthy tests. At least 50 lamps of each make were procured, and every lot consisted of two separate orders placed with different firms. More than 50 lamps were purchased from several makers, and from these lots 50 lamps were selected at random and set aside for tests. The manner in which the tests were conducted is described, and numerous target diagrams and life curves are given, there being 37 figures in the paper, including a number of diagrams of spherical candle-power. The paper does not formulate any general conclusions based upon the tests. It appears, however, that with respect to candle-power, out of 14 lots of lamps tested, one lot did not give a single lamp that came within a target limiting the candle power to 1½ candles above or below the normal rating. Only five lots showed a percentage above 50 per cent., and three lots a percentage of 80 or above. It is stated that at least 80 per cent. of all the selected lamps should have come within such a target. With respect to economy, those coming within a target limiting the lamp to one-half watt per candle above and below the rating, none of the lamps of two lots were within the target; only four lots were above 50 per cent. and three lots reached 80 per cent. or higher. In the life tests twelve lamps of each lot were operated, being selected as closely as possible to the rated candle-power efficiency. The results are tabulated in terms of arbitrary candle-power areas, and no general discussion of the test is given. A final table shows that the average initial watts per horizontal candle-power varied in 14 lots from 3.36 to 5.30; that the average watts per horizontal candle-power during the useful life varied from 3.73 to 5.88 watts; that the average watts per horizontal candle-power during

1,500 hours varied from 4.38 to 6.08, and that the estimated period of useful life varied from 467 hours to 3,502 hours.

Measurements made of mean spherical candle-power showed that the ratio of mean spherical to mean horizontal candle-power was quite uniform, averaging about 82 per cent. for "double oval" filaments.

SIGN AND DECORATIVE LIGHTING.

Sign and decorative lighting was the subject of two papers, one by Mr. Russell Spaulding, having the title, "Display Lighting, Signs and Decorations," and the other by Mr. E. J. McAllister, on "The Possibilities of Sign and Decorative Lighting." In the paper by Mr. McAllister it is stated that in New York City current is used for out-door lighting equivalent to that consumed by 100,000 16-cp lamps, or about 10 per cent. of the entire lighting current. Illustrations accompanying the paper show a number of examples of sign and decorative lighting, and the business side of such lighting is discussed both from the standpoint of the central station and the user. It is stated that one lighting company in a large eastern city has adopted the policy of furnishing and maintaining any ordinary electric sign or decorative illumination designed by a customer, upon the agreement of the latter to use it a given number of hours per year, the consumer paying for current at regular meter rates. Other central stations have followed the practice of making a liberal special rate to this class of lighting. Several of the latest novelties in the way of systems of decorative and sign lighting are described.

The paper by Mr. Spaulding is brief, being principally an introduction to a reprint of a paper by Mr. Luther Stieringer on "The Evolution of Exposition Lighting," originally read before the Association of Edison Illuminating Companies, and to an article reprinted from these columns, entitled, "From Christmas Tree to Pan-American."

RATES.

One of the most important parts of the programme of the meeting was a series of papers on "Rates," the authors being Messrs. Doherty, Wallis, Patterson, Scovil, Phillips, Dow and Ferguson. Mr. Doherty said that much success had been met with in introducing at Denver and elsewhere the system of rates which he outlined in a paper read before the association at its convention held in May, 1900. According to this system, as applied at Denver, every consumer pays $12, plus $6 for each meter more than one, plus $1.80 per lamp connected, plus 5 per cent. per kw-hour for current. From the aggregate a discount of 50 and 10 per cent. is allowed. This system of rates has been adopted at Denver, Colo.; Madison, Wis.; Lincoln, Neb., and Quebec, Canada, with excellent results. Immediately upon the adoption of the scheme in Denver the output and maximum demand began to increase. From April to January the connected load increased 8 per cent., the maximum demand 32 per cent., and the output 70 per cent., the latter increase being confined to approximately 50 per cent. of consumers; some of the latter increased as much as 400 per cent. The increase in consumption is attributed largely to the adoption of the lower rates and not particularly to the system of charging. It is felt, however, that if a system of charging had been adopted based largely upon consumption, the rates would have had to be very much less to have brought about the same increase in output. When customers found that they could buy additional current at a much lower rate, they felt more inclined to use it liberally, and many of them are now paying a gross amount greater than they paid before this system of charging was adopted.

The paper of Mr. L. R. Wallis related to the "Foresee" system of charging. This system has been applied in a city of 30,000 inhabitants since July 1, 1901. The consumers contract with the company for a period of one year, agreeing to pay for the capacity demanded in 16-cp lamps or their equivalent, at certain definite tariff rates, plus a meter rate of 6 cents per kw-hour. The legality of this method was questioned by certain consumers, and an appeal was taken to the Massachusetts State Board of Gas and Electric Light Commissioners, who after thorough investigation rendered an opinion favorable to the company. The board in its opinion said, that "The system is evidently intended to increase the profits of the company by increasing its output, and at the same time to reduce the price to a large majority of its customers, enabling them, without a proportionate increase in their bills, to use lights much more freely and with increased convenience."

Mr. Ralph J. Patterson described a system in operation in Waterville, Maine. The schedule rates are based upon the number of lamps contracted for, and a customer is allowed to make that number anything he chooses, except in some residences where 10 lights or less is the actual number installed, in which case the actual number installed is taken. According to the rate schedule for residences, a house using 1 lamp would pay $0.80 per month; for 5 lamps, $1.41 per month; for 10 lamps, $2.46 per month, and for 20 lamps, $3.52 per month. The cost above 20 lamps is 17½c. each per month. A device is installed which will not permit the simultaneous use of more lamps than have been contracted for.

Mr. Samuel Scovil criticised both the Wallis and Doherty methods of charging. He said that the former is sadly deficient, since in dividing the total installation and fixed cost by the capacity demanded, or to be demanded, it fails to take into account the fact that there is a great difference in the cost of a distribution system for 500 customers and one customer, and the cost of serving 500 customers as compared with serving one customer. Mr. Doherty with his charge "per customer" in addition to other charges, does provide for some of the difference which a company can profitably allow in serving the two classes of customers above considered. But after adopting what was figured to be an equitable system of charges, these were reduced by a discount of 50 and 10 per cent, thus reducing the guarantees which the great bulk of customers are asked to make, to such a small amount that they do not have to give them any consideration whatever. Mr. Scovil considered that all Mr. Doherty's system is doing in Denver is to allow him to carry on his competitive war on lines that tend to increase the load factor of his station, so that if there is any profit per unit in selling current at the price fixed by him, he gets all there is in the business. He considers that a correct system of charging would be one that bases the cost of service to the consumer in the main on the hour's use of the capacity demanded by him, and that the tariff schedule should be proportionate to the cost. These costs consist of those expenses which are fixed and those which are proportional to the kw-hour output. There is, however, a diversity of opinion as to what expenses are fixed and what are proportional to the output, and until an agreement could be arrived at on these points, Mr. Scovil considers that no universal system of tariff is possible.

Mr. E. F. Phillips said that his station has made a radical departure in the matter of rates and adopted a system whereby the consumer was required to pay at the rate of 16 cents per kw-hour for the first two hours per day of connected load, or 60 hours monthly; all current used in excess of this to be paid for at 5 cents per kw-hour, the total bill to be subject to discount if paid within 10 days of date of bill. This departure had the effect of widening out the curve of the peak load and brought quite a noticeable amount of new business. The net earnings per kw-hour of output fell off somewhat, yet the net earnings to the company for the year showed a healthy increase. During this time the regular rate for power service had been put at 10 cents per kw-hour; this was changed to 10 cents per kw-hour for the first 30 hours per month per kilowatt connected, and excess current charged for at 5 cents per kw-hour. Within a year the power rate was changed to 10 cents per kw-hour for the first 30 hours of "maximum demand" instead of "connected load." This brought about a very noticeable increase in power service and a corresponding change in the light load curve. In the meantime the two-hour per day rate had been applied to the residence service, and produced general satisfaction; the method pursued was an arbitrary one based on the average use, this to form the maximum demand for the 16 cents rate, with excess current at 5 cents and minimum bill of $1 per month. The average earnings per kilowatt of output showed in the residence district a decided drop, yet the net earnings were increased. This rate is the one still in use for residences.

The next step was the adoption of a 1-year contract system on the maximum demand plan and a change to one hour per day at the 16 cent per kw-hour price, excess current at 5 cents per kw-hour —the maximum demand contract, however, to cover all electrical service used by the customer. This has proved the most popular of any plan yet instituted and is the one in general use by the company at the present time for all service except residences; but it is optional with the customer as to whether he shall take the open order at 60 hours per month of connected load, or 30 hours per month on maximum demand. In the case of arc lamp service, however, the customer is required to take the maximum payment contract for one year. This maximum demand arrangement necessitated the installation of the Wright demand meter in all cases where connected load was known to be in excess of the demand.

Mr. Alexander Dow stated that after five years' experience with ifferential rates, he is of the opinion that when a reduction of ite is to be made, it should be done in such a manner that the eduction will apply on the business which is being done at a profit, id not on the business which is being done without profit, or at a ss. The theory of equity requires that each kw-hour sold should ring a uniform profit to the company. If any current is sold at a ss, a higher margin of profit is necessary with respect to the isiness that is done at a profit. Mr. Dow said that he nevertheless cognizes that the ideal service is that which operates with a con- ant load 24 hours a day, and that the ideal rate is that which is iiform to all users, regardless of the time of day or season of the ar. Therefore advantage should be taken of every class of busi- ess which will straighten the load curve. This may be done in me cases by obtaining a day load which can be switched off at isk; in other cases, as in New York, by linking together districts hose periods of maximum load succeed one another; or pos- bly in future by using such a large proportion of storage tteries that inequalities are thereby done away with. While at esent the load curve cannot be so straightened as to warrant a iiform rate, efforts should be made in that direction; and while cognizing the necessity and the equity of the differential rate under esent conditions, we should persistently endeavor to so modify ese conditions that the necessity for the differential rate will ulti- ately disappear.

Mr. Louis A. Ferguson considered that the necessity for the loption of an equitable rate of charging is becoming more and more parent, because on all sides city authorities are bringing forward e cry of discrimination, and sooner or later those companies that e not prepared to go before their city council or their State legis- ture and demonstrate conclusively that the system on which they arge for supply of electricity is equitable, will be subjected to fair uniform kw-hour regulations. Mr. Ferguson believes that an uitable system of charging, which is based on underlying prin- ples of cost of production, will not only withstand the attacks of city and State authorities, but will return to the stockholders a r dividend on their investment.

Mr. Ferguson gave an account of the different methods of charging t had been pursued by the Chicago Edison Company, none of ich were satisfactory until the adoption, in 1897, of the Wright nand system in modified form. Each monthly bill is based upon customer's actual maximum in that month, and during each of six winter months the customer is charged the full rate of 20 ts per kw-hour for all electricity consumed monthly until the sumption reaches the equivalent of 45 hours' use, or the maximum ıber of lamps lighted simultaneously, as indicated by the Wright ıand meter; 10 cents per kw-hour being charged for all electricity sumed in excess of that amount. During the summer months full rate is charged for light consumption until it reaches the valent of 15 hours' use of the maximum number of lamps lighted ltaneously, and for all electricity in excess of that amount the of charge is 10 cents per kw-hour. For the low-rate portion of bill, a discount is given, the amount ranging from 5 per cent. to omers whose low-rate portion was 100, and increasing by 5 per for each 100 of the low-rate portion, making the maximum dis- t 50 per cent. in the case of a customer whose low-rate portion 00. Within the last year this method has been simplified by doning the difference between summer and winter rates.

charging for power, the full rate is 10 cents per kw-hour for rst 30 hours' use of the maximum power per month. The low- is 8 cents per kw-hour for the second 30 hours' use, 6 cents for ird 30 hours' use, 4 cents for the next 450 hours' use, and 3 cents he next 180 hours' use. The low-rate portion of the bill is cted to discount ranging 15 per cent. on amounts from $20 to o 40 per cent. on amounts ranging from $100 to $200. These for power give a range from 10 cents to 2.88 cents per kw-hour minimum.

Chicago, at present there are in use a total of 13,022 Wright d meters and 15,633 recording meters, the income from the ners using Wright demand meters being $986,560 for the fiscal nding March 1. The average discount from the list is 31.1 nt. for light and 49.1 per cent. for power. Of the Wright de- meters 94 per cent. are for 10 and 25 amperes, showing that the f the business on this system is with relatively small customers. tal number of customers on the book is 18,623, of which 61.7 nt. are on the Wright demand system. Of 2,737 power cus- tomers, 50.7 per cent. are on the Wright demand system. The total investment in meters of all kinds is $353,000, of which 23 per cent. is for Wright demand meters. The load factor of the Chicago companies for the last fiscal year was 27.1 per cent., showing an average daily use of the system's maximum for 6½ hours. Before adopting the Wright demand system of charging, the total yearly expense per recording meter, including salaries, supplies, repairs and renewals, was $2.95 per recording meter. Last year the total yearly maintenance expense per recording meter, including the same items, was only $1.85, showing that the cost of maintaining Wright demand meters is inconsequential.

Criticism has been sometimes made of the method used in Chicago, on the ground that the company might do a large amount of unprofitable business, owing to the fact that there is no guarantee to the company that the consumer will pay for at least one hour's daily use of the maximum demand. An analysis shows that of the total income from Wright demand business, only 8.6 per cent. of the total comes from customers using the equivalent of the maximum demand for less than one hour daily; and, furthermore, that the ratio of gross delivery to full rate lamp hours of these "shortage customers," is 57.3 per cent. Thus the actual amount of business which falls short of using the maximum demand one hour per day is only 3.67 per cent. After five years' experience with this system, Mr. Ferguson said that he is strongly convinced of the necessity of some such equitable tariff being adopted by all electric light companies in every city and town, not only in justice to the consumer, but to protect the investor from loss of revenue resulting from injudicious contracting and unfair municipal price regulation, both of which will become inevitable without a proper system of charging.

LIQUID BOILER FUEL.

Two papers were on the subject of "Liquid Fuel"—"Boiler Firing with Oil," one by Mr. Jas. W. Warren and the other by Mr. H. T. Edgar. Mr. Warren gives an account of his experience with the California petroleums, which are of asphaltum base, and carry with them about 30 per cent. of asphalt. At the station of the Los Angeles Electric Company the fuel is pumped from a main storage tank to the furnace supply tank of 100 barrels capacity, where it is heated to 80° F. It is then pumped at 20 lbs. pressure through pipes within the breeching of the boilers, where it is heated to 190° F., and then passed to the burners. The burners are of the spray type, using steam as a medium for spraying the oil. Each burner has an evaporation efficiency of 3,000 barrels of water per hour from and at 190° F. A high-temperature thermometer is used in the smoke pipe, in order that the amount of air necessary for perfect combustion may be graduated. By the use of the thermometer the fireman can so regulate the burners that each boiler will do its proportional amount of work, the temperature of the stack being kept at 450 degrees. The evaporative efficiency of California oil as compared with the same weight of average good steam coal is 20 per cent. higher. There is a saving of 75 per cent. in the cost of keeping the boiler in clean condition, and the use of liquid fuel solves the smoke problem, and also reduces the deterioration of the steam generating apparatus 75 per cent., and of the repair account 80 per cent. In conclusion, Mr. Williams says that the record of results obtained from the use of liquid fuel in Southern California stands out so prominently in favor of said fuel that many of the large steam generating plants in the northern part of the State have abandoned the use of coal in favor of liquid fuel.

Mr. H. T. Edgar gives the result of his experience in burning Texas fuel oil at the electric light plant at El Paso, Tex. The oil is stored in steel tanks buried in the ground, and is drawn from the tanks through a 1½-in. iron pipe, which discharges through a 1-in. pipe into a small chamber about 14 ins. in diameter by 2 ft. 6 ins. long, placed by the pumps. The oil enters this chamber at one end, passing through a partition of very fine wire gauze, and at the other end comes in contact with a coil heated with the exhaust steam from the pump, thus raising the temperature of the oil to about 145° F. The oil is sprayed from the burners by steam, and in order to insure a steady pressure an auxiliary air chamber is required. It is stated that a very great saving has been made at the El Paso station through the substitution of oil for coal. It is claimed by the advocates of fuel oil that four barrels of 42 gallons are equal to one ton of good bituminous coal. Results of tests made by the waterworks company of El Paso show that the cost of burning fuel oil is but half the cost of burning coal, when the coal costs $5 per ton and the fuel oil 70 cents per barrel.

HOT WATER VS. EXHAUST STEAM HEATING.

This subject was considered in papers presented by Messrs. J. F. Porter, P. H. Korst and C. R. Maunsell. Mr. Porter gave his experience with a hot-water heating plant which supplies 50,000 feet of radiation placed in residences, business houses, offices and schools. The plant had been in operation since 1889, and the repairs for the first two years has amounted to less than $400. During these two years the plant was operated without any back pressure on the engines, but owing to increased heating business and the severity of the past winter, it was found necessary to weight the back pressure valve from 3 to 5 lbs. when there was but little electric light or power load; but during the late afternoon and until midnight there was ample steam to furnish heat without back pressure on the engines. In conclusion, Mr. Porter says that he believes that a hot-water heating plant of sufficient capacity to use the exhaust steam of a combination railway and lighting station would prove satisfactory to any operating company.

Mr. P. H. Korst in his paper also gave testimony in favor of the hot-water system. The advantage of this system he stated to be the utilization of exhaust steam without putting back pressure on the engines, and that it even enables engines to be run condensing. Mr. Korst said that his customers, after two seasons of use, are highly pleased with the hot-water system, and recommend it to all inquirers. An objection to charging by the meter system is that customers will thereby be encouraged to keep down the supply, with the result that the system is discredited when the temperatures of a house or store is thereby kept low. He considers that the most satisfactory system is to charge according to the cubic contents of the space to be heated, with additions for variations in exposure of walls, etc., and then install enough radiation to keep the rooms comfortable at all times.

Mr. Maunsell gave his experience in the operation for five years of an exhaust steam-heating system at Topeka, Kan. About one-sixth of the total investment of his company is in a steam-heating system, and this has proved a particularly good investment. He considers that the effect of back pressure while operating an exhaust steam-heating system is not such a serious matter as many have been led to believe, and a table is given to sustain this opinion, the table showing the number of hours and the different pounds of pressure on the mains throughout the year. The maximum back pressure is required but a few hours during the heating season of 5,760 hours, or 8 months, and during 872 hours no back pressure is required. Steam is supplied by the flat rate or by the meter system. The rates are 30 cents per sq. ft. for direct radiation per season; 35 cents for indirect radiation, and 20 cents for cooling coil. The meter rate is 60 cents per 1,000 lbs. of water. A square foot of radiation is about 3 ft. of 1-in. steam pipe. Indirect radiation consists in placing the piping in such a manner that cold air is passed over it from any source to extract the heat. A cooling coil is necessary to extract the remaining heat from the water before it is discharged to the sewer, as without this device considerable waste of heat would occur.

CREOSOTING LINE POLES.

With this title Mr. W. E. Moore considered the question whether it pays to creosote wooden line poles for telephone line work, and gave the results of the experience of the Augusta (Ga.) Railway & Electric Company. Some three years ago this company bought a plant for creosoting poles and railway cross ties. The poles are placed within a cylinder, and after being subjected to a steaming process for a period of 4 to 6 hours, a vacuum is created in the cylinder by means of a pump, and the cylinder heated by superheated steam in coils in the bottom to about 350 degrees, this process lasting from 4 to 6 hours. Connection is then opened with a creosote oil storage tank, and the atmospheric pressure forces the oil into the cylinder until it is filled. After this an oil pressure pump is started, and a pressure of 60 lbs. per square inch maintained for a period ranging from 2 to 4 hours. The oil is then drained from the cylinder into the storage tank, and steam is left circulating in the superheating coils in the cylinder for about an hour in order to decrease oil drippings from the timber. Steam is circulated through superheating coils located in the bottom of the cylinder throughout the entire process, which ranges from 16 to 24 hours. The cost of creosoting is approximately $20 per thousand feet, board measure, or about twice the first cost of poles. It is thought that the life of creosoted poles will be prolonged four to six times that of untreated timber. The only objection to creosoted poles is in their handling, which inflames the hands of the workmen. The electric conductivity of poles is also increased to such an extent that linemen can no longer depend upon the poles to insulate them from ground when handling from one to three thousand volts.

PHOTOMETRIC VALUES OF ARC LAMPS.

The third progress report of Prof. C. P. Matthews on the investigation of the photometric value of arc lamps deals with tests o 6.6 ampere direct and alternating-current enclosed arc lamps; test of 7.5 ampere alternating enclosed arc lamps; tests of 450-watt ar under varying conditions of energy, supply, etc.; tests of variou brands of high and low grade carbons in a 9.5 ampere open arc; an a consideration of illumination on a plane normal to the ray a different distances from the lamp.

Five direct-current 6.6-ampere enclosed arc lamps were teste with the following results: With no outer globe and opalescer inner globe the watts per mean candle power were respectivel 1.07, 1.37, 1.24, 1.27, 1.3 and 1.28. With a clear outer globe an opalescent inner globe corresponding values of watts per mean hen ispherical candle power were respectively 1.2, 1.29, 1.35, 1.24, 1. and 1.37. A conclusion arrived at is that for street lighting the be distribution is obtained with closed base inner globes.

Three 6.6-ampere alternating-current lamps were tested wi the following results: With no outer globe and an opalescent inn globe the watts per mean hemispherical candle power were 1.8 2.06 and 1.76; with clear outer and opalescent inner globe the corr sponding quantities were 2.25, 2.06 and 1.55. Three 7.5-ampe alternating current series enclosed lamps were tested with the fo lowing results: With no outer globe and an opalescent inner glo the watts per mean hemispherical candle power were respectiv 2.28, 1.94 and 1.8. Comparing the result of the above tests, Pr Matthews says the average for the direct current 6.6-ampere lam with opalescent inner and clear outer globes is 1.31 watts per c. for the alternating current 6.6-ampere lamps with opalescent in and clear outer globes 1.92 watts per c.p.; and for alternating c rent 6.6-ampere lamps with opalescent inner globe and with sha is 1.48 watts per c.p. These figures show that while the alternati current lamp taking 6.6 amperes is inferior to the direct-curr lamp of the same current capacity in light producing power bel the horizontal, the use of a shade in the former brings down specific power consumption to within 13 per cent of that of the dir current lamp. The mean power factor of the 6.6-ampere alternat current lamps is .88 and of the 7.5 lamps .83.

The tests of a 450-watt arc were made under varying condit and the results show that 450 watts expended between a given n ber of carbon points may produce, under varying conditions suc occur in every day practice, widely different values of candle p in useful directions. These variations depend upon whether current is direct or alternating, the arc open or enclosed, the gl clear and opalescent, the arc shaded or otherwise, the current l or small. Another conclusion is that no advantage comes from substitution of the 6.5-ampere arc with clear globe for the 9.5 am open arc in so far as distribution of light is concerned. Still an conclusion is that if the open and enclosed arc tested were suspen at the same height, say 25 feet, they would produce equal illum tion at a suspension of about 117 feet from the lamp, but beyond distance the enclosed arc would have the advantage over the o as a street illuminant. The superior candle power distributio the enclosed arc is clearly and chiefly through the use of the op cent inner globe. This globe becomes itself highly luminous. strengthening the intensities near the horizontal.

Tests were made of high and low grade carbons, the primary ject being the determination of the relative candle-power obta when the carbons were burned in 9.5-ampere 450-watt open The high grade carbons when solid gave more candle power at of the three angles of measurement. When however they were they fell behind the low grade carbon throughout one of the an This is doubtless due to the deep crater formed in the cored ca Although high grade carbons give superior candle power showed somewhat shorter life when burned open, the diffe being about 9 per cent for the positive, but slight for the neg The report concludes with an account of experiments on the h of a lamp with respect to the illumination furnished at diff points.

ADVANTAGES OF GAS ENGINES FOR CENTRAL STATION WORK.

Mr. Chas. H. Williams presented a paper with the above in which he gave an account of the results of operating a

engine electric generating plant at Madison, Wis., supplemented by data gathered from other gas engine stations. Tests made of the steam generating plant in the Madison station showed that the efficiency of energy transformation is 6.6 per cent. under favorable average working conditions. It is stated that while this efficiency may appear low to a great many central station men, it probably represents much better than the average conditions; and that the large majority of the smaller stations in operation throughout the country will not transform more than from 2.5 per cent. to 4 per cent. of the energy of the coal into dynamic energy. In the case of the Madison gas engine plant, 20.8 per cent. of the original number of heat units contained in the pound of coal that was put into the gas generator was utilized, or 3016 heat units for useful work per lb. of coal, against 1008 per lb. with steam. Mr. Williams discusses in his paper a number of points connected with the operation of gas engines, and gives data as to the thermal value of different kinds of gas. Data are also given as to the operation of gas engine central station plants located at Mankato, Minn., and Oshkosh, Wis.

At Mankato there are installed one 85-hp and one 125-hp gas engine, and recently there have been added two additional 50-hp engines. These furnish power for 107 32-cp lamps, 63 2,00*c* cp open arcs, 35 commercial multiple arcs and 1,800 16-cp incandescent lamps, together with a motor load of 60 horse-power. The books of the Mankato company show that the amount of gas used for the six months ending January, 1902, was about 78 per cent. increase over the previous gas output, and that this increase lowered the cost of the gas to the company 8 cents per thousand; this was exactly the same as giving them an additional profit of 8 cents per thousand on every thousand sent out to its regular customers. Mr. Williams considers that it is perfectly legitimate for that company to credit the gas engine account with 8 cents per thousand on 16,000,000 cubic feet of gas, that being its actual output, or $1,280 per annum; and this credit amounts to 18 per cent. of the total amount which it had paid for power previously.

At the Oshkosh plant there were installed two 50-hp and two 125-hp gas engines, and the output is 45,000,000 cubic feet of gas per year. The extra output here lowered the cost of gas in the holder 8 cents per thousand, so that the gas engine should be credited with $3,600 per year due to decreased cost in gas generation.

There are also installed two gas engines at Red Wing, Minn., two at LaCrosse, Wis., and three at Appleton, Wis., all running on illuminating gas. The Bradford, Pa., central station has three 150-hp and one 210-hp gas engine, which have been in operation for three years, and that company is just installing an additional 210-hp engine. The manager of the plant, Mr. J. H. Rose, speaks highly of this installation. Formerly steam engines were used, the boilers being fired with gas. The last days of the steam plant showed a consumption of 51.09 cubic feet of gas per 1hp, while with the gas engine the consumption is but 13.6 cubic feet per electrical horse-power, which reduced to indicated horse-power would be equivalent to between 11 an 12 cubic feet. The gas engine repairs for the year 1901 amounted to $196.90, including extra exhaust valves for all the engines.

Several gas engine plants for furnishing power to manufacturing establishments were referred to. In conclusion Mr. Williams says that so far as reliability of operation is concerned, he believes the earlier manufacturers are more to blame than anyone else for what trouble was experienced, too many units having been sold with the assurance that anyone could run them. The same advice carried out at a steam station would put it on a losing basis. There are a very few small details which demand intelligence and regular attendance of the gas engine, and if these proper conditions are maintained the engine will operate satisfactorily, and the attendance troubles are over.

THREE-PHASE VS. TWO-PHASE FOR CITY DISTRIBUTION.

Mr. B. A. Behrend, in a paper with the above title, said that the question whether or not the three-phase current is superior to the two-phase current for the distribution of light and power in cities, has been argued for the past eight years. At first, there were a great many advocates of the two-phase current, on account of the greater simplicity of this system. Looking to-day over the installations of alternating-current systems for city distribution, we find the fact established that the three-phase distribution has been preferred to the two-phase distribution in the majority of plants.

That system will be most favorable for distribution of light and power in which the potential on one phase is as little as possible affected by a change on load on another phase. This may be considered the criterion by which to form an opinion of the superiority of one system over another.

At first sight it would seem that the two phases in a two-phase generator, being in quadrature with each other, would not be subjected to mutual induction. We must consider, however, that the two armatures of a two-phase machine, although displaced toward one another by ninety electrical degrees, and, so far as this displacement is concerned, being independent of one another—are electromagnetically connected with each other through the revolving field. We therefore find that the two phases in a two-phase machine are *not* independent of one another; that is, a load on one phase affects the potential on the other.

Theoretical considerations, as well as experience, have established the fact that a two-phase machine, so far as independence of phases is concerned, is not superior to a three-phase machine if the load on the latter is properly arranged.

The output of a two-phase generator is equal to the output of a three-phase generator. In other words, any two-phase generator may be wound as a three-phase generator without changing the rating, and *vice versa*.

The regulation of both two-phase and three-phase machines being equally good, according to the statements above made, it would seem that the three-phase system was preferable to the two-phase on account of requiring only three wires instead of four, leaving out of consideration the two-phase three-wire system. There is, however, a very interesting fact which should be observed, namely, a three-phase generator on which the load is connected between the outside wires is greatly inferior to a two-phase so far as regulation is concerned. Only, if the neutral connection of the three-phase generator is made use of, and if the load is put on between the neutral and the outside wires, the regulation in the three-phase machine is, in all respects, equal to that of the two-phase machine. But it must be observed that the three-phase machine requires, under these conditions, four wires, as in the case of the two-phase machine.

Summing up the pros and cons, Mr. Behrend considers that there is comparatively little choice between the two-phase and the three-phase systems, but there are certain slight advantages in favor of the three-phase system. If 75 per cent. of the load is a lighting load and 25 per cent. is a load that requires little attention to regulation, as, for instance, an arc-light load having its own regulator or a motor load, a three-phase generator has the further advantage that it can be operated as a single-phase machine, the lighting load being connected between two outside wires. In this case, the lighting load can be very easily regulated, while no attention need be paid to arc-light or motor load, as that is supposed to take care of itself.

WATT METER IMPROVEMENT.

Under the title "What Improvement is Desired in Meters," papers were presented by Messrs. Robert Ferris and Clifford A. White. Mr. Ferris offered the following suggestions:—A universal meter in size and style; a backboard for meters, of a standard pattern, which could be adapted to meters of any make on the market; a registering dial that would read directly in dollars and cents, or if not that, then the adoption as a standard of direct reading dials and a simple tell-tale hand on clock for calibrating purposes; a meter that would take the place of the combination of watt and discount meters, having the effect of registering at different rates of speed, which would be governed by the load that was passing. To illustrate, assume a 100-volt wattmeter of 25-ampere capacity, which instead of showing a straight line from five per cent. of its capacity to full load, the meter speed would represent at full load accurate registering, and as the load dropped the proportional rate of registering would be a certain per cent. slow or fast.

If it were wanted to increase the hours of lighting on a twenty-four-hour service, the first method would apply; and in the stations where only night service is given and it is wanted to increase the quantity of lighting for short hours, the latter would apply. Of course the reading would not give the actual watt-hours, but it would be sufficient to call them units, which would be charged for at a uniform rate.

Speaking from the standpoint of a cashier of a central station, Mr. White said that anything that concerns the public should be as simple as possible. Therefore the meter dial should read direct in kw-hours, thereby eliminating any constants; the use of watt-hours shauld be abandoned, for by adopting the rule of reading in every case the figures the hand has passed on the unit dial, the

error in reading would never amount to more than 10 cents to the customer, and the total sales of the company would never be affected at all. A direct-reading dial should be designed to replace those requiring a constant, for it is next to impossible to make the customer understand the meaning of the latter. Testing should be done at the dial and not at the disk.

BEST METHOD OF CARING FOR METER COMPLAINTS.

With this title Mr. Irvin Butterworth presented a paper giving an account of a system adopted by the Denver Gas & Electric Company. This company has in operation a very complete system for receiving, recording and attending to complaints and requests received from its customers, which is regarded as one of the most important "bureau" of the office. It is in personal charge of what is called the "order clerk," whose sole duty it is to receive complaints and requests from customers and have them promptly and satisfactorily attended to. All complaints received personally or by mail are referred at once to the order clerk, who enters them on a large book so ruled as to show the reference number of the complaint and date and hour of its receipt, the name and address of the complainant, character of complaint, the name of employe sent to remedy it, the time of sending him, the time the complaint is reported as remedied, and the work that has been done. An order is then immediately filled out and turned over to the shop force for prompt attention; in urgent cases the shop is telephoned a confirming order following.

When the workman has attended to and remedied the complaint, and while he is still at the premises of the complainant, he fills out the remaining blanks on the order, showing the cause of the trouble, his method of remedying same, the date and his own name, and secures the signature, at the bottom of the order, of the complainant, or of a responsible member of his family, certifying that satisfactory attention has been given. The order is then returned to the order clerk, who enters the facts on his record book, above described. He then fills out and mails to the complainant a return postal card, worded as follows: "On————————, 1902, you reported..... Kindly fill out this return postal card stating whether the matter has been attended to to your entire satisfaction. Your prompt reply will be greatly appreciated. Very truly yours, The Denver Gas & Electric Co." The reference number is put on each of these cards before sending them out, in order that responses not signed may be identified, and those that are returned are checked off on the record book.

Of course many of the cards are not returned, but many of them are; and most of these report the trouble to have been satisfactorily remedied, many of them expressing thanks and appreciation. Occasionally one comes back with the statement that the trouble still exists or has not been satisfactorily attended to. In such cases a second order is made out and sent to the shop for immediate attention, with proper caution to the workman taking the order. The returned postal card is then attached to the original order, and after the second order comes back with the notation that the trouble has been remedied, the workman that attended to the original one is called upon by the order clerk to explain his failure to have properly remedied the trouble. Occasionally such derelict workman is brought before the manager and properly disciplined for his remissness. In this way each man knows that his work is under the review of the management, and a high degree of efficiency on the part of the workman has thus been developed. It is, of course, the duty of the record clerk to see that a report is turned in within a reasonable time on every order that is sent out for attention.

Two subjects relating to accounting were presented before the convention, one being "What Changes Should be Made in the Plan of Uniform Accounting?" by Mr. J. P. Crowley, and the other "Are Loose-Leaf Ledgers Desirable for Electric Companies?" to which Messrs. G. E. Tripp, H. H. Fairbanks, George W. Davenport and Charles R. Price contributed.

Mr. Crowley's paper consisted of comments on the "Plan of Uniform Accounting" submitted at the last convention. He considered that a more detailed classification should be made for the larger companies, and questioned the wisdom of the idea of harmonizing the system with the system adopted for street railway accounting, suggesting that in view of the tendency of consolidating electric and gas companies, it would be more advisable to produce a similarity with respect to the latter. The "Plan" is then criticised in detail and numerous suggestions are made as to changes and additions.

Mr. G. E. Tripp offered a number of objections to the use of a loose-leaf general ledger, and advocated the use of three different ledgers, namely, customers' ledger, general ledger and construction ledger. The loose-leaf customers' ledger would not be of any use in this system, as a new one is opened each year. It would not be required for a general ledger, for there will never be any dead accounts in such a book. The only advantage then of a loose-leaf ledger for the general ledger would be that of never having a break in an account, but by limiting the number and names of accounts the book is divided quite accurately, and the chance of a break small. As to the construction ledger, this is merely a memorandum book containing certain details as to charges to construction. Each account is closed as it is finished, and the dead accounts are of as much value for information as the live ones. Therefore there is no reason to eliminate the dead accounts.

Mr. H. H. Fairbanks explained the card system of accounting used by his company, giving reproductions of some of the forms of cards. The cards are kept in boxes and drawers which are fitted to the safe. It is stated that the card ledger can be posted quicker than a book, and that in general the system involves a saving of an immense amount of labor, and in practice is entirely satisfactory.

Mr. George W. Davenport said he did not believe in any form of accounting book, and gave a brief account of a card system used by a company having 2,500 customers.

Mr. Charles R. Price described a loose-leaf ledger system employed by a company having 4,500 gas and 1,000 or more electric customers. He said the Cambridge (Mass.) Gas Light Company had adopted a card ledger system which is giving complete satisfaction, an addressograph being used for writing up. While Mr. Price's company has not appreciated the advantages of a loose-leaf ledger to the extent of adopting it, it has devised a loose-leaf sales journal, which is found to facilitate getting out the monthly work in a way much appreciated by the bookkeepers. These are printed forms of uniform size, on different colored sheets for the different departments, showing the usual material and labor charged on jobs for wiring, piping, or shop accounts, fixtures, etc. They are usually filled in by the workmen as to items, price filled in by the foreman, and when numbered and bound in ready-made covers, form an original day book. Each sheet has all the information regarding any particular job, and is good evidence if a legal question arises. The last sheets of each month have a recapitulation of the total work under each heading for the month, and are posted into the sales ledger, from which a simple journal entry carries the monthly work into what is called the "Corporation Set." All bills are made from the journal sheets, so that the work is transcribed but once in the office, and with from three hundred to six hundred bills per month, of varying lengths, this is a very considerable item of labor saved. In conclusion, Mr. Price said that he does not at present see any advantages over the above system in a change to a loose-leaf method of keeping the acounts of his company.

PROTECTION OF LONG-DISTANCE TRANSMISSION LINES.

This subject was discussed in papers presented by Messrs. Charles H. Baker, L. Denis, P. N. Nunn, Henry J. Gille, P. M. Lincoln. The system with which Mr. Baker is connected transmits from Snoqualmie, at 30,000 volts, by two circuits each to Seattle, and two circuits each to Tacoma. The lines travel mostly through a densely timbered region, which, when cleared, is sowed with white clover, thus producing a fine turf, which removes the danger of running fire in the dry summer months.

The Seattle and Tacoma circuits are parallel to each other for twenty miles, and at the twenty-mile point they are interchangeable through a plugboard. It is the purpose later on to put a plug board at one or two intermediate points, in order to be able further to interchange the circuits. By means of such boards if there is a break on any circuit it can be located on a parallel short division and the circuit in trouble can be cut out and repaired. The wires are spaced thirty inches apart in the triangle, and it is the practice to repair a circuit in trouble while the current is running on the other circuit on the same set of poles. About every fifth pole has a spare cross-arm tacked upon it, and every half-mile there is a spare pole resting on skids, so that when there is trouble the patrolmen know where to go for relief material. A telephone booth is located every three miles along the transmission. The length of the section in charge of each patrolman varies, but in general one man has about twenty-one miles in charge, and patrols it twice

eek. Owing to the manner in which the Snoqualmie line is built, d to rigid inspection, all troubles have been eliminated due to fall- g timbers, running fires, or windstorms; in fact, the troubles ve narrowed down entirely to those due to interference by ma- ious persons or boys throwing wires over the transmission lines. law has been enacted making any such interference a penitentiary ense.

As soon as a short-circuit occurs the lines are tested out imme- ately to find out in what section the trouble lies. The trouble is ariably on one section only, so that the entire load is immediately ced on the other circuit pending the removal of the trouble. soon as the trouble is located on a division, the troublemen from ch end of the division start toward each other in great haste to ch the point. There are lightning arresters on the main gen- ting circuits at each of the sub-stations. There is, however, very le lightning in that locality, and the arresters have only once in ee years been called to duty, and on that occasion worked to fection. All circuits are fused at sub-stations for 100 per cent. erload. Mr. Baker suggests that it is better to have the apex the wire triangle located below the base for the reason that any- ng thrown across the lines would be less likely with such an angement to cross two wires; and he considers that 36 inches uld be better spacing than 30 inches. He suggests that insulators ould receive a brown glaze instead of white, as they will thus esent a poorer target for anyone aiming at them. The petticoats many insulators have been broken, but the wire almost in- iably remains on the core, which would not be the case if glass ulators were used. He also suggests that the telephone system maintained upon a separate set of poles, as trouble on transmis- n lines is very sure to put the telephone out of circuit.

The Quebec-Jacques Cartier Electric Company has, Mr. Denis d, thus far had little experience with lightning trouble. The nsmission line consists of two three-phase 23,000-volt lines, some nteen miles in length, and is protected at both terminals where wires enter buildings with lightning arresters, which are the y protection used against lightning. Although they spark occa- ially, no trouble has been experienced more than a partial short- uit from the discharge. There is more trouble from gradual harge and from induced discharge that takes effect on the low- ion side of station transformers. On one occasion one of these ges caused quite an amount of damage on the 2,000-volt switch- rd, but in this, as in similar cases, apparently no damage was e to station transformers. Mr. Denis adds that the locality has e a reputation for the severity of its lightning storms.

r. P. N. Nunn said that on several parts of his lines located in orado, Utah and Montana, each operated at voltages ranging n 40,000 to 60,000, Wurts non-arcing arresters are used, and there never been a serious disaster caused by lightning or by violent lations caused by opening and closing of long power lines of e capacity and at a very high potential. There have been, how- , numerous small annoyances from the above causes, and for reason it is not considered that the present lightning protec- is entirely satisfactory, and experiments have been made to im- e it, including shunted and series resistances and fewer paths ound.

ne St. Croix Power Company, with which Mr. Gille is con- ed, is operating 25,000-volt transmission lines approximately y miles long, from Apple River Falls, Wisconsin, to St. Paul, nesota. During electrical storms the line is almost always ted in some way, sometimes very slightly, and sometimes caus- he system to be shut down entirely. When the storm is severe, lischarge is usually on one leg of the arrester. The discharge ts the generators at the power house practically the same as a heavy short-circuit, and there seems to be a strong tendency e generators to motorize and always slow down, in some cases ng practically to a standstill. In several cases lightning has ently disregarded the choke coil and lightning arresters and ged the transformers. At the sub-station the rotary con- rs slow down, but apparently remain in step until the fields ically become dead, which occurs in about ten seconds. When enerators begin to pick up at the power house the rotaries also up, with considerable flashing at the brushes, but sometimes their polarity reversed, in which case it is necessary to shut down and change their polarity. The alternating-current sys- s not so easily affected by lightning as is the direct-current sys- n. If the electrical disturbance is light, the lamps in the city y wink; when, however, the disturbances are very severe, it is difficult to keep the converters in service. There is evidence on a great many poles on the transmission of discharges which have jumped from the wire to the poles, but there have been no insulators broken through lightning discharges. The lightning arresters and static arresters are so adjusted that they discharge constantly, the discharge being very light and visible only on two or three gaps next to the line wire. The arresters at one end of the line were very badly damaged in a storm last summer, when the discharge apparently jumped from the line to the ground, arcing across the cylinders without regard to the resistances, forming a straight path to the ground. The trouble where no synchronous apparatus is used is not serious, but all the companies of which Mr. Gille has knowledge, that are operating synchronous apparatus, have considerable trouble during electrical storms.

Mr. P. M. Lincoln gave his experience in connection with the Niagara plant. So far as construction of apparatus is concerned, the Niagara-Buffalo line has been peculiarly fortunate during the five and a half years of its operation. Practically the only apparatus that has been destroyed by lightning have been lightning arresters, the only exceptions being a 500-kw transformer, an ammeter transformer and a few ground detectors. Experience has shown that it is absolutely necessary to limit by means of resistance the dynamo current which flows on the discharge of an arrester; for, no matter what the number of gaps through which the discharge takes place, the arc, once started, seems to be maintained unless the dynamo current is limited. The most satisfactory lightning device is that now used on the lines, the Westinghouse "Low Equivalent" lightning arrester, the gaps of which have an ohmic resistance in series with them and another larger resistance in shunt to a portion of the gaps. In general, this arrangement gives the line-discharging effect of the small series resistance, and the current interrupting effect of the combined shunt and series resistances. Experience has led to the adoption of fuses on the discharge circuit, so that in the case of a short-circuit taking place in the arresters, both lines and arresters are protected. In all lightning arresters choke coils are put in the line, and the discharge circuits attached on the line outside of the choke coils.

As to how frequently the lines are affected by lightning that the devices have failed to arrest, those occasions when the arrester conducts off the flash, but becomes short-circuited, can hardly be called failures to arrest. It is possible—and perhaps even probable—that other apparatus might have been destroyed had not the flash been taken care of by the arrester. In most of the failures to arrest, as observed on the Niagara-Buffalo line, the lightning has caused short-circuits somewhere along the overhead line, sometimes with a simultaneous discharge across the gaps of the arrester and sometimes with no sign of such discharge. Observations would indicate that the voltage necessary to jump over a wet insulator does not differ greatly from that required to jump across the gaps of the lightning arrester. In case such a short-circuit is once established anywhere along the line, it almost always continues until the current is pulled off the lines, in spite of the fact that the distance between the conductors is 36 inches. Most of the lightning interruptions are of this nature. No permanent damage is done. All that is necessary is to take off the current for an instant; supply of power can be resumed immediately. An examination of the records for the past three summers—those of 1899, 1900 and 1901—shows that during that time eighteen interruptions occurred due to lightning, five of which occurred within a space of about three hours, during a storm of unprecedented severity. The average duration of the interruptions has been about four minutes. In view of the prevalence of lightning on the Niagara frontier, Mr. Lincoln considers this record a very good one.

The New President.

Mr. Louis A. Ferguson was born at Dorchester, Mass., Aug. 19, 1867. He was educated in the Boston public schools, graduating from the Dorchester High School in 1884. Entering the Massachusetts Institute of Technology, he took the full four years' course, graduating in 1888, with the degree of bachelor of science in the department of electrical engineering. In August of the same year he joined the staff of the Chicago Edison Company, whose rapid growth furnished an excellent opportunity for his ability. He was soon made electrician of the underground department, a position he filled until the beginning of 1889, when he became assistant electrical

engineer of the construction department. In 1890 he was appointed electrical engineer of the company.

In 1893 Mr. Ferguson's duties as electrical engineer were increased by the placing in his hands of the contracting department of the company, and in June, 1897, he was appointed general superintendent of the Chicago Edison Company, in charge of the operating and electrical engineering departments, together with the contracting department. This meant virtually the technical oversight of all the central station work within Chicago city limits, as the Edison Company had become master of the situation; soon after, strengthening its hold on the territory by the formation of the Commonwealth Electric Company, which consolidated the properties in the larger field outside the denser sections of the city. In 1898 Mr. Ferguson became general superintendent of the Commonwealth Company also.

Mr. Ferguson was the first one to suggest, in this country at least,



L. A. FERGUSON, PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION.

a station generating three-phase alternating current with transmission lines to sub-stations operating "rotaries" converting from alternating to direct current for general distribution. The first apparatus built for this purpose in connection with lighting stations is now in operation in Chicago. The Chicago Edison Company now has eight substations using rotary converters and motor generators, and at the present time is building the largest double-current generator known, the nominal capacity being 2,500 kilowatts, and the ultimate capacity 3,200 kilowatts, generating direct current at 300 volts, and alternating current at 180 volts, the machine weighing 320,000 lbs.

Mr. Ferguson, in 1895, was appointed on the staff of lecturers of the University of Wisconsin. In 1898 he was elected president of the Northwestern Alumni Association of the Massachusetts Institute of Technology, serving one year. He was elected vice-president of the National Electric Light Association in 1900 and 1901, and has read papers before that body as well as before the Edison Association, of which body he was elected president last year. Mr. Ferguson has also contributed to the technical press at various times, and has made several trips to Europe to investigate electrical development there.

Convention Exhibits and Notes.

THE DAILY BULLETIN issued by the Bullock Company, under the editorship of Mr. Bolles, was a great boon, and, coming out at least once a day, was much in demand by everybody. Each person in attendance, on signing a numbered card, received a numbered button, and the name, number, etc., were printed in the Bulletin in full, proving very handy for reference. The Bulletin, which was narrow enough to fit a vest pocket, contained also an excellent map of Cincinnati, the programme and other matter.

AMERICAN CIRCULAR LOOM CO. was represented by H. B. Kirkland and Thos. G. Grier.

R. B. COREY represented the various lines he carries.

J. W. MCDOWELL, New York, represented the Manhattan Electrical Supply Co.

J. H. DALE represented the Dale Company, New York City.

THEO. D. MOULTEN represented the Shedd oscillating fan, New York, and had some of his "Dick Swiveller" fans in most grateful operation.

E. J. MCALLISTER, Newark, N. J., representing the Electric Motor & Equipment Co., showed its photometer and its sign commutating devices.

MR. C. E. [illegible] and J. S. Moore represented the Ohmite Flexible Conduit Company, and had a small exhibit board of samples.

F. C. COLWELL represented the General Incandescent Arc Light Co. Engineer Hallberg, of the lamp department, was also in attendance.

JAMES JONES, JR., was present for J. Jones & Son, electrical supplies, New York City.

J. VAUGHAN represented J. Buchanan & Co., Philadelphia.

THE PHOENIX GLASS CO. was represented by E. H. Peck, New York.

R. EDWARDS, JR., and E. W. Rackafellow, of New York, represented the Western Electric Co.

C. J. HARRINGTON, New York, represented the Scranton Fire Brick Clay & Conduit Co.

W. S. ECKERT, New York, was on hand for the National Conduit & Cable Co.

F. J. ANDERSON, of New York, represented the Stanley Instrument Co., of Pittsfield, Mass.

THE GOULD STORAGE BATTERY CO., New York, was represented by Chas. M. Gould, F. P. Huntley, W. W. Donaldson and A. Hubbard.

MR. H. B. MOORE represented the Chase-Shawmut Co., of Boston and interested many delegates in the new indicating enclosed fuse which that company is just putting on the market.

MR. S. B. CONDIT, JR., of S. B. Condit, Jr., & Co., Boston, arrived Tuesday morning. The attention of central station men throughout the country is being attracted to the Elden oil circuit breakers and switches, which this firm manufactures, and the large switchboards which it is equipping with this apparatus; and Mr. Condit had many inquiries to answer.

MR. C. F. MUNDER, of the Munder Electric Co., Springfield, Mass., was an early arrival at the convention. He is a familiar figure at electric light conventions, and he and his incandescent lamps became better known than ever before.

SPRAGUE ELECTRIC COMPANY, of New York City, was represented by Mr. Alex. Henderson, of the conduit department, who occupied one of the parlors and had on view one of the most comprehensive and illustrative exhibits of steel armored conduits that it is possible to imagine. The range of sizes included everything from signal, bell and telephone work up to the largest runs of light and power circuit, and the flexibility and adaptability of the system was admirably shown, and attracted a large amount of attention.

AMERICAN ELECTRICAL MFG. CO., of Philadelphia, was represented by Mr. J. Allen Heany, who had on view in one of the parlors three of his new and interesting enclosed arc lamps, two of 110 volts taking 3½ amp., and one 220, taking 2 amp., all direct current. These lamps, which were recently described and illustrated in the pages of ELECTRICAL WORLD AND ENGINEER, are of most simple construction. The lamp body or frame is built up of three tubes. At the top by a casting and at the base by a plain stamping a small solenoid coil is held and adjustably supported by the tubes, and provision is made which allows the coil to be slid up and down so as to adjust the lamp to the amount of current that is to be consumed, without making any change in the resistance of the lamp. Within one of the tubes is another, carrying the upper carbon, and surrounding it is a combination solenoid core and clutch, composed of two semi-tubular members on pivots or hinges, and arranged to slide up and down on the carbon-containing tube. These hinged members have jaws to grip the upper carbon; and when the solenoid core is energized by the coil that surrounds it, they act like pole. Repulsion takes place, throwing the jaws inward, both to clutch the upper carbon and to lift it, establishing the arc; and when the carbon has to feed the clutch jaws let go, so that the carbon can slide down. The solenoid coil contains less than a pound of wire and cannot be broken down. The total weight of the lamp is less than six pounds, and the length is less than 18 inches. The voltage of the arc may be regulated by cutting in and out the regulating resistance, but Mr. Heany stated that he preferred 75 to 80, as giving less blue or violet in the arc. The dash-pot is also a very simple mechanism, and the arrangements for holding the globes for carbon renewals, etc., are equally simple and ingenious.

THE WESTINGHOUSE ELECTRIC & MFG. CO. had a most interesting exhibit, which naturally and properly centered around the Nernst lamp. Vice-President Taylor was in charge of the Westinghouse forces, and Mr. Calvin W. Rice, the second vice-president of the Nernst Company, had charge of the lamp display, the room be

by a central cluster, and having a most elaborate exhibition of np parts, glowers, heaters, ballast, etc., for the four sizes of 88, 5, 264 and 528 watts. There was also an apparatus to illustrate e ease with which fabrics could be used or shown under its rays thout the apparent change of hue due to the use of other illu- nants. The exhibit contained also a variety of instruments, in- ding glass case integrating wattmeters, single phase, 7,200 alter- tions, 10 amp., 100 volts, and iron case, 1,600 alt., 5 amp., 100 lts; voltmeters, 7,200 alt., 150 volts; ammeter for alternating cir- ts, 800 amp.; power factorometers; synchronouscope; automatic cuit breakers, 1,500 amp., 750 volts, for direct and alternating cuits; small transformers for lighting, of the shell type. In addition Messrs. F. H. Taylor and C. W. Rice as named above, the Westing- use interests were represented by Messrs. W. M. Probasco, C. B. mphrey, W. S. Rugg, J. W. Shantz, H. C. March, R. U. C. Barnes, ex. Wurts, W. R. Pinckard, C. S. Powell, W. H. Whiteside, A. odby, H. D. Shute, G. B. Griffin, C. F. Scott, C. Townley, E. wger, F. Hodkinson, T. H. B. Whiffie and G. A. Nellis, the two ter also being in charge of Sawyer-Man Electric Co.'s interests, h Mr. C. A. Ross.

General Electric Co. occupied a parlor, but made no exhibit, ntenting itself with the distribution of literature, and with the play of a sign in miniature lamps outside its headquarters. It s represented by Messrs. J. R. Lovejoy, manager of the lighting partment; A. D. Page, manager incandescent lamp sales; J. B. vear, manager Cincinnati office; C. B. Davis, manager Boston ce; Irving Hale, manager Denver office; A. L. Rohrer, E. E. Gil- t, P. D. Wagoner, H. W. Hilman and F. Vaughan, of the Schenec- y works; E. H. Mullin, of the New York office; R. Fleming l F. B. Cox, of Lynn, and others.

Prof. W. E. Goldsborough, director of the department of elec- al exhibits at the St. Louis Fair, was in attendance to meet the nufacturers and delegates and to foster interest in the subject he fair for 1904.

Lieut. E. J. Spencer, of St. Louis, was present in behalf of the rests of the Safety Insulated Wire & Cable Company, which he resents in the West.

Mr. Luther Stieringer, although not in the best of health, braved steamy rigors of the Cincinnati climate to attend the convention keep in touch with the latest developments in the art.

The Chas. E. Dustin Co., of New York City, was represented Mr. W. S. Barstow, its consulting engineer. This well-known tric light manager has a number of new and old plants in hand treatment on modern lines.

Bossiter, MacGovern Co., of New York, was quite adequately esented in the person of Mr. Frank MacGovern and Mr. James Pierce, western representative.

The Banner Electric Co., Youngstown, Ohio, was represented Messrs. N. L. Norris, J. E. Hart, F. C. Kirchner and R. T. Ham- n. They exhibited a complete assortment of Banner lamps of ous types and voltages. Prominent among these were their 220-volt lamp and their standard 16-candle-power lamp. On ry attractive showboard were displayed in operation a large ber of styles of ornamental and sign lamps. The Banner Co. their own filaments. A feature of their exhibit which at- ed a great deal of attention was a case in which were shown the ous steps in incandescent lamp manufacture, from the cellulose pound from which the filament is made to the completed lamp. boxes made of celluloid, with a transparent top and containing of dice, were distributed as souvenirs, as were also "Banner" ms. An unusually attractive and elaborate folder, prepared essly for the occasion, was handed to all visitors. It was en- "The Right of Way."

The Electric Storage Battery Co., of Philadelphia, was repre- d at the convention by Mr. Chas. Blizard, manager of the department; Mr. E. Vail Stebbins, manager of the Cleveland , and Mr. G. H. Atkin, manager of the Chicago office. The battery of "chloride accumulators" on the system of the Cin- ti Gas & Elect. Co. was visited with much interest by the dele- Another battery of considerable interest is a small signal t the East Norwood station of the B. & O. R. R. This is one e early installations of "chloride accumulators," having been rvice continuously for over eight years.

The Helios-Upton Co., Philadelphia, was represented by Mr. Upton and by Mr. C. D. Meyers, of Philadelphia, and Mr. rt Gregg, of the Chicago office. They exhibited in operation their series alternating lamp and their high-economy Continental lamp. Bulletins describing these lamps were distributed.

Mr. James I. Ayer, manager of the Electric Heating Corporation (department of the Simplex Electric Co.) of Cambridgeport, Mass., was, as usual, in active attendance and very cordially welcomed by all old friends as well as by many new. Aside from his business interests, Mr. Ayer has done a lot of valuable work for the Association and he is one of the past presidents who retains a lively concern in the welfare of the Association. He participated in all that was going on that had reference to the advance of the art.

The Nernst Lamp Co., whose exhibit has already been referred to in connection with the Westinghouse exhibit, not only made one of the most original and interesting displays under the direction of Vice-president Rice, but distributed some excellent literature One neat and tasteful pamphlet, with a pretty cover in green and silver, dealt with the subject broadly and in detail, not only giving the history of the lamp, but enumerating a number of patents on it and then dealing with practical questions. It illustrated the lamp collectively and in parts and explained the *modus operandi;* while there were also a number of cuts devoted to manufacturing and commercial details. The statement was also made, of no slight significance, that within a few months after the close of the Pan-American Exposition at Buffalo, there were over 2,500 Nernst lamps operating under all conditions of service, representing a total of not less than 300,000 cp, at which time also the company was making over one thousand 50 cp glowers per day.

Electrical World and Engineer occupied the suite 330-4 and was represented by Pres. J. M. Wakeman; T. C. Martin and J. R. Cravath, editors; G. W. Elliott, New York office; J. V. S. Church, Chicago office; E. T. Walker, Boston office; C. Walker, Philadelphia office.

Visitors From England. A very active interest was taken in the proceedings of the Association by two English engineers who had but just arrived in the country on a tour of inspection. One of these gentlemen is Mr. L. Andrews, the electrical engineer of the Hastings corporation, and the other is Mr. C. T. Thompson, who until recently was assistant works manager with the Brush Electrical Engineering Co., of England. Reaching America as the convention began they immediately "made tracks" for Cincinnati, and found a great deal to interest them in the proceedings. They will visit several factories and stations before returning home.

Pass & Seymour, Syracuse, N. Y., were represented by C. M. Crofoot (Cincinnati) and F. M. Hawkins (N. Y.).

Crouse-Hinds Elec. Co. (Syracuse, N. Y.) was represented by Mr. Hinds and C. M. Crofoot of Cincinnati.

Hart & Hegeman Mfg. Co., Hartford, Conn., was represented by R. B. Corey.

American District Steam Co., Lockport, N. Y., was represented by H. C. Eddy of Chicago.

American Electrical Works, Providence, R. I. was represented by F. E. Donohue of Chicago.

The Pettingill-Andrews Co., Boston, through its representative, Mr. W. J. Keenan, distributed leather-bound copies of the Underwriters' Rules—a souvenir that made a decided hit.

The Marshall-Sanders Co., Boston, was represented by Mr. C. A. Sanders.

The Lombard Governor Co., Boston, was represented by its manager, Mr. Allan V. Garratt, who has recently returned from some important work out west.

Mr. J. C. Shainwald was present in behalf of the interests of the Standard Paint Co., of New York and the rest of the world. Mr. H. W. Benedict was also in evidence.

The Triumph Electric Co., of Cincinnati, whose motors and dynamos are so well known throughout the west, as well as other sections of the country, did not make an exhibit at the hotel, but was represented by Messrs. J. C. Hobart, manager, W. H. Jacob, manager of sales, C. S. Reno, chief electrician, and D. D. Gill. They gave away a neat souvenir in the shape of a tape measure. Among recent large motor equipments have been those for the French piano factory and the great Globe-Wernicke bookcase shops.

National Bureau of Standards was represented by Mr. Frank A. Wolff, Jr., of Washington, D. C., who had much to discuss with delegates and members in regard to the work to be done in the lighting field.

Fort Wayne Electric Works occupied a parlor on the long hall, and were represented by F. S. Hunting, general sales manager, A.

A. Serva, assistant sales manager, T. L. Sturgeon, Indiana agent, T. J. Ryan and G. B. Edgar, Cincinnati, J. E. Hall, Pittsburg, W. S. Goll and W. C. Knight, of Chicago. There were exhibited arc lamps of all descriptions, type K meters, motor starting panels, instruments, and the revolving fan motor with cord suspension. Several of these fans were distributed around the hotel and gave a grateful breeze.

Those Who Exhibited fan motors during the roasting, or rather boiling week, were rewarded by the hearty gratitude and appreciation of every delegate. The breeze shed by the Shedd was voted "it."

The Consumers' Carbon Co. was represented by Messrs. Edmund Dickey, general manager; M. M. Hayden, supt.; W. C. McGowan, selling agent for the South; A. J. Webb, eastern agent, and W. H. Schott, Chicago agent. The concern is making a full line of standard carbons and bid fair to win and retain a wide popularity for its product, if its reception at the convention was any indication.

National Carbon Co. was represented by Mr. N. C. Cotabish, its well known sales manager, who, in view of the universal use of its product by central station men, deemed it hardly necessary to make an exhibit of points or brushes, etc.

Mr. Jas. Wolff was on hand in the interests of the New York Insulated Wire Co.

Kuhlman Elec. Co., of Elkhart, Ind., was represented by Mr. E. Kuhlman, who had a neat pamphlet which illustrated and described their transformers.

Adams-Bagnall Electric Co. was represented by Mr. J. G. Pomeroy, in charge of western sales of its well known lamps, at Chicago.

Mr. G. S. Searing, of Chicago, was present on behalf of Peru Elec. Mfg. Co. and Hart & Hegeman Mfg. Co.

United States Carbon Co., of Cleveland, was represented by Mr. B. P. Foster, general manager.

Bryan-Marsh Company had its well known incandescent lamps represented by C. D. Marsh, G. C. Keech.

Trip to Bullock Works. The Bullock Elec. Mfg. Co. had parlors at the hotel, but made their exhibit at their fine new works at Norwood, still in process of rapid and considerable extension. A special train ran out over the Baltimore & Ohio at 4 P. M., on Wednesday, and the convention having adjourned for the purpose of accepting the invitation to visit the shops, some four or five hundred delegates and guests availed themselves of this excellent opportunity to see one of the newest, largest and best electrical shops in the west. On arrival at the beautiful works, built in a light cream brick with stone trimmings, a photograph group of the visitors was taken and a brief, cordial welcome was extended by Pres. George Bullock. The visitors then filed through the buildings and were particularly struck with the main shop, 600 feet long, without a belt or shaft or wire in sight, but with motors in every direction on large and small machine tools, direct connected, short geared, etc., and doing their work with a facility and smoothness that justified all the claims that have been made for motors. Some very heavy work was in process, including generators up to 3,500 kw for the Cincinnati Gas & Elec. Co. Other parts of the works were visited in turn, and then a lunch was served in one of the buildings. Messrs. Lozier, Neave, Bolles, Behrend, Alexander, Collyer, and others assisted Pres. Bullock, and everyone voted the trip most enjoyable and a profitable use of the afternoon.

National Electric Improvement Co. made a splendid display of their "Elblight" system under the efficient direction of Mr. Russell Spaulding. There were no fewer than 2,000 lights shown outside the hotel and 2,000 within, fixed into the special twin cable by means of the well known sharp pin terminals or fastened similarly into the boards of insulating material specially designed for the Elblight work. The outside of the hotel had long streamers of lamps from roof to portico, with a crown at the top and a fine representation in the center of the badge of the Association. Inside the main hall or rotunda were long streamers of the cable with green and white lamps, from the dome to the side pillars, giving a most dazzling and graceful effect. In the meeting room there was a sign made up like the Association badge; in the long hall there was the American flag studded with lamps, and in the Elblight parlor there was a most notable collection of signs using the lamps and material. A dramatic test was made of the system by the storm that swept over Cincinnati on Tuesday morning, killing several people and doing a million dollars damage. The rain fell in torrents, the wind traveled 60 miles an hour. But outside the hotel only about ten lamps were broken, by their tips striking the stone walls. Inside the rain poured in a deluge through sudden leaks into the rotunda, over lamps and cables, but it "never phased them a bit," both lamps and cable standing up as to insulation, etc., and giving out their light serenely all through the pitchy darkness of the storm. It was a great and convincing demonstration.

Am. Vitrified Conduit Co. had an exhibit in the long hall of it conduit under the management of Mr. G. M. Gest. A huge manhole on the Cincinnati Gas & Electric Co.'s system, 11 feet by 11 by 11, was fitted up also as a reception room and delegates were invited thither to enjoy all the comforts of home, with a few of the restaurant and bar. The place, right under the center of the street was fitted up as a parlor with rugs, draperies, fans, etc., and proved one of the most curious and attractive novelties of the whole convention.

Hubbard & Hall Co., of Cincinnati, were well represented by Mr. W. A. Hall, who is agent for a great many well known electrical specialties as well as maker of others. The concern was also spoken for by Mr. G. H. Jones. A great many visitors made their way to the headquarters of the concern, where they made very much at home.

Post-Glover Electric Co., of Cincinnati, was represented by Messrs. S. Glover, G. Devon, F. D. Van Winkle, G. Knoff and others, and received friends at its spacious store.

Creaghead Engineering Co., of Cincinnati, were represented by Mr. T. L. Creaghead.

DeVere Electric Co., of Cincinnati, who are just occupying a fine new store, were represented at the convention by Messrs. W. Stewart, W. H. Schepers and others.

The "X. S." Capacity Indicator was shown in operation in the long hall by the Excess Indicator Company, of 7 Water Street, Boston, who are following up the work done by Mr. Wallis, of Woburn, with his "4-c" system. They showed the new model of the device for 1902 in operation, with the case removed; and its fire-proof qualities, small current losses, ease of adjustment, etc., were all illustrated. The company were represented by Messrs. R. Patterson and G. K. Boutelle, who showed the indicator under test on the bank of lamps to all comers.

John A. Roebling's Sons Co. were well represented by Messrs. Bailey, F. Harrington and others.

Mr. H. F. Tate, of Chicago, responded or the National Conduit & Cable Co.

Lane & Bodley Co. invited the delegates visiting the Bullock works to note their fine new twentieth century cross compound direct-connected engine being installed in the new power plant. They were represented at the convention by Messrs. G. H. Lane and W. S. Nourse.

The Sterling Elec. Mfg. Co., Warren, O., were represented by Messrs. William Coale, Glenn C. Webster and J. W. McNair. They distributed copies of their recent booklet, "The Midnight Sun," as well as other literature descriptive of "The Sterling Special" lamp.

The Pittsburg Electric Lamp Co., Braddock, Pa., was represented by Mr. E. R. Morrow, of Pittsburg.

The Standard Underground Cable Co., Pittsburg, was represented by J. R. Wiley, Chicago, T. E. Hughes, Philadelphia, and J. Marsh, New York. Their exhibit included samples showing paper and rubber insulated lead-covered underground cables for very high voltages. Among other literature which was distributed was a booklet showing handsome illustrations of buildings in which their rubber covered wire was used. Engineers were invited to register their names and addresses to insure receiving a copy of the new edition of the hand book of useful information to be issued shortly. The book has proved so popular that the previous edition has been exhausted.

Robert Kelly, Jr., of Newark, O., and M. J. Davies represented the Holophane Glass Co.

Charles G. Wertz showed the exhibit of the Elliott & Hatch Book Typewriter Co.

W. V. Sweeton represented the American Push Button Telephone Co., New York.

Mr. J. A. Vaughan, New York, represented J. F. Buchanan & Co., Philadelphia.

The New York & Ohio Co., Warren, O., was represented by Mr. W. D. Packard on behalf of their lamps, transformers, etc.

Mr. C. K. Hill, Pittsburg, was at the convention, meeting his many friends.

The Warren Electric & Specialty Co., Warren, O., was represented at the convention by Messrs. E. W. Gillmer and E. E. Nash.

The Colonial Electric Co. was represented by Mr. J. B. Estabrook, Ravenna, O.

Guttmann Meters. One of the exhibits attracting attention was the light and compact Guttmann recording wattmeter. It was exhibited by the Electrical Appliance Company, of Chicago, which was represented by Pres. W. W. Low and Mr. Millard, who have long since become familiar at the electric light conventions. The Sangamon Electric Company, manufacturer of meters, were represented by Mr. L. Guttman. The meter, with its aluminum cover, presents a handsome appearance, is remarkably small in size and simple in construction. The meters on exhibit were for 2 or 3-wire circuits and the latter for balanced or unbalanced loads. The internal construction was frequently examined and the workmanship favorably commented upon.

Mr. Geo. B. Davis, manager of the Standard Chemical Co., Boston, was in attendance; Mr. Davis has been at several of the electric light conventions explaining the merits of his company's "Soaposo" for the cleaning of central station floors. He states that central stations are, as a class, the cleanest plants in the world.

Gen. Incandescent Arc Light Co. were not only represented by several thousand enclosed arc lights on the Cincinnati circuits, but by Messrs. Martin Insull, Hallberg and Colwell.

Stanley Elec. Mfg. Co. Just at the entrance to the Assembly Hall was the S. K. C. system (Stanley Electric Mfg. Co.) exhibit, consisting in main of maps and photographs of the great transmission lines of California and displaying the coils and core of a 10-light S. K. C. oil transformer. The method of separately winding and insulating the sections of the coil in this type of transformer was nicely demonstrated by showing the sections of one half a coil before assembling. An interesting treatise in the form of a 16 page circular headed, "Recent Transformer Litigation" was distributed, occasioning considerable comment. Copies of Dr. Perrine's paper before the New York Electrical Society on "Power Plants of the Pacific Coast" were also dispensed. This is a beautifully printed and illustrated and highly interesting piece of literature. A Falk photograph of Lord Kelvin, autographed "Kelvin, New York, May 6th, 1902," provided a very interesting addition to the S. K. C. corner. The photograph itself shows Lord Kelvin perusing the March *Review of Reviews* article on "Long Distance Transmission in California," the illustrations and part of a page of text being readily recognized. This page, cut from a copy of the magazine, as well as the cover of the magazine were framed with the portrait, making an exceedingly interesting combination. The Stanley Electric Mfg. Co. were represented by Mr. Bergenthal, of the Chicago office, and Mr. Bibber, of the New York office. Dr. Perrine, as noted elsewhere, presented a paper, "Protection to Long Distance Transmission Lines." Mr. Ray D. Lillibridge, advertising manager of the Stanley and other concerns, arranged the exhibit and was also on the ground during the convention.

Mr. Alex. Henderson, in slight acknowledgment of his valuable services as acting Master of Transportation and especially in connection with the convention train leaving New York on Sunday morning, was presented at the Bullock works, on the occasion of the visit there, by a number of the delegates, with a handsome, jewelled cigar cutter, marked "Cincinnati, 1902." It was greatly appreciated by the recipient, who immediately proceeded to try it on one of the choice Bullock Havanas. The compliment to Mr. Henderson was well earned.

John S. Nowotny Elec. Co., of Cincinnati, was represented by the gentleman of that name at the head of the concern.

Robbins & Myers Co., of Springfield, O., were represented in regard to their fans, etc., by Messrs. W. W. Munroe and R. P. [illegible]

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THE NATIONAL ELECTRIC LIGHT CONVENTION.

The electric light convention at Cincinnati last week, to which we devoted a 16-page supplement last week, far exceeded any previous gathering of the kind, both in the number of interested attendants at all sessions and in the volume and value of the proceedings. That the attendance at the sessions kept up in spite of the depressingly hot weather, which the stifling atmosphere of the convention hall did not render any more bearable, and that almost the entire time for three days, including evenings, was taken up by sessions, demonstrated the fact that something more than ordinary was presented by the management. The unusual success of the recent gathering was, undoubtedly, due to the energy, enthusiasm and untiring work of ex-President Doherty. His administration has marked a turning point in the affairs of the association, and, in view of the new life which he has instilled into it, it is a matter of regret that precedent did not allow his continuance in office for an additional term or two. The only criticism that could be made on the programme which he served up to the association, was as to its superabundance. So many subjects were taken up at length, by discussion prepared in advance, by the "question box," and by discussions on the floor of the convention, that members at times became satiated with the amount of good things laid before them, and were unable to appreciate and discuss many matters as clearly as might have been had fewer subjects been taken up. The success of the convention was a full indorsement of President Doherty's plan of making a programme which differed considerably from the programmes of former years, in that each subject was discussed by several members in advance. Although some of these discussions lengthened into what might be termed "Papers," as a rule, better results were secured than by the old plan of a single paper on a subject and with impromptu discussion. The mass of discussions printed in advance and presented to the convention was so great that it is doubtful if any of the members present will have read and digested them all fully even by the time this issue reaches its readers, and the additional proceedings of the convention taken by the official stenographer would make another volume equally as large. As to the large attendance, it may be noted that the action of the association in reducing membership fees to minor central stations operating in the smaller cities, of course, has as its aim the attraction of small companies, and is along the commendable line of policy advocated and followed by President Doherty.

In the selection of Mr. L. A. Ferguson as president, and Lieut. Cahoon as secretary, the convention has probably made the wisest move possible to have continued the energetic policy started by Mr. Doherty. The selection of Chicago for the next convention came as somewhat of a surprise to Eastern members, who naturally expected New York to be selected for 1903, after the association had accepted the invitation of the Louisiana Purchase Exposition to meet at St. Louis at the Exposition in 1904. However, it must be remembered that ours is a big country, and those who urged the selection of Chicago as the next meeting place may be right in their position that it would be a mistake at the present time, when the membership of the numerous smaller central stations in the middle west is being solicited, to compel a trip to the Atlantic seaboard for all who wish to attend the convention. Although the Atlantic states still have the preponderance in the number of supply men and manufacturers, the central stations are distributed over the country very nearly according to population, the present center of which is in

Indiana, and even with a Chicago convention, central station men from the far west have much more to complain of in the way of a long trip than do those from the Atlantic states. At the same time, we have a lingering conviction that at this season of the year Western managers have no great objection to getting nearer to the sea.

The 3500-volt Limit for City Over-head Lines.

As many of our readers know, a proposed amendment to the Underwriter's National Code provides that no overhead electric circuit carrying wires having a difference of potential of more than 3,500 volts alternating current between them should be allowed within 75 feet of any building. This rule has been under consideration by a committee of the American Institute of Electrical Engineers for some time, and it is perhaps well that attention was also called to the proposed rule at the recent convention of the National Electric Light Association, as a body of practical men of this kind are able to deal with an obstructive rule of this character with effect. There are already installed in our large cities miles upon miles of circuit which, under this rule, would either have to come down or the insurance could be canceled in any of the buildings along the street. As Mr. W. L. Abbott, of Chicago, pointed out, since these circuits cross other circuits of various kinds, the existence of such circuits in a city should logically cause the canceling of the insurance on an entire city if such a rule went into effect. Captain Brophy suggested that there is no consistency in restricting the voltage on alternating-current circuits to 3,500 volts and allowing 8,000-volt, direct-current arc circuits to go unmolested. The use of higher voltages than 3,500 for transmission distribution in cities is becoming so common, and the rules which should govern the construction of high voltage circuits of this kind are becoming so well known, that the resolution unanimously passed by the National Electric Light Association, saying the proposed rule is uncalled for, and that good construction of such circuits rather than their prohibition should be the remedy for any troubles from them, is most timely.

High versus Low Economy Lamps.

For a number of years the tendency among central stations has been towards the use of incandescent lamps of higher and higher economy. It has, of course, been to the advantage of lamp manufacturers to encourage this tendency, and it has furthermore been advocated as the most economical form of practice by a large number of progressive central station managers. Discussion on the subject has been on the wane for several years, but was revived at the National Electric Light Convention last week with the vigor of a normally slumbering West Indian volcano. The most ardent champion of the low economy lamp, with an energy consumption of about 4 watts per candle, as against one of about 3.1 watts per candle, was President Doherty, while among the central station men, President-elect Ferguson, of Chicago, took a most decided stand in favor of the 3.1-watt lamp. When two such doctors disagree, there is certainly good reason for analyzing the subject thoroughly before arriving at a conclusion. Stated in as simple terms as possible, the argument of the advocate of the low-efficiency lamp is this: If a central station having 3.1-watt lamps should replace these lamps with those taking 4 watts per candle, there will then be required about 13 per cent. more energy to furnish the customer with the same amount of light as formerly. It is proposed to reduce the rate per kilowatt-hour charged a customer by 13 per cent., so as to give him the same rate per thousond candle-power hours as with the high-economy lamp. Now, it is claimed by the low-economy advocate that the saving in lamp renewals by this process will not only compensate for the increased amount of current which must be supplied for a given price, but will leave a balance in favor of the central station; at the same time giving the consumer the same amount of light as before for the same money. Whether this is true or not manifestly depends on two things: The difference in cost of lamp renewals per kilowatt-hour between the high and low-economy lamps, and the actual cost to the central station of the 13 per cent. additional energy which must be supplied as a result of the change to the 4-watt lamps. The cost per kilowatt-hour for lamp renewals of 16-c.p. lamps was given in the discussion by Mr. F. W. Willcox as .73 cent for the 3.1-watt lamp and .18 cent for the 4-watt lamp. For the sake of argument, assuming these figures to be correct, it is evident that the central station must be able to supply the 13 per cent. additional energy to the consumer at a very low cost, and the whole discussion hinges on the actual cost of this additional current.

The partisans of the low-economy lamp claim that in the stations for which they advocate the use of such lamps, the only increased cost is that due to the additional amount of fuel which would be burned in order to produce that much extra current. If a station was not fully loaded so that no additional investment would be required, this contention might hold true so long as no additional capacity in generating machinery or distributing system had to be installed; but such a condition could only exist for a short time, and if interest, depreciation and distribution costs be figured in, there is surely no profit in the change to lower economy lamps. Indeed, it might be argued on the other hand that if, instead of decreasing the lamp efficiency by 13 per cent. additional, consumers could be taken on to that amount, it would increase the gross revenue 13 per cent. To us it appears evident as a general proposition that in a live central station with a growing load the higher economy lamp is the more desirable. But there may possibly be special cases in which the lower economy lamp will be more economical, and the recent discussion at the convention was of benefit in that it will set central station managers to thinking and considering each case on its merits, rather than following a general rule, however few its exceptions.

The 220-volt Lamp.

One of the noteworthy papers at the electric light convention was Mr. Bailey's report on tests of 220-volt incandescent lamps. These high-voltage incandescents seem to be steadily coming into more and more extended use, whatever their ultimate status may prove to be. They certainly have their uses, and must be reckoned with as a factor of some importance in the art. Mr. Bailey's tests were on a considerable scale, embracing 14 lots of 50 lamps each, purchased in the open market, and including practically all the makes of 220-volt lamp available in this country. All were of 16 candle-power, although the author notes that one of the weak points of 220-volt service is the lack of good 8-cp lamps. In our observation, there is rather a strong tendency toward the use of 20 to 32-cp lamps at 220 volts, and we wish that some of these had been included in the tests. The general result was such as might properly have been expected, and was by no means cheering. The most conspicuous failing was complete lack of uniformity in rating. The target diagrams are something horrible to see, and only two or three of them would be considered tolerable by the station manager. These two or three, however, were pretty good, and show that some makers at least are careful and conscientious in sorting the product. Most of the lamps were rated at about 4 watts per candle-power, and one lot thus rated actually showed 5.6 watts per candle. Only one lot was rated below 3.5 watts per candle-power, and it is interesting to note that this was conspicuously good in most respects, showing an initial average of 3.29 watts per candle, and an average of 6,545 candle-power for the useful life prior to falling below 80 per cent. of the initial intensity. The tests show very plainly that while it is possible to make a good 16-cp, 220-volt lamp, and while such lamps can be obtained in the open market, they are the exception, and few makers are careful

enough in sorting and rating the product. The obvious moral is to test this class of lamps with exceptional care and to insist on getting the best. These, as Mr. Bailey's tests show, are very creditable, although painfully rare.

The Demand System in Chicago.

A most timely paper at the recent electric light convention was Mr. Ferguson's very interesting account of the experiments in the use of the demand system in Chicago. There is certainly a general call for some improvement over the flat-rate system in any of its usual modifications, and the results of experience on so large a scale as at Chicago cannot fail to be instructive. It is practically agreed on all sides that there is need in every large station for something better than any fixed arrangement of discounts based on gross quantity alone. There is no simple, or perhaps no practicable, way of taking into account all the variables which enter into the cost of furnishing energy to a given customer. Even if there were, it is a grave question whether it would be the best policy to apply it, or whether when applied it would not prove a nuisance and be put down by legislative enactment. The demand system, which practically bases discounts on the customer's load factor, has at least the merit of relative simplicity and of dealing somewhat directly with one important feature of cost of supply. Mr. Ferguson found, as others have done, that the original scheme required some modification to fit it to local conditions, and based upon it a somewhat empirical schedule which appears to have worked admirably. On two points we could have wished for additional information. Why is the demand system applied almost entirely to small consumers, and what has been the actual effect upon their monthly bills and upon the rate per kw-hour actually paid? We think there is room for much valuable study of this matter of rates, but a searching investigation of the "preparation" item would often be decidely awkward and difficult; and the Chicago plan, albeit empirical, appears to have much more to recommend it to the ordinary manager. Truth to tell, any reasonably simple system of charging must be somewhat empirical, and the vital point is to evolve a system easy to operate and for the customer to understand, and nearly as may be fair to all classes of consumers, and of a character not likely to stimulate unprofitable business.

The Protection of long Distance Transmission Lines.

A collection of five short papers on this subject was read before the National Electric Light Association at Cincinnati, abstracts of which appeared in our issue of last week. The papers all relate to plants in the belt of territory comprised between the 45th and 50th degrees of north latitude, but from as far west as Snoqualmie and as far east as Quebec. The troubles which are experienced in these various plants are reported as differing considerably. At Seattle there are very few thunder-storms, and the difficulties on the transmission lines arise from big timber and rifles. At St. Paul lightning gives serious inconvenience. From Colorado and Niagara there are reports of minor troubles from lightning. At Quebec, although there is a good annual share of thunder-storms, yet the high-pressure lines, operated at 23 kilovolts, have not suffered appreciably from lightning, although some lightning troubles have occurred on the low-pressure side of the system. There can be little doubt but that as time goes on the transmission line will come to be regarded as the weak point of electric power systems. Generators, motors, and apparatus are all undergoing evolution and improvement, but the lines must always remain liable to injury by storms, falling trees, neighboring fires and malicious damage.

The records of break-downs due to malicious interference with transmission lines are already numerous, especially in the West, where the white porcelain insulators make attractive targets for the rifle. Insulators of brown porcelain are in some cases preferred to those of white porcelain, as being less conspicuous and alluring to the sportive instinct. Still more troublesome are the short-circuits maliciously produced by pieces of wire thrown across the line wires. For malicious short-circuiting exemplary imprisonment is the best protection, although detection and conviction are very difficult. Some protection has been occasionally gained by the judicious dissemination of information in the public press as to the dangers to which the employés in the power-houses are exposed by wanton short circuits. As regards lightning, the discussion makes it evident that there is room for considerable improvement in arresters; but after everything has been done to improve arresters, there must still be cases in which lightning discharges will occur beyond the power of any arrester to control or avert. Perhaps the most complete immunity from lightning discharges on the lines can be obtained by installing an iron grounded wire above the transmission wires, as has often been tried with more or less success; but this plan, besides its expense, has the advantage of adding one more wire necessary to maintain and keep from crossing. When, however, much synchronous machinery has to be operated, the sensitiveness of this machinery to atmospheric electric disturbances may eventually make necessary some overhead ground shielding of the transmission lines.

The Velocity of Light.

The current *Bulletin* of the American Physical Society contains an abstract of an important paper by Michelson on this subject, which is his specialty, and to which he has so largely contributed. The mean distance of the sun from the earth, or the mean semidiameter of the earth's annual orbit, is a very important astronomical constant, as it forms the base line for estimating the distances of stars. Its accurate measurement has been the quest of astronomers for centuries, under the title of "the mean solar equatorial parallax," or the mean angle subtended by the earth's radius to a hypothetical observer at the sun's center. This angle is something like 8¾ seconds of arc (usually taken as 8.78) with a probable error of 1/175, obtained from purely astronomical observations. Michelson shows that by purely optical methods the observed velocity of light and the observed siderial aberration constant give a solar parallax of 8.808", with a probable error of less than 1/1000th. He regards the optical method of measuring the sun's distance as inherently more trustworthy, and far less expensive, than the astronomical methods.

The highest development of the optical method calls, then, for as accurate a knowledge of the velocity of light as can be experimentally observed, and in this direction we have the aid of three converging sets of experimental methods; namely, those of electromagnetic measurements of the light-speed ratio v; those of invisible Hertzian waves; and those of visible light waves. He quotes the report of the 1900 International Physical Congress as giving 300,010 kilometres per second for the best result with v; 299,130 kilometres per second for Hertzian-wave measurements, and he inclines to 299,890 ± 60 kilometres for the best result with optical measurements. Finally, a new method of optical measurement is outlined, a sort of combination of the methods of Foucault and Fizeau, for measuring with a revolving mirror, making 250 turns per second, the retardation in light during a journey of six meters, magnified by a luminous pointer virtually 6 kilometres long, and using a stationary grating reflecting surface acting as a toothed-wheel. With this experimental method it is hoped that the speed of light may be measured to within 5 kilometres per second or less. It seems curious to reflect that the most accurate way of measuring the distance of about 150 million kilometres to the sun is by carefully measuring a distance of three metres, and the time it takes light to travel to and fro across this little space.

Engine Builders' Convention at Pittsburg, Pa.

The Engine Builders' Association of the United States held a semi-annual meeting at the Schenley Hotel, Pittsburg, Pa., on May 22 and 23. Among those in attendance were: H. L. Ide, president A. L. Ide & Sons, Springfield, Ill.; W. R. Fleming, president Harrisburg Foundry & Machine Works; D. N. McBrier, vice-president Ball Engine Company, Erie, Pa.; F. A. Millard, president Murray Iron Works, Burlington, Ia.; Walter C. Kerr, Westinghouse, Church, Kerr & Co., Pittsburg, Pa.; George E. Gaskell, manager at Philadelphia for Ames Iron Works, Oswego; Thos. C. Wood, Ball & Wood Co., New York; C. A. Gates, secretary Russell Engine Co., Massillon, Ohio; Wm. Taylor, president Chandler & Taylor Co., Indianapolis; H. A. Chuse, superintendent Chuse Engine Works, Mattoon, Ill.; Prof. John E. Sweet, president Straight Line Engine Works, Syracuse, N. Y.; J. H. McGregor, Goldie & McCulloch Co., Ltd., Galt, Ont.; A. K. Spotton, Goldie & McCulloch; C. B. Little, The Brownell & Co., Dayton, Ohio; C. H. Sembower, Orr & Sembower, Reading, Pa.; S. H. Payne, Payne Engine Co., Elmira, N. Y.; F. M. Rites, Ithaca, N. Y.; E. H. Sniffen, Westinghouse, Church, Kerr & Co., New York; S. F. Bogg, Watertown Engine Co., Watertown, N. Y.; W. M. Howell, Phœnix Iron Works, Meadville, Pa.; E. L. Clark, Westinghouse, Church, Kerr & Co.; S. B. Richards and Edwin Baillie, Buckeye Engine Co.; Fitz John Porter, Bethlehem Steel Co.; H. M. Longwell, Westinghouse Machine Co.; J. M. Wakeman and T. C. Martin, ELECTRICAL WORLD AND ENGINEER; C. W. Rice, Nernst Lamp Co., Pittsburg; P. D. Wagoner, General Electric Co.; George Bullock and R. T. Lozier, Bullock Elec. Mfg. Co.; W. G. Bole, Westinghouse Machine Works.

A brief address of welcome was delivered on Thursday at the opening by President Taylor. A paper on "Engine Forgings" was read by Mr. H. F. J. Porter, of the Bethlehem Steel Co. Papers were also read by Mr. E. M. Tingley, of Pittsburg, on "Engine Requirements for the Parallel Operation of Alternators;" by Mr. H. M. Longwell, of Pittsburg, on "The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders"; and by Mr. John B. Berryman on "Piping Material for Steam Plants." The paper by Mr. Longwell appears in abstract elsewhere in this issue.

The paper by Mr. Tingley noted that the Westinghouse Electric Manufacturing Company had been called upon for information and suggestions as to the parallel operation of engine-type or direct-connected alternators, and that their work in this direction had crystallized into the form of specification. He then gave the details and discussed the various sectional paragraphs. He remarked that the parallel operation of alternators driven by water-wheels had been uniformly successful, and that the same should be true of engine-driven machines. With suitable governors, and allowing ample flywheel capacity, there was no reason to doubt that in all cases successful parallel running could be duly accomplished.

The paper by Mr. Berryman on piping material for steam plants was an admirable discussion of this topic as viewed from the standpoint of the practice of the Crane Company, of Chicago, and described a series of results obtained in testing in the field of high pressures. The paper took up the various details of pipe, flanged joints, facing flanges, cast-iron flanges, flanged fittings, valves, and pipe bends. Summing up his paper, Mr. Berryman made a strong recommendation of the use of standard, staple, catalogued articles. He could see no use for the enormous variety of special goods they and others were called upon to produce, many of which embodied only some fad or whim of the engineer in charge of an installation. Besides, with standard goods, there is reasonably prompt shipment and lower price.

Friday morning was devoted to an executive session, and then, after lunch, the delegates, accompanied by friends, visited the shops of the Westinghouse Machine Company at East Pittsburg. This large plant is even now in process of extension, a new erecting shop being rapidly erected. The party were escorted around by Messrs. Keller and Bowles, of the executive staff, and saw everything, including gas engines, steam turbines, small "Kodaks" and the enormous engines for the latest generating plants in New York City. A visit was then paid to the adjoining works of the Westinghouse Electric & Manufacturing Co., where generators to be attached to these engines and motors to be energized by their current were seen in every stage of production.

In the evening a banquet was given at the Schenley, which was well attended, but which broke up at the early hour of 9:30, on account of the fact that many present had to catch night trains. Mr. Taylor presided and Mr. Gates acted as toastmaster. Among those who were called upon to speak were Messrs. Wood, Wakeman, Spotton, Longwell. Mr. Martin, who was called upon to speak for the electrical interests in relation to engine building, deprecated strongly the suggestion in Mr. Longwell's striking paper that the modern electrician was a man of marvel and mystery. That might have been true in earlier days, when the electrical inventor with a "system" of his own could be described in the couplet applied by Cowper to a distinguished master of legerdemain of his day: "Like Katerfelto, with his hair on end, at his own wonders wondering for his bread." Such times had passed, and with them had gone the electrical "wizards," "magicians" and charlatans. Nothing had contributed more to this than the fact that electricians had been able to hitch up to steam. Out of a total production of nearly $110,000,000 of electrical apparatus in the United States in 1900, at least $75,000,000 was due to the use of current generated from dynamos, and all of which would have been impossible with other sources of power. Looking back to the days which he could well remember, when Prof. Sweet coupled his earlier engines to the first Brush arc dynamos, and when Edison was glad to summon the Armington & Sims engines to his aid, it could be seen that improvements in engines and dynamos had gone hand in hand. That process would continue, he believed, and even such magnificent machinery as they had seen that day at the Westinghouse works was not the end. He could promise the engine builders that whatever other opportunities they had, electricity would help them to build bigger and bettter in the days to come than they had ever done before.

Mr. B. J. Arnold to Report on Chicago Traction Problems.

Mr. B. J. Arnold has been selected as engineering expert by the Chicago City Council in an investigation to be made of the Chicago traction problem. Mr. Arnold's duties will be multifarious, as will be seen from the following synopsis of the work to be done:

He will prepare an estimate of the cost of a new and adequate urban system designed along the lines of the best practice in vogue, and an estimate of the net earnings of such system, based on present business. He will report on the feasibility and desirability of an underground conduit system in the downtown district and on all trunk lines within prescribed limits, with arrangements for transferring from overhead to underground trolley, and suggest new routes for the present lines outside the business district, in order to furnish the best facilities to residents. He will furnish preliminary plans for a system of subways in the business district, which, coupled with the surface system of terminal facilities, will supply adequate accommodations to the public, and also provide for an increase in traffic in years to come, relieve the congested district, and create a much larger district available for business purposes. Among other things which will be required of Mr. Arnold are the following:

Report on the necessity for the abandonment of the practice of operating cars in trains. Report on a universal system of transfers. Make an estimate of the value of all lines whose franchises do not expire in 1903. Report on the desirability of through routes as against down-town terminals; on the advisability of joint use of tracks by the companies, and on the possibility and cost of converting cable lines into underground trolley lines; rearrangement of the Union Loop; a plan for the prevention of electrolysis, and an estimate of the cost and the advisability of laying cement roadbeds.

Among other work will be a report on the cost of operation and the earnings of the present street railway companies, on their capitalization, and a valuation of the present plants; an estimate of the number of passengers carried during different hours of the day, and a report on the wages paid employees, and the rules and regulations under which they work, together with recommendations for changes. Mr. Arnold will also be required to submit a standard rail design for use in the future.

Without affiliations with any of the manufacturing companies, and possessed of a rare judgment, not only with respect to technical details but also the broader questions involved in large engineering operations, the Chicago Council is to be congratulated upon the choice of Mr. Arnold as its engineering expert. Moreover, as an engineer in independent practice and high professional character, who can always be counted upon to consider every question in a spirit of fairness to all of the interests concerner, Mr. Arnold's appointment is doubtless entirely satisfactory to the traction companies.

A Model Suburban Electric Station.

REVERE and Winthrop, suburban towns along the shore of Boston Bay, lie within limits of more than three, but less than seven, miles from the State House on Beacon Hill. The population at the census of 1900 was 10,395 in Revere and 6,058 in Winthrop.

The former of these towns furnishes the site, and both of them the distribution area of a model station for electric lighting. This property is owned by the Suburban Gas and Electric Company, which supplies both gas and electrical energy in the towns named. Gas is not manufactured by this company, which acts simply as a distributor of gas purchased from works outside of the town limits.

The electric station, built little more than one year ago, is 101 by 103 feet on the ground, and one story high, with basement. A brick wall divides the main floor of the station into two parts, one part being used as a boiler room and the other for the engines and dynamos. The outside walls of the stations are brick, the floor

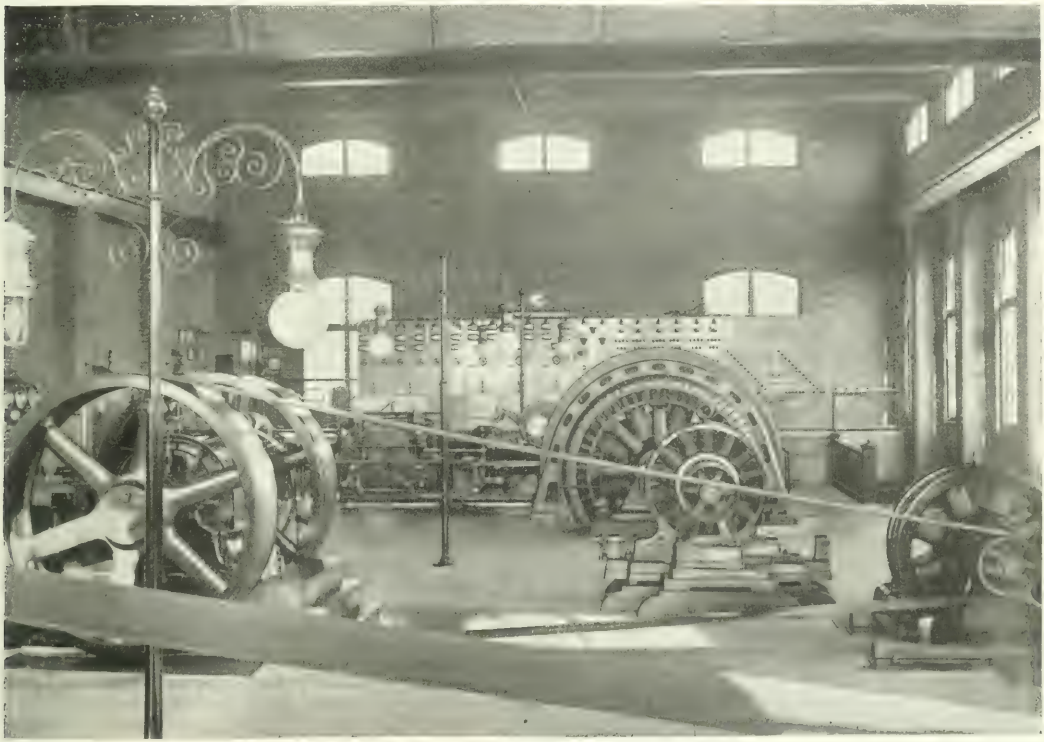


FIG. 1.—INTERIOR VIEW OF REVERE CENTRAL STATION.

cement, and the roof is supported on iron trusses. At one end of and exterior to the building is a brick chimney 187 feet high and of 7.5 feet inside diameter. This chimney furnishes natural draft for the boilers. A traveling crane, operated by hand, with a capacity of 15 tons, sweeps the entire length and width of the engine and dynamo room.

The boiler plant comprises two Stirling, water-tube boilers, each with 374 tubes of 3.25 inches diameter, and rated at 300 horse-power. Also one Hodge tubular boiler, 72 inches in diameter, containing 138 three-inch tubes, and rated at 125 horse-power. The total boiler horse-power is thus 725. The boilers are usually operated at 135 pounds gauge pressure.

The steam engine equipment comprises one Rice & Sargent tandem compound, cylinders 14 x 28 x 36, operating at 150 revolutions; one Armington & Sims' engine, cylinder 18½ x 18, operating at 200 revolutions, and one McIntosh & Seymour engine, cylinder 18½ x 18, operating at 200 revolutions. The condenser for the 14 x 28 x 36 compound engine is of the jet type, with vertical beam air pump; size, 9 x 12 x 20. This condenser was made by Geo. F. Blake Manufacturing Company, and is located in the basement of the station. Water for condensing purposes is obtained from the Atlantic Ocean, as the station is within 100 feet of the sea wall.

Three alternators, made by the General Electric Company, are driven by these engines. A dynamo of 400-kw capacity, 60-cycle, three-phase, at 2,300 volts, is direct connected to the largest engine. A 100-kw, 60-cycle, three-phase, 2,300-volt dynamo, at 900 revolutions is belted to one of the other engines. The third generator, of 180-kw capacity, 60-cycle, single-phase, 2,300-volt, at 600 revolutions, is belted to the remaining engine.

One of the exciters for these generators has a capacity of 30 kw, at 125 volts, and is direct-connected to a three-phase induction motor of 40-hp. The other exciter has a capacity of 17.5 kw, at 125 volts, and is belted to a Westinghouse engine, with cylinders 7.5 x 7, operating at 392 revolutions, and rated at 36 hp. The usual mode of excitation is with the motor-driven dynamo, and the engine-driven exciter forms a reserve.

At one end of the dynamo room, and on a platform several feet above the general floor level, a marble switchboard is mounted on a steel frame. This board contains panels with switches, indicating and recording meters for the main generators, exciters, commercial circuits and series lines for street lighting. The entire energy output of the station is metered at the board. Alternating current at 2,300 volts, 60 cycles, and either three-phase or single-phase is supplied on all of the circuits for commercial lighting.

The four constant current transformers, located in the basement, have capacities of 60 kw and 6.6 amperes each. Arc and incandescent street lamps, operated by these transformers, are arranged on separate circuits, but these circuits are at times combined on the switchboard so as to bring both arc and incandescent lamps onto the same transformer. All of the incandescent street lamps are rated at 25 candle-power and 6.6 amperes each. Transformers connected to the distribution lines of the system are as follows in numbers and capacities:

Watts.	*Number.*	*Watts.*	*Number.*
600	2	4,000	3
1,000	108	5,000	25
1,500	75	7,500	25
2,000	5	10,000	11
2,500	23	15,000	4
3,000	2	30,000	2
3,500	2		

The total number of these transformers is 267.

All of the arc lamps operated from this station are of the enclosed type for alternating current, whether used on the streets or for commercial purposes. All of the incandescent street lamps are of 25 cp.

In the town of Revere, 89 series enclosed arc lamps, of 2,000 nominal candle-power each, and 147 series incandescent lamps are operated on the streets. In Winthrop the number of 2,000-cp enclosed series arcs used for street lighting is 80, and 144 series incandescent lamps are also employed for a like purpose. During the summer months about 95 series enclosed arcs and 100 multiple enclosed arcs are operated on the Crescent Beach State Reservation, in the town of Revere. The State Bath House, at Crescent Beach, also uses about 1,500 multiple incandescent lamps during the bathing season.

In Revere the number of commercial incandescent lamps supplied by the electric lighting system is about 9,000, and in Winthrop the corresponding number is 14,000, making a total, with those at the State Bath House, of 24,500 commercial incandescent lamps. The total number of series enclosed arc street lamps named above is 264, and to this must be added the 100 commercial arcs, giving 364 connected to the system. The whole number of series incandescent street lamps is 291. To operate the commercial lamps 262 transformers are in use, and 829 meters record the energy delivered to consumers.

The distribution system connected with this station includes 1,249,693 feet of overhead wire. This wire is suspended on 1,808 poles, and extends over 52 miles of public streets. Owing to the fact that the towns in question are to a large extent summer resorts, this being especially true of Crescent Beach, the heaviest loads come in the month of August. Last year the amount of the maximum load was 720 kilowatts, which represents a slight overload for the present dynamo capacity. Besides a condenser for the compound engine

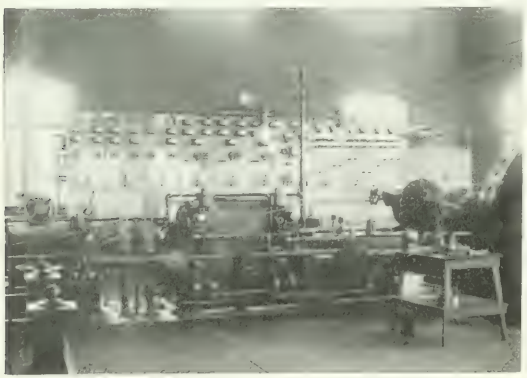


FIG. 2.—VIEW OF [illegible]

and the constant current transformer, the basement of the station contains tub and shower baths for the employees of the company.

Month, 1901.	*Mechanical hp-hours output.*	*Pounds water evaporated per pound of coal.*	*Pounds of coal per mechanical hp-hour.*
[illegible]	137,350	8.75	2.80
December	180,081	9.05	2.53
1902.			
January	176,200	9.22	2.57
February	116,976	8.40	2.78
[illegible]	[illegible]	8.61	2.90
April	98,956	8.30	2.88

The above table is a record of the output and efficiency of the electric stations from November, 1901, to April, 1902.

The average temperature of boiler feed water during these months was 209 degrees. This exhibit of efficiency is instructive as showing what can be done by good engineering in even a small station. As might be expected, the smallest consumption of coal per mechanical horse-power hour was in December, the month when the output of energy was the largest.

The Suburban Gas & Electric Co. began to lay gas mains April 18, 1901, and had gas in them on November 14 of the same year. During the period between these dates 18.63 miles of pipe were laid

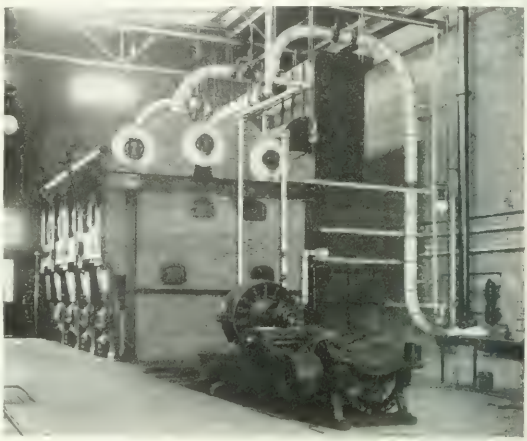


FIG. 3.—BOILER PLANT.

in Revere and Winthrop, ranging from two inches to ten inches in diameter. Besides this, 525 services were laid, 400 meters set and 250 gas stoves put in. Applications to the number of 800 have been received for gas. The Suburban Company makes no gas, but takes its supply from the East Boston Gas Company, and charges consumers $1.20 net per 1,000 cubic feet, only 20 per cent. more than the Boston rate.

Credit for the electrical features of this model station is due Mr. F. C. Sargent, the chief electrician of the company, who has kindly furnished the foregoing facts.

The Effect of Electric Waves on the Human Brain.

By D. McIntosh and J. Graham-Willmore.

UNDER the above title there appeared in the Electrical World and Engineer of Feb. 22, 1902, an article, by Mr. A. Frederick Collins, in which the author gives an account of experiments which show that human brains, as well as those of living and dead animals, are sensitive to Hertzian waves, in that they exhibit the well-known "coherer" effect; and from these results draws conclusions regarding the effects which electrical storms can have on human beings, supporting his contentions with results which have come under his notice.

These results seemed to us so very interesting, and at the same time the experimental methods seemed so defective—since Mr. Collins in testing the coherer effect had used a telephone, an instrument gauged by an organ having much less discriminating sensibility than the eye—that it appeared worth while repeating the work, with apparatus which left small possibility of error.

The apparatus for generating the waves was that ordinarily employed, and consisted of an induction coil operated by three accumulators. The secondary terminals were brass balls, about two centimeters in diameter, and the spark-gap during the experiment ranged from two to five centimeters. The terminals were directly connected to two plates made of sheet zinc, having a combined area of one square meter.

In order to detect the waves and to test the apparatus before each set of experiments, coherers filled with metallic particles with the usual terminal wires, consisting in this case of brass rods seven

feet long, were employed; and to eliminate effects due to distance,* experiments were made with the coherers, four, ten and twenty-five feet from the induction coil.

In series with the coherer were placed an accumulator and a Weston millivoltmeter, reading by aid of its shunt currents to milliamperes. The resistances of the coherers, which were carefully measured by means of Kohlrausch's apparatus, were in case of the three used, between thirty and forty-five thousand ohms. These resistances changed after the passage of the waves for ten seconds to four and one-half, five, and five ohms, respectively.

Since we know the brain to consist of moist material, and the passage of electricity through it to be due to electrolytic conduction, it seemed not out of place to try the effect of Hertzian waves on solutions. For this purpose two solutions were used: one of zinc sulphate between amalgamated zinc electrodes, so as to avoid polarization currents† and enable the resistance to be measured with a Wheatstone bridge; and the other, a normal (0.6 per cent.) solution of sodium chloride between platinum electrodes. The cells containing these solutions were substituted for the coherers and the coil started.

Although these resistances could be measured to within one-tenth per cent., the Hertzian waves could not be found to have any effect.

In our experiments on brains, two pieces of apparatus for making contact were employed. The first consisted of two stout platinum plates, platinized to facilitate conductivity measurements, sealed into glass tubes and arranged on a frame so that the distance between them might be varied; the second was made of two platinum wires sealed into glass tubes and kept exactly one millimeter apart. The resistances were measured either by the ammeter (with a potential difference of from two to twenty-three volts), or by Kohlrausch's apparatus, the current in either case flowing for only a few seconds.

The following experiments were performed:

A cat was anæsthetized with ether, an incision made in the median line and the bone cleared of the occipito-frontal aponeurosis. A hole (2 cm in diameter) was then drilled in the parietal bone not far from the median line. The membranes were then cut away, the surface of the brain swabbed clean and dry, and the electrodes were introduced, at first at a distance of .75 cm apart and afterwards 1 mm apart, so as just to penetrate the grey matter. The coil was then turned on, but absolutely no change in the deflection of the ammeter needle was observed, nor could any change in the resistance be noticed when measured by Kohlrausch's apparatus. The electrodes were then introduced into the subjacent white matter. This also gave a negative result. The electrodes were then pushed downwards and slightly forwards and inwards to a distance of about 3 cm, so as to reach the grey matter of the basal cerebral ganglia. Here again no deflection was observed.

During this experiment the cat was kept fully under the influence of the anæsthetic, *i. e.*, the anæsthetic was pushed to the usual "anæsthetic" or operative stage, as shown by the respirations being normal, the pulse slightly quickened and the corneal reflex abolished. At no time, however, did the cortex fail to respond to the stimulus caused by the make and break of the current.

A fresh human brain, with the meninges practically intact (1161.5 gms. weight), from a woman just recently dead from cancer and absolutely free from contamination with any antiseptic, was the next subject for experimentation. It will be remembered that Mr. Collins affirmed to have obtained the most marked coherer effects with this material, and in view of this hopes were entertained for a refutation of the negative results obtained in the previous experiments. These hopes were, however, speedily shown to be vain, as in no part of the cerebrum, cerebellum or medulla, in spite of the most elaborate precautions, were observed the phenomena so definitely described by Mr. Collins. The dura and arachnoid were dissected off, the cerebral surface carefully dried of cerebro-spinal fluid and the electrodes inserted at a distance of 1 mm apart into the following portions of the brain:

1. Cortical grey matter of the ascending frontal gyrus, near its termination.

2. Subjacent white matter, the grey having been previously sliced away in this region.

3 and 4. Cortical grey and subjacent white matter of Broca's convolution.

5 and 6. Cortical grey and subjacent white matter of gyrus angularis.

7 and 8. Cortical grey and subjacent white matter of superior temporal sphenoidal gyrus.

9 and 10. Cortical grey and subjacent white matter of ascending parietal gyrus, at about the level of the center of the Rolandic fissure.

11. The internal capsule, both of the motor (anterior limb) and sensory (posterior third) portions.

12 and 13. Grey matter of the optic thalamus and caudate nucleus.

14. The striæ acusticæ on the floor of the fourth ventricle.

15 and 16. Cortical grey matter and white matter of the arbor vitæ of the cerebellum.

17. As accurately as possibly, the granular or rust-colored layer of the cerebellum, which Mr. Collins found the most sensitive of all portions of the encephalon.

18. Various parts of the pons, including most of the nuclei of the cranial nerves situated therein.

A happy coincidence enabled the observers to endeavor to reproduce Mr. Collins's results during a somewhat violent thunderstorm, which broke over Montreal during the noon of April 26th. A pigeon was hastily decapitated—the first animal at hand, since it was impossible to foretell how long the storm would last—the electrodes placed in position in its brain and the ammeter carefully watched during the entire course of the storm for a deflection of its needle. Unforunately negative results were again encountered, as though several flashes occurred, not the slightest trace of any cohering action in the brain was observed.

It may be objected by Mr. Collins that the brain of a pigeon is so low in the scale of evolution—and his most remarked results were with the highest brains—that no reaction could be possibly expected. If, however, a short excursion into the realm of theory be permitted, it might be argued that Mr. Collins explains the indisputable power that various individuals have of predicting the advent of an electrical storm, upon the ground that the brains of these individuals are specifically affected by the advance guard of Hertzian waves sent out by that storm; that this condition, when the higher psychic centers were alone affected, resulted merely in fear or a vague feeling of uneasiness, but that when the medullary vital centers were affected it resulted in some pathological condition varying from pain to actual death itself.

It has often been noticed that upon the approach of a storm, long before the first flash be seen or the first distant roll of thunder be heard, that birds show unmistakable signs of fear, or of a premonition of evil; they suddenly become hushed, not a note of song is heard, and they all huddle together as if for sympathy or mutual protection. Surely the same agency, whatever it may be, must be at work upon the brains of birds and upon susceptible human beings. If so, it seems reasonable to argue that the brain of a bird should be a singularly fit subject for an experiment of this nature.

A cat was again chosen for the next experiment; it was decided to ascertain whether or not the depressing action of the ether upon the sensorium was responsible for the negative results hitherto obtained. Accordingly, after exposing the brain in the usual manner in the ectosylvian region, the electrodes were inserted and a preliminary trial made, with as before, a negative result. Upon this occasion Dr. Wesley Mills, professor of physiology in the university, kindly lent his presence both as an impartial observer of the phenomena manifested and in the capacity of an expert superintendent of their physiological aspect. The cat was then allowed to recover from the anæsthetic until all reflexes were established and a certain amount of voluntary movement noted.

The grey cortical matter, the white, the internal capsule, and the basal ganglia were then in turn tested, with, as before, absolutely negative results in each case. The bone was then replaced—the cat

* Bose, London *Electrician*, 776, 864, 895; 1901 *Phil. Trans.*, 1901.

† We might mention here that the astonishment of Mr. Collins in finding difficulty in measuring the resistance of a brain (an electrolyte) by means of a Queen testing set, will not be shared by those who have attempted to measure such resistance with a direct current. The sudden swinging of the galvanometer-needle when an approximate balance was obtained is due, of course, to polarization currents, and is probably not affected by atmospheric electricity. Such measurement can be made accurately and rapidly by means of an alternating current and telephone. (See Kohlrausch and Holborn; "Leitvermogen der Elektrolyte.")

being then under the influence of more ether—the wound sewn up, dressed and the cat allowed to recover.

En passant, it may be observed that during this operation the characteristic twitching of the muscles mentioned by Mr. Collins, as occurring only during the emission of the waves, was repeatedly noted. This twitching, as any anæsthetist knows, is by no means uncommon; it occurs either at the commencement of, or more usually during the recovery from anæsthesia, and it seems unnecessary in this case to call in the aid of electricity to explain what is, after all, a purely pharmacological condition.

The various functions of the brain have been regarded as controlled by centers, each of which has its own work and definite status in the economy of the organism. These "centers" are susceptible to the action of drugs, particularly to the depressing action of the alcohol group, to which ether belongs. In each case the highest—or more lately evolved—centers are the first to be influenced, the lowest, the great vital centers of the medulla, the respiratory, cardiac and vaso-motor centers, are among the last. This must necessarily be so, since they are essential to life.

The action then of ether consists in a transient stimulation, followed by a progressive depression and later paralysis of these centers, in a descending order—the highest being the most susceptible are also the last to recover their normal functions.

Voluntary motion of all kinds may be regarded vaguely as the composite result of two main centers, a "stimulating" of which the function is to set the neuro-muscular apparatus in operation, and an "inhibiting" which governs and co-ordinates the movements performed by regulating the nerve-impulses sent out by the former.

Among the highest centers of all are the inhibitory of all kinds, and a condition is easily conceivable in which the centers co-ordinating or inhibiting the action of those muscles, would be inactive, while the lower stimulating center—either recovering sooner or succumbing later—would have full play; this would cause in the muscles, which it supplied, an incoördination of movement, *i. e.,* it would run riot.

This is well shown in the talkative delirium of a patient recovering from ether, in which spasmodic contractions of other muscles are an earlier symptom; the freedom of speech of a man under the influence of alcohol is also another case in point. Moreover, similar twitching—amounting in some instances even to convulsions—is seen in cases where there is an anæmic condition of the brain from any cause, resulting in imperfect nutrition. Mr. Collins seems to have been much impressed, too, by the death of a delicate and nervous child, occurring immediately after a flash of unusual severity, and to regard mere fright as a by no means sufficient cause therefor. Mr. Collins may, or may not, be aware that death from "psychic shock" is by no means an uncommon accident, under conditions which absolutely preclude the very possibility of atmospheric disturbances being the causative agent.

Death in these cases is usually due to a sudden reflex depression of the medullary centers—any kind of sudden mental impression, provided it be of a sufficiently violent nature, proving an effectual initial stimulus. Thus patients often died, in præ-anæthetic days, immediately upon the first incision, and one case, at least, is on record in which a French surgeon (Desault[1]) "drew his finger-nail over the perineum of a patient to mark the line of incision, when the patient suddenly gave a cry and was dead." Cases of this nature tend most strongly to the conclusion that fright, and fright alone, can cause death.

In conclusion, the theory advanced by Mr. Collins as regards the peculiar nervous phenomena evidenced by various people, especially those of a neurasthenic disposition, during an electrical storm, is undoubtedly most suggestive; but the present experimental evidence seems to show it to be far too speculative for it to be regarded even in the light of a working hypothesis.

It only remains for the writers to express their sincere and heartfelt thanks to Professor Rutherford and Professor Wesley Mills for the loan of apparatus and much kindly interest and encouragement.

[1] Solomon. Textbook of Pharmacology.

Electric Light in St. Paul's, London.

A private view of the electric lighting of St. Paul's Cathedral, in London, was given to press representatives on May 28. It is stated that the light is distributed in a very effective manner. The entire installation is not yet completed however.

The Guarini Automatic Wireless Telegraph Repeater.

By A. Frederick Collins.

In the Electrical World and Engineer, under date of March 29th, there appeared in the column of Current News and Notes an interesting paragraph, entitled, "A Wireless Telegraph Relay," which read as follows: "The steamer *Philadelphia* of the American Line, which arrived last week at New York, was the 'repeating station' of the Cunarder *Campania,* racing with her for New York, and the Cunarder *Lucania,* bound for Queenstown. It was in latitude 42.02 to 44.30 and longitude 38.40 to 40.30 that the experiment was made, and it was satisfactory. Many messages were relayed by the *Philadelphia* in both directions. The *Campania* caught the American about 90 miles away. Knowing that the *Lucania,* eastward bound, was somewhere in the zone, the *Campania* tried to reach her but failed. Then she asked the *Philadelphia* to signal, and as soon as the American liner caught her the 'relay system' became a fact."

This tells in a few words the story of a pretty experiment as well as describing the first attempt to repeat wireless messages on the high seas; incidentally it dawns upon the reader the value of equipping vessels with the necessary apparatus for automatically relaying them. In the case cited, the cableless messages were received by the operator on the *Philadelphia,* who, when the opportunity presented, retransmitted them in the regular course of procedure, which naturally required a considerable length of time before the two extreme vessels were in communication, one with the other, but the results showed clearly the possibilities, if not, indeed, the absolute necessity, of devices for relaying messages automatically.



FIG. 1.—TRANSMITTER AT BRUSSELS STATION.

An automatic wireless telegraph repeater fulfilling the conditions required for trans-oceanic service has been invented by M. Emile Guarini, of Brussels, Belgium, who, with the assistance of Artillery-Lieutenant Poncelot, made some exceedingly interesting experiments in 1901 between the cities of Antwerp and Brussels, a distance of 25 miles, with the repeater located midway at the village of Mechlin.

M. Guarini has described the experiments in the Electrical World and Engineer, of August 3, 1901, but I am not aware that he made known the construction of his apparatus, which is here appended.

The difficulties encountered in combining a wireless transmitting

apparatus with a wireless receiving device so that the powerful outgoing radiation of the former may not conflict with—or what is more likely—annihilate the feebler incoming train of electric waves will be at once apparent to the veriest tyro, and to those who have worked along these lines the task will assume stupendous proportions.

In wireless telegraphy, it is well known, that when the transmitter is in action the receiver is cut off completely from the antenna or vertical wire by means of a switch and the reverse. The principle function of a wireless repeater must resolve itself into an electro-mechanism that will automatically, at every impulse received by the coherer attached to the antenna, operate to cut out the antenna and then throw into contact the secondary terminal of the transmitter and close the circuit operating the primary of the induction coil. All this must be done with a rapidity the time value of which should be measured by the one-hundredth part of a second.

Before describing the repeater proper, let us commence at the Antwerp station, the antenna of which is suspended from the tower of the Cathedral of Notre Dame, and follow in detail a new method originated by Guarini for transmitting a message without wires, and where waves longer than any heretofore deemed available are propagated to the Mechlin station, and there received, translated into waves of much shorter length and re-transmitted to Brussels, where they are finally received.

The new form of transmitter is similar in many respects to the one designed by Edison in 1888, but the coherer was yet to be invented, and it remained for Guarini to discover the effects of an alternating current of low frequency on metal filings. The transmitter is shown in Fig. 1, with Guarini at the key. The coil is of the ordinary Ruhmkorff type, with mechanical vibrator; this is operated by a 12-cell storage battery, shown to the right; the current thus derived is led to the switchboard, on which are placed a voltmeter, ammeter and the necessary resistance coils, and then to the primary winding of the induction coil.

It will be observed that there are no oscillator balls attached to the secondary terminals of the induction coil, but that the antenna and "ground" wire are connected in alignment with the secondary of the induction coil; in other words the principal part of the oscillator-system forming the basis of the popular conception of etheric wave wireless telegraphy is missing, as there can be no high-frequency oscillations take place in the antenna since there is no disruptive discharge to set up such oscillations.

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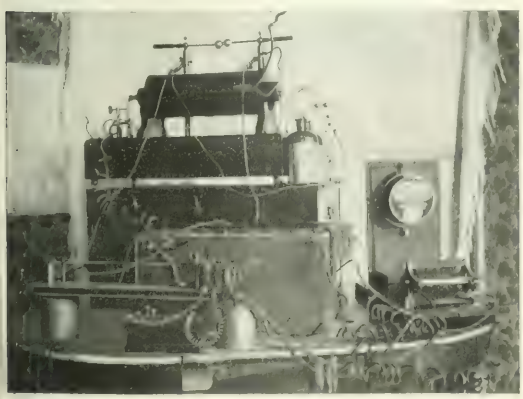


FIG. 2.—GUARINI AUTOMATIC REPEATER MECHLIN STATION.

nating current of low frequency on metal filings. When the transmitting coil is in action alternating currents of high potential surge through the secondary, antenna and ground wire, and although the frequency of the pulsations are low, being synchronous with the make and break of the interrupter, long electrical waves are radiated that have evidently the same effect on metal filings that the shorter waves emitted by a high-frequency oscillation due to a disruptive discharge have. This method is a radical departure in electric wave propagation. The waves thus propagated were received at the Mechlin station and were translated by the automatic repeater into re-energized waves.

Fig. 2 shows the repeater reproduced in half-tone, and Fig. 3 represents the arrangement of the apparatus in diagram. A single antenna, 1, is employed to receive and transmit the Mechlin messages; a special relay, termed an aerial switch, 2, provides the means for automatically cutting off the antenna from the high-tension secondary current of the coil 3 when the receiving apparatus is brought into play and *vice versa*.

The induction coil the operator employed here was equipped with

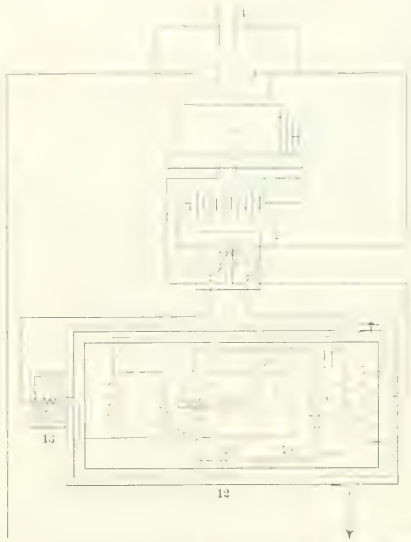


FIG. 3.—DIAGRAM OF GUARINI AUTOMATIC WIRELESS REPEATER.

oscillator balls, and gave a maximum spark of 25 cm, with a current of 3 amperes at a potential of 30 volts. The spark was cut down to 5 mm, and a condenser 4 is placed in shunt with the spark-gap to "diminish the normal length of the spark, and consequently the travel of the interrupting electromagnet" of the switch 2. So much for the transmitting device. In the receiving portion of the repeater a second relay 5, of exceeding sensitiveness, is introduced and placed in series with a Blondel regenerable coherer 6, the platinum surface contacts of this relay were insufficient to carry the necessary current to operate the transmitting coil, and to overcome this deficiency Guarini used this relay to actuate a second circuit having a greater carrying capacity.

The antenna is not connected directly to the coherer, but terminates in the primary winding of a small induction coil 7, the other end of which leads to the earth through the metal box 12. The object of this induction coil, according to Guarini, is to increase the tension of the coherer circuit. A condenser, 8, is shown in the circuit, including the coherer and secondary winding of the induction coil 7, and serves a dual purpose in that it breaks the continuity and modifies the capacity of the circuit in its relation to the inductance coils 9 and 10, the battery 11 and the relay 5.

To insure the proper protection of the apparatus from extraneous electric waves the coherer and its attendant decohering tapper are enclosed, together with the relay, inductance coils, condensers and all wires over which such waves could be led to the coherer, in a metal box, 12; the relay is especially protected by a special inductance coil in an iron box.

The second relay, or aerial switch, occupies a position outside the metal casings, as the spark found in breaking contact sends out trains of miniature waves sufficient to close the circuit should they reach the sensitive coherer. The aerial relay 2, Fig. 3, as well as the antenna which is connected with the primary winding of the coherer induction coil 7 is protected from the untoward effects of extraneous waves, due to atmospheric electricity, by several ingenious methods; for instance, in Fig 2, the aerial relay will be seen in the foreground resting on two cylindrical boxes, the armature with

the attached lever is 30 cm in length and is divided into no less than three parts with the metal portions insulated one from the other by hard rubber plates. The first metal bar forming a portion for the heavy current operating the coil, the second bar forming the armature for the relay magnets, and the third bar acting as an interrupter for the antenna.

Where the juncture is effected between the antenna and the primary of the coil 7 it is well insulated and then enclosed in a sheath of iron

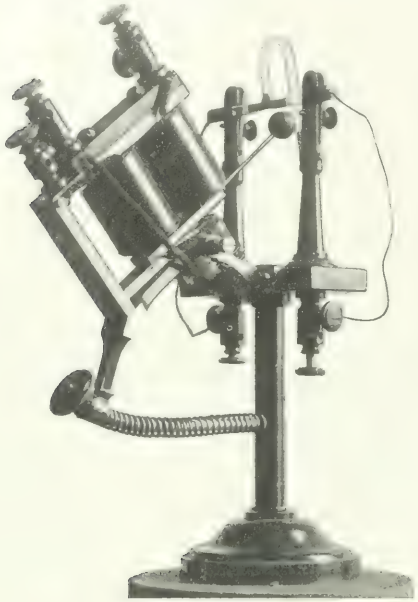


FIG. 4.—DECOHERER.

tubing having a ground connection for the purpose of leading foreign waves to the earth. In testing the value of different metals for this use Guarini found that electric waves permeates lead tubing even though it may be 2 or 3 mm in thickness. A triple contact is employed in the aerial switch for obtaining greater precision in operation than would be possible with a single contact.

The relay 5 is of the Siemens polarized type, but modified to suit the requirements of the repeater in that the T-pole is insulated from its armature. It is exceedingly sensitive, requiring but one-twenty-thousandth of an ampere to move the armature to point of contact and closing the circuit. The Blondel regenerable coherer, shown in the photograph, Fig. 4, consists of a glass tube with conductor plugs having parallel faces as in the ordinary forms, but also has an additional U-shaped tube blown midway in the tube and at right angles to it. This inverted U-tube is considerably longer at the free end than the one forming the juncture with the coherer tube proper. In the lower free end of the U-tube there is an additional supply of the metal filings for the purpose of increasing the amount in the coherer pocket, or by turning the U-tube and coherer around the axis of the latter the amount of filings may be decreased without destroying the vacuum and re-exhausting the tube each time a change is made. Guarini prefers fine filings of silver and nickel enclosed in a pocket between the electrodes or conductor plugs, 5 mm in length; this renders the sensitiveness of the coherer very great, since its sensibility depends largely upon the pressure and quantity of the filings which decrease with the size and oxydization of the latter. The standards for holding the coherer in position are arranged so that the tube may be removed and another inserted with ease and expediency, and at the same time when once set is perfectly rigid. To remedy the trouble often caused by a broken terminal wire of the coherer connected with the conductor plugs, the inventor has designed special copper cylinders which slide over either end of the coherer tube, the inner surface of these forming contacts with the plug terminals and from the cylinders heavy wires lead to the binding posts, as shown in Fig 4.

A single dry cell is sufficient to operate the polarized relay through the coherer; if, on the other hand, there is an excess of current, on every tap from the decoherer, the effect on the filings is practically the same as an interruption or break in a direct current, except in the case of the coherer filings they are multiplex; the spark taking place between any two particles of the filings causes them to act as oscillators, sending out miniature trains of waves which react on themselves, and re-cohesion is the result. To obviate this difficulty in the Guarini repeater the relay is started with a current operating through a total resistance of 1,100 ohms, but when the tapper strikes the coherer tube an auxiliary resistance of 2,000 ohms is automatically added and thus decoherence occurs upon very slight strokes with a very weak operative current; both of these features tend to lessen the oscillatory action of the filings.

The decoherer, Fig. 4, is of the single-stroke, electro-mechanical type, arranged with a spiral spring and screw, giving a micrometer adjustment, permitting strokes of any required degree. It is one of the simplest and most efficient modifications of all decohering devices yet invented.

The repeater is absolutely automatic in all its functions, and from the instant the feeble radiation from a distant station falls on the antenna, through all the succeeding translations from the coherer to the powerful re-energized waves emitted from the same antenna, no human hand is required to assist it.

If the regular trans-Atlantic service were equipped with these repeaters, messages could at all times be relayed between England or the Continent and the United States, thus establishing a cableless system of telegraphy that would be at once practical, efficient and, what is more to the point, commercial. In this case the additional attachment of a Morse printer could be easily applied, so that each vessel might have, indeed, its own daily paper with the very latest news, including stock quotations and society gossip, so that life for a week on the ocean would no longer be the dull routine of promenade on deck and perusal of copyright fiction that has heretofore marked it, but up-to-the-minute mode with each passenger buried behind the *Atlantic News* during his breakfast hour. All this is not only possible, but extremely probable, and that within a very short time. The writer is informed by M. Guarini that negotiations have



FIG. 5.—RECEIVER.

been entered into between himself and the Marconi interests to bring about such conditions as referred to above, but the outcome has not yet been made public.

To return to the Antwerp-Mechlin-Brussels system, where the messages have been received and retransmitted by the automatic repeater at Mechlin, it is finally received at Brussels by the arrangement shown in Fig. 5. The apparatus consists of essentially a coherer and decoherer, as in the repeater just described, together

with the Siemens polarized relay, inductance coils and condensers, all of which are placed in a metallic case connected with the ground. A Morse recording apparatus with a special resistance coil in a wooden case completes the receiving equipment.

Guarini has been an assiduous worker in his endeavors to ascertain the most suitable form of antennæ. He has experimented with many kinds, and finally selected the following as best suited for the purpose: At both the Brussels and Antwerp stations the antennæ assumed the form of a cylinder composed of fifty parellel wires, the diameter measuring 50 cm and the length 10 m. These were suspended from the tower of Notre Dame Cathedral and Column of Congress by means of a cable of copper wires. The antennæ at the repeating station at Mechlin terminated in a cylinder of wires, as in the case of the two principle stations, but was suspended at a heighth of 70 m above the level of the sea, against 80 m as arranged at the Brussels station. It has been demonstrated by the inventor that antennæ constructed according to these specifications are excellent radiators though the damping co-efficient is large, the oscillations producing only one and one-half to two complete swings until zero is reached.

In his experiments between Antwerp and Brussels, Guarini's object was not to operate commercially, though the perfect action of the installation would have warranted this, but to work out in practice his system of repeating automatically wireless messages.

Guarini has blazed the way for wireless telegraphy to any distance by his clever invention, just as Morse made it possible to operate regardless of space, over wires by means of his relay. The signs of the time point not only to trans-oceanic wireless telegraphy by means of repeaters, but to revolutionary methods of overland wireless telegraphy, in military operations, where storms have destroyed the aerial wires, and for everyday commercial use as well.

European Polyphase Railways—I.

In a paper read last week before the American Institute of Electrical Engineers, Mr. Carl L. DeMuralt gave an account of some of the more important polyphase railway systems that have been installed or experimented with in Europe.

The first systematic tests with alternating current traction in Europe were made by Siemens & Halske, of Berlin, in 1892, in Charlottenburg on a specially constructed track of about 360 m. length, with one curve of 40 m. radius. There were two overhead trolleys, the rails forming the third conductor. The voltage was between 500 and 600, the periodicity 50 cycles per second. An open car was used on an ordinary street railway truck, equipped with a three-phase induction motor driving one of the axles by means of a single reduction gear of 1 : 11. The speed of the motor being 1,400 revolutions per minute, the maximum speed attained was about 25 km. (15 miles) an hour.

The primary winding of the motor was arranged to allow being connected in delta for starting purposes, whilst it was changed to star connection for full speed. The starting torque of the motor was therefore made about six times the full load running torque. The motor was also provided with slip rings on the rotor, which allowed for inserting resistance into the secondary winding.

These tests showed clearly that an alternating current railway was absolutely feasible, and proved that no serious difficulties would be encountered in regard to the trolley line construction. However, the street railway problems then under consideration did not absolutely require the use of anything else but the use of the well-known continuous-current system, and this is probably the reason why these tests were not carried any further and put into actual practice.

The installation as just described was sent to the Chicago Exhibition in 1893, where it attracted considerable attention, but nothing has been heard of it since.

Lugano Tramways.—Brown, Boveri & Co., of Baden, Switzerland, may claim the honor of first putting alternating current into actual use for traction on a commercial scale. The tramways of Lugano, the first three-phase railway, were opened for traffic in 1895. The power station for these tramways is 12 km. outside of the town, therefore transmission with 500-600 volts continuous current was impossible. Rotary converters seemed too expensive, and thus it happened that all conditions were favorable for an experiment with three-phase alternating currents. The total length of the line is 9.00 m. (about 3 miles), with maximum grades on long stretches of 3 per cent., and on short stretches of 6 per cent. The transmission voltage is 5,000 volts at 40 cycles. Transformers reduce this to 400 volts. Two trolley wires of 6 mm. diameter, 25 cm. apart, are used, and the rails serve as third conductor. The cars hold twenty persons each. There is one 20-hp motor per car, completely enclosed, with single reduction gear 1 : 4. The speed of the car is 15 km. (9.3 miles) an hour. Two trolleys, one 1 yard behind the other, make contact with the two lines. Motors are started by means of a reversing switch, and their speed is controlled by means of a resistance in the rotor circuit. Cars can be handled from both platforms.

Fig. 1 gives a good idea of one of these cars, and shows part of



FIG. 1.—CAR ON LUGANO RAILWAY

the line. Tests have demonstrated that it is possible to start with ease, even on 6 per cent. grades and under more than full load.

Gornergrat Railway.—After the Lugano plant had thus proved that alternating currents could be applied to ordinary tramway purposes, the Gornergrat road was destined to show that they could also be used to advantage on a much larger scale and under the most severe conditions met on a Swiss mountain road. The total length of this line is 9 km. (5.6 miles). The difference in altitude of the two terminals is 1,412 m. (4,660 ft.). The maximum grade is 20 per cent., the minimum radius in curves 80 m. The gauge is 1 m. (3 ft. 3⅜ ins.), with an Abt rack between rails. The power station generates 5,400 volts at 40 cycles. Three transformer stations of 180 kw, each 2, 5 and 8 km. respectively from the beginning, reduce from 5,400 to 540 volts. The high-tension line follows a separate route. The trolley line consists of two wires of 8 mm. diameter suspended by means of cross-wires from wooden poles every 25 m., the rails forming the third conductor. The speed is 7 km. (4.35 miles) an hour, and there are five stations, 2.5 to 3 km. (1.5 to 1.8 miles) apart. The normal train consists of one locomotive, one main passenger car (sixty persons), and one second car (fifty persons) added when needed. As a maximum there are two trains up and one down on the road at the same time. The locomotive weighs 10.5 tons, two cars 9.2 tons, and 110 passengers 8.3 tons; total for one train, 28 tons. The motor capacity is therefore 160 hp, or about 180 hp on axles, and the locomotive is equipped with two motors of 90 hp each, running at 800 r. p. m. Each motor drives by means of a double gear one of the two cog-wheels. The total reduction of gear is 1 : 12. The motors are controlled by a reversing switch, through which the stator is connected to the line, and by the usual starting rheostat in the rotor circuit. The rheostat is placed on the top of the motors to save space, and the switch, fuses and instruments for the same reason on the side and against the roof of the car. Two trolleys are employed on each line wire, on account of the large current and in order to pass switches without making a break. The motors start on any grade under full load without using more current than when running at full speed and full load. They can start under more than full load, but with proportionately more current. Fig. 2 shows the truck of the Gornergrat locomotive with one of the motors in its place. This line was completed in 1897 and opened to traffic in 1898.

Jungfrau Railway.—Before the Gornergrat road was finished, work was already begun on a very similar line, the Jungfrau Railway. The total length of this road is 13 km. (8 miles), with a difference in altitude between the two terminals of 2,100 m. (6,900 ft.).

The grade, almost immediately after leaving the little Scheidegg station, is 10 per cent., and this is increased to 20 per cent. at about half-way to the Eiger Glacier Station. From there on, the grade increases to the maximum of 25 per cent., when the line enters the tunnel. The permanent way is of metre gauge, with a rack of the Strub system half-way between the rails. The sharpest curve on the open section has a radius of 100 m; in the tunnel this is increased to 200 m. Water-power is made use of in the valley of the White Lutschine to generate three-phase currents at 7,000 volts and 38 cycles, which is transmitted by overhead wires to transformer stations along the line, where it is transformed down to 500 volts. The substations are stone buildings, designed to withstand the action of the most inclement weather. They are fitted each with two 200-kw transformers. When the whole line is completed, transformers will be placed about every 1,000 yards. There is a double trolley line, as on the Gornergrat. The locomotives are very similar to those on the Gornergrat line. They weigh 13 tons complete, and contain each two 125 to 150-hp induction motors, driven at 760 r. p. m. The motor-controlling devices and the contact arrangements are exactly the same as on the Gornergrat road. The cars hold forty persons each, and a normal train consists of one locomotive pushing two cars, the total weight of such a train, when filled, being 28 tons, as on the Gornergrat road. The speed, however, is 8 km. (5 miles) per hour.

The first section of the Jungfrau Railway, to Eigergletscher, was opened in September, 1898, the second, to Rothstock, in April, 1899; since then each year has seen further progress toward the summit, which will probably be reached in five or six years.

Stansstad-Engelberg Railway.—The next alternating-current railway to be built was the one from Stansstad to Engelberg. This road, although of metre gauge only, approaches in the shape of its cars normal gauge railway conditions. The total length of the line is 22.5 km. (14 miles). The first 15 km. have small grades up to 2 per cent., the next 3 km. have grades of 2.5 per cent. to 5 per cent.; then follows a section 1.5 km. long with a grade of 25 per cent. and a so-called ladder rack, finally about 3 km. more with grades of 2.5 per cent. and less. The minimum radius in curves is 50 m. The power station is situated at the beginning of the rack section, about 18 km. from Stansstad; therefore it is near the point where the maximum energy is used. The voltage generated is 750 volts at 32.5 cycles, and this is fed direct into the trolley line. A 90-kw step-up transformer produces 5,300 volts, which is transmitted to two substations situated at about 3 and 7 km., respectively, from Stansstad, and containing each a similar transformer, reducing the

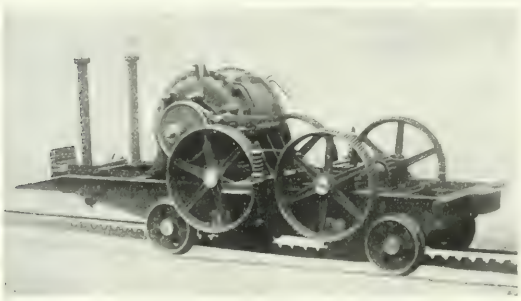


FIG. 2.—TRUCK OF GORNERGRAT LOCOMOTIVE.

voltage again to 750 volts. The trolley line construction is similar to that found on the Gornergrat and Jungfrau Railways.

There are nine passenger stations on this road. Three locomotives and seven motor passenger cars are used. The cars are of the double-truck type, and their total length is 14 m. Each car weighs 14 tons and has room for forty-six passengers, besides being provided with a baggage compartment. The front truck carries two motors of 35 hp each, running at 400 r. p. m., with single reduction for a car speed of 20 km. (12.5 miles) per hour. The contact with the trolley line is made by means of two double-contact bars attached to the roof near each end of the car. The cars can be controlled from either end platform, and the control is similar to that already described for the other roads. One automobile car is able [illegible] to haul a trailer of about 10 tons on grades up to 2.3 per cent. The first 15-km. section which happens to have the heaviest traffic is therefore worked with two cars at a speed of 20 km. per hour. The next section, with heavier grades up to 5 per cent., is traversed by the motor car alone at the same speed, the motors furnishing about 80-90 hp for a 16-ton load on a 5 per cent. grade. At the beginning of the rack section a locomotive is added, which pushes the car up the grade of 25 per cent. at a speed of 5 km. an hour. The last stretch, with grades up to 2.5 per cent., is covered by the automobile alone.

The locomotive not only serves for the above-mentioned purpose, but is destined also to haul freight trains of 20 tons total weight over



FIG. 3. CAR ON STANSSTAD-ENGELBERG RAILWAY.

the lower part of the road at a speed of about 11.5 km. an hour. Its design, therefore, varies greatly from the Gornergrat and Jungfrau locomotives. Two motors of 75 hp each and 650 revolutions per minute drive through a single reduction gear a countershaft, which, by means of two symmetrically placed gears, drives the cog-wheel placed in the center of the locomotive. This wheel is mounted on a hollow shaft fitted over the crankshaft, which, in its turn, drives the four main carrying wheels of the locomotive. On the rack section the cog-wheel alone is driven. In the level country a friction coupling is set in such a manner that the two main axles are driven and the cog-wheel is allowed to follow loose. The contact device is similar to the one on the passenger cars. Fig. 3 gives a good idea of this locomotive. The Stansstad-Engelberg Railway was opened also during 1889.

Paralleling of Alternators.

At the meeting last week in Pittsburg of the Engine Builders' Association, Mr. H. E. Longwell read a paper entitled "The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders." The first part of the paper consists mainly in criticism of the part electrical engineers have taken in the endeavor to arrive at a solution for the problem of parallel operation as affected by the prime mover. The criticism at times approaches captiousness, as in its reference to the "formidable array of mathematics, Greek letters and scientific terms" used by electrical engineers, and in an expression of satirical wonder at the mystery of electricity, the apparent understanding of which by the electrical engineer "suggests to us a superhuman intelligence."

Mr. Longwell considers that while to-day quite a considerable number of installations are operating in parallel quite satisfactorily, this has been due to dint of strenuous effort blindly applied. As to the reasons of success or failure, however, the opinions have differed so widely that it may be safely said that there is no theory that has not been attacked from some point or other. Some authorities maintain that dash-pots on the governors do the business; others that the turning moment of the engine was improved; still others will say that the use of copper pole tips or dampers on the generators is what turns failure into success. In a great many instances the difficulties experienced in paralleling alternators have been more or less completely overcome by tinkering with the governing mechanism

of the engine, and consequently it has become fashionable to say that the troubles originate in hunting, oscillating, or otherwise faulty governors. This Mr. Longwell considers an unfair statement, adding that coincidence and cause are two entirely different things. The interaction between generators is not necessarily caused by the hunting or oscillating of the governors, even though both phenomena are coexistent, and even though the latter tends to aggravate the former. A more fair statement of the case is that the parallel operation of the alternators imposes a duty on the governing mechanism of the engine which is abnormal, and which is directly opposed to its natural function. The use of dash-pots, friction brakes, etc., is justified, not because the governor is faulty, but because we must make it so to prevent its resisting the contradictory demands of the electrical part of the plant.

Mr. Longwell discusses the matter of cross-currents as affecting parallel operation, and quotes Mr. W. I. Slichter on the subject. In a paper read by the latter the statement is made that the requirement as to departure from uniform rotation has the object to limit the amount of cross-current that can flow between generators. With a displacement of 1-72 of the pitch angle between two poles, ahead or behind the position corresponding to uniform mean speed, two generators might be coupled together in parallel at the instant when the relative positions of the cranks of the two engines would be such that one generator would be the maximum distance in advance, and the other generator the maximum distance behind the position corresponding to uniform rotation. In this event the two generators might have a maximum relative spacing of 1-36 of the pitch angle between two consecutive poles. With this displacement Mr. Slichter states that the cross-current will be 10.9 per cent. of the full load current, provided the electrical characteristics of the alternators are such that the short-circuit current is 2½ times the full load current.

Commenting on this, Mr. Longwell says that alternators are actually built giving short-circuit currents as low as 2½ times full load current, while others are known to give as much as 6 times full load current on short-circuit, and all of these are supposed to come within the limits of standard representative practice. If, therefore, the amount of cross-current allowable is a very important matter, it does not seem reasonable that the manufacturers of alternators should put out an invariable specification to cover the requirements of generators which differ so widely. If the larger cross-current is allowable, it is asked why the engine builder should be burdened with the expense of making a fly-wheel which will give a displacement which will cause only 11 per cent. cross-current. Or if, on the other hand, 11 per cent. cross-current is nearer the allowable limit, it is asked why the engine builder should be blamed when the generator builder furnishes machines that will give 31 per cent. cross-current with the specified displacement.

The effect of cross-current is next discussed with respect to a synchronizing force tending to keep generators in step. The conclusion of Mr. Longwell is that while some synchronizing force is necessary to make paralleling at all possible, yet such force cannot pull two generators into phase and hold them there any more than the force of gravitation can pull an ordinary pendulum to the vertical position and hold it there. The synchronizing force tending to check the relative displacement between the generators exists only after the displacement has occurred, and when the generators are in phase the force is nil, and consequently there is nothing to hold them in phase. The conclusion is finally arrived at that the effect of the synchronizing force of the alternators is to *increase* the irregularity of the regular speed of the engine, instead of to *diminish* it. Mr. Longwell states that on first consideration this proposition seems absurd, but nevertheless it is capable of being demonstrated practically as well as mathematically. The portion of the paper in which this demonstration is given we reprint below in full.

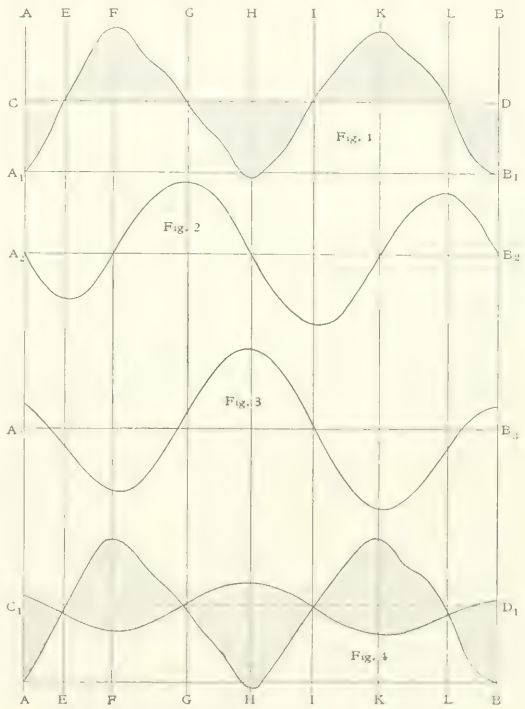
Mr. Longwell says that the matter first suggested itself to him some two years ago, in connection with the paralleling of some alternators in which the synchronizing power was rather large. The synchronizing force in an alternator can be varied by increasing or decreasing the field current and, in consequence, the voltage of the machine, and in these particular machines, which were of the two-phase type, the synchronizing force could also be greatly reduced by running the machines with only one phase connected in circuit.

Some difficulty was experienced with the paralleling at the start, and a rather extensive line of experimental work was undertaken in the endeavor to locate the trouble and to overcome it. Having a tank load available, these experiments could be carried out independent of the demands of the regular lighting service, and consequently the action observed of the machines over any desired range of load and voltage. It was found that when the generators were run in single phase they would parallel very satisfactorily, but when the second phase was cut in the cross-current would increase, and quite serious transfers of energy would take place between the machines. At that time it was authoritatively denied by electrical engineers of high standing that any two-phase machine would parallel more readily on one phase than on both; now, however, the fact is freely admitted.

It was also determined beyond question that by lowering the voltage to 80 per cent. of the normal—or, in other words, decreasing the synchronizing force 20 per cent.—the action of the machines in parallel was not open to criticism, even when running with both phases connected up.

The repetition of these experiments a sufficient number of times to determine that the observed phenomena were not accidents, but were in accordance with some fixed law, made it quite apparent that at least over the range covered by the experiments, the difficulties in paralleling increased with the synchronizing force of the generators.

Irrespective of whether a correction of the trouble could be effected by decreasing the sensitiveness of the governor, or improving the turning moment of the engine, or doing both simultaneously, the



FIGS. 1, 2, 3 AND 4.—PARALLELING OF ALTERNATORS.

indisputable fact remains that with the original engine performance a variation of 20 per cent. in the synchronizing power made the difference between success and failure in operating the generators in parallel, and this seems to indicate the utter fallacy of specifying the same characteristics in the engine for alternators in which the synchronizing force may differ by 200, or even 300, per cent.

The fact that the synchronizing force does, under all ordinary conditions, increase the angular variation in the engine may be shown theoretically in a general way without recourse to any abstruse mathematics.

Fig. 1 represents a typical diagram of crank forces in a single-crank double-acting engine. $A_1 B_1$ represents the path of the crankpin for one revolution, and the ordinates of the curve represent to some chosen scale the tangential pressure on the crankpin at the corresponding point in the revolution; the area included between the

curve and the base line $A_1 B_1$ represents the work per revolution in foot pounds.

$A_1 C = B_1 D$ represents the mean resistance of a uniform load reduced to the radius of the crank, and neglecting friction, the area of the parallelogram $A_1 C B_1 D$ also represents the work per revolution in foot pounds.

The shaded portions of the area included between the lines $C D$ and the curve, if above the line $C D$, represent in length the portion of the revolution in which energy is being stored up in the fly-wheel and in area, the amount of this energy in foot pounds. In like manner the shaded areas below the line $C D$ represent the portion of the revolution in which the stored energy is being given up by the fly-wheel, and the amount of this energy.

While the crank is passing from E to G the fly-wheel is absorbing energy and its velocity is increasing. Consequently, at G, after having taken up the last foot pound of available energy, the velocity will have reached a maximum, and will then begin to decrease from G to I, while the wheel is giving up energy, becoming a minimum at I; similarly other maximum and minimum points will be found at L and E.

By mechanical integration of the curve in Fig. 1 referred to, the base line $C D$, we obtain a second curve, that of Fig. 2. The ordinates of this curve measured from the base line $A_2 B_2$, representing uniform mean velocity, indicate the velocity of the crankpin above and below the mean velocity. The scale of these ordinates depends on the mass and radius of the fly-wheel.

Referring to the velocity curve, Fig. 2, it will be noted that the velocity is less than mean from A to F, and consequently at the end of this period, at the point F, the crankpin will be at a maximum distance behind the position corresponding to uniform angular speed. From F to H the velocity is above the mean, and consequently at the point H the crankpin will be at a maximum distance ahead of the position corresponding to uniform angular speed, and so on.

Integrating the velocity curve referred to the base line $A_2 B_2$, we therefore obtain a third curve, Fig. 3, the ordinates of which referred to a base line $A_3 B_3$, drawn midway between the highest and lowest points in the curve, represent the departure at any point in the revolution from the position corresponding to absolutely uniform angular speed.

It will be noted that the displacement curve, Fig. 3, and the curve of crankpin forces, Fig. 1, have a general resemblance in shape, in that each has the same number of nodes; but the nodes of one curve are directly opposite to those of the other. In other words, when the crankpin effort is above the mean and the surplus energy is *accelerating* the rotating masses, these masses are always *behind* the position corresponding to uniform angular speed; and when the crankpin effort is below the mean and the rotating masses are being *retarded*, these masses are always in *advance* of the position corresponding to uniform angular speed.

Next consider the effect of the synchronizing force of the generators. For simplicity it will be assumed that the engine-driven alternator is coupled in parallel with a number of turbine-driven alternators running at absolutely uniform speed, and that the total mass of these alternators is such that the synchronizing force can effect no appreciable change in their velocity. Whenever the steam-driven alternator is behind the position corresponding to uniform angular speed, the synchronizing force tends to accelerate the rotating masses; and wherever it is in advance of the position corresponding to uniform angular speed, the synchronizing force tends to retard the rotating masses. The intensity of these accelerating and retarding forces is represented at any point in the revolution by the ordinates of the displacement curve, the scale being portional to the synchronizing power of the generator. It will therefore be readily seen that *the synchronizing force acts in unison with the crankpin force.* During the period of the revolution in which there is a surplus of crankpin effort this surplus is augmented by the synchronizing force, and during the period in which there is a deficiency of crank effort, this deficiency is further augmented by the synchronizing force.

This may be shown graphically in Fig. 4, in which the crank effort curve is reproduced from Fig. 1, and the line of load resistance, instead of being represented by a straight line, is represented by a curve of the same general form as the displacement curve, indicating the change in load during the revolution, due to the synchronizing force. The shaded areas in this diagram illustrate the unbalanced forces resulting from the combination of the crankpin and synchronizing efforts. It will be noted that the unbalanced forces are very much greater than those due to crankpin effort alone, and as these unbalanced forces are the cause of the departure from the position corresponding to uniform angular speed, it is evident that whatever increases these unbalanced forces will increase the variation from uniform speed.

The calculation of the exact amount by which the synchronizing force increases the displacement is a tedious and somewhat involved mathematical process. It is necessary to compute the displacement from the force diagram, and after finding the value for the synchronizing force, to construct a new diagram combining the two forces, and compute the displacement corresponding to the new force diagram. This process must be repeated until no appreciable increase in the displacement curve is found.

The effect of the synchronizing force between the alternators is analogous to that of a spring capable of both extension and compression, and, considered apart from all other forces, will produce an oscillation of the rotating masses, the period of which oscillation depends on the intensity of the synchronizing force and the magnitude of the masses.

The period of this oscillation has a very important bearing on the amount the angular displacement is augmented by the synchronizing force. With a period which corresponds with the time of one revolution of the engine the angular displacement seems to be increased indefinitely. As this natural period of oscillation is increased or decreased from the critical period, the effect of the synchronizing force on the displacement seems to decrease.

Of course, if the synchronizing force were infinite we would have the same effect as if the generators were solidly linked together, and the actual displacement would be the mean of the individual displacements of the several units in parallel, and would be less than that of any unit running independently. There is also, perhaps, a period of oscillation between the critical period and an infinitely short period, which would not increase the displacement, and doubtless as the period decreases from the point the displacement would decrease. At the outset, however, the general proposition was limited to *practical cases*, and these are not practical. The rotating masses must of necessity be of such magnitude that it is impracticable to have a synchronizing force sufficiently large to cause oscillations having a period much, if any, less than the time of one revolution.

Mr. Longwell, in conclusion, said he would feel happy if he has succeeded in indicating a new line of investigation in connection with this troublesome problem, and doubly happy if he shall succeed, even in the smallest degree, in making it plain to the electrical fraternity that the electrical and dynamic features in the case are so inter-related that real knowledge can come only when the electrical engineer and the mechanical engineer drop all petty differences and co-operate with each other in the most frank and hearty manner.

As long as one is expected to blindly and unquestioningly follow the dictates of the other, successful paralleling will be by accident rather than design. The whole matter is one of compromise. Let it be freely admitted that the irregularities in the action of the engine do set up electrical disturbances. The reciprocating engine will always have an irregularity in angular speed, and consequently electrical disturbances are inevitable. The engine builder can control the amount of this irregularity to a certain extent, but he is barred by constructional and commercial limits from reaching absolute perfection.

On the other hand, the electrical disturbances react on the engine, augmenting the inherent irregularities in the latter, and the intensity of this reaction is, within certain limits, under the control of the electrical engineer. It is therefore only when the engine builder and the electrical engineer each recognizes the limits beyond which the other cannot go, and each endeavors honestly to make the task of the other as easy as possible, with due regard to the commercial excellence of the direct-connected unit as a whole, that we may hope that the parallel operation of direct-connected alternators will cease to be a subject for discussion.

One Martinique Tragedy

A cable dispatch from Paris says: Young Mme Martinot, married a year ago, unable to receive news from her husband, who went to Martinique a few weeks ago to install a new electric tram line, fatally shot herself and her babe a few days ago.

St. Louis Municipal Electric Power Plant.

The electric power plant operated in connection with the St. Louis municipal water works, though but a small plant, it is of considerable interest because of the sumptuous manner in which it has been equipped, and also on account of the rather unusual method adopted for driving one of the alternators, which is direct-connected to an impulse water-wheel receiving water from the delivery side of the main pumping engines. This somewhat roundabout way of

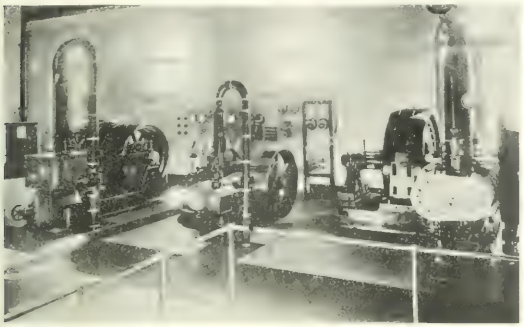


FIG. 1.—ENGINE ROOM, ST. LOUIS MUNICIPAL PLANT.

transmitting power from the engine to the dynamo has proved perfectly satisfactory under the conditions existing in this plant.

The plant furnishes current for the municipal railway, extending from the Baden pumping station to the Chain of Rocks, and for lighting the several buildings belonging to the water department and located at various points in a distance of about five miles along the Missouri River. Although the electric plant is, in a way, but an adjunct of the waterworks pumping plant, it is handsomely installed and excellently maintained, and, for its size, is a model power station.

The electrical equipment consists of a 100-kw railway generator and two alternators, one of 100 kw and one of 20 kw, with exciters, switchboard, transformers, etc., all furnished by the Westinghouse Company. The direct-current machine operates at 575 volts and 275 r. p. m., and is direct-connected to a Straight Line engine. This generator has run continuously at full load for 24 hours, with a temperature rise above the surrounding atmosphere of considerably less

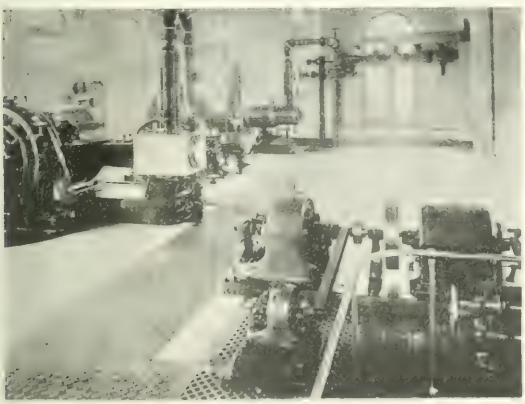


FIG. 2.—ENGINE ROOM, ST. LOUIS MUNICIPAL PLANT.

than 40° C. In the same test the economy of the engine was 22 lbs. of steam per hp-hour.

The large alternator, which is used during the heavy lighting load in the evening, is of the revolving-field, single-phase, engine-type, running at 277 r. p. m., 1,150 volts and 60 cycles. In a 24-hour full load test it has shown a maximum temperature rise much below 40° C. It is direct-connected to a tandem, compound Ideal engine. The exciter for this machine is of 3.75-kw capacity, and is a multipolar, compound-wound, belted generator, running at 125 volts and 1,600 r. p. m.

The 20-kw alternator, which is also used for lighting, operates during the entire day and that part of the night in which the load is light. It is direct connected to a Pelton impulse water-wheel supplied from the water mains and running at 1,200 r. p. m. This method of transmitting power through the engine and pump to the dynamo may at first thought seem questionable, because of the many transformations and consequent loss of energy involved; but when it is remembered that the efficiency of a large pumping engine is high while that of so small a steam engine as 20 kw would be low, the reason for the choice of this method is apparent. Indeed, tests have shown that the Pelton water-wheel is so efficient that this generator is operated on a total steam consumption of about 30 lbs. per electrical hp-hour, which is probably much less than could be obtained with so small a unit by direct connection to an engine. Of course, the principal advantage of the water-wheel drive is in the matter of first cost, a water-wheel costing much less to install and requiring less care than an independent steam engine of the same capacity. The exciter is a 0.56-kw, compound-wound multipolar machine, running at 1,400 r. p. m. and 125 volts.

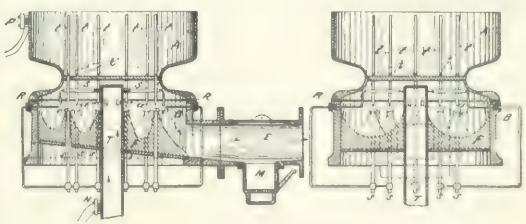
Recent Developments in Electrochemistry.

BY CLINTON PAUL TOWNSEND.

Reference has recently been made in these columns to the electrical methods developed by M. Paul Bary, of Paris, for the distillation of various metals, either for the production of powders or of oxidized products. In so far as these methods have depended upon the principle of volatilization of molten metal by a sufficient current, they are merely modifications of what is well known in the art. M. Bary's most recent patent, however, is distinctly novel in character, depending for the volatilization upon the spark, or perhaps more accurately the arc, which is formed when a stream of molten metal carrying a current is momentarily interrupted. Under the sudden increase of resistance metal is vaporized, and if the operation is carried out in a closed vessel, and in a current either of inert or oxidizing gas, the products are readily collected.

In all forms of apparatus described, molten lead or tin flows in a thin stream from an upper to a lower vessel, and conducts the current between them. This falling stream is momentarily interrupted, either by a mechanically operated valve controlling the outflow, by a rotating skeleton wheel whose spokes break the column, or by the current itself as hereafter described.

Full utilization of the current requires a more rapid interruption than can be effected by mechanical devices, and M. Bary describes as his preferred form the construction herewith figured. The molten metal flows from the upper chamber *A* to the hearth *B* through a series of nozles *t*, perforated at t^1 and extending above the surface of the pool. Each stream impinges upon a metallic contact *c* in the circuit *s*, and the volatilized products, together with the excess of liquid metal, pass through the tube *E*, the former to the collecting



APPARATUS FOR DISTILLATION OF METALS.

chambers and the latter to the trap *M*. A current of inert or oxidizing gas flows through the pipe *T* and the lower chamber *B*. This chamber is fitted with a refractory bed *F* and with resistances *S*, the function of the latter being to keep the metal in both chambers in molten condition. Electrical connections are shown at *P* and *N*, the circuit being completed through the stream issuing from the orifices *a* of the tubes *t*, and otherwise broken by the line of insulation *R*.

The necessary interruption of the flowing stream in this construc-

tion depends upon the experimental fact that a film of metal traversed by a current of sufficient density is contracted and broken, to be at once restored, the interruptions occurring at the rate of several hundred per second. In curious parallelism to this is the observation of Bredig and Haber that a heavy current passing through an electrolyte to a lead wire cathode (in other words, a Wehnelt interrupter) disintegrates the cathode metal, filling the solution with clouds of its dust.

TREATMENT OF ZINC ORES.

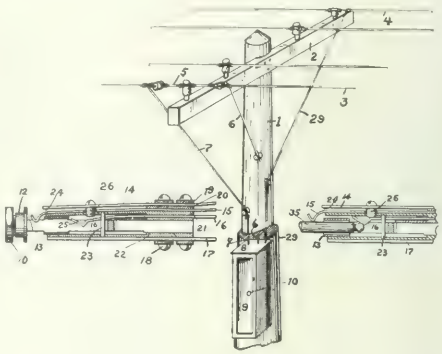
A patent to Mr. Samuel S. Sadtler, of Philadelphia, covers the process of treating zinc ores which formed the subject of one of the papers at the recent meeting of the American Electrochemical Society, and was reported in that connection. Briefly, zinc sulphide, subjected to alkaline hypochlorite solutions yields free sulphur and sodium zincate; the solution is electrolyzed, zinc being deposited and the solvent regenerated. Now the method of Burghardt consists in reacting with caustic solutions upon oxidized zinc ores to form the zincate, followed by electrolytic deposition of the zinc and recovery of the caustic. The invention is, therefore, in effect the substitution for metallurgical oxidation, of oxidation by hypochlorites; and to determine its value the speed of this reaction must be known. This is the one essential point, but with reference to it the specification is silent.

REDUCTION OF NITRO AND AZO-COMPOUNDS.

Few reactions have been more fully studied in their electrochemical relations than the reduction of nitro-benzene to aniline. The influence of the solvent and the current density have been clear, and the later work has recognized also the further influence, at first unsuspected, of the nature of the cathode. Dr. Max Buchner, of Mannheim, Germany, bases three patents upon the selection of a suitable cathode material for the reductions, or what amounts to the same thing, the introduction into the cathode solution of appropriate metals or metallic salts. A series of eight examples is given, detailing for as many compounds the best conditions for the reduction. For the nitro-compounds it is found that a cathode of tin exerts the most favorable influence, and permits the use of current densities approximating 18 amperes per square decimeter; the reduction occurs without sensible evolution of hydrogen, and the metal of the cathode passes continuously from the molecular to the ionic state and *vice versa*, being continuously taken up by the nitro-compounds and again thrown out by the current. For the reduction of azo-compounds powdered tin is preferably suspended in the catholyte, and the current density reduced to 3 to 4 amperes per square decimeter, or a cathode covered with tin sponge may be used. In either case the temperature is maintained at about 60° C. Copper also, it is found, may serve as a cathode for the reduction of nitro-compounds, and is preferably added as cuprous chlorid to the catholyte and separated out by the current.

New Telephone Patents.

The solitary telephone patent of the issue of May 20 is hardly calculated to work a revolution in the art or to make a fortune for the inventor, Mr. Evan Shelby, of West Lafayette, Ind. The invention is described as a telephone or telegraph system, and consists of a special form of jack mounted on a box set on a pole of a telephone or telegraph line, and so connected to one wire of the circuit that the insertion of a plug connected to a portable set will cause that set to be connected to the central office and the line beyond the test-pole to be cut off. A battery is connected so that the insertion of the plug puts the battery momentarily to line to throw the drop or signal at the exchange. The inventor claims that one of the important uses of the system is to provide telephones for police-calls or patrol-boxes, fire-alarms, or any similar purpose. For illustration, this system of police calls can be introduced by merely placing jacks, inclosed in suitable boxes on the telephone poles, at various points in a town or city, and connecting the boxes with the regular telephone wires above. This avoids the necessity of an independent telephone system for such purposes and does not materially interfere with the use of the regular lines. In the drawings, Fig. 1 shows the method of mounting the test-box on the pole and of wiring the circuits to the jack and battery, wire 3 being broken at 5 and led by wires 6 and 7 to the jack, and wire 4 being tapped by wire 29 to the battery. Figs. 2 and 3 are sections of the jack adapted to be fastened in the door of the box by the ring-bolt and nut, 12 and 10, so that the plug may be inserted and connection made with the jack without opening the box. Fig. 4 shows a diagram of the connections. The lead 7 from line 3 is connected to line-spring 15 of the jack, and lead 6 is connected to strip 17, in which is imbedded a contact pin, 23, on which spring 15 normally rests, so that in the idle condition of the jack the line 3 is continuous through 7, 15, 23, 17 and 6. The spring 16 is connected to one pole of the battery, the other pole being connected to line-wire



FIGS. 1, 2, AND 3.—SHELBY TELEPHONE AND TELEGRAPH SYSTEM.

4. Spring 16 is also connected to strip 14 on the top of the jack by wire 30. When the plug is inserted line-spring 15 is first lifted from pin 23 and then pushed into contact with contact-plate 24, thus breaking the continuity of line 3 and putting the battery across the circuit, so that the act of inserting the plug cuts off the line beyond the pole and puts signalling current on the line toward the central office. When the plug reaches spring 16 and pushes it up, strip 14 is raised out of contact with spring 15 by the upward pressure of 16 on the insulating stud 26, as shown in Fig. 3. The battery is then cut-out and the portable set is in circuit. The arrangement is neat and effective and might conceivably find application for economical police

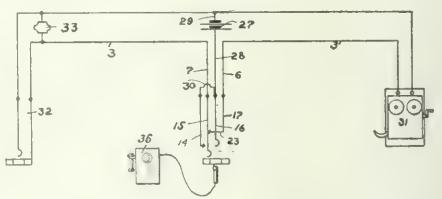


FIG. 4.—DIAGRAM OF CONNECTIONS.

patrol systems in comparatively quiet places where telephone users would not rage too furiously at their telephone connections being occasionally interrupted in the interests of the public safety. Even if special circuits were run, the system provides a cheap method of equipping patrol or call-boxes; it has the defect, however, of giving no indication of whether the line cut in on is in use or not.

Independent Telephone Convention.

It has been arranged that the Independent Telephone Association of the United States will hold its annual meeting in Philadelphia, June 24, 25 and 26. The headquarters have not been selected, but a very large attendance is expected. The committee on programme and arrangements is: S. P. Sheerin, Indianapolis, Ind.; S. E. Wayland, Philadelphia, and E. D. Fisher, Grand Rapids, Mich. The Ohio convention usually held in June, will be put off until later.

American Export Trade Figures.

A good deal of encouragement to the manufacturing interests of the country is found in the detailed statement of commerce for the month of April and the ten months ending with April, just issued by the Treasury Bureau of Statistics. It shows that manufacturers' materials formed one-half of the importations during the month of April, and in the ten months formed over 16 per cent. of the total; while the exports of manufacturers in the month of April formed 36.54 per cent. of the total exports, against 29.15 per cent. in April, 1901, and for the ten months ending with April, 1902, they formed 28.55 per cent. of the total exports, as compared with 27.40 per cent. in the corresponding months of the preceding fiscal year. The total value of manufacturers' materials imported in the ten months ending with April, this year, is $348,657,061, as against $280,801,407 in the corresponding months of last year, an increase of $67,855,654, or 24 per cent. Exports of manufactures, it will be observed, are nearly overtaking those of last year, the gain in the month of April alone being four and a half million dollars over April, 1901, while for the ten months the total value of manufactures exported falls but $5,486,814 below that for the corresponding months of last year. Manufactures formed considerably more than one-third of the exports in the month of April, having formed 36.54 per cent. of the total, against 29.05 per cent. in April, 1901; while for the ten months the percentage which manufactures form of the total exports is higher than in any preceding year except 1900.

Road Test of Edison Storage Battery.

During the past week, several important tests have been made at Glen Ridge, N. J., with the Edison storage battery mounted on a light runabout. A standard equipment of cells was placed on the vehicle which had its ordinary motive power of one motor. The test was a very severe one, 12 per cent. grades being climbed, while the roads were the roughest to be found in the Orange Mountain region. The vehicle made, all told, 62 miles before coming in, and when the battery was tested it had still left in it a capacity of several miles. It is understood that there were 21 cells, weighing 332 pounds.

Several days later the vehicle, still equipped with the same battery, made another run over fairly level and smooth roads, on which it covered 85 miles on the single charge. The battery came back in excellent shape, ready for recharge, and perfectly ready to run out again.

Such results are regarded as highly satisfactory, being merely preliminary, and leaving no doubt in the minds of those working on the adaptation of the battery to automobile work, that much better showing even will be made at an early date. Mr. Edison is naturally very much gratified at this prompt confirmation of his statements in regard to what the battery will do.

CURRENT NEWS AND NOTES.

CUBAN TELEGRAPH SYSTEM.—During the period of occupation of Cuba by the United States, 5,000 miles of telegraph lines were built by the United States Signal Corps. The system was turned over to the Cuban government on May 20, when the authority of the United States was transferred to the representatives of the new Cuban republic.

HIGH-SPEED RAILWAY.—A Norfolk, Va., newspaper refers to an electric car on exhibition in that city, designed to run at the low speed of 400 miles an hour. The inventor, it is stated, declares that "the speed at which the car will travel is restricted only to the speed at which electricity travels on a telegraph line, making allowance for a certain amount of friction." Why further Zossen trials now?

WESTINGHOUSE ELECTRIC CLUB.—The employees of the Westinghouse Electric Manufacturing Company, at the East Pittsburg plant, have organized an electric club for instruction in applied electricity, drawing and mechanical engineering. Classes will be formed and lectures given. The club has 175 members. It is stated that officials and heads of departments, together with skilled mechanics will have charge of the instruction.

THE LOST "GRAPPLER."—The West India and Panama Cable Company announces that it has chartered and properly fitted up the steamer "Newington," which will leave London in about three weeks, to replace the cable repair steamer "Grappler," which, with her entire crew, was lost as a result of the first of the recent outbreaks of Mont. Pelée. The "Newington" will take the place of the "Grappler" until a new steamer can be built. Over a hundred miles of cable was lost aboard the "Grappler." Four cable sections are now interrupted.

THE AMERICAN ELECTROCHEMICAL SOCIETY will hold its second general meeting at Niagara Falls, N. Y., beginning Monday, September 15th, and extending to the 17th, or possibly to the 18th. The local committee will provide interesting excursions and exhibitions of the local electrochemical industries, which will be an important feature of the meeting. A number of important papers are already promised, and the prospects are that the meeting will be even more successful than the inaugural meeting at Philadelphia. Entertainment will be provided for ladies.

JOHN FRITZ MEDAL.—An organization of members of the four great national engineering societies has been effected to found a gold medal in honor of the eightieth birthday of John Fritz, the celebrated American metallurgist. The bodies represented are the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers, and the committee formed comprises the following: S. T. Wellman, chairman; C. Kirchhoff, secretary; John Thomson, treasurer; C. W. Hunt, F. R. Hutton, R. W. Pope, A. Swasey, J. M. Smith, E. E. Olcott, T. C. Martin, J. C. Kafer, H. G. Prout, E. G. Spilsbury, S. W. Baldwin, N. H. Heft, R. W. Hunt and O. Williams. The subscription to the fund is ten dollars, and it is expected to raise five or six thousand dollars. The founding of the medal will be celebrated in the Fall by a dinner, about November. Rules and regulations governing the award of the medal by a board of sixteen, drawn from the membership of the four societies, have been carefully drawn up and are printed in the circular issued by the committee announcing this movement. Every indication points to the great success of this plan of doing honor to one whose work has done so much for the advance of American industries based on the metallurgy of iron and steel.

SPANISH ELECTRIC RAILWAYS.—Mr. B. H. Ridgely, U. S. Consul at Malaga, Spain, says: As a matter of interest to American builders and projectors of electric railways in Europe, I would report that a meeting of the stockholders of the Orense and Vigo Railway Company will shortly be held, to discuss a plan for applying electrical traction not only to the line (82½ miles in length) from Vigo to Orense, but to all the various lines of the important province of Galicia. There is a large waterfall in the midst of these lines, and it is proposed to utilize this for producing power, beginning first on the line connecting the important seaport of Vigo with the large interior town of Orense. It may be said, incidentally, that there is a strong feeling in Spain in favor of the American system of electrical traction, as well as of American rolling stock, and if it should be decided to introduce electrical traction as widely as is proposed, it seems to me that Americans interested in such ventures would do well to look into the matter. While writing on this subject, it may be worth while to call attention to the city of Toulouse, in southern France. This is one of the largest towns of the French Republic, with a population of about 175,000. It has an extensive street railway system with many suburban lines, but the whole system is operated by animal traction. It is thus the only large city in France that has not adopted electrical traction, and a gentleman in discussing the matter with me recently expressed the opinion that it must soon follow the example of the others. Here, then, is another town that interested Americans would do well to watch. In closing this report, I may add that an American electrical engineer arrived at Malaga some months ago, and is now engaged in surveying a route for a proposed electrical suburban railway to connect this city with various neighboring towns and villages.

LIGHTING A TUNNEL.—The Erie Railroad tunnel at Jersey City is being equipped with electric lights, and it is expected that the system will be in operation within a week. There will be 150 lights, placed at intervals of 50 feet. They will be on a level with the locomotives, so that the engineers can have no trouble in seeing them.

A RUSSIAN CONCESSION.—A cable dispatch from St. Petersburg, of May 21, says: A concession for the establishment of an electric railroad from St. Petersburg to a suburb of the city was awarded to-day to M. A. Verner, of Pittsburg, Pa. Mr. Verner's friends regard the granting of this concession as an indication of favorable action with regard to a concession embracing the entire surface traction system of St. Petersburg.

LARGE TROLLEY PROJECT.—A double-track electric railway from the borders of Canada to the Gulf of Mexico will be a realization within the next few years, if the plans of a syndicate of the Mississippi Valley, with Judge John Porter, of Eldora, Iowa, at the head, shall be carried out. The railway, according to the present plans, will start near the Lake of the Woods, and will follow the Mississippi Valley to the Gulf. A meeting of the promoters, representing every State between Minnesota and the Gulf, will be held at Des Moines June 1, to perfect the organization.

MARCONI SEA STATION.—The schooner "Pleiades" sailed from Philadelphia on May 15, to take her permanent station 300 miles off the Cape Cod coast, as a wireless telegraph signal vessel. The schooner is equipped with the Marconi system and will lie directly in the track of vessels bound to and from Europe. She will report all vessels carrying Marconi equipment. Communication will also be maintained with two steel steamers, now being equipped with the same system, which will lie along the Atlantic coast line to the south, one being stationed near Cape Hatteras.

A UNIVERSITY COMMERCIAL COURSE.—The University of Birmingham, England, has instituted a Faculty of Commerce, which will begin its work on October 1, 1902. This will consist of a course of training suitable for men looking forward to business careers, and its object is the education, not of the rank and file, but of those who will ultimately guide the business activity of Great Britain. A three years' course, leading to the degree of Bachelor of Commerce, has been drawn up, and it comprises studies falling into four main categories: language and history, accounting, applied science and business technique, and commerce.

LORD KELVIN HOME.—English dispatches announce the safe return of Lord and Lady Kelvin. Interviewed in London by the correspondent of the New York *Journal*, Lord Kelvin said: "My sojourn there was really to all intents and purposes a private one. I learned much as to the immense strides in scientific processes accomplished by Americans, of which too little is heard here. As to the shipping combine, though people were talking about it over there, expressing great admiration of Morgan, I have heard more about it from the English papers than I did in New York. All my intercourse with friends in America showed that there existed a very real and sincere friendship on the part of the American people for Britain. Everything I saw strengthens this impression, and friendships are strong enough to outweigh any political troubles that may arise. There will, of course, be a very strong commercial competition between the two countries in the future, but I believe we shall gain as much by it as our American friends."

VOLCANOES AND MAGNETIC NEEDLES.—Superintendent Tittman, of the Coast Geodetic Survey, furnishes the following memorandum regarding the disturbance of magnetic needles by the second eruption of Mont Pelée: "One the morning of May 20, from 4:07 to 4:16 eastern time, or 5:03 to 5:12 St. Pierre local mean time, there occurred a slight disturbance of the magnetic needles at the Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Md., beginning abruptly and reaching its maximum effect at 5:07. From 11:57 P. M., May 20, to 0:09 A. M., May 21, eastern time, or from 0:53 to 1:05 A. M., May 21, St. Pierre local mean time, a similar but somewhat larger disturbance occurred. According to the cable dispatch from Gov. L'Huerre, of the Island of Martinique, sent from Fort de France, and dated Tuesday, May 20, the second eruption of Mont Pelée apparently began about 5:15 A. M., closely coincident with the time of the first magnetic disturbance given above. Respecting the second magnetic disturbance, about midnight of the 20th, it is of interest to note that almost continuous earthquake shocks were felt at St. Augustine, Fla., from 9 to midnight, May 20."

WIRELESS TELEGRAPHY ON LAKE MICHIGAN.—A telegram from St. Joseph, Mich., of May 19, says: The Northwestern Wireless Telephone and Telegraph Company of Chicago purposes by July 1 to have a fully equipped wireless telegraph station at St. Joseph. If this proves successful other stations will be built at Holland, Muskegon and other east-shore points. The company are now establishing a station at Chicago, and will have one at Milwaukee, and intend to carry wireless apparatus on summer lake excursion boats. The company was incorporated in 1891 with $5,000,000 of stock. John S. Schwab, of Lafayette, Ind., is president; John P. Tansey, president of the Chicago Electric Engineering Company, is secretary; Prof. Henry Shoemaker and H. P. Davis, of Philadelphia, consulting electric engineers; Perry F. Miller, of Chicago, electric engineer and general manager of electrical construction. The system which is to be installed in Michigan has been given experimental tests at Lincoln Park, Chicago, and is not that of Marconi. A. B. Saliger, of the University of Washington, is the designer of the new system. The company estimates that it can transmit messages to and from vessels between Chicago and St. Joseph for 10 cents for a 10-word message, or 15 cents less than a land telegraph company who would carry messages.

LETTERS TO THE EDITORS.

The Telegraph of To-day.

To the Editors of Electrical World and Engineer:

SIRS: The letter from Mr. J. C. Barclay which appears in your issue of May 24 is apparently a reply to Prof. Pupin's recent criticism of the Western Union Telegraph Co. The suggestion at the beginning of the letter, "that the professor displays a wonderful lack of knowledge of the telegraph," is at least questionable. It is undoubtedly true that "practical experience" in telegraph business is a very valuable thing, but it is submitted that it is not necessary to be an operator or a superintendent of an office to become familiar with the business methods of the telegraph companies of the United States. It is certainly true that Prof. Pupin is entirely familiar with all the arguments set forth in the letter.

The real point at issue, as it seems to us, is the failure of the telegraph companies to recognize that there are two classes of messages which demand very different treatment, and are as distinct from each other as the telephone is from either. Another point is the failure of the companies to bring into use a system which not only meets the already existing demand, but stimulates and creates a much larger one.

No one questions that the Morse system of hand transmission and reception, as now in use, with all its perfection of detail, has come to stay, and fills an important demand, perhaps the most important; but this system should not be overburdened with business which is not suited to it, and which it transmits too well and too quickly and at too great a cost. In 1890 the president of the Western Union Telegraph Company testified before a committee of Congress that it cost that company an average of 22.4 cents per message transmitted. It will hardly be maintained that it will cost the company anything like this figure to transmit messages upon the plan outlined below. The quick transmission of stock quotations is evidently so important that the balance of attention has been given to this field instead of to the other.

It would undoubtedly be profitable to-day to establish a telegraph business such as that started in 1870 by Mr. Craig, or later by the American Rapid Telegraph Company, if it were not for the fear that the enterprise would meet with the same untimely end experienced by those companies which went out of business, not because there was any failure to find a demand for such a system. So far as I am aware no attempt has been made by the existing companies

to establish such a business as Mr. Craig contemplated, and certainly no successful attempt, which is of more importance.

Mr. Craig's idea was that each business house might be furnished with a typewriter perforator capable not only of making a typewritten copy to preserve in the office, but to prepare the letter in such shape that it is ready to transmit over the telegraph wire at the central office. All that the telegraph company is then required to do is to transmit this already prepared message over the wire and make sure that the received record agrees with that transmitted. The difficulties of doing this are often exaggerated, probably because of the small experience in the use of such systems. If a page and line receiver is used there is no difficulty in following with the eye the lines as fast as they are made, and a glance will reveal any important interruption of the line, for it is usually long enough to extend over several lines.

It is then proposed to send this letter just as received to the person addressed, and allow him to decide whether he will read it himself, have his stenographer make a copy of it, or have this work done at a typewriting office. In any case his letter is received in a very small fraction of the time required for a railroad train to carry it to its destination as is now the custom. This also gives an opportunity, for those who are willing to do so, to save the main expense of telegraphing, for the telegraph company is relieved of the business of typewriting, and does a strictly telegraph business. The telegraph company cannot then complain that the system is too slow as compared with the present one.

A very small number of trunk wires devoted to this purpose is all that will be required for some time to come, and the maintenance of them is insignificant when compared with that required to do the same business in the now accepted way. In fact, the part taken by the telegraph company is so small that it may not seem worth while to them to begin such an undertaking involving a great amount of pains and expense in developing it, and educating the people to its use.

The great influence which the controlling company can and does have over the progress of such plans is unquestioned, and is evidenced by a single example of which there are many. An independent company undertaking to do such a business would not be able to count upon obtaining any business from the Associated Press for example, its most important customer, for it is in the power of the existing company to refuse to lease any wires to them if they do any business with the new company. This would, of course, prevent them from dealing with the new company until such a company could offer the very extensive service all over the United States which the existing company affords.

The opinion as expressed in your editorial has my hearty indorsement.

TARRYTOWN, N. Y. ALBERT C. CREHORE.

To the Editors of Electrical World and Engineer:

SIRS.—Although Mr. Barclay's communication in your last issue, reviewing a criticism by Prof. Pupin on the slowness of the Western Union Telegraph Company in adopting new methods, is, as he himself states, "for the benefit of those unfamiliar with the practical workings of the telegraph," I, while confessing a limited knowledge of the subject, find warrant for intruding in the controversy, in view of Mr. Barclay's strongly expressed views on automatic telegraphy, which he assumes Dr. Pupin had in mind when he made his criticisms. At all events, it seems to be the *crux* of Mr. Barclay's action. As Mr. Barclay presumably writes in his official capacity as electrical engineer of the Western Union Company, and cites with pride its position in the march of events in the past, it is but fair to follow him through the different stages of progress from the beginning.

He says that when Prof. Morse built the first telegraph line—Washington to Baltimore—"he did not realize that he had invented the best, cheapest and quickest system of telegraphy that has been *introduced* up to the present time." I think Prof. Morse lived long enough afterward to be fairly well satisfied that under the management in control of the telegraphs at his death, no other system would be *introduced* in their day.

Mr. Barclay says that his company has kept pace with the demands of the people, and that foreign experts sent here to investigate admit that American telegraphy is years in advance of those of "most all other nations." So far as the writer is aware these admissions have never appeared in print, which leads to the suspicion that their private expression may have been in the nature of the tribute that polite insincerity frequently pays to bumptious conceit.

Mr. Barclay enumerates the steps of advance made by his company as follows: Abandonment of the Morse register for the sounder, multiplex systems, automatic repeaters, switchboards, copper line wires, insulation and conductivity, motor dynamos and storage batteries. Let us see about this formidable exhibit.

When operators began to read by sound it was forbidden by Western Union under pain of dismissal. Stearns duplex was opposed and derided by the Western Union Company for several years, while in operation on an opposition line—the Franklin. Edison's quadruplex was jeered at for a long time, although in successful operation on another opposition line—the Bankers and Brokers.

The synchronous multiplex system was at first denounced as a laboratory experiment, and when the owners built a line and put the system in operation between Boston and Providence, the Western Union claimed it would not work any further. This system, sending six messages simultaneously over a single wire, by Morse, has been in successful operation in England for 17 years. It is not used in this country.

Automatic repeaters and switchboards have been in use all over the world for nearly 40 years. Insulation as good or superior to the Western Union's has been used everywhere from the beginning of the telegraph. The American make of cheap glass is greatly inferior to the porcelain insulators used abroad. Copper wires were first used by the Bell Telephone Company, several years before the Western Union adopted them.

Motor-dynamos and storage batteries were articles of commerce, the latter at least being used abroad in advance of their use here. To go outside of this list, the Western Union ridiculed the telephone, and called it a toy for the amusement of women and children. They could have bought it for the price of a good automobile.

For years Germany and France have had underground wires as well as overhead lines over all important routes. England has had a magnificent underground cable containing 76 wires in operation between London and Birmingham for two years past, and is extending the service. The Pennsylvania Railroad and a telephone company are now considering underground communication between New York and Philadelphia. The Western Union was forced to bury its wires in the City of New York, but has shown no disposition to extend the work since, notwithstanding that during the sleet effects last winter it used the trains as a telegraphic medium for nearly a week.

Mr. Barclay's trial of the foreign automatic system referred to is small credit to the foresight and understanding of a telegraph engineer of his ability and prominence, and the selection of such a system as a representative of the automatic type looks very much as though the trial was for the purpose of exploiting a failure to support a fallacy. Every telegrapher knew from the first that such a system was impracticable, involving, as it does, photography and an apparatus so sensitive as to render it as useless for telegraphy over ordinary wires as a seismograph would be for tracing earthquakes when mounted on the Elevated Railway structure.

It requires for its operation less than one-half the voltage usually found vagrant on every wire within twenty miles of a trolley line, which would, of course, render its operation as erratic as a Thomson recorder would be on a circuit with leakage intakes varying from zero to 60 volts, not uncommon in these days. How any practical telegrapher could seriously entertain the idea of using a photographic record for commercial purposes must be a mystery to many besides myself; and the fact that this trial of a system, manifestly unfit, made two years ago, is now put forward as an evidence of the up-to-date alertness of the Western Union, does not seem to me a very strong point in the company's behalf.

Mr. Barclay uses the old argument that a Morse operator can send a message in the time that it is being perforated or prepared for transmission. No one has ever denied this, but he sidesteps the well-aimed fact that if there are fifty messages to be sent they can all be transmitted by automatic over one wire in the time of two messages by Morse. I do not care to go into the latest developments in automatic telegraphy, but it is now pretty generally understood that its opponents, to be fair, should shift their ground and abandon objections which belong to a past age. With the automatic system, affording at all times surplus carrying capacity, the average delay in transmission of telegrams would be very much reduced. To send the first

message within a minute, and delay the twentieth message an hour, makes an average delay of 30 minutes, which is rather below the average time that messages now hang on the operator's file.

Mr. Barclay points to telegraphic transactions between stock exchanges in 55 seconds as an example of the efficiency of the present service. Such deals were made 20 years ago in 15 seconds between Philadelphia and New York Exchanges over the Bankers and Merchants lines, and have been done between London and New York in 55 seconds, land lines and cables included; but the record of "Cresceus" is not a fair rating for "the old gray Dobbin."

Mr. Barclay objects to automatic on account of errors and the difficulty of correcting them. Seven years ago a Morse sounder was operated over an Atlantic cable, and the inventor, after many years of hard work and large expense, thought that his reward would be great; but the scope of his expectations was as nothing compared to the degree of his disappointment on being informed that though he could work a sounder at 40 words a minute, the company would not use it, on account of the *superior accuracy of automatic transmission and recording*. With the exception of those operated by the Western Union, all the Atlantic cables are equipped with automatic apparatus, and everybody knows that owing to coding and cipher, cable telegrams are the most difficult of all, and at the same time the most correct. A cipher cablegram from New York to Nagasaki, Japan, goes more correctly than a message in plain English from New York to Newark, New Jersey, and, generally, in quicker time.

The broker business between exchanges is the only branch of telegraphy that has "kept pace with the demands of the American people." If broker messages had to take their turn with those of the general public, the brokers would quickly see to it that the general average was raised. Before the ordinary citizen has a chance, the stock and other exchange wires, sporting news wires, Associated Press wires and newspaper private lines must all be provided, so that a summons to a death-bed must hang on the hooks for hours to make way for the stock transaction "in 55 seconds."

Mr. Barclay says that a number of automatic systems have been tried by his company, "but they have all been found lacking except for 'emergency' service." It would be interesting to know what constitutes an "emergency" in the Western Union. It cannot be the accumulation of business on the files for an hour or two, since the average time of the ordinary telegram throughout the country is more than two hours, against half an hour in the United Kingdom, where automatic is extensively used. Lying on the writer's desk is a telegram from a point 500 miles distant, which took over 25 hours in coming, and this in good weather. This would probably be considered an "emergency" warranting an automatic system.

If the Western Union was honest with the public it would put on each delivered telegram the time at which it was filed at its place of origin; but this it will never do, unless compelled by legislation, and the company is not disturbed on this point. Ohm's law does not apply to the "frank." Its motive force is not divisible by any resistance—on the part of the legislators. The telegraph company hoodwinks the public by putting the time of *arrival* on each message, thereby checking the movements of the much abused messenger boy, whose speed is, after all, as a winged son of Jupiter compared with the *modus operandi* of the telegram before it reaches the messenger's pocket.

The boast of nearly a million miles of wire and 66,000,000 messages in 1901 is a lamentable admission of mismanagement and stale engineering. With the speeds ranging from 10 to 60 words per minute, and 30 cents for ten words, it is no wonder that the number of messages fall below one per head per year. A modern conception of a telegraph plant for this country would be 100,000 miles of wires, automatic transmission yielding speeds of 100 to 2,000 words per minute, 20 words for 15 cents, and a business of 600,000,000 messages per year.

If Mr. Barclay will point out a single improvement in telegraphy originating on the outside that his company has not hampered, discouraged and discredited; or a single instance in which its encouragement has been extended for the development of an idea, whether for its own protection or the public benefit, the writer, who may not, and many who do not, "understand the workings of the telegraph" would be enlightened.

SOUTH ORANGE, N. J. PATRICK B. DELANY.

To the Editors of Electrical World and Engineer:

SIRS.—In responding to your request for comments upon charges made that the American telegraph systems are antiquated, I can only give my personal views as I have no client to defend. The subject must necessarily be considered with reference to existing conditions. The great demand by the public for telegraph facilities is between the hours of 8 A. M. and 5 P. M. A very large number of private wires are used by brokers and others between all principal cities, mainly between 10 A. M. and 3 P. M., New York time, during business days. The difference of time between London and New York and between New York, Chicago, Denver and San Francisco introduces some shifting backwards and forwards of heavy service at far west points to other hours of the day, but nearly all the United States commercial cities have to adopt their communications to New York City's business hours. So that outside of the hours mentioned the two great telegraph companies have a large surplusage of wires (including brokers' private wires), for which I believe the companies would be delighted to have profitable business. Sundays and holidays these wires are nearly all idle, and nearly all the expense of the maintenance and operation, including rents, taxes, management, etc., has to be borne by the traffic during business hours of business days.

The operation of wires at night is more expensive than during the day, as operators cannot stand so long hours of labor nor work to as good advantage, and expense for light is added. The hundreds of thousands of miles of wires used upon the single Morse system by private parties during the day can all be duplexed and quadruplexed nights and holidays by the telegraph companies leasing the wires, thus more than doubling the carrying capacities of such wires.

The telegraph companies for many years have had their offices open to receive and transmit at half rates the very class of messages you refer to in your editorial of the 24th inst., and they have actually differentiated between telegrams "demanding most rapid haste" and those "that may as well be delivered some hours later"; and I believe that the companies can prove, if they care to do so, that the latter class of telegrams and press service do not pay the expense of operation, and that, as before stated, the whole burden of expense rests upon the day traffic. This deferred traffic at half rates is naturally limited to very small proportions by reason of the splendid mail facilities between our principal cities, enjoyed by the business public, which alone has any use for such a convenience. Communications that will stand a few hours delay are more conveniently committed to the mails which not only insure sufficient dispatch but secrecy as well, not to mention the small cost of transmission.

I know of no automatic system that can be satisfactorily employed to move the great daily telegraph traffic of the country so expeditiously and economically as is done by the present Morse. I believe I have already made an accurate comparison of the systems in a discussion of the subject before the American Institute of Electrical Engineers, and printed in its *Transactions*, commencing page 130, Vol. 14, May 18, 1897. If customers' messages could be thrown into a hopper in New York and come out of a machine in Chicago at the rate of 500 or 1,000 words a minute, correctly printed upon blanks and ready for delivery, then the charge of old fogyism could be justly made against the proprietors of the telegraph in not adopting such a system and giving the public the advantage of lower rates. In fact, the proprietors would be foolish to persist in investing millions of dollars in pure copper wires when an automatic system would do so much better. But no automatic system of sufficient carrying capacity over one wire has yet been invented that obviates the expensive and slow preparation of the telegrams by special codification and manual manipulation at the sending end, and the special translation and manual transcription at the receiving end, with machinery more complicated than Morse, and at an expense for labor quite as great all told, as Morse, other things being equal; not to mention, as to each message, a delay to which the business public will never submit so far as the telegrams which "demand the most rapid haste" are concerned. At the same time I do not pretend to shut the gate in the face of improvements which are bound to come in all departments of industry, and there is very great room for them in the operation of the telegraph.

If these things are true, then the question arises, is there any method of transmitting telegrams that will enable the telegraph companies to handle the traffic, either cheaper or better, or both.

I attach hereto a record of a quadruplex circuit operated by the

Postal Telegraph-Cable Company between New York and Boston, 250 miles, for 21 days, 9 hours daily, showing an average of 1,485½ telegrams per day, or 41.26 per sender, per hour. On April 21st the highest record shows 1,699 telegrams in 9 hours—47.2 per sender per hour, or a total of 188.8 telegrams transmitted hourly over this circuit, all of which miscellaneous telegrams, including cablegrams, stock orders and quotations, were beautifully copied as received by sound, without an error, by the receiving operators at both ends of the circuit upon typewriters, and were instantly started to their destinations.

The business public is not finding fault with the present Morse system of transmission. Mr. Barclay accords to an automatic system its only value to meet emergencies, which I infer are incident to shortage of facilities by collapse of structure and wires during storms, which may be likened to the "half loaf being better than no bread." It will be found more satisfactory to erect trunk lines that cannot be disarranged nearly every day in the year. The telegraph has attained a public importance which demands between large cities a more substantial structure and wires of greater strength to be available to their full limit at all times. There should be two very stout short poles side by side, instead of one pole to support the cross-arms and wires, and when necessary other similar poles should be erected alongside to extend the system laterally. If private companies are to be allowed to continue the telegraph service of the country, they should be protected by the various State legislators, and be permitted to secure and maintain suitable rights-of-way, the same as railways. It is only after erecting such substantial lines that we could rely upon any automatic system which utilized a single wire for a large volume of traffic. A basket containing many eggs should not be liable to fall, and an automatic system must be produced which is as satisfactory and cheaper to operate than the Morse.

New York, N. Y. Francis W. Jones.

Regular telegrams averaging 30 words, each transmitted on Postal Telegraph-Cable Company's quadruplex circuit between New York and Boston, from April 14 to May 7, 1902, 21 days, exclusive of Sundays, during hours from 8 A. M. to 5 P. M., 9 hours daily. The 19th of April a holiday in Boston. April 26th and 30th, weather very wet. May 3d and 6th, business dull on the circuit, and very light every day between 8 A. M. and 9 A. M.

April 14	1,583	April 22	1,578	April 30	1,549
" 15	1,410	" 23	1,502	May 1	1,557
" 16	1,576	" 24	1,475	" 2	1,425
" 17	1,471	" 25	1,493	" 3	1,343
" 18	1,443	" 26	1,550	" 5	1,476
" 19	1,012	" 28	1,505	" 6	1,414
" 21	1,690	" 29	1,507	" 7	1,505

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Heyland Induction Motor with Power Factor Equal to Unity.—BRESSLAUER.—A paper read before the Electrical Society of Vienna. He first describes, in a very simple and elementary way, the principles of the Heyland motor for three-phase currents, and remarks that he has found Heyland's theory fully confirmed by tests with an experimental motor. He points out the following advantages for the construction. It is no longer necessary to be as careful concerning the diminution of leakage and air gap; the number of slots which had to be made very high on account of leakage, can be essentially diminished; the motor becomes cheaper. He thinks, however, that Heyland's principle will be of still greater practical importance for the construction of generators. In the generator, however, a compound winding is to be added; this is the ideal method of compounding. In a foot note he states that Heyland has informed him that a 500-kw generator, designed according to this principle, has been tested and found to be very satisfactory; compounding was successful for a power factor equal to unity as well as for one equal to zero; he emphasizes this point because this has never before been accomplished in alternating current generators. Heyland generators can easily be operated in parallel. In the discussion which followed, some questions of Seidener brought out the fact that the no-load current in the experimental motor dropped from 15 amperes to 3 amperes, when the Heyland compensator was set into service; the current in the leads to the brushes was 250 amperes; the part of the stator winding which has to carry this current, is made a bar winding with a few turns; the other part of the stator winding is made of wire of smaller cross-section.—*Zeit. f. Elek.*, April 20.

REFERENCES.

Alternators with Commutator.—LATOUR.—An article, in which he discusses his alternators, which have been noticed repeatedly in the Digest. Their operation is explained by diagrams and simple mathematics. The article does not seem to contain any results which have not been noticed in former abstracts of the author's papers.—*L'Eclairage Elec.*, April 12.

Operation of Alternators in Parallel.—KLOENNE.—A long mathematical article, illustrated by diagrams. For the operation of alternators in parallel it is important that the relative variations in the instantaneous positions of the magnet poles relative to the corresponding armature windings in the different dynamos should be as small as possible. He calls these variations the "angular variations." He discusses at length mathematically the relation between these angular variations and the variations of speed, and gives graphical methods for determining these values. Numerical examples are added.—*Elek. Zeit.*, April 3.

Former-Winding.—DAVIES.—The first part of an article of a general nature on "formers and former-winding."—Lond. *Elec. Eng.*, May 9.

British Electric Machinery.—A well-illustrated description of the recently completed extensions of the Electric Construction Co.'s works, especially for the manufacture of large generating sets; also an illustrated description of the manufacture of continuous-current dynamos of the English Elec. Man. Co. In an editorial note it is said that the British "manufacturers have gone forward once again, and, we trust, will soon regain their leading position."—Lond. *Elec.*, May 9.

Steam Turbine Generator.—An illustrated description of the steam turbine generator of the Hartford Elec. Light Co. The generator is a 2,100-kw, 2,400-volt, two-phase machine.—*Elec. Rev.*, May 17.

LIGHTS AND LIGHTING.

Bremer Arc Lamp.—An illustrated description of some improvements of this lamp. As is well known, the two carbons are nearly vertical; they form a very small angle with each other; to light them, they are made to slide down in the direction of their own axis until they touch, and are then again removed from each other. But this is not a safe method, because the sides of the carbons which come together are often non-conducting, on account of the formation of a non-conducting sediment. The lower ends of the carbons, which are conductive, do not touch, in general. He therefore uses a special conducting plate, which is brought in contact with these lower ends. By an electromagnetic device, when the lamp is to be lighted the two carbons are brought nearer and the special conducting plate is at the same time brought into contact with the two ends of the carbons; current will then flow from the one carbon through that conducting plate to the other carbon; the electromagnet, which is in shunt with the carbons, then no longer receives sufficient current, and its action ceases, so that the carbons are removed from one another, and that especial conducting plate is also removed; the arc is thus formed. It is also recommended to combine with the lamp a small knocking device, which makes the carbons vibrate either continually or at intervals, and thus causes the non-conducting sediment which has been formed to fall off.—*Zeit. f. Beleucht.*, April 30.

REFERENCES.

Manufacture of Incandescent Lamps.—The first part of a detailed

illustrated description of the works of the Incandescent Elec. Lamp Co., at Brook Green, Hammersmith, which makes the Robertson lamp, and of the different steps of the manufacture.—Lond. *Elec. Rev.*, May 9.

Arc Lamp.—An illustrated description of "a new type of continuous-current arc lamp." It is a lamp containing two arcs enclosed in the same globe. Both arcs are controlled by the same mechanism.—Lond. *Elec. Rev.*, May 2.

POWER.

Large British Power Distribution Plant.—An article on the South Wales Electrical Power Distribution Co. A map is given showing the proposed area of supply. There will be several generating stations, among them the Pontypridd station, concerning which the following information is given: The completed station will have a total capacity of 75,000 hp, but only a fifth of the ultimate plant is to be put in at present. There are five steam engines, each of 3,000 hp, directly coupled to three-phase 12,000 generators, the frequency being 25. The alternators are to be run in parallel and excited by a separate direct-current generating set. The three core cables are to be paper insulateed, lead covered, and laid in earthenware troughs, run in with bitumen and covered with protecting tiles. This scheme is discussed in a long editorial. The fate of the enterprise will be decided by the question whether the company can afford to deliver power at a price that will make it worth while for the consumer to use it rather than generate it for himself. The only reason for anxiety is the relatively great capital expenditure on distributing mains. A high load factor is expected—very probably above 35 per cent. There is an extremely favorable "diversity factor" in the colliery and iron districts of Glamorganshire and Monmouthshire in respect to the consumption of power. Not only would this characteristic of the districts served insure a high average load factor, but the nature of many of the industries involve high load factors for their individual demands; as examples are cited the pumping and ventilating loads of collieries, the demands of electrochemical works, and the motor loads of such works as have to be intermittently carried on, day and night. The district covered by the scheme has an area of 1,034 square miles, with a population of over 1,000,000. For underground work in collieries, the induction motor will probably come into prominence.—Lond. *Elec.*, May 9.

Power Equipment of Grain Elevators.—An illustrated description of the electric power equipment of the three Great Northern grain elevators at West Superior, Wis. The power house contains at present a 410-kw and a 300-kw, 440-volt, 120 periods, three-phase alternator; extensions are to be made. In the three elevators there are installed on the whole sixty-two motors, ranging in size from 7.5 to 100 hp, and having an aggregate capacity of 2,750 hp. Many of the motors are designed for a 150 per cent. overload. The motors are all of the three-phase induction type, and operate on 400-volt circuits.—*West. Elec.*, May 3.

REFERENCE.

Colgate Power House.—HEITZMANN AND CURRIE.—A long and well-illustrated description of "S. K. C." apparatus at Colgate.—*Jour. of Elec.*, April.

TRACTION.

Polyphase Currents for Traction Work.—GALMOZZI.—A paper in which he develops the formulas applicable to the case of a trolley line supplied with either two-phase or three-phase currents. He advocates the two-phase in preference to the three-phase system mainly on account of its greater economy, resulting from the fact that for a given frequency and a given amount of power delivered to the motors the current in the two trolley wires will be less, and that in the rails greater, in the two-phase than in a three-phase system, with a consequent saving in the Joulean heat losses, owing to the very much higher conductivity of the rails as compared with the trolley wires. He shows that under the conditions ruling in practice the additional lag due to the rails is not sufficient to cause serious inconvenience.—*Ass. Ing. El. Liege*, Bull., Anz, Sept., Oct., 1901, abstracted *Science Abstracts*, April 25.

Electric Traction.—DAWSON.—An abstract of a paper read before the Tramways Committee at the Town Hall of Northampton. In 1896 the total capital invested in electric undertakings in Great Britain was about $30,000,000. Taking all the power distribution and traction schemes which are now either completed or under construction, the total amount of money invested reaches nearly $500,000,000. The total station capacity in kilowatts installed for lighting and traction purposes in the United Kingdom amounts to about 500,000 kw more. The total station capacity installed in London for all purposes is not much over 100,000 kw. New York has nearly 250,000 kw. There is a very large variation of the capitalization per mile of route. The total expenditure varies from a minimum of $45,000 per mile of route in the case of Leeds and Halifax, to $280,000 and $420,000, respectively, in the case of Blackburn and Glasgow. For estimating purposes it may be stated that the very best system, including power station, track, car, overhead work, feeders, etc., should be installed for from $75,000 to $100,000 per mile of route. A table gives the approximate cost of various parts of an electric traction system. A second table gives the increase of passengers carried in the case of some British electric railways; in the case of the Dover electric tramways the passengers have more than tripled within the last three years. He then refers to Berlin, with a population of 1,810,000; the tramways, which have now been converted entirely to electric traction, carried 188,000,000 passengers in 1899, as against 306,000,000 in 1901. The question of laying down a proper power station which will economically supply electricity for traction purposes is a very important one; and as the conditions that obtain in traction are entirely different from those which are met with in lighting work, a station eminently well designed for lighting purposes will generally be uneconomical for traction work. In a case in which an old lighting station exists and power is required for traction work, in nine cases out of ten there is but one thing to do, and that is to install an entirely new plant, with the possible exception of the boilers, for the traction work. This is the most economical method in the end. He also gives tables showing the influence of the load factor on the cost of generation, and prices paid by tramways for electric traction.—Lond *Eng'ing*, May 2.

The Double Trolley at Cincinnati.—An illustrated article. This system, which has the distinction of being the only double trolley in commercial use in the United States, was installed originally for the purpose of overcoming interference with the telephone system, and also with a view of eliminating trouble from electrolysis. Many complaints, however, have been made because of the failure of the latter precaution, and as the telephone system has been practically reconstructed, the reason for continuing the double trolley seems to have disappeared. The experience of the Cincinnati management shows that, in addition to the complications arising from a multiplicity of overhead wires, there are other disadvantages, mainly due to the difficulties experienced in keeping up the insulation at the curves and crossings. Many delays are also experienced in operating the cars, owing to the necessity of shifting the trolleys in rounding corners. There is also much "side wear" on the wire, which is said to be more than the ordinary wear of the single trolley, on account of the grinding action of the trolley-wheel. In order to keep this overhead system in condition ten emergency wagons are employed by the Cincinnati Traction Company, in addition to the regular repair crews. Attention is also called to the fact that where there is a grade the trolley wires are worn faster coming down the hill than those ascending, showing that the burning action of the current does not cause as rapid wear as the friction of the trolley rubbing on the wire coming down the hill. The management, however, states that the cost of motor repairs where the double trolley is used is noticeably less than on the single trolley system.—*St. R'y Jour., Int. Ed.*, May.

New Types of Overhead Material.—A description of three devices which have recently been perfected. The efficiency of an overhead trolley line depends very largely on the character of the crossings and section insulators, and much ingenuity has been shown in these devices to prevent the trolley-wheel from coming off, and to make them easy of installation. An uninsulated crossing is illustrated where the wires are electrically connected. Hinges and clamps are provided at the ends of the arms, which hold the wire firmly, no solder being used. The wire crosses over the insulator; the wheel in passing underneath runs on its flanges. Another figure shows an insulated crossing which is almost as simple. An insulating cylindrical cup, placed at the top of the crossing, separates the two wires, keeping them electrically apart, while the mechanical continuity of the overhead system is retained by the under portion of the device. A third figure shows a new section insulator which is particularly smooth underneath. This also secures the trolley wire by clamps. In all of these devices the clamps are adjustable, so as to accommodate all sizes of trolley wires ordinarily used, and the same crossing can be

used for both small and large wires at the same time without changing the parts.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

Fayet-Chamonix Electric Railway.—An illustrated description of this railway, which has recently been opened in the French Alps; it is a branch line of the Paris, Lyons & Mediterranean Railway Co. The gauge is 3 ft. 3⅜ ins., the length 11.8 miles. The rack and pinion system could be dispensed with, the grades being mounted by adhesion. The sharpest curves are 490 ft. in radius; and of the two steepest gradients, one is 9 per cent. for 1.35 miles, and the other is 8 per cent. for 0.85 mile; the other gradients do not exceed 2 per cent. A third rail is used, with direct current at 550 volts. At the gradients a central brake-rail is fixed between the track rails, on which a special shoe-brake acts for limiting the down grade speed to 6.25 miles an hour. The contact rail rests on creosoted wooden blocks placed between every alternate sleeper. The electric bonds are of the usual plastic type. The contact rail is omitted over lengths of 16 ft. at those parts where the line runs over level crossings and in the vicinity of the covered platforms, turn-tables and switches, and the two ends are connected together by copper wire cables placed in a wooden conduit. The contact rail itself is also protected at several places with a wood covering. There are two generating stations, water-power being used. All the cars are motor cars; there are four or five to a train. They are all controlled from the front platform by a steering mechanism devised by Auvert, in which compressed air is used.

The good results obtained on this line, and the other experiments which the P., L. & M. R'y Co. are carrying out with electric traction, may lead it to introduce electric power on some of the new branch lines, among which would be that connecting Nice with the Italian frontier.—Lond. *Eng'ing*, May 2.

REFERENCES.

Cheatham Electric Railway Switch.—An illustrated description of this device, which is said to remove the necessity for bringing the car to a stop, to improve materially the running time, and to effect a considerable saving in the actual cost of power. In one test mentioned this switch gave satisfaction in service on one of the St. Louis Traction Company's lines at a point where 750 cars passed daily.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

Syracuse.—A complete and profusely illustrated description of the street railway system of Syracuse, N. Y., which has recently been thoroughly recognized. The total capacity of the plant is now 3,000 rated hp, with a large allowable percentage of overload.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

Traction Plant.—An illustrated article on the system of "firing the Metropolitan power plant" in New York, which is the largest railway power plant of the world. —*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

Installations. Systems and Appliances.

French Central Station.—H. H. B.—An illustrated article on the central station of Salon, a city in France of 13,000 inhabitants. The original station, erected in 1895, had three steam-driven single-phase alternators, the voltage being 2,500 and the frequency 100; transformers were distributed through the city, supplying a secondary network with a tension of 100 volts. Recently, when extensions became necessary, a small water-power of 50 to 55 hp in the city was bought, the hydraulic station charging a battery during the day and working in parallel with the steam station during the night; the alternators in the latter had therefore to be replaced by direct-current dynamos. The station now contains two steam-driven direct-current machines, each of 75 kw, and a third of 150 kw, the voltage being 250 volts. There is a storage battery of 170 cells, with a capacity of 1,000 amp.-hours, when discharged in 5 hours. A 30-kw booster is in use for charging. The hydraulic station contains a turbine-driven, 37.5-kw, 250-volt, direct-current dynamo. For distribution the three-wire system is used, with 250 volts between the outers. It is thought that the new arrangement will result in a considerable saving. During the summer months the hydraulic station and the battery will be sufficient to supply all the current.—*L'Ind. Elec.*, April 25.

Influence of Tariffs on Electricity Supply.—Dick.—An article in which he criticises sharply a recent article by Baker, and shows that the statistical methods used are wrong in principle. The only correct method of considering the influence of a tariff upon the load factor is to eliminate all other influence on the load factor. One should observe the results following the use of a given tariff in each individual station; one should notice whether the load factor shows an increasing, stationary, or diminishing tendency with the tariff in use, without regard to its absolute value compared with other stations. The load factor is not only the only consideration involved in the use of Wright's system; there is the equally important question of how to sell to each customer at the lowest possible price consistent with making a profit, or at least no loss. No method, except Wright's modification of Hopkinson's system, has ever thoroughly answered that question.—Lond. *Elec. Rev.*, April 25.

REFERENCE.

Determining the Size of a Battery.—Izart.—An illustrated article in which he describes a graphical method for calculating the size of a storage battery which has to supply a certain given irregular load. —*L'Ind. Elec.*, April 10.

Wires, Wiring and Conduits.

REFERENCES.

Gas Explosions in Electric Supply Conduits.—An article on a recent explosion and the resulting legal suit between the electric company and the gas company. The following rules of the Board of Trade concerning this exist in England: For all conduits, casings and street boxes used as receptacles for electric lines, reasonable means shall be taken to prevent accumulation of gas in them, and they shall be regularly inspected for the presence of gas.—Lond. *Elec. Rev.*, April 25.

Aluminum Transmission Lines.—An article giving short reports and notes on six transmission lines in which aluminum wire is used. —*Alum. World*, May.

Electro-Physics and Magnetism

Magnetic Field Due to Electric Convection.—Righi.—A paper on this subject, which has become of special importance at present through Cremieu's experiments. Levi has investigated the problem of "an electromagnetic field produced by a charge in uniform rectilinear motion on the other side of an infinite conducting plane." The magnetic field is smaller on the other side of the plane than it would be were the plane not there. If the charge moves with a velocity equal to one-millionth of the velocity of light, parallel to an infinite copper plate 1 mm. thick, the magnetic field on the other side is only 8 per cent. of what it would be in the absence of the copper plate. Screens used in all experiments on electric convection must have a pronounced effect upon the magnetic field observed, if the moving charges are discontinuous. "If the electric field does not change, the effect of the screen is nil, and since the magnetic field of a current is not sensibly intercepted by a conducting screen, it follows that the electrons must move in the conductor in a practically continuous stream."—*Phys. Zeit.*, April 15; abstracted in Lond. *Elec.*, May 9.

Cremieu's Experiments.—Potter and Poincare.—A reprint of a correspondence between these two physicists, the subject of which was Cremieu's experiments and an objection by Wilson. The correspondence is highly mathematical. They discuss the influence of the screen, and reach the agreement that its influence is zero.—*L'Eclairage Elec.*, April 26.

Ionic Theory of Self-Discharge.—Stark.—According to his theory of ionic shock, ionisation is usually produced by the impact of an existing positive or negative ion on neutral molecules. The force of the impact is due to the kinetic energy acquired by the ion in running down the slope of the potential, and the difference of potential necessary to secure an ionising shock is between 20 and 50 volts in the case of the negative electron, and 200 to 400 volts in the case of the positive ion. Regarding spontaneous discharge, he proves that it is not due to the emission of ions by the electrode. The fact that a very considerable difference of potential may be maintained between two electrodes placed very close together without producing a discharge, shows that there is some kind of constant force which prevents the ions from penetrating into the gas surrounding the metal. The author, therefore, attributes all self-discharge to what he has called, "frontier ionisation." The ions most concerned in that type of ionisation are the positive ions, and discharge begins to set in as soon as the difference of potential traversed by the positive ion in its mean free path is sufficient to make it produce an ionisation shock. —*Ann. d. Phys.*, No. 4; abstracted in Lond. *Elec.*, April 25.

Auto-Decoherers.—Rochefort.—A discussion of decoherence. There are auto-decoherers and there are coherers which require tapping for decoherence. He shows that any auto-decoherer becomes a coherer which requires tapping for decoherence, if the pressure between the particles be relaxed. This is just the reverse of what has

been believed or what would be expected. The practical importance of self-righting coherers is greatly increased by their successful employment for wireless telephony. By a slight modification of the soft iron coherer, he has succeeded in using it both for wireless telegraphy and for telephony, according as to whether it was used as an ordinary coherer or as an auto-decoherer. The soft iron tube in question is derived from Tissot's tube. Such a tube, when "cohered" by a preliminary wave-train, shows a diminution of resistance which brings it exactly into the state of a highly sensitive auto-decoherer. This way of obtaining the required pressure is easier, more constant, and more certain than any mechanical means, which requires a too delicate manipulation.—*Comptes Rendus,* April 14; abstracted in Lond. *Elec.,* May 2.

REFERENCE.

Disruptive Discharges.—JOHNSON.—A brief article in which he gives some notes on the conditions of the formation of disruptive discharges.—*L'Eclairage Elec.,* March 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Hoepfner Zinc Process.—A note stating that the production of zinc by Hoepfner's electrolytic process at Brunner Mond & Company's works, at Norwich, England, is now about 1,000 tons a year. "The process is admittedly a troublesome one in many ways, and but for the fact that the product is of a high degree of purity, and for this reason is in demand at an increased price, it is doubtful whether it would continue in existence." Practically the whole output is supplied to cartridge manufacturers who use it in preparing special copper-zinc alloys. The process is of some importance to the firm, as it helps in the recovery of chlorine from calcium chloride, which at present is a waste product in the ammonia soda process. "The process, however, will in all probability never have a wide application." —*The Eng. and Min. Jour.,* May 17.

Hargreaves-Bird Electrolytic Process for Producing Soda and Bleach.—WALKER.—A communication giving some information on this process, supplementary to his article, which was recently abstracted in the Digest. The diaphragm has a life of about 100 days, and must then be renewed. The carbon anodes require occasional renewal, but not so often as the diaphragms. The other parts of the cell are subject only to the usual wear and tear of ordinary machinery and plant. The only raw materials required in the process are brine, coal and lime, and there is no by-product or waste. Regarding processes with mercury cathodes, he claims that "none of them have been found to stand the test of practice as commercial propositions." —*Eng. and Min. Jour.,* May 17.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Reichsanstalt.—The official report of the work of the German Reichsanstalt in 1901. Among the investigations of electrical interest are the following: Platinum resistances were standardized up to 500 degrees, and found to be correct within 0.15 degrees, whereas the error at the temperature of liquid air exceeds 2 degrees. Small standard resistances of 0.1, 0.01, 0.001 and 0.0001 ohm were tested after several months' rest, and were found to have remained constant to within a few millionths of their values. An important piece of work has been carried out with regard to the absolute temperature of a black radiating body; the laws according to which the total energy at a given wave length is proportional to the fourth power of the temperature, and the maximum energy proportional to the fifth power, lay the foundation of a new scale of temperature. The tests of the d'Arsonval galvanometer are nearly concluded. In the technical department a number of electrical measuring instruments, chiefly watt meters, were tested; also insulating materials and arc light carbons.—*Zeit. f. Instrumentenkunde,* April; abstracted in Lond. *Elec.,* May 9.

Ship's Compasses.—MELDAU.—A summary of the guiding principles underlying the construction of the modern mariner's compass. The only effective way of avoiding the disturbing swing of the compass needle is to increase the period of swing. The equality of mechanical moment about various horizontal axes is brought about by the subdivision of the originally single needle into several needles, mounted parallel to each other at various distances from the center of the rose. The moment of inertia of the latter is increased, after Kelvin's example, by placing the mass of the rose near the margin, the central portion consisting practically of silk threads only. Another successful method of providing the required steadiness is that of using a liquid in which the needle floats. The liquid generally used is a mixture of alcohol and water. The magnetic system has, of course, to be much stronger owing to the viscosity of the liquid. "The quadrantal deviation by masses of soft iron can only be obviated by means of needle induction." In the German navy soft iron masses are attached to the compass box itself.—*Phys. Zeit.,* April 15; abstracted in Lond. *Elec.,* May 9.

REFERENCES.

Analyzing Alternating Waves.—ARMAGNAT.—A long mathematical article illustrated by many diagrams, on the analysis of alternating waves and one determination of their harmonics, by means of a combination of the oscillograph with Pupin's method of resonnace. He replaces the electrometer in Pupin's experiments by an oscillograph. Numerous arrangements are described for special purposes. —*L'Eclairage Elec.,* March 15.

Analyzing Wave Curves.—HOSPITALIER.—An article illustrated by diagrams, on the application of the ondograph for the decomposition of complex electric wave into its harmonics.—*L'Ind. Elec.,* April 10.

Oscillographs.—BLONDEL.—The first parts of a well illustrated description of new oscillographs for plotting periodic curves of alternating currents.—*L'Eclairage Elec.,* April 12, May 3.

Measuring.—ARMAGNAT.—An article giving brief illustrated descriptions of several apparatus for measuring currents. Carter's device for the photometric study of arc lamps, Nisbett's speed indicator, Rieter's electromagnetic brake, and Morgan's transmission dynamometer.—*L'Eclairage Elec.,* April 26.

Weston Voltmeters.—A. S.—An illustrated description of the well-known modern Weston voltmeters of precision for industrial laboratories.—*L'Ind. Elec.,* April 10.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Cable Relay.—BROWN.—An abstract of a paper read before the (Brit.) Inst. Elec. Eng. He describes his cable relay, which is no longer in an experimental stage, but is in everyday use on some of the lines of the largest cable companies, notably those of the Eastern Tel. Co., their system at Gibralter having been the first to be fitted up for "automatically translating" cable messages between Porthcurnow, in England, and Alexandria, in Egypt. The adjoining diagram shows the arrangement of the relay. The cable and the

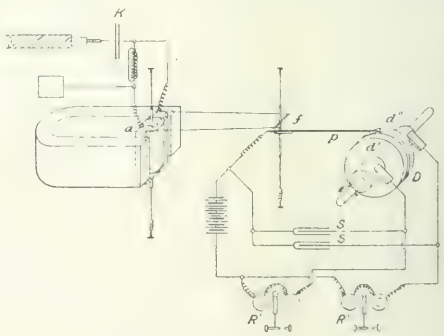


DIAGRAM OF CABLE RELAY.

galvanometer part of the siphon recorder are to the left. The moving coil is harnessed to *f* by two silk or quartz fibers. The pointer *p* is a fine siphon-glass tube, carrying through its bore a phosphor-bronze wire with an iridium tip for the contact. The drum *D* is in three sections, of which *d'* and *d''* are connected for the dot and dash deflections. The middle section is insulated, and is merely a resting place for the contact pointer. There it rests, whatever is sent into the cable, unless the drum be rotated. When, however, the drum is driven at, say 150 revolutions per minute, the contact friction that makes the pointer stick is removed, and the pointer obeys the impulse of the recorder coil and gives dot and dash currents in the relays *P'* and *P''*. Two condensers, *S'* and *S''*, are used in the battery circuit to the relays; they are said to greatly improve the contact between the pointer and the drum. To stop earth currents, and for other reasons, signalling on cables is done through a condenser, *K*. The condenser becoming charged under a succession of signals of the same sign, there is a variable zero, which would be fatal to the action of the relay; to get rid of it, he devised what he calls the "local correction." A current from a local battery and the relays

R' R'' is sent through a circuit "having the proper (large) retardation." This circuit is made up of a condenser placed between two high resistances, condenser and resistances being capable of minute adjustment; the relays R' R'' produce the same order of signals as that which charges up the condenser K. As the current from the cable, due to the choking action of the condenser, dies away, so at exactly the same rate does the current from the local correction circuit increase. The correction current flows through a separate winding on the suspended coil a in the same direction as the signals, so as to compensate for the loss of current from the cable, thus eliminating "variable zero" disturbances. A "magnifying relay" is also briefly described. It has not yet come into use; it is a modification of the above relay.—Lond. *Elec. Times,* May 8; Lond. *Eng'ing,* May 9.

Theory of Wireless Telegraphy.—R. Kennedy.—An illustrated article on "electromagnetic oscillations." Marconi's achievement disposes of the assumption of the rectilinear propagation of the waves. He believes that the effects are not due to ethereal waves traveling as light does, but to electrical oscillations set up in the earth itself considered as a whole sphere, insulated in space, and the same effects can be reproduced on a small scale on a large ball, or artificial earth, as it may be called. "In this view of the electromagnetic transmission of waves, we can imagine the rapid discharges at great potential at one point agitating the whole electrical system of the earth, and that the earth is surrounded by an electrical atmosphere normally at rest and neutral, so that when disturbed at one point, this atmosphere vibrates or oscillates throughout its whole mass. And, therefore, there is no reason why communication between antipodes should not be practicable." He considers a wireless telegram to be actually an effect of the surface charge of the earth as a whole, and not at all due to radiant energy traveling in space like a ray of light. He describes a model telegraph, without wires over a large globe, under the assumption that the globe can be charged electrically, and the charge can be reversed at will.—Lond. *Elec. Rev.,* April 25, May 2.

REFERENCES.

Central Energy Systems.—Clausen.—An article illustrated by diagrams, on "central energy systems of to-day; Independent vs. Bell."—*Tel. Mag.,* April.

Multiplex Telegraphy.—Anizan.—The first part of a well illustrated description of the Mercadier multiplex telegraph.—*Jour. Teleg.,* April 25.

Statistical.—Comparative statistical tables on telegraphy in various countries in 1900 (the United States not being included); continuations of the article on the effects of the 1899 telephone tariff upon the development of the telephone service in Germany; also of the article on telegraphy and telephony in Belgium in 1900.—*Jour. Teleg.,* April 25.

MISCELLANEOUS.

REFERENCES.

Magnetic Separator.—A well illustrated description of a magnetic separator of the Brit. Thomson-Houston Company.—Lond. *Eng'ing,*

Cornu.—An account, with portrait, of the life and work of the late Prof. Cornu.—*L'Eclairage Elec.,* April 19.

Morton.—An account, with portrait, of the life and work of the late Dr. Henry Morton.—*Eng. News,* May 15.

New Book.

Logarithmic Tables. By Thos. W. Marshall. New York: The Engineering News Pub. Company. Flexible leather. 106 pages. Price, $2.

The contents of this book consist of a set of tables of seven-place logarithms of feet and fractions of feet from $^1/_{16}$ inch to 50 feet, in steps of $^1/_{16}$ inch; a table giving values of inches and fractions of an inch in terms of a foot, and a preface explaining the application of the logarithmic tables. Just why these should require any explanation is not clear; they give the logarithms of dimensions that are expressed in feet, inches and fractions of an inch, and can have only one possible use—that of facilitating the multiplication or division of one dimension in mixed units by another. The book should be of considerable convenience to bridge engineers or others whose work involves computations in the mixed units on which the tables are based.

Directory of Electrical Societies, Etc.

American Association for the Advancement of Science. Next meeting, Pittsburg, June 28 to July 3, 1902.

American Electochemical Society. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Institute of Electrical Engineers. Extra meeting, 220 West Fifty-seventh Street, New York, May 28; annual convention, Great Barrington, Mass., June 18-21, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Independent Telephone Association of the United States. Next meeting, Philadelphia, Pa., June 24, 25 and 26, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association. Next meeting, Chicago, May, 1903.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Ohio Street Railway Association. Next meeting, June, 1902.

Society for Promotion of Engineering Education. Next meeting, Pittsburg, June 28 to July 3, 1902.

Absorption of Sprague Electric by General Electric.

The reported pending purchase by the General Electric Company of the stock, or a majority of it, of the Sprague Electric Company is one of great interest to the electrical industry. It is understood that the sale is the culmination of various negotiations which, in one form or another, have been pending for over a year. The terms, according to the president's circular to the Sprague Company stockholders, are, so far as it affects them, as follows:

For the 5 per cent. debenture bonds: 55 per cent. in Otis preferred stock, now quoted at 102, and 45 per cent. in cash.

For preferred stock: share per share in 3½ per cent. General Electric 40-year gold debenture bonds, with the right of redemption at par within ten years, and 105 after ten years.

For common stock: 41.9 per cent. of par in Otis common at par, now quoted at 32, and 21.42 per cent. of par in the 3½ per cent. debentures.

All provided 75 per cent. of each class of securities assents, which amount is already assured by the action of the principal stockholders. All stockholders are treated alike. According to probable valuations of the various securities, the equivalent cash prices are therefore about 101 for the bonds, 95 for the preferred stock, and 30 to 35 for the common.

The reasons for the purchase of the Sprague Company, the price paid for its patents and good will, and the probable effect on the electric railway situation are matters of interest. The Sprague Company is a busy, solvent, going concern, with a fine factory, developing under inventions, etc., of Messrs. Sprague, Lundell and Greenfield. According to a recent statement, it had, exclusive of patents and good will, something over $2,700,000 assets, against $1,100,000 liabilities (exclusive of capital stock), or, say, $1,600,000 of net assets, of which over $300,000 was in cash. Besides the nominal assets and liabilities of the Sprague Company, the Sprague Company is under a long-time contract with Mr. Sprague, which, it is rumored, is in certain respects modified as a condition of purchase. It is reported that the total present payment to be made by the General Electric Company for the net assets of $1,600,000, and for the patents, good will and contracts, amount to nearly $2,500,000 in 3½ per cent. debenture bonds, and $850,000 in Otis common stock. It would, therefore, seem that about $1,250,000 has been paid for patents and good will.

The real reason for the purchase apparently lies in the possession by the Sprague Company of what are claimed to be the master multiple-unit patents, covering the operation of existing elevated railroads in Chicago, Brooklyn, New York and Boston, and the systems which are to be used on the Rapid Transit and other roads, the practrical development of the multiple-unit system dating from Mr. Sprague's work in Chicago.

For a long time there has been a very active patent contest between the Sprague Company and the General Electric and Westinghouse Companies, the former having brought suit on its multiple-

unit patents, and having just closed its *prima facie* case, and the latter having brought suit on various patents which it claims the Sprague Company was infringing. The warfare over these patents is said to have been costing the opposing interests fully $100,000 a year, with little likelihood of an end for some years, yet with the possibility that the multiple-unit patents might be upheld, with consequent grave results where large contracts are concerned. It is also understood that, as in Boston on the elevated railway, tests of apparatus have been proposed by the Rapid Transit Company. These are not only necessarily expensive to carry out, but the result of which would be entirely in doubt, for the Sprague Company is said to have determined to actively take up railway motor construction.

Pending the settlement of the various patent suits and the carrying out of competitive tests, the public, rather than the manufacturing companies, would possibly be the financial gainers, and it therefore seems advisable to the various interests, some of which are interested in both the General Electric and the Sprague Companies, to come to an understanding, which is represented by the offer which has been made and accepted.

Under the circumstances it seems fair to say, therefore, that the multiple-unit patents and interest created by Mr. Sprague within the past few years have been sold for fully $1,000,000, and it curious to note that a single inventor has twice created an epoch in electric railway operation, as well as one in stationary motors and one in elevators, and that his electric interests have each time finally come into possession of the same company, outside of elevators. It will be remembered that the Sprague Company's interests in electric elevators were some time ago sold to the Otis Elevator Company for something over $1,000,000.

This deal apparently affects the United States alone, as it is understood that the Sprague Company is not prosecuting railway business abroad, and has no interest in Mr. Sprague's patents there. The effect upon public interests of this wise and strategic move by Mr. Coffin cannot be exactly foretold. It means the probably certain upholding of the multiple-unit patents, and in that way sure control of suburban and interurban electric railway developments by the General Electric Company and its allied interests. It is likely, however, that the best points of the apparatus which has been designed by the various companies will ultimately be combined, and the railway companies will not only get more matured and perhaps better apparatus, but will be relieved from the contending claims and dangers due to divided ownership in matters of vital concern.

As to Mr. Sprague's personal future, it appears that his activities will not necessarily be any less effective, but that he will be in a position to do freer work where the larger railway problems are concerned, and, indeed, it is understood his connection with the Sprague Company continues under some specific agreement.

The Nernst Lamp.

We present herewith illustrations of the Nernst lamp in some of its commercial forms as developed in this country. Those who have seen this lamp in operation can have but one opinion as to the character of the illumination which it furnishes, which approaches nearer to that of daylight than any other commercial source of artificial light. So excellent is the light in this respect that even if handicapped by an efficiency much less than that of the incandescent or arc light, its older rivals would be out of competition where quality of light is a desideratum. In efficiency, however, tests have shown that the Nernst lamp is on a parity with the enclosed arc, and has double the efficiency of the incandescent lamp. The comparison with the enclosed arc lamp is still further strengthened by the flexibility of the Nernst lamp, which can be installed in units ranging from 528 watts corresponding to the enclosed arc, down to 88 watts, the efficiency being practically the same for all the units. Yet another advantage in this connection is the uniformity of the light and its superior distribution for many purposes, ninety per cent. of the illumination being well below the horizontal.

Four sizes of the lamp have been perfected, namely, the one-glower lamp, consuming 88 watts; two-glower lamp, consuming 176 watts; three-glower lamp, consuming 264 watts, and four-glower lamp, consuming 528 watts. Each glower is equal in candle-power to three ordinary 16-cp incandescent lamps. The life of a glower is about 800 hours on 60 cycles and 400 hours on 25 cycles, the life of the heater being about 2,500 hours. The power factor is unity. The one-glower lamps are provided with an Edison base, and thus may be inserted in the ordinary incandescent lamp socket.

Fig. 1 shows the essential parts of a Nernst lamp, and a circuit diagram is given in Fig. 2. The "glower" is the light-giving element, and consists of a small white rod about $^1/_{32}$ inch in diameter and 1 inch long. It is fastened to the "holder" mechanically and electrically by means of terminal wires and small aluminum plugs. The glower is a non-conductor when cold, becoming, however, a conductor when heated.

The "heater" is made up of two or more small white porcelain tubes about the size of a lead pencil. These have been wound with fine

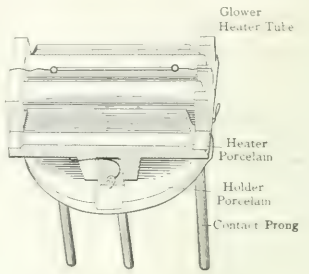


FIG. 1.—PARTS OF LAMP HOLDER.

platinum wire, and in turn covered with a refractory paste which protects the wire from the intense heat of the glower. These tubes are mounted on the "heater porcelain," which constitutes a part of the holder. The "holder" is the removable part of the Nernst lamp upon which the glowers and heaters are mounted. The contact terminals and prongs, by which the current is conducted to the heater and glowers, also constitute a part of the holder. The "ballast" is a steadying resistance connected in series with each glower. It is enclosed in glass and mounted in the body of the Nernst lamp.

The "cut-out" is the automatic device for preventing waste by

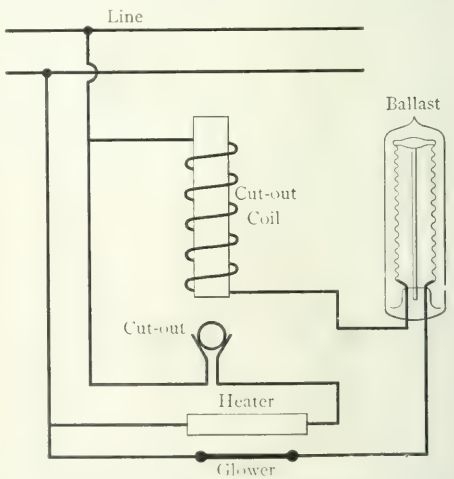


FIG. 2.—DIAGRAM OF ARRANGEMENT AND CONNECTION OF PARTS.

interrupting the heater current after starting the glowers. The heater and glowers are connected in parallel. The current taken by the glowers is passed through the coil of the cut-out. When the glowers are taking no current, as in starting, the cut-out armature closes the heater circuit by resting upon two contact pins. As soon as the glowers take current, however, the cut-out coil lifts the armature from the contact pins, thus disconnecting the heater from the circuit. The various parts and their connections are arranged as shown in the accompanying diagram (Fig. 2) of a one-glower Nernst lamp. The same principle is adhered to in all the other sizes and styles.

When a dome shade is used, the large Nernst lamps are provided with a small inner globe, termed the "heater case." This is to be slipped over the holder into three springs which extend slightly below



FIG. 3.—INDOOR TYPE OF LAMP.



FIG. 4.—CEILING CLUSTER SINGLE-GLOWER LAMPS.



FIG. 5.—THIRTY-GLOWER INDOOR TYPE OF LAMP.

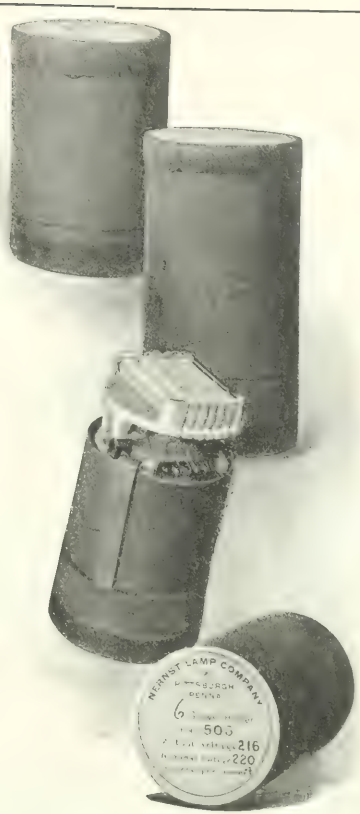
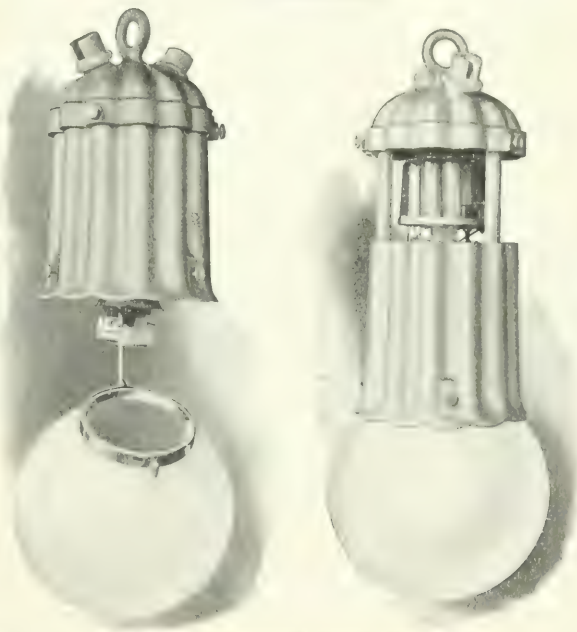


FIG. 8.—HOLDER BOXES.



FIGS. 6 AND 7.—[illegible] OF INDOOR TYPE OF LAMP.

VARIOUS STYLES OF NERNST LAMPS AND HOLDER BOXES.

the petticoat of the Nernst lamp housing. The heater case may be dispensed with entirely when outer globes are used.

In Fig. 3 is shown a one-glower lamp with an opal dome shade, and in Fig. 2 the same unit as enclosed for use in a ceiling cluster. Fig. 4 shows a three-glower indoor lamp, and Fig. 5 a six-glower indoor lamp. Figs. 6 and 7 illustrate a six-glower outdoor lamp, the ballast tubes being visible in the former figure.

Fig. 8 shows the manner in which the removable element of the Nernst lamp is packed. As taken from the case, the part is ready for operation when the holder has been firmly pushed into place and the shades or globes attached. When a renewal is required, the part is returned to the case and shipped to the factory to be refitted and returned.

Wattmeter Error Calculator.

The mechanical calculator shown herewith is for use in determining quickly the error of wattmeters by solving the general meter formula:

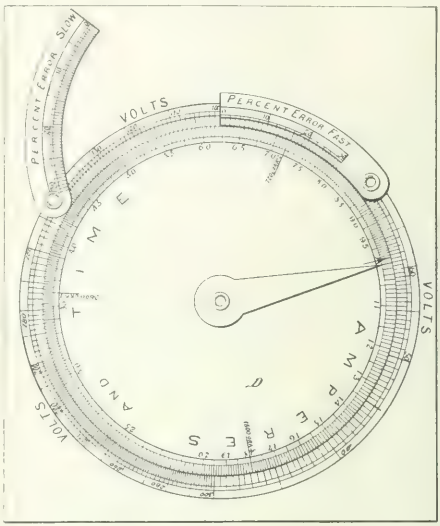
$$\frac{EI\frac{3600\,K}{T} - EI}{EI} \times 100$$

in which E is the e. m. f., I the current, T the time and K the meter constant.

The usual way of testing electric recording-wattmeters is to place an ammeter and a voltmeter in the circuit supplied by the meter, and then note the time required for one revolution of the meter-disk when a definite current is flowing through the meter at a definite voltage. From the data thus obtained, and the meter constant supplied by the manufacturer, the error may be quickly, accurately and conveniently obtained by mechanically actuating the parts of the calculator and then reading the indicated results.

On a base of celluloid or cardboard is arranged a graduated circle indicating the voltages likely to be met with in practice and laid off logarithmically. Concentric with this is an inner pivoted circle, graduated to amperes and time, and divided logarithmetically into ten parts and subdivisions. On the same pivot is mounted to turn independently a pointer for the purpose of indicating points on the two above-graduated circles. Two hinged percentage scales are arranged to overlie the outer graduation, one scale indicating slow, and the other fast errors.

To use the instrument, the current reading on the movable scale is placed opposite the volt reading on the fixed scale, and the pointer is placed over the zero reading on the graduation on the movable scale. Then the time reading on the movable graduation is placed under the pointer, and the percentage error of the meter fast or slow is then indicated on the percentage scale by the line on the movable graduation, which indicates the constant of the meter. The meter-constant lines may be conveniently represented on the movable scale by figures corresponding to the constant or multipliers as given by the manufacturers. Thus the meter-constant line for a meter whose multiplier as stated by the manufacturer is two, is located at the logarithmic-scale line for thirty-six hundred multiplied by three or seventy-two. If the meter is correct, the meter-constant line indicates zero error. It is noted that the fixed voltage scale is laid off in a direction opposite to that of the movable ampere and time graduation. The calculator described is the invention of A. T. Beauregard, Darien, Conn.



WATTMETER ERROR CALCULATOR.

Automobile Brake Tests.

On May 1, last, trials were held on Riverside Drive, New York City, of automobile braking. According to the report of the Technical Committee of the Automobile Club of America, which conducted these tests, the results were favorable to automobiles, as compared with other vehicles driven by other means. The tests lasted for an hour and a half, during which time about 90 runs were made. The speeds were determined by running the vehicles over a course of one-tenth of a mile, or 528 feet in length, and the time was measured by a stop watch, electrically connected with the starting and finishing points. This apparatus constitutes the Mors timing instrument belonging to the club. The average results were as follows: 17 different types of automobiles, running at about 8 miles per hour, stopped in an average distance of 9 feet. At a 15-mile speed the stop was accomplished in an average distance of 29 feet, and at 20 miles the average distance was 53 feet. Similar tests were simultaneously





FIGS. 1 AND 2.—AUTOMOBILE BRAKE TESTS.

conducted with reference to a victoria drawn by two horses, a four-in-hand coach and a bicycle-mounted policeman. The victoria, at the 9-mile rate, required 17 feet 8 inches in which to stop; the coach, going at the same speed, required 26 feet, and the policeman on the bicycle, going at 9.4 miles, stopped in 8 feet. At the 15-mile rate, the victoria stopped in 37 feet and the four-in-hand in 77½ feet. At the 20-mile rate, the policeman stopped in 61½ feet and the four-in-hand coach in 91 feet. The tests showed conclusively that automobiles can be stopped in a much shorter distance than can other vehicles. They also proved that automobiles can be manœuvered with great ease and convenience. A report of the test to the governors of the Automobile Club is signed by Dr. S. S. Wheeler, chairman of the technical committee. The two accompanying views show an automobile under way and the time recording instruments under the supervision of the judges.

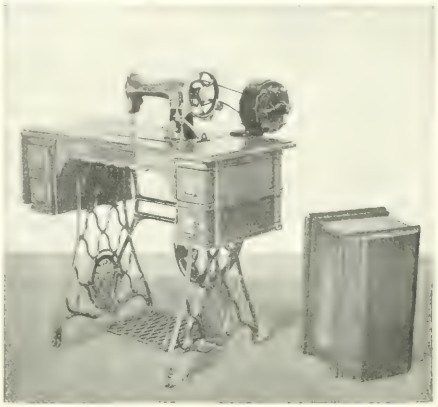
Electricity Building, St. Louis Exposition.

Although the opening of the St. Louis World's Fair has been deferred until 1904, the work of preparation for that event continues with sustained vigor. In the Department of Electricity substantial progress has been made, and an interested co-operation on the part of electrical manufacturers has been developed. Prof. Goldsborough, chief of the Department of Electrical Exhibits, reports that the representatives of the department have been met with hearty assurances of support.

In this connection it is now interesting to show a general view of Electricity Building as it will appear when finished. This building, as has already been pointed out, will have a frontage north and south of 650 ft., and toward the east of 525 ft., and a floor space of 350,000 sq. ft. The plans provide a balcony on all four sides of the interior, which will afford additional exhibit space amounting to 100,000 sq. ft. As will be seen from the illustration, the design of the exterior is a bold treatment of the Corinthian order of architecture, and the important matter of light has been duly considered and provided for in the ample window space.

Sewing-Machine Motor.

The illustration herewith shows a General Electric motor of special type for the operation of sewing machines. These motors are compact and simple of construction and are readily installed to machines for domestic use. They can be attached to most of the standard sewing machines. The speed is controlled by pressure on the treadle, and the machine can be instantly stopped by removing this pressure.



SEWING MACHINE MOTOR.

Change from motor power to foot power is readily accomplished.

These motors in size and construction are similar to the company's fan motors, but in place of the ordinary pedestal base they are provided with a frame casting, having a clamping foot for attaching to the table of a sewing machine. They can be connected to a lamp socket or wall receptacle by means of a flexible cord and plug. A small snap switch placed on the under side of the machine table



General View of Electricity Building, St. Louis Exposition.

enables the operator to stop and start the motor without leaving the machine. The motor is clamped to the back of the machine table so that the pulley is brought in line with the pulley on the sewing machine hand wheel. The pulleys are connected by a small round leather belt, the length of which is such that the machine will not take power from the motor unless the belt is tightened by pressure on the idle pulley on the rocker arm. The machine is controlled entirely by the foot treadle, the process of starting and stopping being the reverse of each other. These motors are wound for 115 volts, direct current, and for 52 or 104 volts, and 60 or 125 cycles, alternating current.

Convention Exhibit Echoes.

In ELECTRICAL WORLD AND ENGINEER last week, a large amount of space was devoted to notes of the exhibits and representatives at the Cincinnati meeting of the National Electric Light Association. As much material as could be prepared and forwarded and printed for inclusion in that issue was then given, but we are now able to supplement that data with further items as to other concerns, late comers and closing episodes.

MR. N. F. BRADY, treasurer of the New York Edison Company, gave a charming little informal lunch in the gentlemen's ordinary at the Grand on Thursday. Among those participating were Messrs. Doherty, Ferguson, S. Insull, A. Williams, J. I. Ayer, E. A. Leslie, J. B. Cahoon, and others prominent in the Association work; 14 in all being present. Mr. Brady proved himself, as usual, an excellent host, and a delightful hour of chat and good stories was enjoyed as an interlude to the hard work on the convention floor.

THE MOERLEIN BREWERY, one of the really great institutions of Cincinnati, was cordial in its invitation to the delegates, and a great many availed themselves of the opportunity to inspect that fine, modern establishment. A few of them were persuaded to try the beer, and pronounced it good. The plant is equipped with some very interesting up-to-date machinery.

MR. J. JONES, JR., who represented J. Jones & Son, of New York, at the convention, had several interesting novelties on view in his rooms, wired up and in operation. These included an automatic time cut-out device, purely mechanical in its operation; the alarm hand of the clock being operated in exactly the same manner as in an ordinary alarm clock, except that the trigger of the alarm in this case works on the circuit opening arrangements. In similar manner the Jones automatic time switches work with two cams which travel together, revolving once every 24 hours, being easily set to operate the switch at the proper time, after which the clock does the proposed work. For sign and window lighting the device is extremely handy. Another form is of the periodic commutating type. Mr. Jones showed also an ingenious rotary ceiling switch of the jack-knife type, in the regular snap connections, and only one chain pull. Another new device is a neat show-case lighting fixture of great flexibility as to adjustments, and constituting an admirable improvement for such work as show window illumination. The firm distributed a neat little pocket memordanum book crammed with information.

MR. L. D. SKINNER, JR., of the Skinner Engine Company, Erie, Pa., was in attendance.

MR. A. M. BARROW, the consulting engineer of Chicago, met several of his old and prospective clients.

MR. W. O. GARRISON, the president of the Columbia Incandescent Lamp Company, was a heartily-greeted participant in the various exercises and functions.

MR. H. P. BALL, engineer of the General Incandescent Arc Light Company, took part in the proceedings.

ELECTRIC APPLIANCE COMPANY, of Chicago, were wholly and adequately represented by their versatile Mr. W. W. Low, as well as by Messrs. G. B. Fairbanks and A. L. Willard.

CHICAGO INSULATED WIRE COMPANY were represented by Mr. W. M. Smith.

MR. I. F. BRINKMAN, the electrician of Lawrenceburg, Ind., came to the convention for the closing days.

MR. J. A. VAIL appeared on behalf of the Hooven, Owens & Rentschler Company, of Hamilton, O., whose engines are becoming favorably known in the electrical field.

GLOBE WERNICKE COMPANY, of Cincinnati, whose files, etc., have been a boon to many a central station man, were represented by Mr. E. K. Pritchett. The large store was also visited, as well as the factory, which has been electrified with a thorough equipment of Triumph motors.

MR. C. R. BISHOP, of the American District Steam Company, of Lockport, was one of the last to register.

THE ERNER-HOPKINS COMPANY, of Columbus, O., were represented by Mr. W. A. Hopkins, Jr., of that city.

DEARBORN DRUG AND CHEMICAL COMPANY were represented by Mr. Dan Delaney, of Cincinnati, and Mr. R. W. Francis, of Chicago.

JANTZ & LEIST ELECTRIC COMPANY were represented by Mr. C. T. Schlochtermeyer.

GREEN FUEL ECONOMIZER COMPANY sent Mr. W. J. Best from their Chicago Office.

SANDERSON & PORTER, the engineers and contractors of New York, were represented by Mr. W. A. Haller, of Galveston, Tex.

FAYERWEATHER & LADEW, the leather belting people, sent Mr. P. M. Burton, of Indianapolis.

MOLONEY ELECTRIC COMPANY, of St. Louis, were represented by Mr. T. A. Moloney, to speak in behalf of the good points of their well-known transformers.

CENTRAL ELECTRIC COMPANY, of Chicago, was represented by Mr. Allen S. Pearl.

HILL CLUTCH COMPANY, of Cleveland, was represented by Mr. H. W. Hill.

MCROY CLAY WORKS were on hand in the person of Mr. E. F. Kirkpatrick, their Chicago agent.

ROYAL ELECTRIC COMPANY, of Peoria, Ill., sent their well-known principal, Mr. G. G. Luthy.

MR. OSCAR CARMAN attended in behalf of the interests of Mr. R. L. McOuat.

MR. T. G. GRIER, of Chicago, met a great many old friends while circulating in the interests of the American Circular Loom Company.

AMERICAN ELECTRICAL WORKS, of Providence, were represented by Mr. F. E. Donohoe.

PROF. C. P. MATTHEWS dropped in from Purdue University, Lafayette, Ind., to take part in lamp discussions.

MR. W. J. PHELPS, by his method of handshaking, illustrated very clearly the high and low features of the lamps made by the Phelps Company.

LUNKENHEIMER COMPANY, of Cincinnati, were represented by Mr. David C. Jones, S. L. Moyer, and others. Most central station men proved on examination to be well posted as to their excellent valve and other specialties in the steam and mechanical line.

CROUSE-HINDS ELECTRIC COMPANY, of Syracuse, whose excellent switch and board work is winning deserved encomiums from central station men, were represented by Mr. Hinds.

MANHATTAN ELECTRIC SUPPLY COMPANY, of New York, sent Mr. J. W. McDowell from the home office.

HIGH LIFE BELOW STAIRS.—One of the most interesting exhibits referred to briefly last week was situated on Central Avenue, several blocks from the hotel. Carriages were kept busy conveying personally conducted parties, under the able management of Mr. B. S. Barnard, of The American Vitrified Conduit Company, who took all his friends to the exhibit, which means that practically everyone attending the convention went. The exhibit consisted of one of the manholes of the underground conduit system, which had been fitted up by Mr. G. M. Gest, the contractor, with carpets, rugs, portieres, divans, lamps, etc., until the manhole was transformed into a veritable Oriental subterranean parlor, except that it contained a washbasin, a telephone, an electric fan and an ice-chest, which are probably not usually found in Oriental parlors. A few papier-maché snakes, skulls and other weird ornaments contributed to the oddity of the situation. Mr. Gest, with true hospitality, provided the visitors with refreshments. The temperature being also much lower than on the street, helped very much to make the visit a relief from the strenuousness of the hotel corridor life, and many men sought peace there. The conduits leading into and out of the manhole will carry 150 cables. About 1,000,000 feet of the conduit is being laid in Cincinnati by Mr. Gest, who has several other large conduit contracts in hand in American cities.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in good supply with a light demand, the closing rates being 4½@5 per cent. for 30 to 90 days, and 4½ per cent for longer arrangements. In the stock market favorable crop reports and easier money rates had a good effect; heavy covering of shorts ensued, after which the market became quieter. Amalgamated copper advanced on the improvement in copper prices. There was more activity in the traction list, the prices closing at an advance over previous quotations. Brooklyn Rapid Transit closed at 68¼, which was within ¼ of the highest price of the week, the lowest being 64¼; the net gain was 3½ points. 40,650 shares having been sold. Metropolitan Street Railway closed at 150, a net gain of 3¼ points; the closing figure was ¼ point below the highest of the week, the lowest price being 146¾. The sales of this stock aggregated 50,900 shares. The electric stocks were generally quiet, General Electric closing at 315, which figure was two points below the highest of the week, the lowest quotation being 314. The shares sold aggregated 2,600. Westinghouse, common, closed at 215, which was the highest figure of the week, and representing a net gain of 7 points, while the first preferred closed at 210, a net loss of 8 points. Western Union reached 91⅞ and closed at 91⅛, a net gain of 1⅛ point. American District Telegraph closed at 38, a net loss of 2 points, and American Tel. & Tel., 178, a net loss of 2 points. Following are the closing quotations of May 27.

NEW YORK.

	May 20.	May 27.		May 20.	May 27.
American Tel. & Cable	92	90	General Electric	315	315
American Tel. & Tel.	177	176½	Hudson River Tel.	—	—
American Dist. Tel.	38	—	Metropolitan St. Ry.	148	147¾
Brooklyn Rapid Transit	66	68	N. E. Elec. Veh. Trans.	13½	—
Commercial Cable	161	161	N. Y. E. V. T. Co.	135	134
Electric Boat	28	28	N. Y. & N. J. Tel.	166	—
Electric Boat pfd	48	45	Tri. & Tel. Co. Am.	—	—
Electric Lead Reduc'n	3	—	Western Union Tel.	90	91⅛
Electric Vehicle	5	7	West. E. & M. Co.	212	212
Electric Vehicle pfd	17	17	West. E. & M. Co. pfd	206	206
General Electric	316	315			

BOSTON.

	May 20.	May 27.		May 20.	May 27.
American Tel. & Tel.	178	178	Mexican Telephone	2¼	2⅛
Cumberland Telephone	18	18	New Eng. Telephone	146	145
Edison Elec. Illum.	—	—	Westinghouse Elec.	—	—
Erie Telephone	36	36	Westinghouse Elec. pfd.	70	—
General Electric pfd.	318	315½			

PHILADELPHIA.

	May 20.	May 27.		May 20.	May 27.
American Railways	16	16	Phila. Traction	95⅝	95⅝
Elec. Storage Battery	88	88	Phila. Electric	5¾	5¾
Elec. Storage Batt. pfd	58	58	Phila. Elec. Vehicle	1¼	—
Elec. Co. of America	7	7	Pa. Elec. Vehicle pfd	4	—

CHICAGO.

	May 20.	May 27.		May 20.	May 27.
Central Union Tel.	—	—	National Carbon pfd.	91¾	93
Chicago Edison	174	175½	Northwest Elev. com.	—	37
Chicago City Ry.	250	250	Union Traction	38	38
Chicago Teleph. Co.	124	124	Union Traction pfd.	82	82
National Carbon	13	13			

* Asked.

MAHONING VALLEY TROLLEYS.—The Pennsylvania and Mahoning Valley Railroad Company has been incorporated under the laws of Pennsylvania, with a capital stock of $8,000,000. The company represents a consolidation of the Trumbull Electric Company, the Mineral Ridge Railway Company, the Mahoning Valley Railway Company, the Newcastle and Lowell Railroad Company, the Newcastle Traction Company, the Lawrence Gas Company, and the Newcastle Electric Company. The combine has also purchased Cascade Park, near Newcastle. It controls 90 miles of track, reaching from Leavittsburg, Ohio, to Newcastle, Penn. The following officers have been chosen: President, M. A. Verner, Pittsburg; vice-president, James Parmlee, New York; secretary, John E. McVey, Youngstown, Ohio; general manager, A. A. Anderson, Youngstown. The company was organized by Col. Myron T. Herrick, James Parmlee, and Benjamin F. Miles of Cleveland, who own a controlling interest in the combined properties. The capital stock of $8,000,000 is divided into $3,000,000 5 per cent. preferred and $5,000,000 common stock. Ultimately it is expected that the road will be a part of a system that will have a through traffic arrangement between Cleveland and Pittsburg. The Eastern Ohio Traction line is now built within a few miles of Leavittsburg, the western terminus of the Pennsylvania and Mahoning Valley Company's road, and is being pushed rapidly forward. From the eastern terminal at Newcastle, Pittsburg capitalists are building an electric line that will shortly be completed, and with which it is expected through service will be arranged into Pittsburg.

INTERNATIONAL POWER.—Soon after the collapse in the price of International Power Company stock, Joseph H. Hoadley, the president of the company, announced that he had requested Harvey Fisk & co. to make an examination of the company's affairs, with a view to giving the stockholders and others who had been caught in the collapse an idea of what the company really owned. The examination, which was made by Haskins & Sells, public accountants, has been made public. The report shows that practically all the statements made by officers and friends of the company when the stock was being sensationally advanced were incorrect. One of the most common statements made at the time was that the company was earning enough to pay dividends at the rate of 10 per cent. on the common stock. The net earnings of the company, as shown by the report for the year ended December 31 last, were $50,005, and the total income from all sources, including dividends from the American Locomotive Company and other sources amounted to $292,796. From this amount must be deducted $47,328 as interest on fixed obligations. The surplus is therefore $245,467. Out of this must come the dividends on the preferred and common stock. At the rate of 6 per cent. on the preferred and 10 per cent. on the common it requires $676,000 to pay a year's dividend on both classes of stock, assuming that dividends are paid on all stock issued. It is stated by the president that the company has orders enough ahead for Diesel engines and auto trucks for shipment abroad alone, aside from orders from this country, to run all its factories continuously for several years.

TELEGRAPH POLICIES.—The election of Mr. Bradley of the Postal Telegraph as a director of Iowa Central, following the election of Mr. John W. Mackay as a director of Minneapolis & St. Louis and of Mr. George Crocker as a director of Postal Telegraph, suggests a possibility that in the not far distant future the Postal Telegraph may supersede Western Union along the lines of Minneapolis & St. Louis and Iowa Central, both of which companies are believed to be dominated by Mr. Crocker. The present installation by the Postal Telegraph Co. in the Arcade Building in Philadelphia is the first by that company in a building controlled by the Pennsylvania Railroad. An official of the Pennsylvania Railroad says: "I do not see any possible chance of the resumption of relations between our company and Western Union. The differences between us have been of long standing, all efforts to come to an agreement having failed, and I am fully convinced that our notice that the compact is to end is final."

LONG ISLAND CONSOLIDATION.—It is announced that a new corporation is to be formed shortly with $3,000,000 capital stock, and $2,500,000 first and collateral trust mortgage four per cent. fifty year bonds, which will be exchanged for the securities of the following companies: Staten Island Electric Railroad, at par; New York and Staten Island Electric Company, at 120 for bonds (interest to be adjusted in cash) and $30 for stock; New Jersey and Staten Island Ferry Company, at par for bonds and 10 for stock, and the Richmond County Power Company, at 125. The capital stock of the new company is to be represented by a five years' voting trust, composed of H. H. Rogers, Walter G. Oakman and William L. Bull. The cash working capital will be $438,880. The new securities are underwritten.

ATTACKING SUPPLY "TRUST."—According to advices from Chicago, complaint is to be filed with Attorney General Knox that the Electrical Supply Dealers' Association of the United States is a trust. Information is being collected by independent electrical supply dealers. When they act, which will be soon, they will ask the Attorney General to proceed against the association under the Sherman law as being a body that acts arbitrarily and illegally in restraint of trade, and to crush competition. The names of the "independents" referred to are not given.

THE CANTON-AKRON RAILWAY COMPANY has executed a mortgage for $2,000,000 to the Knickerbocker Trust Company, of which $850,000 is reserved to retire the bonds of the Canton-Massillon Company now owned by the same people, and $400,000 will be reserved for future improvements. The balance will be used in getting the road into operation. The bonds are for 20 years at 5 per cent. A mortgage for $1,000,000 given a few months ago was cancelled.

THE BELL TELEPHONE COMPANY OF CANADA has increased its capital stock from $5,000,000 to $6,000,000, and each stockholder of record of May 23 can subscribe for the new stock at $125 per share on the basis of one share of new stock for every five shares held. Subscriptions will be payable in $25 installments every three months, beginning July 2, 1902.

PROVIDENCE TRACTION DEAL.—The terms under which the United Improvement Company of Philadelphia will take over the United Traction Company of this city have been given out. The local company has a capital of $8,000,000, all common stock, and when it was incorporated, nine years ago, was bonded for $8,000,000 more. The Philadelphia capitalists have had organized in this State a company with the nominal capital of $2,000,000, to take over such Rhode Island properties as it may buy. This concern has been called the Rhode Island Company, but it is reported that still another company is to be chartered in another State for the purpose of taking over the Rhode Island company. The announcement to the United Traction stockholders is that the Rhode Island company will guarantee 5 per cent. on the Traction Company's stock, and in addition will give one share of its own stock for every four shares of Traction stock. The offer will be accepted, as it is a good bargain for the Traction stockholders, most of whom bought their stock at very low figures. The stock at present pays 4 per cent., and is quoted at 121. United States Senator Nelson H. Aldrich is the president of the local road, and he has seen his heavy holdings grow in nine years from nothing to a premium above par. Anthony N. Brady, Hugh J. Grant and several other New Yorkers made a lot of money in the original purchase of the road from the horse-car owners. In addition to the Traction Company, the Philadelphia men are to take over and include in their Rhode Island Company the Providence Gas Company and the Narragansett Electric Lighting Company. The gas company is owned largely by Goddard interests, and pays 8 per cent. on $50 par value stock. Both companies will come in under a dividend guaranteed.

GENERAL ELECTRIC-SPRAGUE CONSOLIDATION.—Stockholders of the Sprague Electric Company have received circulars from President Markle of that company, informing them of an offer of the General Electric Company to acquire their stock. It is understood that a sufficient number of stockholders have already accepted the offer, so that the acquisition of control by the General Electric Company is assured. Under the terms of the offer the Sprague bondholders will receive 55 per cent. in Otis Elevator preferred stock and 45 per cent. in cash. Sprague preferred stockholders will receive General Electric 3½ debenture bonds, one bond for each share. Common stockholders will get 41.9 per cent. in Otis Elevator common and 20.42 per cent. in General Electric forty-year gold debenture bonds. The circular explains that the reason why Otis Elevator stock appears in the exchange is that some years ago the Sprague Electric Company sold its elevator business to the Otis Company, for which it received Otis stock. This stock has since been in the treasury, so what amounts to a distribution of the treasury assets will take place before the actual absorption is completed. The capital stock of the Sprague Electric Company is $5,000,000. That of the General Electric was recently increased to $45,000,000. Fuller details have been collected and given elsewhere in this issue.

PHILADELPHIA TROLLEYS.—With the affixing of the signatures of John B. Parsons, president, and J. B. Selfridge, secretary, of the Union Traction Company, and W. T. C. Sanders, president, and J. Edward Ryan, secretary, of the Philadelphia Rapid Transit Company, on May 24, the lease of all of the trolley lines in Philadelphia operated heretofore by the Union Traction Company passed to the new corporation, controlled by the Mack syndicate. The document transfers to the new concern the largest street railway system in the world, comprising a trackage of over 480 miles. The lease goes into effect July 1, and by that time, it is asserted, everything will be in readiness for the rapid transit company to take over the property and operate it. Prior to the execution of the lease John M. Mack was elected director of the Union Traction Company to fill the vacancy made by the resignation of Thomas Dolan. The Rapid Transit Company will organize this week. The slate for Board of Directors follows: John B. Parsons, P. A. B. Widener, William L. Elkins, George D. Widener, John M. Mack, Michael Murphy, W. H. Shelmerdin, and J. J. Sullivan. Mr. Parsons is to be the president of the Rapid Transit Company.

NORFOLK, VA., TROLLEYS.—The report is current, as already noted, that Mr. G. R. Webb, vice-president of the United Railways of Baltimore, is to become president of the Norfolk, Newport News and Portsmouth Company, which is the $9,000,000 consolidation of the street railway and kindred interests of Norfolk and neighborhood, financed by Baltimore capital. It is understood in financial circles that this official slate has been agreed upon: president, R. Lancaster Williams, Richmond, now president of the Norfolk Railway and Light Company, one of the constituent companies; vice-president, W. J. Payne, Newport News, now president of the Newport News and Old Point Railway and Electric Company, also included in the deal. General manager, E. C. Hathaway, Baltimore, now general manager of the Railways and Light Company of America, which owned the Berkeley property included in the consolidation.

MASSACHUSETTS ELECTRIC.—The trustees of the Massachusetts Electric Co. are asking permission for the issue of $5,500,000, par value, of new preferred stock. They say that all the proceeds will be invested in the securities of the companies in which the Massachusetts Electric Co. is already a shareholder, and will be applied to the carrying out of improvements.

GENERAL ELECTRIC AND COPPER.—An official of the Greene Consolidated Copper Co. says: "Reports to the effect that a controlling interest in the Greene Consolidated Copper Co. is now in the hands of the General Electric Co. are without foundation." The rumors are also denied as absurd by the General Electric Co.

Commercial Intelligence.

THE WEEK IN TRADE.—The only unfavorable feature in trade conditions during the past week was the continued unrest of labor and the idleness of large numbers of industrial workers as a result. The coal strike is the serious element of disturbance in the domain of manufacturing and industry generally, which naturally depends upon coal for its basic force, involving a loss of $1,500,000. weekly in wages to the miners and allied industrial operatives. In all other lines favorable reports have been received by the mercantile agencies. Hardware is active and lumber is meeting with unprecedented sales. Cleveland advices are to the effect that iron and steel mills are running at high tension and are sold far ahead; Pittsburg reports little let-up in the crush of demand in the iron mills; structural mills are crowded with orders, and the bar and bolt mills have all they can do. Railway gross earnings continue in a very satisfactory condition. The roads thus far reporting for the first half of the year show earnings of 8.9 per cent. in excess of the figures for the same period last year. The business failures for the week, as reported by Bradstreet's, aggregated 152 as against 190 the week previous and 192 the same week last year. The copper market continues firm, a good business being reported both for domestic consumption and for export, and prices show a further improvement. The closing quotations are 12½ c. for Lake, 12⅛ c. for electrolytic in cakes, wire bars and ingots, 12 c. in cathodes and 12⅛ c. for casting copper.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended May 17: Antwerp—19 pkgs. material, $1,321. Argentine Republic—81 pkgs. material, $1,761; 3 pkgs. machinery, $212. Brazil—166 pkgs. material, $3,594; 33 pkgs. machinery, $5,754. British Australia—342 pkgs. material, $16,979; 5 pkgs. machinery, $561. Bremen—8 pkgs. material, $304. British East Indies—25 pkgs. material, $919. British West Indies—69 pkgs. material, $2,625; 18 pkgs. machinery, $844. Chili—8 pkgs. material, $113; 1 pkg. machinery, $22. Christiania—3 pkgs. machinery, $119. Central America—19 pkgs. material, $195; 15 pkgs. machinery, $784. Colchester—2 pkgs. material, $53. Copenhagen—4 pkgs. machinery, $2,931. Cuba—13 pkgs. machinery, $2,666; 132 pkgs. material, $9,969. Gothenburg—4 pkgs. machinery, $700. Gijon—3 pkgs. material, $50. Genoa—7 pkgs. material, $334. Glasgow— 12 pkgs. material, $374; 57 pkgs. machinery, $10,586. Hamburg—10 pkgs. machinery, $495; 8 pkgs. material, $386. Havre—5 pkgs. machinery, $483; 24 pkgs. material, $385. Japan—7 pkgs. material, $475. London—331 pkgs. machinery, $5,092; 101 pkgs. material, $3,939. Liverpool—68 pkgs. machinery, $6,719; 37 pkgs. material, $1.331. Lisbon —6 pkgs. material, $545. Mexico—75 pkgs. material, $2,414; 53 pkgs. machinery, $800. Manchester—203 pkgs. machinery, $32,391; 4 pkgs. material, $1,005. Peru—5 pkgs. material, $150. St. Petersburg—1 pkg. machinery, $75. Southampton—12 pkgs. material, $971; 4 pkgs. machinery, $890. Siam—1 pkg. material, $45. Tasmania—6 pkgs. material, $175. U. S. Colombia—4 pkgs. material, $171. Vienna—2 pkgs. machinery, $1,000. Viborg—13 pkgs. machinery, $3,000.

STANTON ON COPPER.—Expert opinion in respect to copper trade conditions is that improvement will from now on be the order. Perhaps the most significant statement of an authority along these lines is this succinct one of John Stanton, quoted by the *New York Times*, as follows: "There is every reason to believe that the price of refined copper will go considerably higher. Consumption is very heavy, and production has not increased to any appreciable extent. Much of the large surplus, which was held in this conutry six months ago, has been shipped abroad. The mills are working to their utmost capacity, and many consumers are anxious to know where the supply is coming from, if consumption and production continue in the present ratio."

BIG BULLOCK ORDER.—The Pittsburg Reduction Co.'s projected works at Massena, N. Y., are to be equipped with four 1800 kw generators to be manufactured by the Bullock Electric Manufacturing Company.

THE BRADLEY MANUFACTURING COMPANY, of Pittsburg, which concern have acquired the American rights for the manufacture of the Willans central valve engine built at Rugby, England, by Willans & Robinson, Limited, have let contracts for the electrical equipment of its works now under construction at Allegheny, Pa. All the machinery will be operated by electricity. The water tube boilers are to be furnished by the Oil City Boiler Works of Oil City, Pa. The generators and dynamos will be of Bullock manufacture. Pawling & Harnischfeger, of Chicago, will install a six-ton electric traveling crane. The machine shop equipment has been ordered from the Brown & Zortman Machinery Company, of Pittsburg, Pa. The Bradley works will cover an area of 100 feet by 380 feet and are to consist of a main building, erecting shop, pattern shop, storage house, engine and boiler room, etc. They are of steel structure after designs by Samuel Discher & Sons, Pittsburg. It is the intention of the company to build engines from 50-hp up to 100. The Willans central valve engines are single acting vertical and are made either simple, compound or triple expansion. The piston rod is hollow and contains the valves which are of piston type, all mounted upon one rod, which is operated by an eccentric mounted on a crank pin. The steam enters the hollow piston rod and is admitted to the first cylinder by the movement of the rod and valves and exhausts through the piston rod into the next cylinder. In place of the ordinary crosshead and guides, there is a guide piston; on the upstroke of the engine, air is compressed in the space above this piston and the bottom of the low-pressure cylinder, and thus the pressure in the bearings is never reversed. The work done in compressing the air on the return stroke is nearly all given out again in the next working stroke, so there is practically no loss. The speed is controlled by a shaft governor operating a throttle valve. All working parts of the engine are enclosed. The principal parties interested in the enterprise are C. H. Bradley, Jr., J. H. Bailey, both of Pittsburg, and D. J. Geary of the Oil City Boiler Works, Oil City, Pa.

MORE ELECTRICAL EQUIPMENT FOR MACY.—R. H. Macy & Company's new store now being constructed at 34th and 35th Streets and Broadway, besides having the largest private lighting plant in New York—particulars of which appeared in our issue of Jan. 18—is to be equipped with one of the most elaborate pneumatic cash carrying and package handling systems, which will be operated by electric motors to be furnished by the C. & C. Electric Company, of special make. The equipment will be furnished by the Pearsall Pneumatic Tube Company, of 52 Broadway. The three blowers will be each driven by 100-hp motors. The New Jersey Foundry & Machine Co., whose offices have been removed to 9-15 Murray Street, is to supply the specially designed package conveying apparatus which will be operated by 245 low-speed motors of 2-hp each and three 5-hp ones. A 30-hp vertical motor will be furnished for driving the water supply pump and two C. & C. 7½ motors are to be used for working the laundry machinery, which is to be installed in the building.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD CO., Providence, R. I., in addition to several recent large installations which they have recently made of their system in this country, have arranged with the Sturtevant Engineering Co., Ltd., Great Britain, to represent them in British South Africa and in Continental Europe outside of Holland, the Dutch Colonies and Belgium. In the latter countries an agency is already established and has been for some little time. The instruments already shipped abroad have given such perfect satisfaction and have rendered such splendid service that a large amount of inquiry has developed concerning them, and the new agency thus formed in connection with the existing one gives the Clark Co. an excellent opportunity of meeting the demand which the value of the system has created. Arrangements have also been made for representation in Australia. Mr. J. L. Putnam, manager of the company, passed through New York recently on a trip west, where the demand for a good intercommunicating system and inquiry in regard to the Clark system specifically has demanded attention.

SOME RAPID TRANSIT CONTRACTS.—The American Bridge Company, of New York, has been awarded the contract for the structural steel to be employed in the construction of the N. Y. rapid transit railroad's power house. The contract calls for some 9,000 tons of steel. The contract for the foundation work of the power station and for the underground condensing water conduits has been placed with Ryan & Parker, of New York. Westinghouse, Church, Kerr & Company have taken an order for two 400-hp exciter engines. The important contract for the generators is expected to be decided upon within the next few days. It will be recalled that the main engines are to be built by the Allis-Chalmers Company.

THE WILLARD STORAGE BATTERY COMPANY, of Cleveland, O., has recently been incorporated under the laws of West Virginia with $250,000 capital stock, fully paid in. The company has organized with Edmund Masson, President; J. A. Richmond, secretary-treasurer, and T. A. Willard, general manager. The company will continue the manufacture of all types of Willard battery. Considerable new machinery has been installed in the factory and new processes have been developed which will improve the plates, rendering the more uniform and in other ways increasing the life of the battery. The work will have the personal supervision of Mr. Willard.

PULLMAN TROLLEY CARS IN RUSSIA.—U. S. Consul Samuel Smith reports from Moscow, as follows: The City Electric Railroad Company, of Kief, has lately received two Pullman cars, which were ordered by the municipality as an experiment. The cars were shipped from Berlin in separate parts and are now being put together at the Kief City Railroad Works. They are of the double-truck type and have four motors of 25-hp each. The cars at present in use at Kief have two motors of 25-hp each. The new cars are equipped with all the latest improvements, including electric brakes and electric lights.

THE ALBERGER CONDENSER COMPANY, of 95 Liberty Street, New York, has recently received an order for an important condensing equipment to be installed in the steam turbine testing room of the new shops of the Westinghouse Machine Company at East Pittsburg. This apparatus consists of an 8000 sq. ft. surface condenser of the Alberger high vacuum type, a Corliss two-stage dry vacuum pump and a centrifugal circulating pump connected to a Westinghouse engine. Owing to the high vacuum desired in steam turbine practice, this condensing outfit is to maintain 28 inches of vacuum.

HANDLING HIGH TENSION CURRENT.—A number of interesting tests of high tension switches have been made at the Colgate power house of the Bay Counties Power Co. at different times. The switch designed by J. N. Kelman, superintendent of the Colgate Division, which stood the most severe test at 4,000 volts, was recently given the same severe test at 60,000 volts and handled this extremely high potential in an exceedingly satisfactory manner proving beyond a doubt that the highest potentials can be safely manipulated and controlled.

THE RENO INCLINED ELEVATOR CO. of 551 West 35th Street, New York City, has requisitioned for four special slow-speed motors varying from 7½ hp to 15 hp. They will be utilized for operating inclined stairways at the Woman's Hotel now under construction in New York uptown, and at the Siegel-Cooper store, Sixth Avenue. The C. & C. Company has also received a contract from the Standard Steel Works, Burnham, Pa., for seven 50-hp slow-speed motors for driving various machinery.

MORE MACHINE TOOLS FOR JAPAN.—Further contracts placed by F.W. Horne, of Yokohama, who it will be recalled is now in the United States and makes his headquarters at 35 South William Street with W. J. Kingsland, include several machine tools for installation, principally in Japanese dockyards and railway shops. The Bradford Machine Tool Company, the Sebastian Lathe Company, Smith & Mills, and the Bickford Drill & Tool Company, all of Cincinnati, O., have been alloted the major portion of the orders.

TROLLEY POLES FOR JAPAN.—The National Tube Company, from its Morris-Tasker, Philadelphia, works is about to make shipment of 1,000 trolley poles for the Tokio Densha Tetsudo Kabushiki Kwaisha, which concern is about to construct a 22-mile electric traction system in Tokio, Japan, the contract for the equipment of which was recently secured by the General Electric Company through the Japanese house of Mitsui & Company, which is financing the enterprise.

VARIOUS C. & C. ORDERS.—The C. & C. Electric Company has been allotted an order by the Grasselli Chemical Company, East Chicago, Ill., calling for a 150-kw belted generator, switchboard, etc., and two motors of 25-hp capacity each. This equipment will be used for operating machinery in the Chicago Works. The John G. Woodward Company, of Council Bluffs, Iowa, has ordered a 75-kw direct connected generator for lighting purposes.

BRILL TRUCKS FOR ADELAIDE.—Brill trucks will be utilized on the projected electric traction system in the city of Adelaide, South Australia, the contract for the equipment of which, as mentioned in these columns last week, has been secured by the Australian electrical engineering and contracting firm of Noyes Brothers, of Sydney, on behalf of the Westinghouse interests. In the first instance at least 150 cars will be operated.

MACHADO & ROLLER, 203 Broadway, New York, have taken over the exclusive manufacturing and selling rights for the ohmmeters formerly made by F. B. Sage & Co. These devices will now be manufactured by the Whitney Instrument Company, for whom Machado & Roller are the general selling agents, and the new facilities will, it is understood, permit a reduction in price.

General News.

THE TELEPHONE.

[illegible] has recently installed a telephone exchange here.

NEW DECATUR, ALA.—The William J. & Frank E. Bell Telephone Company, of Chicago, Ill., is making arrangements to establish a system in this place to compete with the Southern Bell Company. They agree to furnish telephones at less than half the rates charged by the latter.

DOVER, DEL.—The International Telephone Company of America surrendered its corporate franchises and filed a certificate of reincorporation. The incorporators are Josiah Marvel, Edward Marvel and William M. Lupton, all of Wilmington, Del.; capital, $1,000,000.

COVINGTON, KY.—The Citizens' Telephone Company has increased its capital stock from $30,000 to $100,000.

SALT LICK, KY.—The Salt Lick & Yale Telephone Company has been incorporated with W. J. Fell, president; J. H. Campbell, vice-president; A. H. Points, treasurer. The above, with W. A. Whitcomb, N. R. Ratliff and Sherman Gullett, are directors.

COUNCIL, IDAHO.—A stock company is being formed to build a telephone line from Meadows to Council. Frank Gribben is interested.

DUNCAN, ILL.—The Duncan Telephone Company is extending its line to Princeville.

TUSCOLA, ILL.—The Coles County Telephone Company has applied for a franchise to enter this city.

COOKSVILLE, ILL.—The Cooksville Telephone Company has incorporated with a capital of $8,000. Jos. Arnold is one of the incorporators.

WATERLOO, ILL.—The Harrison Telephone Co. of Waterloo, Ill., has petitioned for a franchise to connect Waterloo and Millstadt by telephone.

CARBONDALE ILL.—The Carbondale Telephone Co. of Carbondale has been incorporated with a capital stock of $5,000. The incorporators are Joseph B. Bundy, Daniel B. Parkinson and Daniel M. Parkinson.

CARLINVILLE, ILL.—Representatives of the Macoupin Telephone Co. and the Chesterfield Telephone Co. held a meeting recently at which an agreement was reached regarding a new telephone line from this city to Chesterfield. The Chesterfield people will construct a line from that village to Comer, and the Macoupin Co. of this city will build from this city to Comer, making a direct toll line. The Chesterfield people will also construct two lines to Medora, one for toll business and one for the farmers along the route. When the three lines are completed they will have connection with the Kinloch system of St. Louis, giving them a long distance line into that city.

GAS CITY, IND.—The council has passed an ordinance over Mayor Lay's veto, granting the United Telephone Company, of Marion, a franchise to use the streets, erect a system and put in an exchange.

CLARKS HILL, IND.—Eighteen co-operative telephone companies in the northern district of the farmers' telephone system are considering negotiations looking to connection with Lafayette and Lebanon, and for better and more permanent connections with Frankfort, Crawfordsville and other cities.

MUNCIE, IND.—The organization of the Delaware-Madison County Telephone Company has been completed, the $500,000 stock being quickly taken. The new company has begun operation in this city. When the system is completed 140,000 telephones will be connected—65,000 in Indiana and 75,000 in Ohio.

FLORA, IND.—Local business men and neighboring farmers have organized the Farmers' Mutual Telephone Company, with a capital of $25,000. The Flora & Bringhurst Telephone Company has been in operation here for three years, but the service is unsatisfactory, and this movement is for self-protection and for lower rates. The old company is desirous of selling to the new.

LAFAYETTE, IND.—The telephone girls of the Lafayette Telephone Company went out on a strike recently and tied up the service for several hours, thereby forcing an answer to their demand for a raise to 10 cents an hour. Compromise terms were finally agreed to, whereby the girls get 9 cents an hour and the company signed an agreement not to discharge anyone for participation in the strike.

MARION, IND.—The Central Union Telephone Company has embarked in the grocery business in this city. The company is taking orders from all subscribers having telephones in their houses, and is delivering groceries at cost. The move is the result of a boycott made against the company by the leading groceries. The company announces that if the boycott is continued it will establish the largest general store in the city.

EVANSVILLE, IND.—Mayor Covert has appointed a committee and started it out to solicit subscriptions for stock to the municipal telephone company which he is promoting. The franchise will not be presented to the board of public works until after enough stock has been sold to insure the completion of the plant. The people do not seem so enthusiastic over the scheme since realizing that they are expected to pay for the enterprise.

INDIANAPOLIS, IND.—The following telephone companies have been organized recently: The Baldwin Telephone Company. Capital stock $4,800, to operate in Montgomery County. The Modoc Telephone Company, of Modoc, capital stock $5,000. Directors, T. F. Whellan, H. A. Gaddis, P. E. Stepanek and R. H. Hunt. The Moncrief Telephone Company, of Moncrief. Capital $1,000. Walter Boyd heads the board of directors.

INDIANAPOLIS, IND.—The directors of the New Castle Telephone Company have filed amended articles of incorporation. The company proposes to extend branches through the counties of Henry, Delaware, Madison, Rush, Hancock and Wayne. R. R. Faulkner has purchased a controlling interest in [illegible] and is [illegible] several independent companies. It is believed the system will now be largely extended. This company came into existence through the raising of prices by the Central Union.

DENISON, IOWA.—A special election will be held June 10 to vote on a franchise for the Crawford County Telephone Exchange.

DAVENPORT, IOWA.—It is probable that the Iowa Telephone Company will extend a line from this city to Plainview and Maysville.

CUSHING, IOWA.—The Farmers' Telephone Company, of Cushing, has incorporated with a capital stock of $6,000. G. A. Dowell is president.

MARYSVILLE, KAN.—The Marysville Telephone Company has incorporated with a capital of $10,000.

RUSSELL SPRINGS, KAN.—The Logan County Telephone Company has incorporated with a capital of $2,500.

RAYVILLE, LA.—The Cumberland Telephone Company will extend its line from Girard to this place.

PONTIAC, MICH.—The Union Telephone Company is building a line from Linden to Holly.

DETROIT, MICH.—The Michigan Telephone Company will extend its lines to Mass City, Greenland and other points in Ontonagon County.

VERNDALE, MINN.—The Central Telephone Company, of Verndale, Minn., has been incorporated; capital, $10,000; incorporators, S. L. Frazier, George E. Merrill, Wilbur N. Morrill, H. M. Henderson, of Wadena, and James Boyd, Alexander Boyd and Peter Boyd, of Central, Minn.

WEST POINT, MISS.—The Citizens' Long Distance Telephone & Telegraph Company is installing a system here.

SOUTH OMAHA, NEB.—The South Omaha Independent Telephone Company has incorporated with a capital of $75,000. W. S. King is interested.

FRANKLIN, N. H.—The Citizens' Telephone Company will construct a line towards Sanbornton.

IVY, N. C.—The Ivy Telephone Company has ordered material for 50 miles of line.

BEAUFORT, N. C.—Mr. R. A. Strong of this place has completed arrangements for a new telephone system by which subscribers can have instruments metallic line to Lincolnton and the cotton mills on the C. & N. W. Railway.

GREENSBORO, N. C.—The Southern Bell Telephone & Telegraph Company has made application for a franchise for a local exchange in this place.

NAPLES, N. Y.—The Naples Telephone Exchange, of Naples, Ontario County, capital $8,000, has been incorporated; directors, S. A. Story, H. W. Blake and G. B. Hemenway, of Naples.

ALBANY, N. Y.—The Coxsackie & Greenville Telephone Company, of Medway, Greene County, has been incorporated with a capital of $995. The directors are W. S. Rundall and James Stevens, of Greenville; G. B. Lampman, D. E. Davis, Spencer Palmer and W. N. Miller, of Medway; William T. Haswell, of Climax; Levi Bedell, of Coxsackie, and Joseph A. Losee, of Grapeville.

STRYKER, OHIO.—The Stryker Rural Telephone Company is reorganizing, and will build a farmers' community system.

MT. BLANCHARD, OHIO.—The Peoples' Telephone Company, of Hancock county, has been incorporated with $25,000 to build a local system.

PORT CLINTON, OHIO.—The Port Clinton Telephone Company will build a third line to Lacarne to accommodate the increasing patronage among farmers in that section.

MILLBURY, OHIO.—The Millbury Telephone Company has been incorporated with $5,000 capital stock by Fred Calkins, F. F. Ohmstead, H. J. Middough, L. T. Williams and M. L. Barmer.

HAMILTON, OHIO.—Judge Belden has refused the application of the Bell Telephone Company for an injunction restraining the Hamilton Home Telephone Company from building its system.

CHILLICOTHE, OHIO.—The Chillicothe Home Telephone Company has organized as follows: Joseph S. McKell, president; William A. Wayland, vice-president; Louis Brehmer, treasurer; Charles Duncan, secretary.

BATAVIA, OHIO.—The Citizens' Telephone Company has established an exchange and is building lines to Manila, Belfast, Newton, Cozadale and Goshen. Free service will be given throughout Clermont county.

MONROEVILLE, OHIO.—The Huron County Telephone Company has been sold by C. R. Callaghan, F. A. Knapp, W. M. Halliday and others to Hon. J. F. Laning, of Norwalk. The property includes exchanges at Monroeville, Chicago Junction, Plymouth and New Washington. The price paid was about $70,000. Mr. Laning is at the head of the proposed Local Telephone Company, which is endeavoring to consolidate exchanges in Huron, Erie, Crawford and Seneca counties. He holds options on exchanges at New London, Greenwich, Milan, Berlin Heights, Crestline and Attica.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company has completed a line to Camden and will push on to Hartsville, a distance of 30 miles. The line to Augusta, Ga., will probably be completed within a month.

CENTERVILLE, TENN.—Mr. I. B. Parker of this place is endeavoring to establish a new independent telephone system. His plans are favored by a number of the citizens.

BON AIR, TENN.—The Gainsboro Telephone Company will in the near future build a line from this place to Ravens Croft, where the new shaft mine of the Bon Air Coal Company is being opened.

SALT LAKE CITY, UTAH.—A long distance telephone system is now in successful operation from Nome as far as Soloman City, below Port Safety. It is understood the Long Distance Telephone Co. will extend its line to all of the different mining districts, or wherever business will warrant. Telephones have been installed at Nome River, Hastings Creek, Port Safety and Soloman City.

SALT LAKE CITY, UTAH.—The Inland Telephone & Telegraph Co. is making improvements in the local system at North Yakima, Wash., and the 40-mile gap between Pasco and Prosser will be at once closed. When this line is completed it will open up eastern Oregon, eastern Washington and parts of Idaho. A new loop will also be built over the Cascade range at Stampede pass, so as to give better service.

ALEXANDRIA, VA.—The English Telephone Company has been chartered. L. Hutchins is interested.

FREDERICKSBURG, VA.—The stockholders of the Upper Rappahannock Telephone Company have organized, with Robt. Beverley, of Essex, president. The line will be built at once.

CUMBERLAND C. H., VA.—The Fluvanna and James River Valley Telephone Company has extended its lines to Cumberland, and communication will soon be established with Richmond. The next extension, it is said, will be to Farmville. A number of farmers along the route are taking the service

CLARKSBURG, W. VA.—The Sardis Telephone Company has incorporated with a capital stock of $10,000. H. A. Swiger is interested.

MILWAUKEE, WIS.—The Wausaukee Telephone Company has incorporated to operate in Marinette County; capital, $10,000. E. F. Fox is interested.

ELECTRIC LIGHT AND POWER.

TALLADEGA, ALA.—The Talladega Company, of Talladega, has petitioned the city for a franchise to operate a light, power and traction system. The capital of the company is $600,000.

LOS ANGELES, CALIF.—The Consumers Electric & Gas Company, of Los Angeles, will attempt to secure a franchise and conduct a branch business in Santa Ana, Calif.

SAN FRANCISCO, CALIF.—The Dillon Electric & Power Company which recently bought the electric plant of the Orr Electric & Power Company, at Dillon, Mont., will improve and extend the system.

SAN FRANCISCO, CALIF.—The Terminal Gas, Electric & Power Company has been incorporated by F. H. Rindge, H. C. Carter and other Los Angeles capitalists. Electric light and power will be supplied in San Pedro, Calif.

SAN FRANCISCO, CALIF.—The General Electric Company has closed a contract to furnish a 500-hp induction motor for the Pacific Coast Smelting & Refining Works. The plant is situated at Bay Point, Contra Costa County, Calif.

SAN FRANCISCO, CALIF.—The Northern California Power Company was the successful bidder for the Glenn County franchise for which it had applied. The company will transmit electric power from its plant on Mill Seat Creek near Shingletown through five counties. The town of Willows will be reached under the new franchise.

SAN FRANCISCO, CALIF.—The great dome of the City Hall in San Francisco will be elaborately wired for 5,000 sixteen-candle power electric lights. The Board of Supervisors has appropriated $3,500 for that purpose. The illumination of the dome has been a great feature on several occasions and the permanent installation will show a great improvement over the temporary effects.

SAN FRANCISCO, CALIF.—The Santa Paula Electric Light Company, which was recently incorporated with a capital stock of $200,000, will install an electric plant within 60 days to furnish current for lighting in Santa Paula, Calif. The directors are J. A. Driffel, of Oxnard, C. C. Teague, of Santa Paula, and W. J. Wayte, of San Francisco. Construction work has been commenced.

SAN FRANCISCO, CALIF.—The United Gas & Electric Company of San Francisco has almost completed its plans for the final transfer of the properties of the three electric companies carrying on business in and around San Jose, Calif. As soon as possible the works of the San Jose Light & Power Company will be shut down and the electric plants of all of the companies concentrated at the Electric Improvement Company's new plant in San Jose. A large central station and sub-station will be established for generating current when necessary and for distributing the current of the Standard Electric Company. All of the towns on the west side of San Francisco Bay will be lighted from the Standard Company's transmission lines. The local power houses in the towns between San Francisco and San Jose will be abandoned and both electricity and gas will be distributed from San Jose.

SAN FRANCISCO, CALIF.—The California Central Gas & Electric Company, San Francisco, which is the distributing company for the Bay Counties Power Company recently held its annual meeting and re-elected its directors and officers. John Martin is president of the corporation, John A. Britton, vice-president, and F. H. Pierson, secretary. The gross receipts for the past 10 months were $255,168.85, and the net surplus is $26,770.10. The company's assets include the gas and electric plants in Chico, Marysville, Woodland, Colusa, Grass Valley, Nevada City, Napa, Santa Rosa, Petaluma and San Rafael. The bond issue amounts to $1,000,000, bearing 5 per cent. interest. An allied company, the California Gas & Electric Corporation, holds an option on the Oakland Gas, Light & Heat Company. The Oakland plant would be very important as a reserve steam plant in case of interruption of the current from the Bay Counties' system.

LAKE CITY, COLO.—The Tobasco Mining Company, of Lake City, will install a complete electric equipment, including hoist, pumps, and drills.

DENVER, COLO.—Col. J. B. Frank, of Denver, who controls the electric light plant at Alamosa, Colo., will rebuild the present plant to twice its capacity.

WILMINGTON, DEL.—The General Electric Company will construct the plant of the Cape Fear River Company at Bladenboro, [illegible] $250,000 has been expended. An examination has been made of sites for a power plant near Fayetteville, N. C.

EISER, IDAHO.—The city council has granted to H. V. Gates, of Hillsboro, Ore., a franchise to install an electric lighting plant. The city is to own the plant, giving Mr. Gates a lease for 15 years at $1.00 per year rental. The city will vote $25,000 in bonds for the plant.

VENICE, ILL.—A new 300-hp engine is to be added to the present equipment of the Venice Light & Power Co.

ALTON, ILL.—The "Big Four" railroad will establish an electric plant near its new station in East Alton, and all railway switches will be operated by electric power.

BOSWELL, IND.—The Boswell Electric Light & Water Company has been incorporated with a capital of $25,000. The incorporators are P. J. Shaw and B. H. Bennett.

NEW ALBANY, IND.—Chicago capitalists, represented by John Tevis of Louisville, have purchased the property of the local light, heat and power company, the consideration being $147,000.

EVANSVILLE, IND.—The People's Light, Heat and Power Company of this city has incorporated with a capital stock of $25,000. The directors are William F. White, Charles W. Wetmore, A. B. Vohus and C. C. Bragg.

INDIANAPOLIS, IND.—The Board of Public Works has decided to grant no more franchises to small companies to lay conduits in the downtown streets for electric light and power purposes. Only large companies, such as are capable of bidding for the city lighting, will be granted franchises.

EVANSVILLE, IND.—C. H. Roberts and Deputy City Treasurer Geo. P. Heilman, are promoting a stock company to build and operate electric plants for the propulsion of farm machinery and implements, gang-plows, etc. Roberts has patents covering his scheme. The headquarters and machinery factory will be situated at Evansville.

NEW ALBANY, IND.—The United Gas and Electric Company, of New Albany and Jeffersonville, has been incorporated with $1,000,000 capital stock. The company is empowered to merge the existing companies by exchange of stock. The incorporators are: Samuel Insull, Chicago; W. B. Hummer, La Salle, Ill.; Rob't W. Waite, New Albany; John Tevis, Louisville, and Jno. W. Dunbar, New Albany.

RAYNE, LA.—Negotiable bonds to the amount of $20,000 have been voted for the construction of a system of waterworks and electric lights.

HOMER, LA.—A proposition will be put before the voters of Homer to allow the town council to issue $10,000 in negotiable bonds to build and equip an electric light plant.

FALL RIVER, MASS.—Electric power is being installed for the driving of the machines in the three new buildings of the Stevens Manufacturing Company in this city. A new generator, direct connected to a 1,100 hp. McIntosh & Seymour engine, will supply the power, which will be distributed to the motors in the various buildings. The largest motors will have a capacity of 150 hp, and the machines will be belted to shafting.

ST. LOUIS, MO.—Articles of incorporation of the West St. Louis Water and Light Co. with a capital stock of $80,000, all paid, have been filed. Among the shareholders are Edward S. Lewis, S. M. Phelan, Thomas W. Crouch, Paul A. Fuez, and Edgar D. Tilton.

ST. LOUIS, MO.—The City Lighting Co. has filed a fee deed transferring all its property to the Imperial Electric Light, Heat & Power Co. The capital stock of the City Lighting Co. is $600,000 and of the Imperial Company $1,500,000. The transfer was effected for the better handling of the affairs of the two companies.

PORTSMOUTH, N. H.—A 22-ton generator has been installed in the Rockingham County Electric Light & Power station. Seventeen horses were required to draw the load from the railroad station to the new plant.

TROY, N. Y.—The Greenwich Co-operative Electric Company has been formed to utilize the water-power at the old cider mill at Sprague town, and furnish power and light to the farmers in the vicinity.

SYRACUSE, N. Y.—The Syracuse Lighting Co. has bought a corner lot at East Syracuse upon which will be erected a sub-station for the purpose of lighting East Syracuse and Eastwood Heights.

ALBANY, N. Y.—The Kingston Gas & Electric Company, of Kingston, has been incorporated with a capital of $70,000, to furnish gas and electricity in Kingston and the towns of Ulster county. The directors are Morris W. Stroud, R. L. Babcock, of Philadelphia, and Franklin J. Tobey, Eugene W. Prout and Jeremiah P. Osterhondt, of Kingston.

LAURINBURG, N. C.—At the recent election the proposition to issue $30,000 bonds for water and electric light plant was carried.

MAXTON, N. C.—A certificate of dissolution of the Maxton Light and Power Company has been filed with the Secretary of State.

RALEIGH, N. C.—The Raleigh Electric Company was awarded the contract for 155 enclosed arc lights at $55.75 per lamp per year. Competition gave the city an advantage of about $10 per lamp.

NEWBERN, N. C.—The new electric plant of the city of Newbern has been completed. It has a capacity of 100 arc and 2,000 incandescent lights, and the town is now lighted after ten months of darkness.

BREVARD, N. C.—Julian D'Este, of Boston, has examined the water powers of this section with a view to purchasing. His plan, it is said, is to develop the water powers and then sell to parties desiring to start industrial enterprises, provided the sites are purchased of Mr. D'Este.

MIAMISBURG, OHIO.—The Miamisburg Water, Light and Power Company will accept the franchise for an electric light plant in the city. The company will first make an offer of $5,000 for the old municipal plant.

LAWTON, OKLA.—The Comanche Light & Power Company, of this city has been incorporated with a capital stock of $50,000. The incorporators are:

W. H. [illegible] Broe, F. M. English and George M. Paschal, of Lawton.

CANYON CITY, ORE.—The City Council of Canyon City has been asked to grant P. R. Riebalt a franchise for an electric light and power plant.

PORTLAND, ORE.—There is a very spirited competition in the electric light and power field tributary to Portland, Ore. F. S. Morris, of the Oregon General Electric and the Portland City & Oregon Railway Companies, was the successful bidder at an administrator's sale of 135 acres of land carrying valuable water rights on the upper waters of the Clackanas River. The price paid was $11,000, though its appraised valuation was $850. The Portland General Electric Company was the rival bidder that ran up the price.

WACO, TEX.—St. Louis capital will probably furnish a $5,000,000 water and electric light plant. Work is expected to commence within 90 days. Representatives from St. Louis are being negotiated with.

HAMPTON, VA.—The town council of Hampton has granted a franchise to the U. S. P. Shield Company, of Philadelphia, to establish an electric light and gas plant in the city. The franchise is open for only 30 days. The company accepting will also be required to deposit a bond of $10,000.

OTTAWA, ONT.—The Ontario Power Company has commenced operations on the upper section of its works at Niagara Falls, Ont., and a large force of men is now at work near Chippawa. This section of the work consists of a canal 100 feet wide and 20 feet deep, running from Welland river, in the village of Chippawa, to near the bluff above the Dufferin Islands.

MONTREAL, QUE.—The annual general meeting of the Demerara Electric Company, of British Guiana, was held a few days ago in Monreal. The company now controls the tramway and lighting business of Demerara, as the gas company has been forced to close down. The electrical plant is being extended to take up the increased business offered. All the members of the old board were re-elected: Sir William Van Horne, president; Senator Drummond, Messrs. W. B. Chapman, James Hutchison, Senator McKeen and B. F. Pearson. Mr. E. Alexander is secretary-treasurer.

THE ELECTRIC RAILWAY.

MUNCIE, IND.—The Muncie & Western Railway Company has been incorporated with $50,000 capital stock by Frank C. Ball, Edmund Ball, Lewis Clark and W. C. Ball.

RICHMOND, IND.—The contract for the construction of the Hamilton, Eaton & Richmond Traction Railway has been let to the Falk Company of Milwaukee, Wis. The figures exceed $1,000,000.

INDIANAPOLIS, IND.—The interests back of the Wabash River Transportation Company and the Logansport Street Railway Company have incorporated the Wabash-Logansport Traction Company, with $100,000 capital.

TOPEKA, KAN.—The Chanute and Iola Interurban Electric Railroad Company has been incorporated with a capital of $300,000.

NEW CASTLE, KY.—A franchise for an electric railway between New Castle and Eminence has been sold to Judge William Pryor, of Frankfort, Ky., and William Ellis, of New Castle, representing Louisville and Baltimore capitalists.

LOUISVILLE, KY.—The Louisville & Mt. Washington Railway Company (electric) has filed articles of incorporation, with $10,000 capital, with the privilege of increasing to $400,000. P. N. Clarke, of Louisville, and a number of others are interested.

AUGUSTA, ME.—The Lewiston, Winthrop & Augusta Electric Railroad has voted to change the name of the company to Augusta, Winthrop & Gardiner.

ST. LOUIS, MO.—The St. Louis & East St. Louis Electric Railway has filed notice of an increase of capital stock from $250,000 to $500,000.

GREENSBORO, N. C.—The Board of Aldermen of High Point has granted a franchise for a street car line. The charter is an ambitious one, proposing to build an electric railway to both Greensboro and Winston-Salem. B. H. Sawyer and others are interested.

SYRACUSE, N. Y.—The Syracuse Rapid Rapid Transit Railway Co. has purchased two parcels of property in Salina, to be used in connection with the building of its proposed new trolley line to Liverpool.

TIFFIN, OHIO.—J. C. Parker, promoter of the Sandusky, Clyde, Tiffin & Southern Railway, has applied for a franchise in Tiffin.

PIQUA, OHIO.—A deal has practically been completed for the lease by the Dayton & Troy Electric Railway Company of the property of the Miami Valley Railway Company.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Railway Company has completed plans for its power house, to be built at Plain City. It will have a total capacity of 3,000 hp.

COLUMBUS, OHIO.—The Ohio Legislature has passed the Thompson bill, by which interurban electric railways will be placed on the same footing with steam roads in the matter of acquiring rights of way.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway Company proposes to make Springfield the central point for repairs. About $100,000 will be spent in the erection of repair shops and car shops.

LIMA, OHIO.—The Lima Electric Railway & Light Company has increased its capital stock from $500,000 to $850,000. Joseph B. Mayer is president and H. L. C. Denny secretary of the company. Improvements will be made.

ZANESVILLE, OHIO.—The report is current that the Pennsylvania Railway Company will equip the Cincinnati & Muskingum Valley Railway with electricity between Zanesville and Trinway, a distance of 14 miles, and possibly the entire line.

FINDLAY, OHIO.—The Findlay, Kenton & Urbana Railway Company has organized as follows: David Joy, president; C. Thorndyke, secretary; W. J. Burket, treasurer. Directors: J. N. Shafer, M. H. Monheimer, David Joy, F. W. McClure, Edward K. Campbell, James Steen and W. J. Burket.

EAST LIVERPOOL, OHIO.—A company, promoted by B. S. Pope, S. B. Goucher, F. G. Porter, Charles Brenneman and Edward Hazlett, of this city, is planning to build a road from New Cumberland, W. Va., to this city. The Hancock county, W. Va., probate court has been asked for a franchise, and the road will be built this summer.

CANTON, OHIO.—The new power station of the Canton-Akron Railway will be larger than originally proposed, as it will furnish power for the Canton-Massillon lines and the proposed New Philadelphia line. The main building will be 131x145 feet and there will be sub-stations at Akron and Massillon. Orders for new machinery, in addition to that purchased some time ago, have been placed.

PORTSMOUTH, OHIO.—The recently incorporated Ohio Valley Traction Company has organized as follows: L. D. York, president; R. D. York, vice-president; John H. Lange, secretary; Samuel Baird, general manager. The above with Harry Miller and George Kircker constitute the board of directors. The company will build a road from Yorktown to Sciotoville. Right of way has been secured and construction work will start at once.

MASSILLON, OHIO.—The Massillon, Dalton & Wooster Street Railway Company has been organized with T. Harvey Smith, president; J. C. Putnam, vice-president; I. M. Taggert, secretary-treasurer and W. S. Goudy, general manager. Others interested are J. W. McClymonds, James Hunt, George Schultz, and Walter J. Mullins. Right of way has been secured between Massillon and Dalton and the company is asking for a franchise in Massillon.

CINCINNATI, OHIO.—The final steps have been taken for the consolidation of the Southern Ohio Traction Company, the Cincinnati Northwestern Railway Company, the Maimisburg & Germantown Traction Company and the Hamilton & Lindenwald Electric Transit Company. The consolidated company will be known as the Cincinnati, Dayton & Toledo Traction Company. The capital stock is $5,000,000 and bonds of like amount will be issued, of which $2,300,000 will be retained in the treasury to retire underlying bonds. There will be issued to retire the Southern Ohio Traction stock, $1,200,000, and there will be retained in the treasury for future extensions, consolidations, etc., $1,500,000.

CHARLESTON, S. C.—The Charleston Suburban and Summerville Railway Company has been granted a franchise in this city.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC EXPLODER COMPANY has been incorporated in Jersey City to manufacture fuses, etc.; capital, $50,000. Incorporators—Samuel Riker, Jr., Jacob Pawel and Ella Hartnett.

THE SORENSON MANUFACTURING COMPANY, of Ravenna, Ohio, has been incorporated with $25,000 capital stock by James Sorenson, E. R. Taylor and A. C. Williamson, to manufacture Rontgen-ray machines and optical instruments, the invention of Mr. Sorenson. The company now has a factory in operation.

PERSONAL.

MR. A. M. MATTICE, chief engineer of the Westinghouse Electric Manufacturing Company, has sailed for Europe on the "Campania."

MR. FRANK SHEPARD, the electric railway engineer, who has been in England attending to important franchise interests there, is again in this country for a while.

MR. C. F. SCOTT, chief engineer of the Westinghouse Electric & Manufacturing Company, has sailed for England at short notice by cable. Mrs. Scott accompanied him.

MR. JOHN L. LEWIS, the electrical contractor, of Mountain Lake Park, Md., has contracts for two central stations in hand, one at Buckhannon and one at Davis, W. Va., both to be completed by August 1.

MR. JAMES A. PIERCE, formerly representing the repair department of the Rossiter-MacGovern Company, in the East, has accepted the position of western manager for that company, with office at St. Louis.

MR. G. B. DUSENBURY, manager of the apparatus department at Pittsburgh of the Westinghouse Electric and Manufacturing Company, has been suddenly called to Europe, and left last week by Cunard steamer.

MR. C. T. THOMSON, M.I.E.E., late superintending engineer of the Brush Electrical Engineering Company, Ltd., of England, is on a trip to this country, and has been visiting various factories and plants during a brief stay.

MR. ISAAC D. PARSONS contributed to the *Engineering Magazine* in January and February an article on "The Economy of Isolated Electric Plants," giving a good deal of data. The article has now been issued in handy pamphlet form.

MR. T. A. ESTEP, president, R. D. Nuttall Co., Pittsburg, will be in attendance at the International Street Railway Convention in London, where the concern will make an exhibit at the Agricultural Hall of its gears and pinions, for which a large market has already opened up in Europe.

MR. W. G. RONEY, of stoker fame, has returned to his New York desk in the Westinghouse offices after a three months' vacation on his ranch in California, where he is growing acres of big walnuts and other nice things. Meantime a large number of contracts for power plants have come up to [illegible] attention.

MR. R. I. WALLIS JONES, of London, sailed for home on May 24 in the "Campania," after visiting Boston, New York and other cities. His stay was unfortunately too short to permit him to give attention to all the important electrical business matters arising in the course of his stay.

MR. JOHN F. CALDERWOOD has been called on to occupy a position as assistant to President Jacob L. Greatsinger, of the Brooklyn Rapid Transit Company. In addition to other duties, he will have charge of the auditing department. Mr. Calderwood comes from Minneapolis, Minn., where he was connected with the Twin City Railroad Company for several years.

MR. LEONARD ANDREWS, M.I.E.E., borough electrical engineer for Hastings, England, has spent his vacation this year in the United States, studying up electrical conditions, and is only sorry it is not longer. He is a shrewd and competent observer, and has made a great many friends and acquaintances in his swift circuit around the country, including the recent electric light convention at Cincinnati.

MR. JNO. A. PILCHER has accepted a position as mechanical engineer for the Norfolk & Western Railway Company, vice Mr. Chas. A. Seley, who resigned to accept a similar position with the Rock Island Railroad. The appointment is effective May 15. Mr. Pilcher was for eight years connected with the Norfolk & Western Railway as chief draughtsman, and for the last three years he has been connected with the Baldwin Locomotive Works.

MR. BRYCE E. MORROW, assistant foreman of the Testing Department of the General Electric Company at Schnectady, N. Y., has resigned his position to take the superintendency of the Hudson River Power Company's plant to be located at Spier Falls, N. Y. Mr. Morrow is at present with the Hudson River Power Company at Mechanicville, and will remain there until the Spier Falls plant is completed. Mr. Morrow is a well known electrician and was in the employ of the General Electric Company for the past fourteen years.

Trade Notes.

DIRECT U. S. CABLE.—The early demolition of No. 40 Broadway for the purpose of erecting a modern skyscraper, made it necessary for the Direct U. S. Cable Company to seek new quarters. It is now located at 65 New street.

KILFYRE.—Gen. C. H. Barney, of the Monarch Fire Appliance Company, 27 William street, Nek York, advises us that the highest award in its class has been given to this extinguisher, supplementing similar awards at other leading expositions.

ELECTRICAL FITTINGS FOR ST. LOUIS FAIR.—The Commercial Electrical Supply Company, St. Louis, Mo., has secured the contract to supply the electrical fittings on the St. Louis Exposition grounds. The contract amounts to $36,895.

THE CENTRAL MANUFACTURING COMPANY, Chattanooga, Tenn., lost its shops and lumber yards by fire on May 10. Preparations are already well under way toward building a new plant, and in a short time orders can be filled for pole-line material.

THE CLEVELAND ENGINEERING COMPANY, Cleveland Ohio, has opened offices at 817 New England building, and is prepared to act as general consulting engineers for electrical and steam power work, heating and ventilating. It will also make efficiency tests on existing plants.

THE BURT MFG. Co., of Akron, Ohio, reports a recent shipment of its Cross oil filters to different cities in the Far East—India, China, Japan and the Philippine Islands. Other important shipments recently made by this firm went to England, Austria, Belgium, Mexico and Argentine Republic.

MOTOR VEHICLE EQUIPMENTS.—Circular No. 1059 of the Westinghouse Electric & Manufacturing Company is devoted to electric motor vehicle equipments. Illustrations and descriptions are given of every detail of a motor vehicle equipment, including cut-out switch, battery and cable terminals, and several types of controllers.

ECONOMY OF ISOLATED PLANTS.—The Payne Engine Company, 120 Liberty Street, New York, has reprinted in pamphlet form an article by Mr. Isaac D. Parsons, on "The Economy of Isolated Electric Plants," which appeared in a recent issue of the *Engineering Magazine*. The article is an argument in favor of isolated plant over central station service.

STORAGE BATTERIES.—The United States Accumulator Company, 212 East Illinois Street, Chicago, Ill., has issued a second edition of its catalogue and price-list of storage batteries for light and power plants. The advantages of the storage battery and of its several applications are concisely set forth. One section is devoted to information as to the selection of a battery for residence lighting.

RHEOSTATS AND DIMMERS.—The Wirt Electric Company, 180 Broadway, New York, has issued a new edition of its pamphlet on rheostats, dimmers, motor controllers and brushes, which includes two-score or more illustrations and descriptions of Wirt apparatus. The rheostats are for innumerable applications, among the less common being rheostats for photometric measurements, calibration of instruments, induction coils and stereopticons.

LAUNCHES AND YACHTS.—A pamphlet of no less than 120 pages is required to set forth in illustration and text the numerous types of launches and yachts manufactured by the Electric Launch Company, Bayonne, N. J. In addition to electric launches ranging from a small fishing boat to a cabin yacht, a number of gasoline boats are shown. The final pages describe and illustrate independent charging plants for launches and for lighting residences.

MR. F. J. NEWMAN has severed his connections with the Westinghouse Electric & Mfg. Co., Pittsburg, Pa., and opened an office as consulting automobile engineer, at 504 Lewis Building, Pittsburg. Mr. Newman would be pleased to hear from carriage manufacturers contemplating going into the automobile field, and from railway and power companies having use for electric tower wagons and an electric automobile with testing apparatus for line work.

PAY STATIONS THAT PAY.—The American Toll Telephone Company, 45 Sheriff Street, Cleveland, have issued a handsome 32-page pamphlet entitled, "Pay Stations That Pay," in which concise descriptions are given of pay station apparatus, accompanied by illustrations. Among the devices illustrated and described are seven forms of coin pay stations, a call register for commercial service, a consecutive counter and a number of minor devices used in connection with pay toll stations.

LUNDELL MOTORS.—In Bulletin No. 301, of the Sprague Electric Company, New York, Lundell motors for driving ventilating fans and blowers are described and illustrated. Among the illustrations are three handsome halftones of the Capitol at Albany, N. Y., and the Congressional Library and Corcoran Art Gallery at Washington, D. C., all of which are ventilated by the aid of Lundell motors. Some useful tables, showing power required for driving air-propellers, etc., are given.

THE SAMSON CORDAGE WORKS, Boston, Mass., call attention to the fact that much of the cord used for arc lamp and trolley cord is rough, or soft, and wears out quickly by abrasion. It is especially important where the safety of a lamp is concerned to use the best obtainable cord made from strong "all cotton" or Italian hemp yarns, and having a hard smooth braid and smooth finish, preferably waterproofed. They are always glad to furnish samples and full information.

THE UNION ELECTRIC COMPANY, Dubuque, Ia., is supplying its patrons with blotters, one side of which carries an illustration furnishing an object lesson in electric lighting. On the face of the blotter photographic reproductions are given of adjacent show windows, one of which is lighted by Welsbach lights and the other by a single arc light. In the latter case all of the wares in the window are brightly illuminated, as well as the sidewalk outside; in the other case the objects in the window as well as the sidewalk are shrouded in obscurity.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that the demand for its Adams secondary generator, which it has recently placed on the market, has been unprecedented. It has received orders for this instrument from all over the United States, and a large number of inquiries from abroad. This is one of the most practical devices recently got out, and fills a long felt want. The company has some very attractive printed matter fully describing this, which will be mailed on application. The apparatus was lately illustrated and described in these pages.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has announced the opening of several "Exide" battery depots for the purpose of caring for, charging and furnishing vehicle batteries of its manufacture. The stations already announced are situated in New York, at 148 West 18th St.; Philadelphia, at 250 No. Broad St.; Buffalo, at 200 Pearl St.; St. Louis, at 3937 Olive St.; Chicago, at 264 Michigan Boulevard. It is the purpose of the Electric Storage Battery Company to open immediately stations in a number of other cities. These stations will be equipped with a stock of battery material, and will be under the charge of thoroughly experienced battery men so that orders can be filled either for complete batteries or for parts, as needed. The facilities for recharging and caring for the batteries will prove of great convenience to the increasing number of users of the "Exide" battery.

INCANDESCENT LAMPS.—An extremely handsome pamphlet of 80 pages has been issued by the Westinghouse Electric & Manufacturing Company with the title, "Incandescent Electric Light—Sawyer-Man Lamps." The numerous illustrations have been beautifully executed, and the production as a whole is one that has rarely been equalled in trade literature. The first part of the text is a historical sketch of the development of electric lighting from the time of Sir Humphry Davy to date, and the second portion gives a clear and concise account of all the steps in the manufacture of Sawyer-Man incandescent lamps. The final portion of the pamphlet is devoted to the economics of incandescent electric lighting, including the selection of lamps, renewals, regulation and distribution. One of the features of the pamphlet consists of illustrations of artistic chandeliers and of interiors showing how artistic effects may be produced with incandescent lights.

SPRAGUE COMPANY'S OUTING.—The weather on Saturday, May 17, was especially designed and constructed at the works of the Sprague Electric Company in order that the office and sales department could have a perfect day for their outing. A large number of men representing the various departments in both the New York and Watsessing offices spent the day at New Dorp, Staten Island. During the afternoon an exciting ball game was played. Henry G. Issertel, of the sales department, acted as umpire, and will be able to be out in a few days. Edgar H. Watlington, who is an authority on electric hoists, kept the score card. The most interesting feature of the game was the playing of Findlay S. Douglas, the ex-champion golf player. It was his first ball game, and when he began batting the spectators ran to cover. His first drive sent the ball into the bunker, and once, when the umpire called "high ball," Findlay exclaimed: "Make it two and I'll join you." The outing was voted a great success, and special thanks were tendered to Messrs. Bourgeois and Vanderhoof, who had managed the affair in a very acceptable manner.

FISHER CABLE TESTING SETS.—For testing insulation, capacity and conductor resistance of cables, as well as for locating faults or breaks, no apparatus is more popular to-day than the special sets designed by Mr. Henry W. Fisher, of Pittsburgh, and made by Morris E. Leeds & Co. of Philadelphia. This is evidenced by the fact that among the more prominent customers for the sets may be mentioned the following: U. S. Signal Corps, Washington, (8 sets), Standard Underground Cable Co., Pittsburgh, (3 sets), Safety Insulated Wire & Cable Co., New York, (3 sets), Reserve Construction Co., Cleveland, (2 sets), India Rubber & Gutta Percha Insulating Co., Yonkers, N. Y., W. R. Brixey, New York City, U. S. Engineer Office, Newport, R. I., Maryland Telephone & Telegraph Co., Baltimore, Columbus Citizens Telephone Co., Columbus, O., Zenith City Telephone Co., Duluth, Minn., Conklin Construction Co., Aurora, Ill., Central Construction Co., Toledo, O., Keystone Telephone Co., Philadelphia, Bell Telephone Co., Philadelphia, Interstate Telephone Co., Trenton, N. J., Nova Scotia Telephone Co., Halifax, Pittsburgh & Allegheny Telephone Co., Allegheny, Pa., Japanese Imperial Telephone Exchange, Tokio. The sale of these sets is controlled by Mr. James G. Biddle, 1023 Stephen Girard Building, Philadelphia, who acts as sole agent for Morris E. Leeds & Co. Catalogues and full particulars will be furnished upon request.

Record of Electrical Patents

[illegible] RAILWAY SYSTEM; G. L. Campbell, Nyack, N. Y. [illegible] of a rheostat is cut out before the field resistance is cut in.

700,182. BRUSH HOLDING RING FOR DYNAMOS OR MOTORS; F. B. Duncan, Akron, O. App. filed Feb. 21, 1902. The brush holding ring is set into another ring and so constructed that it can be rotated to adjust the brushes only by passing a screwdriver or pointed instrument through a hole in the second ring and thereby push the brush ring around. This prevents accidental displacement and avoids a projecting handle.

700,207. COMBINED RHEOSTAT AND HEATER; M. C. Kruger, Chicago, Ill. App. filed Oct. 4, 1901. The resistance material is in the form of a rod having openings at intervals into which the contacts are inserted.

700,210. STORAGE BATTERY; L. W. Lombard, Boston, Mass. App. filed Feb. 11, 1902. An element composed of sheets of an oxidizable metal alternated with sheets of an unoxidizable metal, assembled closely together and being all electrically joined.

700,240. BLOCK SIGNAL SYSTEM; L. Riebe, Lansford, Pa. App. filed July 24, 1901. The semaphore arm is carried by a wheel which is adapted to be clutched to either of two other wheels moved by solenoids in opposite directions.

700,250. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed July 31, 1901. A switch is used to connect either the transmitting or receiving apparatus with the aerial terminal, making it necessary to use the switch when about to receive or send.

700,302. RAILWAY BLOCK SIGNALING SYSTEM; W. M. Chapman, Newton, and W. Pastell, Lynn, Mass. App. filed May 8, 1902. A signal is provided at each end of a block, and an actuating mechanism for each signal, both mechanisms being rendered operative to set a signal when a car enters a block from either direction.

700,310. ALTERNATING CURRENT ELECTRIC MOTOR AND CONTROLLING MEANS THEREFOR; Rudolf Eickemeyer, Dec'd., Yonkers, N. Y. App. filed Aug. 10, 1892. (See Current Nwes and Notes.)

700,335. MEANS FOR VENTILATING CORES FOR ELECTRICAL APPARATUS; J. D. Keiley, New York, N. Y. App. filed May 27, 1901. For ventilating armatures, spiral passages are formed therein.

700,340. ELECTRICAL OUTLET BOX; H. Krantz, Brooklyn, N. Y. App. filed March 26, 1902. The box has a split connecting neck, one part being integral with the box and the other separate, the separate part occupying the space of a removed portion of the box, and the two parts being clamped together.

700,346. ELECTRIC RAIL BOND; W. J. Long and J. B. Nolder, Windber, Pa. App. filed Feb. 25, 1902. The bond, consisting of a copper plate, is placed in a groove on the inner face of the fish plate.

700,380. TELEPHONE OR TELEGRAPH SYSTEM; E. Shelby, West Lafayette, Ind. App. filed Sept. 17, 1900. (See page 962.)

700,410. PLURAL FUSE CUT OUT; C. J. Dorsey, Baltimore, Md. App. filed Oct. 12, 1900. Details.

700,437. APPARATUS FOR ELECTRICALLY OPERATING TOOLS; C. E. Moore, Chicago, Ill. App. filed April 11, 1900. A reciprocating drill in which the solenoids have magnetic shields for concentrating the lines of force on the core.

700,454. SECONDARY ELECTRIC CLOCK; S. P. Thrasher, New Haven, Conn. App. filed Feb. 23, 1901. A number of drums on the same axis and bearing numbers or advertising matter on their faces, are rotated by electro-magnets step by step to bring different portions of their surfaces in line.

700,461. ELECTRIC RAILROAD SIGNAL; W. D. Vandecar, Grand Rapids, Mich. App. filed June 6, 1901. Details.

700,463. INSULATOR FOR ELECTRIC CIRCUITS; W. J. Walther, Boston, Mass. App. filed Jan. 20, 1902. A mushroom shaped insulator having strengthening ribs between the head and the post.

700,491. SAFETY SPEED LIMITING MEANS; G. W. Hendricks, Indianapolis, Ind. App. filed Oct. 14, 1901. Consists in the application to the shaft of a generator, of a loose pulley and controlling mechanism including friction-faced elements, whereby the pulley can be normally locked to and also released from the shaft.

700,494. ELECTRIC HEATER; W. B. Hinman, Joplin, Mo. App. filed Feb. 11, 1901. An electric lamp is nested in a box containing fibrous material [illegible]

700,495. ELECTRODE FOR ARC LAMPS; R. Hopfelt, Berlin, Germany. App. filed Feb. 24, 1902. (See Current News an Notes.)

700,497. ELECTRIC BATTERY; C. Hubert, New York, N. Y. App. filed Aug. 9, 1900. The top of the cell is fitted with an annular and a central contact, flush with each other, so that when the cell is placed in a box, and the cover of the box, which is provided with contacts, is applied, the circuit can be readily connected with the contacts on the cover of the box.

700,536. APPARATUS FOR DEMONSTRATING THE PHENOMENA OF ELECTRICAL STORMS; G. J. Moore and D. C. Moore, Graham, Mo. App. filed Nov. 20, 1901. A friction generator and Leyden jars mounted in a case with suitable terminals for the purpose indicated in the title.

700,544. PIVOT CONNECTION OF CURRENT COLLECTING OR TROLLEY; P. McCullough, T. Blaney and R. Baron, Liverpool, Eng.

700,563. PROCESS OF EXTRACTING METALS FROM ORES AND SCRAP CONTAINING SAME; S. S. Sadtler, Philadelphia, Pa. App. filed July 10, 1900, renewed April 11, 1902. (See page 962.)

700,570. INSULATOR SUPPORTING ARM; J. E. Sharpe, Oneida, N. Y. App. filed Dec. 26, 1901. A cross-arm for insulators, made of channel metal.

700,585. ELECTRIC ALARM; D. Vial Fils, Lyons, France. App. filed July 31, 1901. A burglar alarm in which the circuit closer is a pendulum whose rod passes through a washer; when the pendulum is disturbed, the arm and washer come together.

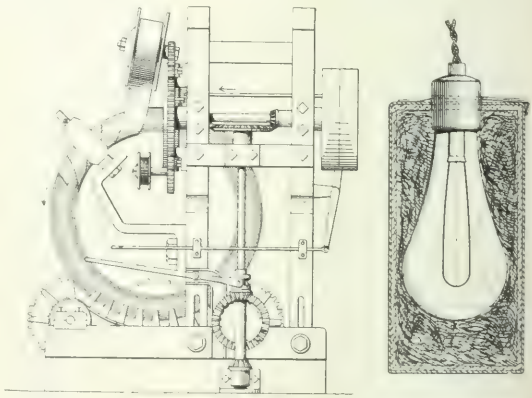
700,597. APPARATUS FOR ELECTRICALLY WINDING UP DRIVING SPRINGS; H. Aron, Charlottenburg, Germany. App. filed Feb. 20, 1902. Details.

700,598. PRIMARY BATTERY; M. M. Bair, Levallois-Perret, France. App. filed March 21, 1901. According to this invention the cell is provided with a detachable cover, so arranged that it can be secured to the outer vessel of the cell or to the outer vessel and the porous chamber of the cell by any suitable connection, such as screw-threads, clamps, catches, or other means that will firmly maintain the said cover hermetically in place and yet permit of its ready detachment.

700,609. ELECTRICALLY PROPELLED VEHICLE FOR SINGLE RAIL ELEVATED RAILWAYS; F. B. Behr, Twickenham, Eng. App. filed Feb. 24, 1902. Relates to the mechanical construction of the car, enabling it to traverse curves of small radius.

700,649. ELECTRODE FOR ARC LAMPS; R. Hopfelt, Berlin, Germany. App. filed Feb. 24, 1902. (See Current News and Notes.)

700,650. ELECTRIC LAMP; C. Hubert, New York, N. Y. App. filed Aug. 9, 1900. A battery casing having a search lamp fitted to one side of it.



700,713.—Machine for Covering Coils of Wire [illegible] Electric Heater

700,652. BURGLAR ALARM; G. Janke, Algoma, Wis. App. filed Dec. 31, 1901. Deetails.

700,666. STORAGE BATTERY; L. W. Lombard, Boston, Mass. App. filed March 1, 1901. The plate is built up of a series of strips strung upon a number of rods.

700,670. ELECTROLYTIC REDUCTION OF NITRO OR OTHER COMPOUNDS; M. Buchner, Mannheim, Germany. App. filed Nov. 18, 1899. (See page 962.)

700,671. REDUCTION OF AZO COMPOUNDS; M. Buchner, Mannheim, Germany. App filed Sept. 24, 1900. (See page 962.)

700,672. REDUCTION OF NITRO COMPOUNDS; M. Buchner, Mannheim, Germany. App filed Sept. 24, 1900. (See page 962.)

700,689. THIRD RAIL CONSTRUCTION FOR ELECTRIC RAILWAYS; C. M. Hobbs, Baltimore, Md. App. filed June 21, 1901. Relates to the means for maintaining electrical contact between the contact shoe and the conductor, when the latter, for any cause, is offset from its normal position.

700,695. MULTIPLE FUSE BOX; J. D. Lytle, Baltimore, Md. App. filed Aug. 23, 1901. Details.

700,708. COHERER; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 16, 1901. (See Current News and Notes.)

700,713. MACHINE FOR COVERING COILS OF WIRE; G. F. Wright and G. M. Wright, Worcester, Mass. App. filed Jan. 8, 1901. A machine for winding tape around closed coils of wire.

700,715. OPERATING MECHANISM FOR MOTOR RHEOSTATS; J. I. Ayer, Malden, Mass. App. filed Feb. 17, 1902. A trolley in a conduit [illegible] the attraction of a magnet on the car and successively closes the circuit to the sections of the sectional conductor.

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END OF THE BOER WAR.

A great sigh of relief goes up from the civilized world at the close of the Anglo-Boer war, from which, as was to be expected, England has finally emerged entirely victorious with a notable addition to her territory, and in spite of a magnificently gallant struggle by the Boers. It is hard to see that the Boers have lost anything save a liberty which they were not willing to share with anybody else; and it is equally hard to believe that the country will not be more progressive and better governed until that British rule which still remains the ideal among practical governments working out the great modern system of civilization for all races of men. Some time must elapse before South Africa is once again wholly given over to the cultivation of the arts of peace, but meantime a better feeling prevails in all the world's markets, and in the long run that rich new country will need all kinds of supplies in exchange for its gold and diamonds, its feathers, hides and agricultural produce. Much of the material will be electrical, and every sign goes to prove that no small portion of it will be requisitioned from the United States. It has been conservatively estimated that the "Rand," which has produced $300,000,000 in gold, has $3,500,000,000 "in sight." This takes no account of Rhodesia or of the diamond fields, and in itself is sufficient to indicate a large consumption of power plant and machinery, to say nothing of its effect in stimulating the industries of the whole world by its continuous flow into the channels of commerce and finance. There are, moreover, great power transmission enterprises awaiting development in South Africa, and again American practice should have an opportunity to repeat itself on the grandest scale.

FATAL AUTOMOBILE RACING.

We can see no objection to tests of speed where only the lives of the contestants, willing to take the risk, are at stake; but surely nothing can ever be gained by speed trials on public highways, such as those which ended in a deplorable accident last Saturday on Staten Island. There, some trouble with the machine or the track—apparently the latter, but nobody knows—caused the flying electric automobile to break a wheel, swerve, and at an estimated speed of 75 miles an hour smash into a crowd of spectators with such effect that two persons are now dead and many were injured. While the vehicle in question might have gained a splendid advertisement had the test resulted as was hoped by its projectors, we can see nothing to be gained by the art of electric automobilism from such work. The designer of the vehicle, Mr. Baker, has done excellent work in the construction of good runabouts, etc., at moderate prices, but it puzzles us to see where he could expect a large market for his cigar-shaped craft. Nobody would ever ride in such vehicles for pleasure; they would not be allowed to make speed on highways, and the only place for them would be racetracks. The development of high speeds has advantages, but there are none to be secured from terrible accidents like that of last Saturday.

From what we know of the conservative temper of President Shattuck, of the Automobile Club of America, and his executive associates, we do not believe they will ever again be induced to patronize road speed contests; and even if they or other clubs did, the public would not tolerate it. Let the manufacturers then seek improvements in their machines in other directions. There is plenty of room. But just at present the public has too much automobile speeding, and while the outcry is unreasoning in some respects, the National Club can best

subserve its purpose by putting itself squarely in line against disturbers of the welfare of the industry, who are also prejudicing the future interests of the sport.

Naval Conservatism.

One of the significant papers of the recent special meeting of the Institute was Lieut. Powelson's discussion of the voltage employed for the standard equipments of the navy, though perhaps the paper would be more correctly characterized were it denominated a remarkably extended apology for a remarkably indefensible naval policy of the past with respect, in this instance, to service voltage. It reads queerly enough to the lay engineer, long familiar with the advantage, nay, the necessity, of working, so far as possible, along standard commercial lines, and fully awake to the importance of keeping up the voltage. But Lieut. Powelson's paper means much more than a recognition of the most fundamental maxims of the practical electrical engineer, for it denotes the effect of young blood and the modern engineering education on the honorable and venerable red-tape office through which modern ideas in naval equipment had so long been sifted. It implies a spirit of progress that came to the new navy when it had work, and serious work, to do, and rose to the occasion. It has long been a subject of wonder to laymen how a system of power distribution for a modern war ship could be anything else than electrical, since no energy transmitting device is so easily defended and so quickly replaced as an electric cable. But year after year steam and hydraulic pipes and donkey engines grew and multiplied, until it was a matter of wonder that room could be found for the complication. Finally, it appears that the Ordnance and Construction Bureaus arose to the occasion, ammunition hoists and turret-turning gear got a hearing, and were, though with ill-concealed distrust, adopted in a tentative way. They were their own argument, and we fancy that no officer who ever turned an electrically operated turret would willingly consent to the use of anything else. And so the good work has gone on, until now we actually have the strange and eccentric voltage, so long demanded by naval specifications, actually put on the defensive and about to be elbowed out of the way. And incidentally it is most encouraging to see that when at last the change began, the voltage went fairly up to modern practice, instead of settling into that comfortable old half-way house, 110 volts. Really, this is the most significant change of all, for nothing else could so plainly show what some of the pious friends of our youth would have called a "hopeful sign of regeneration." Though it may take many years, the new must some time come and the old eventually disappear. Donkey engines and hydraulic pipes must follow whale oil lamps and join sail power and black powder. Peace to their ashes!

Polyphase Traction Abroad.

The important Institute paper by Mr. De Muralt, the concluding portion of which we print this week, gives a clear perspective of what has actually been accomplished abroad in the development of traction by polyphase motors. We have described from time to time all of the roads mentioned, but it is a good thing to take account of stock and to see the actual present state of affairs. The foreign engineers have been most evidently building roads while we in this country have been talking about the advisability of doing so. It is interesting to note that since the initial road at Lugano, none of the lines built have belonged properly to the tramway class. As we have frequently remarked in these columns, tramway working is not the strong point of polyphase railway motors. We have had in this country sufficient experience with the continuous current, double trolley system to look askance at any scheme requiring double working conductors. The average railway manager is pretty well convinced that troubles arise as the square of some higher power of the number of trolleys, and with some justification thinks that one trolley is quite enough. The later foreign roads are distinctly in the class of special or interurban roads. Several of them are of a character unusual in this country, and had they been built here would quite certainly have been equipped with ordinary continuous current motors fed from rotary converters. The relatively higher cost of copper abroad changes the economic conditions very radically. At prices for apparatus and copper current here, the saving in the cost of working conductors, due to the use of polyphase motors, would not be so material as in Europe. By far the most interesting foreign roads are the Burgdorf-Thun and the Valtellina lines, the latter notable for the prominence given it in the "Inner Circle" arbitration last year. Unhappily, it is not yet in full and regular operation, so that data which might be of very great value are lacking. But it is a case in which polyphase motors give a far greater hope of success than in tramway operation, and should be closely watched by American engineers. The new features in it are of a somewhat radical character, and great advantages are claimed for them, of which we shall know more later.

The paper by Mr. De Muralt shows that in Switzerland there are half-a-dozen three phase electric railways, aggregating about 75 miles of road. Experience in their operation dates from 1895, the time of installation of the earliest. Almost all are heavy grade roads, with light passenger traffic. The power is obtained from waterfalls, and carried by three-phase to the track. In some cases the cars carry transformers, and tap off high-pressure currents from the trolley wires. In the greater number of cases stationary step-down transformers are installed. The car motors are three-phase induction motors, requiring at least two trolley wires for their supply. The paper points out that under certain conditions the continuous-current system is superior to the alternating-current system, while under other conditions the case is reversed. Frequent startings and stoppings with short runs, such as are characteristic of urban railway service, are particularly unfavorable to the alternating-current motor. Such conditions approximate, in fact, to the condition of the electric elevator as an extreme case, and the consensus of opinion at present is that the existing continuous-current motor is distinctly superior to the existing alternating-current motor, both in compactness for a given torque and in average efficiency. Consequently for tramways, the present induction motor can hardly expect to supersede the continuous-current motor, even considering the inconvenience of converters and commutators.

For long-distance running, however, with or without grades, the paper claims that experience shows the alternating-current railway motor to be superior. Here the speed is practically uniform, and best suited to the induction motor. The relative amount of power wasted in starting becomes small, while the simplicity of the system becomes particularly advantageous when many miles of road have to be covered. On down grades the motors are capable of acting as brakes by acting as generators, thus restoring part of the energy to the line, and the system is relatively very flexible under variations in the service. Without doubt there will be a development for the alternating-current traction in this country, as the electric railway acquires higher speeds, and covers greater distances at a stretch. The principle difficulty lies in the way of equipment and standardization. The continuous-current railway is now standard in every detail, whereas a change to the alternating-current motor would involve a material modification in car equipment and in line material. The innovation is, therefore, handicapped by additional cost and delay. Meanwhile it is interesting to watch the experience that is being

gained in Europe, and the trend of development towards the alternating-current railway motor on that continent. Yet there seems no doubt that the ordinary trolley street railway system must continue to be operated by direct-currents, if only for the reason that polyphase motors would require at least double trolleys, and our overhead wiring is already burdensome with single trolleys. If, however, the alternating-current motor becomes standard, the difficulty of providing double trolleys may force the trolley wires in all the cities into underground conduits.

THE EARTHQUAKE AT MARTINIQUE.

A preliminary report from the U. S. Coast and Geodetic Survey indicates that magnetic disturbances manifested themselves on the morning of May 8 at the recording magnetometers of Cheltenham, Md., and Baldwin, Kan. These disturbances are described as tremors in intensity and declination, commencing at 7:54 A. M., referred to, St. Pierre local time, and continuing until midnight of the 9th, and even into the 10th. The amount of the disturbance was from 0.5 to 0.6 millimaxwell, and from 10 to 15 minutes of declination. The town clock at St. Pierre is said to have stopped at 7:50 A. M., so that the commencement of the magnetic disturbance in these United States observatories appears to have been nearly coincident with the eruption which overwhelmed St. Pierre in a few minutes. The disturbance of the sea bottom in the neighborhood of Martinique seems to have broken the submarine cables in several directions. The London *Electrician* reports that the Martinique-Puerto Plata (San Domingo) cable was interrupted on May 6th; while on the 9th there were added interruptions to the cables from Martinique to Guadeloupe, and to Dominica, on the north; also to St. Lucia, on the south. The southbound cables from St. Lucia to St. Vincent and to Grenada were also reported broken on May 9th. Considering the forces brought into play in the rupture of so many submarine cables by changes at the bottom of the ocean, it seems wonderful that the eruptions at Martinique and St. Vincent were not even greater and more terrific than those reported.

PHOTOMETRIC VALUES OF ARC LAMPS.

The third Progress-Report of the committee of the National Electric Light Association on this subject was presented at the recent Cincinnati convention, and contains a number of interesting data. The standard of comparative measurement adopted throughout the report is the Hefner lamp. It is generally admitted that the Hefner lamp is a very imperfect standard luminous source, but, on the other hand, by comparison with standard candles, it is a lamp to be thankful for; so, for the present, until a more suitable and reliable standard lamp can be found, it is well to be content with the Hefner, and it would be a great blessing if we could discard the British candle altogether. If it were not for existing contracts and literature, the British candle might be extinguished without a sigh. In industrial practice, however, the British candle is a fiction that has to be sustained. Professor Matthews fortunately adopts the relation given by the National Bureau of Standards, at Washington, namely, 1 Hefner unit = 0.88 British candle, which means that 1 British candle is 1.136 Hefners.

Comparative tests are recorded for 6.6-ampere enclosed series arc lamps of the direct and alternating-current types. These lamps absorb approximately the same volt-amperes, viz., about 450; but, whereas this represents real power in the direct-current lamps, it only represents about 400 watts in the alternating lamps, whose mean power-factor was 0.88. Unfortunately, the results are compared on the basis of specific hemispherical consumption and not in terms of efficiency or of lumens per watt. The results show, however, that the direct-current lamps gave 46 per cent. more light in the lower hemisphere than the alternating lamps, both types taking 6.6 amperes, and being provided with opalescent inner and clear outer globes. With a shade replacing the outer globe of the alternating lamps, this superiority of the direct-current lamps fell to 13 per cent., or, roughly, to the proportion of watts consumed by the two types, respectively. The 7.5-ampere series alternating enclosed lamps had a slightly lower power-factor (0.83), but consumed about the same amount of power (450 watts) as the 6.6-ampere direct-current lamps, and these two types gave, it would seem, nearly the same amount of light in the lower hemisphere. Some noteworthy experiments are reported upon lamps of different types, all adjusted to absorb 450 watts during the test. The 9.5-ampere series open arc was far the strongest in intensity at 30 deg. dip; but at dips less than 12 deg., the 6.5-ampere series, opal-inner-globe, enclosed arc-lamp gives a greater intensity than the open arc-lamp. This means that although the opalescent inner globe absorbs an appreciable amount of the light emitted by a 450-watt arc-lamp, yet it redistributes the remainder in such a manner that near the horizontal its intensity is superior to that of the open arc-lamp. Consequently, for the illumination of distant objects, as in street arc lighting, the 450-watt series arc-lamp, with opalescent inner globe, is not only more pleasing to the eye, but is also more effective than the 450-watt series open arc-lamp.

The conditions peculiar to street lighting give rise to merit in a definite zone of luminous distribution. That is to say, a street arc-lamp is more effective according to the proportion of the light which it emits in the zone between the horizon and a dip of 30 deg. Above the horizon the light can only illumine trees and houses, with but little advantage to the nocturnal wayfarer. Below 30 deg. the light practically falls into a pool below the lamp, for the nearly exclusive benefit of insectivorous creatures. The opalescent inner globe is an artificial means for increasing the light-giving powers of the street arc-lamp in this valuable zone. In store or factory arc-lamps these conditions are modified, and a more nearly uniform luminous distribution is preferable. For similar reasons, the report shows that with open arc-lamps it is advantageous to raise them considerably above the ground. The mean normal illumination of 9.5-ampere, 450-watt arc-lamps appears to have been increased nearly 60 per cent. by raising them from a height of 15 feet to a height of 40 feet. On the contrary, there seems to be but little advantage gained in general ground illumination by raising the enclosed direct-current series arc-lamps above a height of 15 feet, and an actual disadvantage in raising them above 30 feet.

A curious point urged in this connection is as to the proper definition of street illumination, whether "horizontal" or "normal." The former is the illumination, from the arc-lamp, at any point of a smooth horizontal plane surface at street level. The latter is the illumination from the arc-lamp, at each point of the street, of a small surface tilted so as to be normal, or perpendicular, to the rays incident thereon. To a person suspended in a balloon above the illumined street, the former would probably constitute the criterion of useful illumination. To a wayfarer looking for obstacles in his path, the latter seems to be the preferable criterion. We shall, therefore, consider that the normal illumination produced at a distant point by a street arc-lamp was the quantity to which attention should be directed, and the surface integral of this normal illumination extended over a circular horizontal area at street level, having the lamp over its center, and a radius of, say, 150 feet, might constitute a useful criterion of the commercial value of street arc-lamps. Its value would depend upon the relative distribution of the light, and would increase with the proportion thrown out at a small angular dip The report as a whole is a most useful addition to the literature of quantitative arc lighting.

The Great Barrington Programme of the Institute.

As already announced, the Nineteenth Annual Convention of the Institute will be held at Great Barrington, Mass., on June 18, 19, 20 and 21, 1902. The headquarters of the Institute will be at the Berkshire Inn, where the convention will be held. Guests will also be assigned to "The Barrington" and the Hotel Miller.

There will be one long morning session each day. One day will be devoted to the steam turbine, with a paper by Mr. Francis Hodgkinson, on the Parsons turbine, and by Mr. R. R. Bowker, or a representative, on the De Laval turbine. The other sessions will be devoted to electric railroading, the education of electrical engineers, and to mathematical and technical papers.

The Presidential Address will be upon the Education of an Electrical Engineer, and papers will be presented by the following members:

1.—"The Function of Series and Shunt Resistances in Lightning Arresters," by Mr. Percy H. Thomas, of Pittsburg. 2.—"A New Photometer for Incandescent Light and Similar Sources," by Prof. C. P. Matthews, of Lafayette, Ind. 3.—"Method of Compounding Alternating Current Generators and Motors, Direct-Current Generators, Synchronous-Motor Generators and Synchronous Converters," by Mr. F. G. Baum, of Stanford University, Calif. 4.—"The New Generating Plants of the Niagara Falls Power Company," by Mr. Harold W. Buck, of Niagara Falls, N. Y. 5.—"The Use of the Cathode Ray to Produce Stationary Diagrams of Alternating Current Waves," by Prof. Harris J. Ryan, of Cornell University, Ithaca, N. Y. 6.—"Formula for Calculating the E. M. F. at Any Given Point on an Alternating Current Transmission Line," by Mr. Maurice Le Blanc, of Paris, France. 7.—"A New Type of Current Tracing Instrument," by Prof. R. B. Owens, of Montreal. 8.—"The Predetermination of Alternator Characteristics," by Prof. L. A. Herdt, of Montreal. 9.—"Notes on Railway Speed-Time Curves," by Mr. C. O. Mailloux, of New York. 10.—"Method of Ascertaining from Dynamometer Car Records the Power Required to Operate the Mott Haven Division of the N. Y. C. & H. R. R. R., and the Relative Cost of Operation by Steam and Electricity," by Mr. B. J. Arnold, of Chicago. 11.—"Commutation," by Messrs. David B. Rushmore and E. E. F. Creighton, of Pittsfield, Mass. 12.—"A Study of the Heating of Railway Motors," by Mr. A. H. Armstrong, of Schenectady, N. Y. 13.—"The Present Status of Electrical Engineering Education in the United States," by Dr. Samuel Sheldon, of Brooklyn, N. Y. 14.—"The Electrical Engineering Courses at College," by Mr. E. B. Raymond, of Schenectady, N. Y. 15.—"Notes on an Experiment with Single-Phase Alternators on Polyphase Circuits," by Mr. C. O. Mailloux, of New York. 16.—"Comparative Acceleration Tests of Steam and Electric Traction," by Messrs. B. J. Arnold, of Chicago, and W. B. Potter, of Schenectady, N. Y. 17.—"The Equipment of an Electrical Engineering Laboratory," by Prof. R. B. Owens, of Montreal. 18.—"Energy Loss in Commercial Insulating Materials When Subjected to High Potential Stress," by Mr. C. E. Skinner, of Pittsburg. 19.—"The electrostatic Wattmeter in Commercial Measurements," by Mr. Miles Walker, of Pittsburg.

The local committee at Great Barrington, under the chairmanship of Mr. William Stanley, is making every effort to provide for the comfort and entertainment of the members and guests. There will be a reception at the Berkshire Inn on the evening of Tuesday, June 17th, followed by an informal dance. Wednesday afternoon, tea will be served at "Brookside," the future home of Mr. Stanley, under the management of the Ladies' Thursday Morning Club. Wednesday evening a lantern slide exhibit with five minutes' talks by various members will be given at the Town Hall. Thursday morning, Dr. Arthur E. Kennelly will lecture before the Thursday Morning Club, in Kellogg Hall. There will also be visits to Kellogg Terrace, the beautiful mansion of the late Mrs. Searles. Thursday evening there will be an assembly, with dancing, at the Town Hall. Thursday afternoon there will be a special organ recital on the magnificent pipe-organ at Kellogg Terrace.

Friday afternoon, by courtesy of the Stanley Electric Manufacturing Company, a special train will take the party to Pittsfield, where the works of that company will be visited, and a lawn tea served at the home of Dr. F. A. C. Perrine. In the evening the Institute will be entertained at the Maplewood as the guests of Mayor England and the Board of Aldermen of the city of Pittsfield. The official programme of the Institute will terminate with the morning session on Saturday, June 21st.

Throughout the convention carriages will be at the disposal of those desiring to drive during the day, or to and from the evening entertainments. Conveyances will also run at regular intervals to the golf links. The roads of Southern Berkshire are fine and adapted to driving, automobiling or bicycling. Members or guests desiring to play golf should bring their outfits.

Manager Bruce, of the new hotel Aspinwall, at Lenox, has extended to the Institute the courtesies of his house for dinner Saturday afternoon, with transportation to and from Lenox station to all who desire to visit this charming resort in the Berkshire Hills. Those who can spare the time will not only enjoy a beautiful trip but may desire to extend their stay over Sunday.

Rooms will be reserved for those attending the convention from the afternoon of Tuesday, June 17th. There will be fifty-eight rooms at the Berkshire Inn and forty-eight rooms at the Barrington. These rooms will be assigned strictly in order of application, except that precedence will be given to past-presidents of the Institute who may desire to attend. On account of the limited number of rooms with private bath it is believed that all these will be occupied by members attending the convention who are accompanied by their wives. These rooms will also be assigned in order of application. The rate at both hotels will be $3.00 for each person, American plan, for rooms without bath, or $3.50 per day for each person in a room with private bath.

Arrangements have been completed for a special train leaving the Grand Central Station, New York City, at two o'clock on the afternoon of Tuesday, June 17th, arriving at Great Barrington about 5:30 P. M. Besides this train, there are also through trains at 9 A. M. and 3:30 P. M. on the New York, New Haven and Hartford Railroad (Berkshire Division.)

The National Electric Light Association and the St. Louis World's Fair.

At the recent National Electric Light Convention a resolution, presented by Mr. James I. Ayer, of Boston, was unanimously adopted, providing that the annual meeting in 1904 of the National Electric Light Association shall be held on the grounds of the Louisiana Purchase Exposition Company at St. Louis, Mo., and that the association will lend its best endeavor to contribute to the gathering of such an electrical exhibit as the industry demands.

Prominent members of the association expressed themselves as being highly desirous of seeing the industrial applications of electricity established on a large scale at the Louisiana Purchase Exposition, and they voiced their willingness to co-operate in any way to secure this end, for the reason that the exposition will have the effect of opening up a great deal of territory now undeveloped electrically, while both the electrical central station managers and the manufacturers are alive to the fact that a proper exploitation will have much to do with extending the use of electrically operated and controlled apparatus and appliances, as well as extending electric lighting in no small degree. It is quite probable that the association will have an exhibit of its own for the demonstration of present methods for measuring and selling electric energy, whether for light or power. This exhibit will be educational in character and be intended to make the general public more familiar with the methods employed by electric companies in keeping their accounts and in making their charges.

Meeting of Canadian Electrical Association.

The annual meeting of the Canadian Electrical Association is to be held at Quebec, at the Hotel Frontenac, on June 11, 12 and 13, with sessions in the Quebec City council chamber. A number of interesting trips and festivities have been provided. The following is the programme of regular exercises:

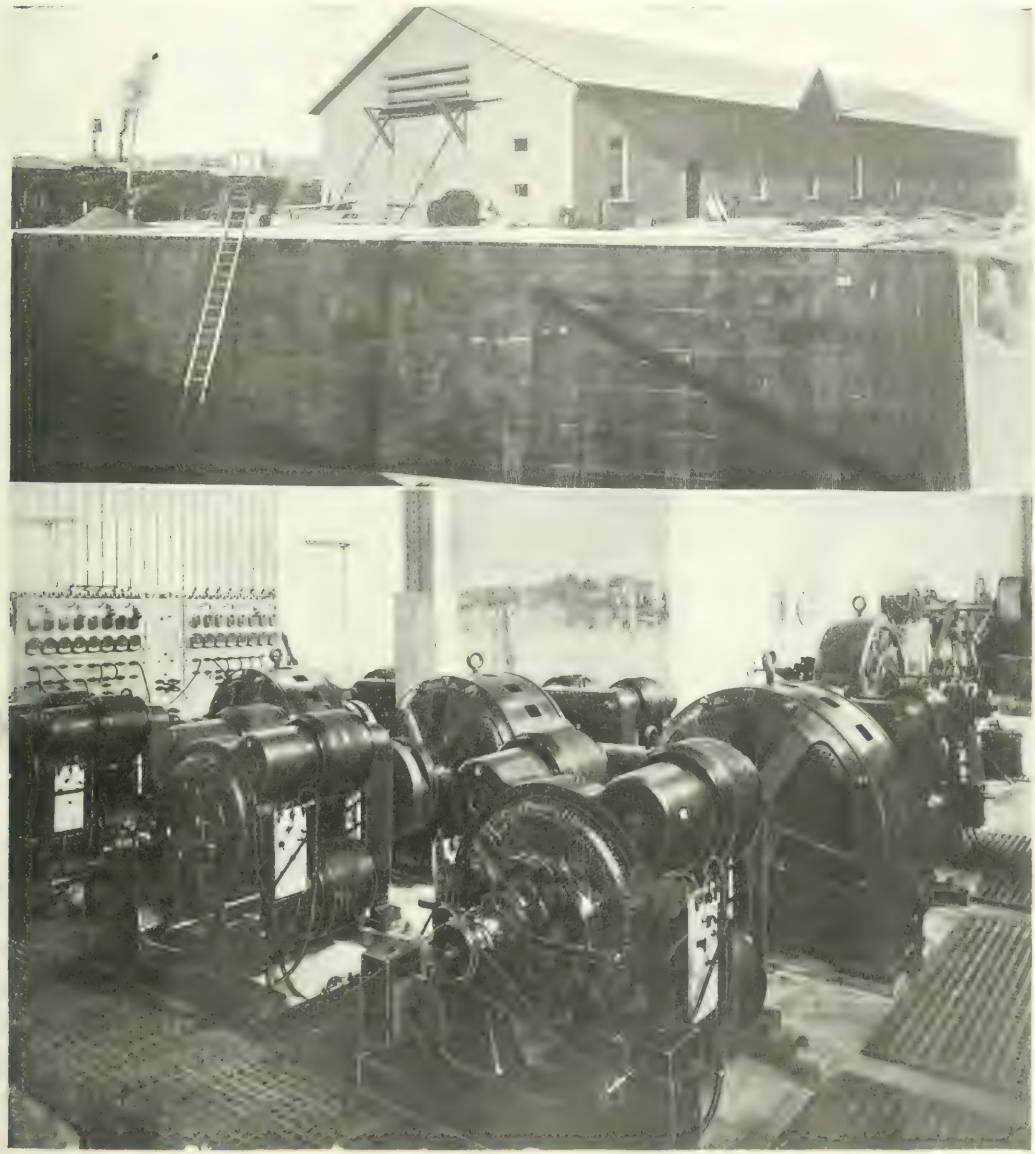
Wednesday afternoon, June 11.—"The Electrical Equipment of an Ordinary Street Car," by Mr. A. B. Lambe, Toronto, Ont. Evening.—"Development of Arc Lighting Apparatus fro 1810 and 1902, with Special Reference to Modern Arc Light Engineering," by Mr. W. D'A. Ryan, Lynn, Mass. Thursday morning, June 12.—"Arc Lighting," by Mr. C. M. Greene, Lynn, Mass.; "Lightning Protection and the Static Interrupter," by Mr. Percy H. Thomas, Pittsburg, Pa. Friday morning, June 13.—"The Use of Storage Batteries in Electric Distribution Systems," by Mr. A. A. Dion, Ottawa, Ont.; "Electric Suburban Railways," by Ed. A. Evans, Quebec, Que.

New Electric Lighting Plant for Ottawa, Canada.

By A. A. Dion.

OTTAWA, the capital city of the Dominion of Canada, occupies a most advantageous position for the utilization of that form of energy with which nature has so bountifully endowed that country, in its mighty and numerous waterfalls. Mainly built on a commanding bluff overlooking the Ottawa River, the city extends in its western section to comparatively low-lying lands—composed in part of islands linked together by bridges—to the main channel of the river, which divides Ottawa from the city of Hull in the neighboring Province of Quebec. Immediately opposite and between these two cities the waters of the Ottawa drop some forty feet over a rocky ledge into a cauldron-like formation. This is known as the Chaudiere Falls, whose great importance is derived from the immense volume of its waters, rather than from its height. A low timber dam extends across the river just above the falls. About this natural and unfailing source of power are clustered on both sides of the river the principal manufacturing and electrical industries of the district.

On the Ontario side of the main channel there are between the islands two large natural canals, which have been enlarged and improved, and are fully utilized by many power users who have built upon the adjacent lands. From these canals the several electric companies of the city derive their power, the water being taken directly [illegible] under flumes



FIGS. 1 AND 2.—EXTERIOR VIEW OF CENTRAL STATION [illegible] OF OTTAWA ELECTRIC RAILWAY COMPANY.

The Ottawa Electric Company was organized in July, 1894, for the purpose of consolidating under one management three other companies previously established for supplying light, heat and power, namely, the Ottawa Electric Light Co., the Chaudiere Electric Light & Power Co., Limited, and the Standard Electric Co. of Ottawa, Limited. After this amalgamation all the stations and plants of the three companies were continued in operation for a time, with but slight change, but the rapid increase of business which followed

compelled the new company to seek more water privileges wherever they could be obtained most quickly and conveniently. Additional plants were installed from time to time without following any comprehensive plan of extension, so that in 1900 the company found itself operating six different stations within short distances of each other. One of these was equipped with steam and used mainly as an auxiliary to the other stations during those periods of "anchor ice" troubles to which they were more or less exposed during the winter, and also to carry the peak of the load during a part of the dark season. One of the hydraulic stations was used as a "central" and distributing station, all other stations delivering their power to a common distributing switchboard, except the arc lighting station, which was run independently.

On the 26th of April, 1900, Ottawa was visited by one of the most destructive conflagrations in the history of Canada. In the space of eight hours fire had laid to waste almost all of the city of Hull, where it originated, and a considerable portion of Ottawa, including all the manufacturing district, rendering fifteen thousand people homeless and mostly destitute, and destroying millions of dollars of property. The scene which was presented to view when the sun arose over the ruins in the power district was one of extreme desolation. Few buildings remained standing, but among these were two of the power houses of the Ottawa Electric Company, the "Central" and the "Steam" stations; of the other four stations nothing remained but heaps of smouldering ashes, heavy stone walls having been calcined and reduced to dust. The two stations which escaped destruction had been saved in part by the efforts of the officers and employees of the company, all of whom, from the president down, turned firemen for the occasion.

There followed weeks of feverish activity for the whole staff of the company. Many and wonderful were the expedients adopted to restore the service. Those who have gone through somewhat similar experiences will appreciate the situation. Part of the incandescent and motor services was not interrupted, but inside of three weeks the whole was in operation, and more than half of the arc street lighting was resumed. Within the same time a general plan of permanent reconstruction had been adopted by the company. The "Central" and "Steam" stations were to be remodeled and improved, and both used as auxiliary stations, and one new and modern, absolutely fireproof station was to be erected to replace the four destroyed by fire, this to be the main and distributing station.

Work was begun on May 10, 1900, in clearing the debris of the fire. The extensive excavations required had to be made into solid rock, and the work was necessarily very slow. On October 24, 1901, water was turned on, and the new station started in operation. The following is a description of the several stations as they now are after this period of reconstruction:

STEAM AUXILIARY STATION.

This is situated alongside a waterway where an unlimited supply of water may be had for condensation. It is built of red brick on stone foundations in cement, the whole resting on solid rock. The engine and dynamo foundations are of solid masonry in cement. It is a one-story building, with flat roof supported on steel trusses. The roofing is of 3-in. pine lumber covered with tar and gravel. The chimney, which rests on a foundation of solid masonry 24 ft. square, built of very large blocks on solid rock, is octagonal in shape and 120 ft. high. The external diameter is 18 ft. at the bottom and 11 ft. at the top; internal diameter, 9 ft. at the bottom and 8 ft. at the top, the walls being double several feet up from the foundation. The dimensions of the building are: Engine room, 89 ft. x 77 ft., and boiler room about 45 ft. square, with a metal-covered wooden frame coal shed annexed, 77 ft. x 33 ft.

It is expected that this station will be little used, therefore no provision has been made for automatic handling of fuel, or any elaborate arrangements for high economy. The boilers are six in number, return tubular type, 16 ft. x 5 ft. in diameter, brick encased, adapted to deliver steam at 120 lbs. pressure in a common header. They were furnished by the Goldie & McCulloch Co., of Galt, Ont. The boiler room also contains two duplex "Northey" feed pumps.

The engines are two "Wheelock" tandem-compound condensing, manufactured by the Goldie & McCulloch Co., with 42-in. driving pulleys 18 ft. in diameter x 48-in. face; speed, 85 r. p. m. The condensers are of the Northey jet type. One engine is belted directly to a Westinghouse two-phase generator of 250 kw, operating at 2,300 volts and 60 cycles. The other engine is belted to a countershaft, from which is belted a second two-phase generator similar to the first. Westinghouse four-pole exciters are used. To this countershaft is also belted a Westinghouse multipolar direct-current generator, 500 kw, 550 volts. This may be used in case of a breakdown in the direct-current power plant installed in the main station, or to assist the Ottawa Electric Railway Company, the engines being adapted to be coupled together to drive this machine. The current generated in this station is transmitted to the "Central" station. The switchboard, consisting of generator and exciter panels, is similar to the generator switchboards in the other stations, which are described elsewhere.

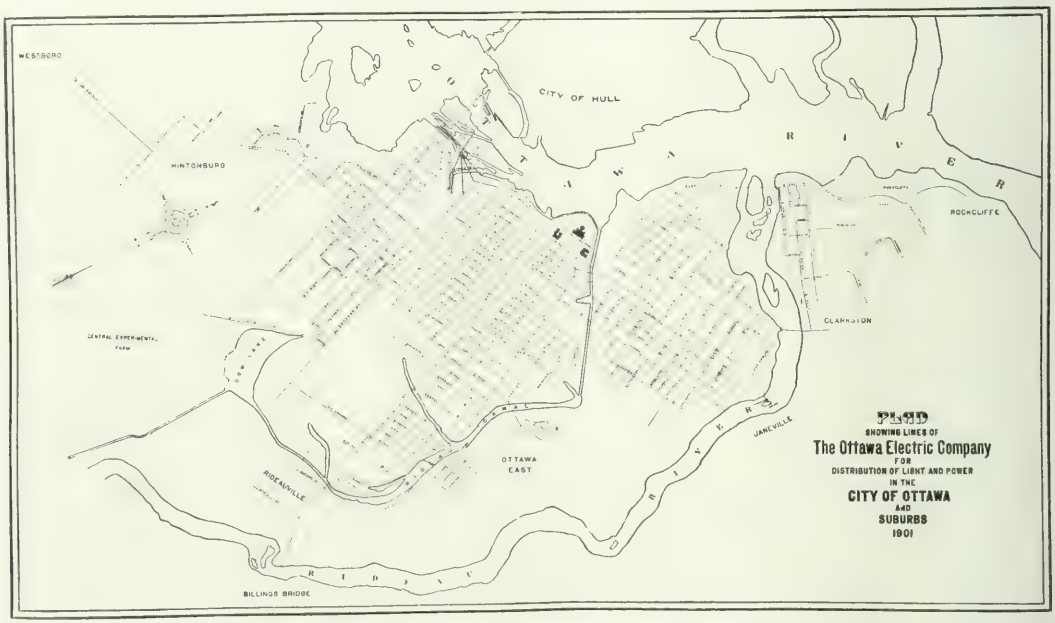


Fig. 3.—Map of Ottawa, Showing Distribution System

HYDRAULIC AUXILIARY STATION.

The water for this station, taken from one of the natural canals above mentioned, known as the "Slide Channel," is led through a



FIG. 4.—MASTER AND POWER SWITCHBOARD.

wide canal cut into rock to a timber bulkhead, where the level is controlled by means of stop logs; beyond this point the rock cutting extends into a pond of considerable size, along the side of which the station is built. The water enters through a wooden rack 92 ft. long by 16 ft. high, made of pine boards 1 in. thick by 6 ins. wide placed on edge 2 ins. apart. After passing through the water-wheels, which rest on heavy timber foundations and are separated by timber partitions forming box flumes, in which the wheels are submerged, the water enters short draft tubes and discharges into a rock excavated tail race, running longitudinally to and under the building, emerges through a stone arch at the lower end, and finally falls into the river a few hundred yards from the station.

The building is a substantial two-story structure, 121 ft. x 46 ft., with flat tar and gravel roof. Only about two-thirds of the ground floor is now occupied by the plant as remodeled. There is a one-story annex to this building, 109 ft. by 38 ft., facing the pond and containing the water-wheels and jack shafts. The wheel plant, which remains substantially as it was before the fire, consists of four "New American" vertical turbines, 66 ins. in diameter, made by Kennedy & Co., of Owen Sound, Ont. These are installed in four separate units, but coupled in two pairs through horizontal jackshafts, to which they are connected by crown wheel and pinion gearing. Each shaft carries a driving pulley 10 ft. in diameter. These are belted to two 700-kw Westinghouse alternating-current generators running at 327 r. p. m., the belts passing under adjustable idler pulleys set in the wall dividing the wheel house from the dynamo room. The generators are two-phase, have 22 poles, and operate at 2,300 volts and 60 cycles.

The two exciters, each of 37½ kw and each capable of exciting both generators, are of Westinghouse manufacture, four-pole, and are belted to the shafts of the generators. The switchboard is similar to that in the steam station. The current generated in this station is transmitted to the main station. In addition to the handwheels for controlling the wheel gates, friction gearing is provided for each wheel. Taking power from the jackshafts, this permits of controlling the speed of the wheels by means of hand levers grouped together in one place, facing the switchboard. No automatic water-wheel governors are used in this station.

THE NEW CENTRAL STATION.

The union of the two natural canals at one point forms a large pond, which is dammed at its lower end. This dam, constructed of heavy timbers, is composed of the intake bulkheads of various water users placed side by side, and a section in the center which is used as an overflow into a natural discharge channel below, which joins the main channel of the river some distance lower down. Starting from the southeasterly end of the dam and going towards the main body of the river, the bulkheads are placed in the following order: 1. The Ottawa Electric Railway Co., taking water directly off the pond, 2,000 hp. 2. The Ottawa Power Co., drawing water through a long timber flume, and supplying electric power to the Ottawa Car-



FIG. 5.—MAIN FLUME LOOKING UP STREAM.

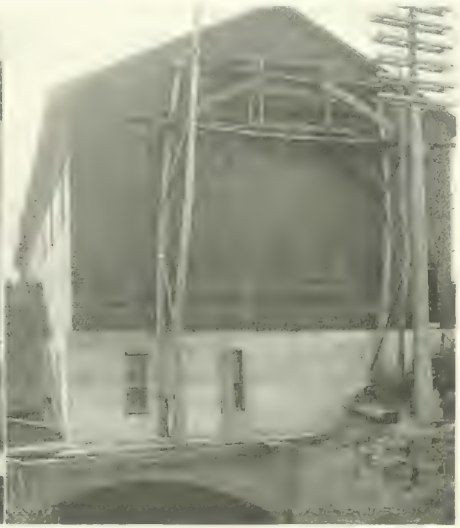


FIG. 6.—NEW CENTRAL STATION, SHOWING MAIN FLUME.

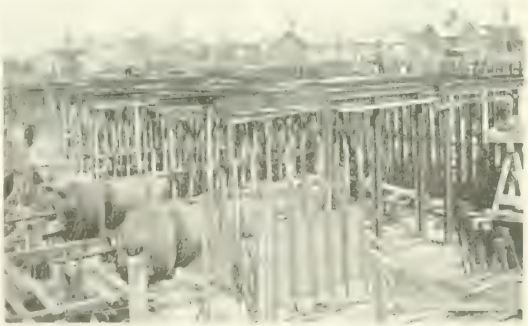


FIG. 7.—VIEW OF CENTRAL STATION DURING CONSTRUCTION.

bide Co., 4,000 hp. 3 Overflow bulkheads and discharge channel. 4. The Ottawa Electric Company new central station, 4,000 hp.

5. J. R. Booth, pulp factory under construction, to take water directly off the pond. Then comes a wide strip of rock, then Head Street, running parallel to the stream. This strip is occupied by the establishments of J. R. Booth (under construction) and the Ottawa Electric Company, both facing on Head Street.

Water for the new central station is taken past the J. R. Booth property in a massive timber flume, 32 ft. wide by 17 ft. high and

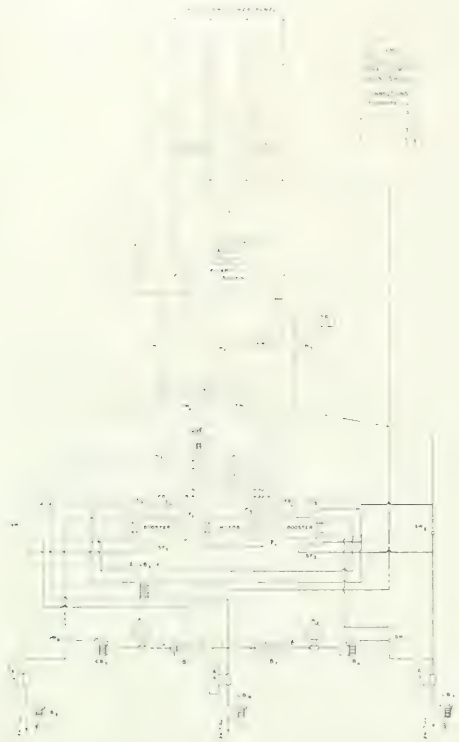


FIG. 8.—DIAGRAM OF CONNECTIONS FOR ROTARY AND BOOSTER PANEL.

FF. FF. Primary fuse blocks. OS. O S. Oil switches. SL. SL. Synchronizing lamps. FR-1. Rotary field rheostat. F-1. Rotary shunt field. SF. Rotary series field. SR.-1. Rotary starting rheostat. CB.-1. Overload no-voltage circuit breaker. CL. Buffer clips closing local circuit. SR.-2. Motor starting rheostat. FR.-2. Motor field rheostats. FR.-3. FR.-4. Booster field rheostats. F.-3. Motor field winding. SF.-2, SF.-3, SF.-4, SF.-5. Booster series field windings. CB.-2. Non-automatic circuit breaker. A.-1. A.-2. Differential ammeters. B.-1. B.-2. Storage batteries. A.-3, A.-4, A.-5. Edgewise ammeters. CB.-3, 4, 5, 6, 7. Automatic circuit breakers. SW. 1 to 10. Knife switches.

made underneath the building site 21 ft. deeper, 30 ft. wide and 150 ft. long, for the tail race. At the downstream end this connects with a similar excavation made in previous years, which, following a curved direction, joins the main channel of the river.

Three sets of horizontal turbines are installed side by side on a concrete arch which spans the tail race, and into which the draft tubes were built. This arch is 30 ft. long, has a rise of 5 ft., is 3 ft. thick in the center and 105 ft. in width. A wall 6 ft. thick and 23 ft. high separates the wheel space from the generator room, which occupies the space between the wall and the line of Head Street, the floor level being 16 ft. below the street grade. The several sets of turbines are separated by cross walls of steel framework built in 2 ft. of concrete, forming a large box flume for each wheel unit, in which the wheels are submerged. These flumes open at the rear end into a common covered flume, 20 ft. wide by 22 ft. high and 105 ft. long, parallel to the building and tail race. The outer walls of this flume are also of steel framework built into concrete 2 ft. thick, except that across the lower end, which is of solid concrete 4 ft thick at the top and 8 ft. at the bottom. In this cross wall an opening is provided—closed by an iron slide gate operated from above—and used for emptying the flume when water is shut off at the intake bulkheads. This flume is roofed over by corrugated steel arches of about 3 ft. centers, set between 6-in. I-beams and covered with concrete to a depth of 5 ins. over the centers. This forms a platform, from which access to the wheels may be had through large trap openings, and stop logs may be handled for closing any of the individual wheel flumes.

The station floor is 150 ft. long, it is 29 ft. wide for 103 ft., and for 44 ft. more 44 ft. wide, as it extends below and around the lower end of the flumes for a width of 14 ft. The upstream foundation wall of the building and the upstream opening of the covered flumes form the base of a triangular pond enclosed within concrete walls. The upper corner connects with the timber flumes already described, from which water is received. One of the sides of the triangle forms an overflow into the discharge channel mentioned above. The solid concrete wall on this side is 17 ft. high, 3 ft. thick at the top and 7 ft. at the bottom. At a distance of a few feet from the end of the station building an iron rack extends diagonally across the pond. It is 18½ ft. high and 82 ft. long, made up of flat iron bars 3 ins. by 5-16 in., placed 1½ ins. apart. The available working head of water varies from 22 to 28 ft.

The station building, which extends 15 ft. laterally over the wheel flumes, is of steel framework furnished by Jones & Laughlin, of Pittsburg, through the Stilwell-Bierce & Smith-Vaile Co., of Dayton, Ohio, 150 ft. x 45 ft. and 38 ft. high from the floor to the roof

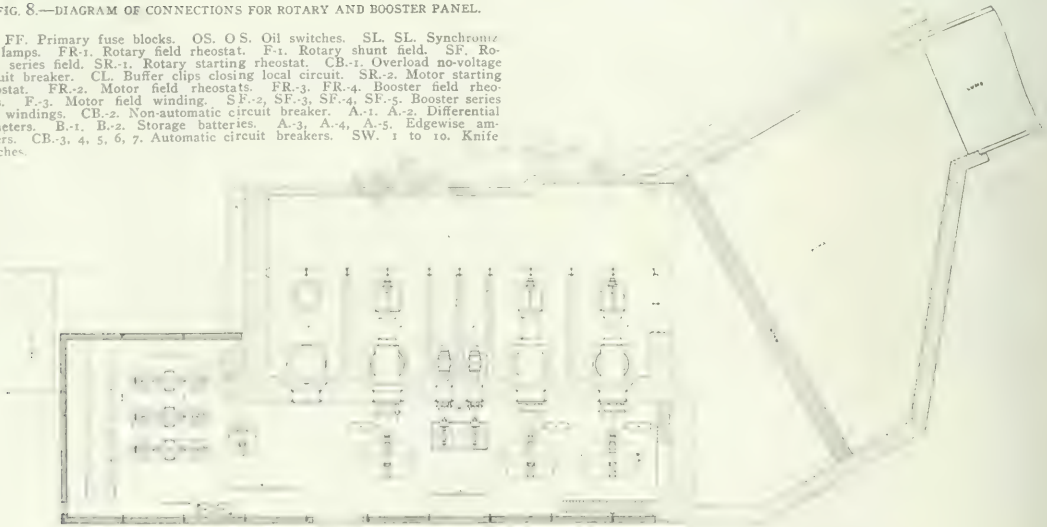


FIG. 9.—PLAN OF THE NEW CENTRAL STATION.

297 ft. long, built along the side of the discharge channel upon rock and concrete foundations. From this point the work of the new station properly begins. Rock having been excavated to a depth of about 16 ft. below the street level over the whole area to be covered by [illegible] and Station Building, a further excavation was

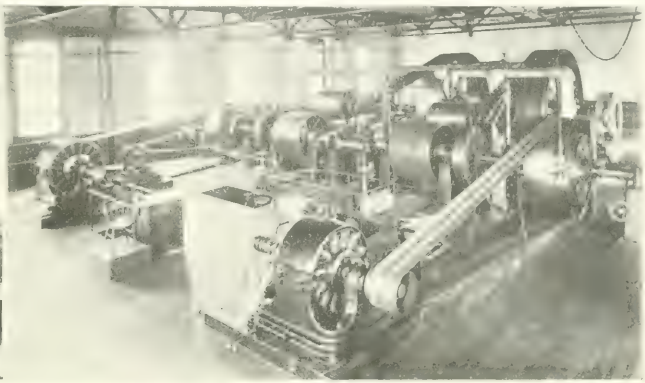
trusses, with roof sloping both sides from the center at an angle of 25 degrees from the horizontal. The pillars and roof trusses are placed 15 ft. apart. Up to about 20 ft. above the floor line the walls are of concrete, and above that of red brick, 17 ins. thick, tapering to 13 ins. at the top. The roofing is a 3 in. slab of cinder concrete laid

on expanded metal, finished outside with Warren's patent gravel roofing and inside with asbestic plaster. The doors are made of channel iron framework, covered on both sides with ⅛-in. sheet iron, and set in heavy iron frames built in the brick walls. The windows, sashes and frames, are of hollow-stamped galvanized iron, with wired glass, and were furnished by the Van Noorden Co., of Boston. All stairs and railings are of iron, and were made by the Victoria Foundry Co., of Ottawa, who also furnished the iron doors. A hand-operated traveling crane of 20-ton capacity, manufactured by the Whiting Foundry & Equipment Co., of Chicago, travels on side rails placed 31 ft. above the floor. With the exception of the roof, all work of excavation building and installation was done by day labor, under the superintendence of the company's regular employees.

The extension of the upper part of the building over the wheel flumes forms a gallery 14 ft. wide and 105 ft. long, 23 ft. above the station floor. This is utilized as a storage battery room, 70 ft. by 11½ ft., and oil room and an office for the station superintendent. Troughs are provided in the concrete floor for all cables between machines and switchboards. They vary in width from 7 ins. to 20 ins. by 6 ins deep, and are covered by cast-iron plates ⅜ in. thick by 2 ft. long. A complete system of drainage has been carried out to prevent flooding of floors and conduits through leakage during spring freshets, from the rising of water in the tail race, a contingency to be feared during years of exceptional flood. Provision is made for collecting the water into a water-tight well, from which it may be pumped. No heating is necessary in the building, owing to its situation partly below the ground level. It is lighted by six alternating-current arc lamps suspended from iron brackets 10 ft. long at a height of 19 ft. from the ground.

The turbine sets consist each of three 39-in. "Victor" wheels mounted in wrought-iron riveted casings set upon and bolted to the draft tubes, and adapted to discharge two into a central draft tube 8 ft. in diameter at the top by 13½ ft. long, and the third wheel through a quarter turn into a draft tube of 5 ft. diameter. There are three such sets, each directly coupled to and driving a generator at 180 r. p. m. Provision has been made for installing a fourth set later on, draft tubes being built in and place made ready to receive it. There are



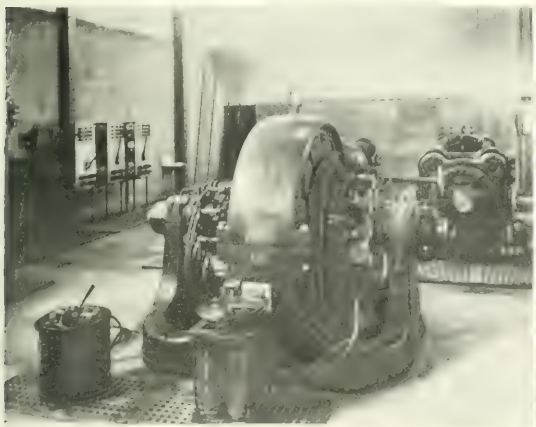


FIGS. 10 AND 11.—EXTERIOR AND INTERIOR VIEWS OF STEAM STATION.

also two smaller sets coupled to exciters. These consist each of two 15-in. wheels discharging into a central draft tube 3 ft. in diameter.

Where the wheel shafts pass through the 6-in. concrete wall, it tapers, funnel-shaped, from the wheel side to a thickness of 2½ ft. over a space just large enough to receive iron thimbles, which are built into the wall, the openings being closed by bolted cast-iron plates, through which pass the wheel shafts and the rods operating the wheel gates. The gates are of the cylinder type, worked by rack bar and pinion gearing from the generator room. These gates allow the water in which the wheel cases are submerged to enter the cases through suitable guideways to pass out through the draft tubes, which are sealed into the wheel cases. The water-wheels and fittings were furnished by the Stilwell-Bierce & Smith-Vaile Co., and installed under their directions.

The three large units are controlled by "Lombard" water-wheel governers set on the floor of the generator room, motion being communicated to the gate rods by small steel cables running over grooved pulleys. The small "exciter" wheel sets are both governed by one "Woodward" governor, from which either set may be disconnected at will by simply disengaging a driving pin, when the gates may be worked independently by hand. It was feared at one time that the



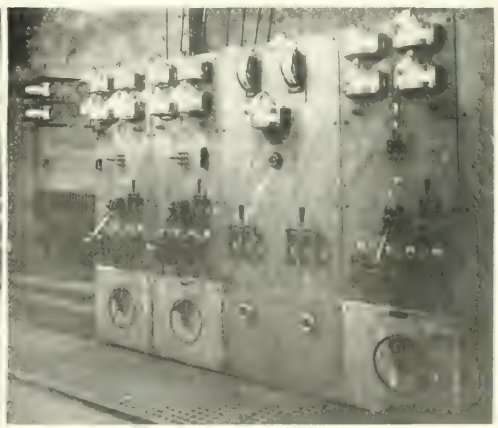


FIG. 12.—[illegible]

FIG. 13.—[illegible]

15-in. wheels would sometimes choke with "anchor ice," and provision was made for driving the exciters, if desired, from the neighboring main wheel shafts. No such trouble was experienced, however, during last winter.

The three generators are Westinghouse two-phase of 700 kw capacity, revolving armature type. They have forty poles, and at 180 r. p. m. give 2,300 volts at 60 cycles. The design of these machines is such as to raise the armature and the field windings above the floor line, which makes injury through flood an impossibility. The two exciters, which may be used singly or in parallel, are four-pole, compound wound Westinghouse machines of 56½ kw, mounted on a block of concrete 3¼ ft. high, in order to raise them to the level of the wheel shafts to which they are coupled. They run at 475 r. p. m. A Westinghouse 12-pole rotary converter of 300 kw provides current for direct-current motor service on a three-wire distribution 500/250 volts. Two Westinghouse oil-cooled transformers, square type, with

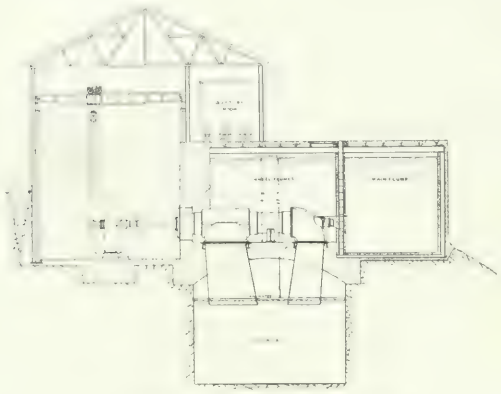


FIG. 14.—SECTION THROUGH CENTRAL STATION.

corrugated sheet iron cases, each of 165 kw capacity, furnish current for the rotary. A tap is taken from the middle point of the secondary winding of each transformer, and these taps joined together form the neutral wire of the direct-current system. A storage battery, connected across the direct-current feeders, permits of starting the rotary from the direct-current side. In case the battery should be out of service, starting current may be had from the street railway system, to which connection may be made. The rotary has been in operation on 60 cycles for many months, often at full load, first on single-phase and later on two-phase currents, with the most satisfactory results. It was necessary to provide direct current for motors already installed by customers, and for direct-connected elevators, but all other power service is being done by alternating currents on a two-phase distribution, so far entirely separate from the lighting service. The water-power available within the limits of this and the adjourning city of Hull, which is used by practically all the large manufacturing industries, restricts the field for the sale of power to the smaller users, so that this portion of the company's business has been of comparatively slow growth.

The lighting of the city streets, parks, etc., is being done under contract by the direct-current series arc system. There is a maximum of 75 enclosed 6½ amp. lamps on each circuit. Between city and commercial circuits 670 lamps are in use, all of Adams-Bagnall make. To supply these, six generators are used, each of a capacity of 150 enclosed lamps. They are Western Electric Company's two-circuit machines. They are driven in pairs by Westinghouse 250-hp two-phase induction motors, running at 580 r. p. m., a motor being placed between two generators and coupled to them. This arrangement gives the advantage of retaining the use of direct-current lamps, while making the arc lighting service independent of any one water-wheel unit, generator, or even any one station, thus insuring a constant service under almost any possible conditions, the arc generator capacity being large and the induction motors most unlikely to break down.

The storage battery equipment consists of 250 cells, "Chloride" in glass jars, with a differential booster of 11¼ kw on each side of the three-wire system, both boosters being driven by one 30-hp motor coupled thereto, all three machines being mounted on a common iron base. This battery was installed uptown at the end of the feeders at a time when the water-wheel regulation was poor and the motor service unsatisfactory, and proved invaluable in evening up the voltage under varying loads. It will now be utilized at the station, although not now so much needed, for the same purpose and for relieving the station during peak hours, if desired, to the extent of its capacity, which is not large, but may be increased 50 per cent. without changing cells. It also permits of shutting down the rotary at night, if necessary or desirable. During a use of 3½ years no trouble has been experienced with the battery. The plates are in good condition, and the only attention received has been that of one man half a day per week, but this man is required to do his work systematically, and nothing but chemically pure sulphuric acid is used in the solution.

SWITCHBOARDS AND CONNECTIONS.

The generator switchboard stands 6 ft. from the wall opposite the exciters, about the center of the station. It consists of three generator and one exciter panels, manufactured by the Wagner Electric Manufacturing Co., of St. Louis. The panels are of blue Vermont marble 2 ins. thick and 28 ins. wide, set in angle-iron frames. The generator panels have mounted on them an ammeter on each phase, a Wagner wattmeter with 3-pole, double-throw switch to connect it to either phase, a Wagner direct-current field ammeter, a voltmeter plug switch, a synchronizing plug switch and synchronizing lamps, also a Wagner 4-pole, single-throw oil switch, four S. K. C. lignum vitæ fuse blocks, a field switch with discharge resistance attachment, and the field rheostat, which is mounted on the back.

On a swinging bracket at the end are two Wagner voltmeters, one of which is connected to the bus-bars, while the other may be connected to either phase of any generator by means of the voltmeter plug switches. The synchronizing switches are used to connect any generator to a Lincoln synchronizer, which is set up on the end wall of the station and may be seen by both the switchboard attendant and the man at the water-wheel regulator, who may vary the speed as required. This instrument at the station has been found to be a great improvement on the synchronizing lamps. It makes the action of throwing generators in parallel exceedingly simple and safe. On the exciter panel, 38 ins. wide, are mounted two Weston edgewise ammeters, one Wagner direct-current voltmeter and switch, two 3-pole, single-throw knife switches, also an equalizer bar, and all neces-

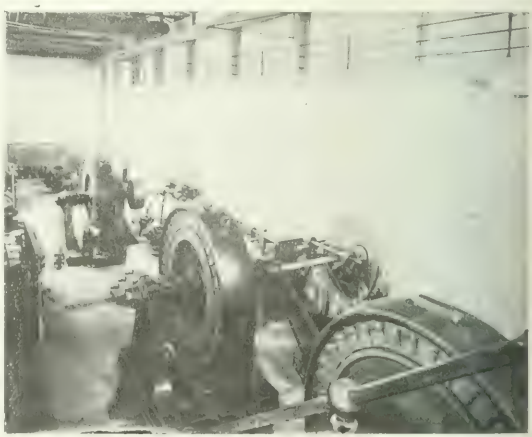


FIG. 15.—VIEW OF GENERATOR ROOM, LOOKING DOWN STREAM.

sary fuses on the back of the panel, together with the two field rheostats, the operating handles coming through the front.

The connections between the generators and this switchboard, as all other connections between machines and switchboards, are made through rubber-insulated, lead-covered cable laid in troughs in the floor, covered by short cast-iron plates, which may be lifted easily. All parts of the cable system may thus be got at without trouble. From each one of the generator panels four cables are run over to another switchboard, which may be called the "transfer and power switchboard," the two left-hand panels being used to connect any of the generators, whether in this or the other stations, to either the

lighting or power bus-bars, and the two right-hand panels are devoted to the distribution of power, both alternating and direct current. Between them there is a blank panel, which was put there to allow more space for wiring at the back. This switchboard, also of Wagner manufacture, is similar as to marble and mounting to the one just described.

The transfer of generators from lighting to power bus-bars and vice versa is accomplished by means of one single-throw Wagner oil switch and four S. K. C. lignum vitæ fuse blocks for each generator. The fuse blocks are specially adapted to change the connections by being turned around; this is done, of course, with the switch open. On the transfer panels are also placed a Wagner static ground detector and switch, and eight Westinghouse integrating wattmeters, whereby the output of each station, and that proportion chargeable to the incandescent lighting system, may be measured. There is also an Elden automatic circuit breaker, through which the generators in the hydraulic auxiliary station may be paralleled with those in the main station. Owing to the absence of automatic water-wheel governors in the auxiliary station, there will be, under certain conditions, a liability to get out of step. Should this occur, the circuit breaker will immediately separate the two sets of bus-bars to which the generators are connected. Two Wagner oil switches of 750-amp. capacity and two ammeters connect to heavy cables, which lead out of the building and onto the power house of the Ottawa Power Co., whereby mutual assistance may be rendered temporarily in case of accident to any machinery.

All cables leading out of the building are heavily insulated with rubber, and run on wooden strips attached to the brick walls or the ironwork of the roof, being fastened on porcelain insulators, which for the heavier cables are iron-bound, the whole presenting a very neat appearance. Each cable is isolated and in full view. All cables were furnished by the New York Insulated Wire Co.

Behind the transfer panels are bus-bars representing the different stations, and from each set two sets of cables are attached and lead,

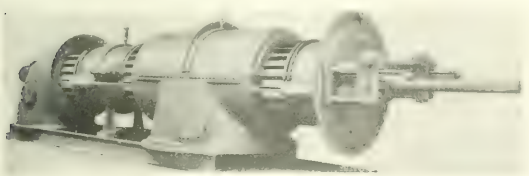


FIG. 16.—39-INCH TURBINE UNIT.

one set to the power panel adjoining, and the other to a corresponding set of bus-bars in the lighting switchboard, which is described below. In the power panel three four-wire circuits start from the main cables just mentioned. One leads to the rotary through four S. K. C. fuse blocks and an oil switch; one leads to the starting panels of the induction motors driving the arc generators, and the other goes out to the line for alternating-current power service, passing through an Elden automatic oil circuit breaker, which is also used as a switch. Each of the three circuits is also represented on this panel by two Wagner ammeters, one Wagner wattmeter on one phase, and a Westinghouse two-phase integrating wattmeter.

The two adjoining panels are used for the control and operation of the direct-current distribution, including the storage battery and boosters, and contain a number of Wagner knife switches, two Weston direct-current illuminated voltmeters, three Weston edgewise ammeters, five Westinghouse single-pole automatic air circuit breakers, one of each on each leg of the three-wire feeders and one on each end of the storage battery shunt, two Weston round-pattern differential ammeters, reading right and left from zero, one on each half of the storage battery, and two voltmeter switches. Provision is also made to cut off the storage battery and boosters in the event of current failing for any reason to the motor driving the boosters, which would cause the boosters to race. An overload no-voltage, double-pole Cutter circuit breaker is placed in the armature circuit of the motor, the shunt coil of this instrument being connected one end above the motor switch and fused cut-out and the other end below, as clearly shown on the plan of wiring. This circuit breaker, on opening, closes through the buffer clips a local circuit in which are included six of the storage battery cells, and the solenoid of another double-pole overload Cutter circuit breaker, which is thus made to open, cutting off battery and boosters.

Across the lower end of the building is situated the switchboard for incandescent lighting. It is composed of ten blue Vermont marble panels, 44 ins. wide x 1½ ins. thick and 90 ins. high (as are all the switchboard panels in the station), mounted in a frame of 2-in. angle iron braced from the wall, 5 ft. back. Each panel accommodates two pairs of feeders. These panels were furnished by the Canadian General Electric Co., and all material to be mounted thereon is now being transferred from the old distributing switchboard in the old "central," now the auxiliary station, except the indicating instruments, which were ordered from the Wagner Electric Manufacturing Co. The equipment of each feeder consists of voltmeter and ammeter, transformer and Westinghouse compensator, Westinghouse lignum vitæ fuse blocks, and an S. K. C. double-throw, double-pole slide switch, which is mounted on the back of the board, with rack bar and handle in front. Two flexible cables, terminating in wooden-handled plugs, are attached to each end of the switch, and come through to the front of the board. The plugs are adapted to enter spring receptacles corresponding to the six pairs of flat copper bus-bars at the back of the board. There are thus two pairs of buses for each station—one for each phase—to any of which any feeder may be connected.

At a distance of 5 ft. in front of the board there stands a row of static boosters in two sections, one for each feeder. They are set into a trench in the floor 1 ft. deep. The faceplates are set horizontally above the transformers, and enclosed in glass, the handles coming through. These boosters are provided with a reversing switch, and have a range of 10 per cent. up and down.

The voltmeters are zero instruments, and a change of half a volt in the secondary voltage of 110 volts causes the pointer to deflect one-half volt. With these instruments, in connection with the boosters and compensators on each pair of feeders, it is possible to maintain very close regulation at the centers of distribution.

The arc switchboard was furnished by the Western Electric Company, and is of its well-known type, with flexible cables and plugs, ammeters and polarity indicators for each circuit. There is also a Weston illuminated dial voltmeter reading to 6,000 volts, and adapted for connection to any circuit. There is accommodation on this board for sixteen circuits and eight two-circuit generators. There is a lightning arrester on every wire entering the station. Wurts arresters are used throughout.

The 250-hp induction motors are started by means of auto-transformers from marble panels containing a four-pole, double-throw knife switch, Westinghouse plunger switch and four Westinghouse lignum vitæ fuse blocks.

The storage battery cells are set on wooden trays painted with P. & B. compound and filled with sand. These are supported on porcelain legs and rest on 6 in. x 6 in. wooden stringers elevated from the concrete floor by 6 in. x 6 in. wooden cross pieces 4½ ft. apart, all painted with P. & B. compound. A large lead-lined tank contains reserve solution, which may be siphoned and led to any cell through rubber hose.

A small air compressor driven by a belt from one of the wheel shafts and a reserve air tank connected to a pipe running through the station, with tap valves at several points, furnishes means of cleaning the machinery.

The interconnection of the several stations of this company and those of the Ottawa Electric Railway Co. and the Ottawa Power Co., for mutual assistance in emergencies, is probably a novel feature in plants of this kind, but one which must be of great advantage to all parties concerned, including the company's patrons, who are thus given a degree of security not otherwise obtainable.

All the distribution is overhead, the lines covering the cities of Ottawa and Hull thoroughly, nearly 6,000 cedar poles being in use. The present installation is 99,000 incandescent lamps, 670 direct-current arc lamps, 175 motors, or 600 horse-power, besides fan motors, heaters, etc. The work of reconstruction was designed by the company's own engineers, in consultation with the Westinghouse and the Stilwell-Bierce & Smith-Vaile Companies. The executive staff of the company is composed of Messrs. T. Ahearn, president; F. P. Bronson, vice-president; A. A. Dion, general superintendent; D. R. Street, secretary-treasurer; J. Murphy, superintendent of stations; W. H. Baldwin, superintendent of hydraulic works; W. G. Bradley, superintendent of lines.

The Possibilities for a Light Weight Storage Battery.

By A. L. Marsh.

IT has become a problem of great importance to the electric automobile industry to produce a storage battery of lighter weight and greater durability than the types now in general use. It is the purpose of this article to point out some theoretical considerations which may throw a little light on this problem.

The ampere-hour capacity which a given material may possess depends upon the equivalent weights of the elements involved in the reactions of charge and discharge, and not upon their specific gravities, as is sometimes stated. For example, the equivalent weight of iron (ferrous) is 28, iron (ferric) is 18.66, lead is 103.46 and gold is 65.73, while the specific gravities are: wrought iron, 7.79; lead, 11.445, and gold, 19.258. Gold has a higher sp. gr. than lead, but a lower equivalent weight, and the equivalent weight of iron varies according to its state of oxidation. To put it in another way, the capacity in coulombs of a substance depends upon the equivalent weight of the compound as determined by its change of valency during the charge or discharge. Lead peroxide is quadrivalent, lead sulphate is bivalent and metallic lead has no satisfied valencies.

(The expressions positive active material, positive plate and positive electrode, apply to the anode in the charge of a cell. A confusion in the use of the terms *positive* and *negative* makes this explanation necessary.)

In the discharge of a positive plate in a lead storage cell, the lead changes from the quadrivalent state to the bivalent, a change of two valencies. A cell in which the lead passed from the bivalent state to metallic lead would theoretically have the same capacity for the same weight of lead; or, if the quadrivalent lead passed to the metallic state, involving a change in valency of four, the positive material would possess twice the capacity as in the first case.

The same applies to the negative material, except that the change is in the opposite direction. Metallic lead passes into lead sulphate during discharge, thus involving a change in valency of two. This change in valency is called in chemical terminology oxidation or reduction, according as the valency is increased or decreased, and whether oxygen or some other element, as chlorine, is involved in the change.

Taking up the consideration of the lead-sulphuric-lead peroxide storage cell, we find that one pound of active positive material is theoretically capable of giving 101.58 ampere-hrs. This may be calculated in the following way. Let us assume that the simple peroxide of lead (PbO_2) is the active material.

The atomic weight of lead (Pb) is..... 206.9
The atomic weight of oxygen (O) is 16, $2O$=..... 32.0

The molecular weight of lead peroxide (PbO_2) is.. 238.9

In the discharge of the plate, the peroxide is changed to lead sulphate, a change of valency of two. Therefore the equivalent weight of the compound is one-half of the molecular weight, or 119.45. .000010384 is the electrochemical equivalent of hydrogen in grams, or, in other words, .000010384 gram of hydrogen (equivalent weight = 1) is capable of giving one coulomb (amp.-sec.) of current. The equivalent weight of PbO_2 being 119.45, it will take 119.45 times .000010384 grams, or .0012403688 grams of PbO_2, to give one coulomb. Since 3600 ampere-seconds = 1 ampere-hr., it will take 3600 times .0012403688, or 4.46532768 grams PbO_2, to give 1 ampere-hr. Taking 453.59 grams equal to 1 pound avoirdupois, 1 lb. of PbO_2 gives 101.58 ampere-hrs. In the negative plate we have metallic lead with an equivalent weight of 103.46. One pound of lead will give theoretically 117.27 ampere-hrs.

These calculations are for plates in the charged state. During the discharge, sulphate of lead is formed on both plates, which become heavier at the expense of the sulphuric acid of the electrolyte. Also, the figures are for the active material alone and do not allow for the weight of the grid.

In practice we do not get 101.58 ampere-hrs. per pound of active positive material. The best type of pasted plate cell on the market to-day gives about 32 ampere-hrs. per pound of formed positive paste when discharged at a four-hour rate. Under the most favorable conditions (*i. e.*, slow discharge) a cell with a conservative four-hour rating of 190 ampere-hrs. gave 270 ampere-hours. This corresponds to 43.2 ampere-hrs. per lb. of formed positive paste. The extreme limit of practical capacity seems to be about 50 per cent. of the theoretical. Practically the same thing holds for the negative active material.

Now let us give our attention to some other elements and compounds which it may be possible to use in storage cells.

POSITIVE MATERIALS.

Nickel Oxides.—By a process of calculation similar to that employed for lead we find that nickel oxides give the following theoretical capacities:

I—Nickel peroxide (NiO_2) reduced to nickelous oxide (NiO) gives 267.85 ampere-hrs. per lb.

II—Nickel peroxide reduced to nickel sesquioxide (Ni_2O_3) gives 133.92 ampere-hrs. per lb.

III—Nickel sesquioxide (Ni_2O_3) reduced to NiO gives 146.88 ampere-hrs. per lb.

Mr. Edison's theory of discharge is represented in I. The writer holds the theory represented in II, and Michalowski that represented in III.

As in the case of lead peroxide, the oxides of nickel are in fact not as simple as represented, but are hydrated oxides. Nickel oxides are used in potassium hydroxide or sodium hydroxide solutions, in which they are practically insoluble. In the discharge of a nickel peroxide plate the weight decreases, since oxygen is taken from the plate and nothing is permanently taken from the electrolyte. Cobalt forms the same series of oxides as nickel, and their capacities are practically the same.

Silver Oxides.—Silver differs from the two preceding metals in that its oxides are reduced to the metallic state in the discharge. The oxides with their capacities follow:

Silver peroxide (AgO) reduced to metallic silver gives 195.7 ampere-hrs. per lb.

Silver oxide reduced to metallic silver gives 104.6 ampere-hrs. per lb.

A small Ag_2O-cadmium cell construced by the writer gave about 56 ampere-hrs. per lb. of Ag_2O used. I think this figure can be increased. Oxides of silver are used in alkaline solutions.

Copper Oxides.—Copper oxides are reduced to the metallic state during discharge. Of course, this depends on what is used as negative material, which is also true of the silver oxides. A silver peroxide-silver couple on discharge would probably result in silver oxide (Ag_2O) on both electrodes, and a copper peroxide-copper couple would result in an intermediate oxide. But such combinations would give a low electro-motive-force and would therefore be impractical.

Copper peroxide (CuO_2) reduced to metallic copper gives 507.9 ampere-hrs. per lb.

Copper peroxide reduced to cupric oxide (CuO) gives 253.95 ampere-hrs. per lb.

Cupric oxide (CuO) reduced to metallic copper gives 304.74 ampere-hrs. per lb.

Cuprous oxide (Cu_2O) reduced to metallic copper gives 169.44 ampere-hrs. per lb.

Oxides of copper are used in alkaline hydroxide solutions. They are somewhat soluble in the alkali under most conditions, but Mr. Edison finds that an extreme degree of subdivision renders cuprous oxide (Cu_2O) insoluble.

Chlorine.—Chlorine is used as depolarizer in contact with some non-corrosive conducting electrode, such as carbon.

Chlorine gives 342.27 ampere-hrs. per lb.

NEGATIVE MATERIALS.

Iron.—Iron is best used as negative material. Ferric oxide and salts are sometimes used as depolarizers, but the e.m.f. produced is rather low. The capacities of iron are:

Iron to ferric oxide (Fe_2O_3) gives 650 ampere-hrs. per lb.

Iron to ferrous oxide (FeO) gives 433.34 ampere-hrs. per lb.

Iron to ferro-ferric oxide (Fe_3O_4) gives 577.79 ampere-hrs. per lb.

Cadmium.—Cadmium is used only as negative material. Its oxide is insoluble in alkaline hydroxide solutions.

Cadmium oxidized to Cadmium oxide (CdO) gives 216.67 ampere-hrs. per lb.

Zinc.—Zinc is used only as negative material. It is soluble in nearly all electrolytes.

Zinc to zinc oxide (ZnO) and zinc to zinc chloride ($ZnCl_2$) each give 373.3 ampere-hrs. per lb.

Copper.—Copper is used by Jungner in his copper-silver cell, as negative material.

Copper oxidized to cupric oxide (CuO) gives 381.53 ampere-hrs. per lb.

Copper oxidized to cuprous oxide (Cu_2O) gives 190.76 ampere-hrs. per lb.

The subjoined table gives in compact form the above figures on theoretical capacities:

Positive Materials.	*Amp.-hrs. per lb.*	*Negative Materials.*	*Amp.-hrs. per lb.*
PbO_2 to $PbSO_4$	101.58	Pb to $PbSO_4$	117.27
NiO_2 to NiO	267.85	Fe to Fe_2O_3	650.0
NiO_2 to Ni_2O_3	133.92	Fe to FeO	433.34
Ni_2O_3 to NiO	146.88	Fe to Fe_3O_4	577.79
AgO to Ag	195.70	Cd to CdO	216.67
Ag_2O to Ag	104.6	Zn to ZnO	373.3
CuO_2 to Cu	507.9	Zn to $ZnCl_2$	373.3
CuO_2 to CuO	253.95	Cu to CuO	381.53
CuO to Cu	304.74	Cu to Cu_2O	190.76
Cu_2O to Cu	169.44		
Chlorine	342.27		

DISCUSSION.

Of the positive materials considered, lead peroxide stands the lowest in ampere-hour capacity per unit of weight, and the figure would be considerable lower if account were taken of the sulphuric acid withdrawn from the electrolyte during discharge.

The other materials in the positive list, with the exception of chlorine, are used in alkaline solution. In the charge, oxygen is transferred from negative to positive; in the discharge, from positive to negative. The electrolyte is unchanged as a whole and may therefore be present in just sufficient quantity to serve as conductor and to allow for the decomposition of water in overcharging.

Copper peroxide (CuO_2) gives by far the greatest capacity—five times that of lead peroxide. This compound has not been used for storage purposes, and perhaps it cannot be so used. When moist this compound decomposes at ordinary temperatures. To keep it, the peroxide must be dry, or if moist the temperature must not be much above the freezing point.

In the consideration of the lightweight accumulator it is the watt-hour capacity, and not merely the ampere-hr. capacity, which counts. Therefore the electromotive force must be taken into account in each case.

The electromotive force of positive active material may be referred to a zero standard; that is, a substance which neither adds to nor subtracts from the electromotive force produced by the action of the electrolyte on the negative electrode. In alkaline hydroxide solution silver oxide (Ag_2O) may serve as the standard, since it practically fulfills the requirements of the definition. Other oxides produce plus or minus e.m.f. according to whether they are endothermic or exothermic compounds. Lead peroxide, being used only in sulphuric acid solution, its electromotive force cannot be referred to that of silver oxide as zero standard.

The following table gives the values for the electromotive force of the different negative materials in an alkaline hydroxide electrolyte:

Negative Material.	*E. M. F.*
Zinc (amalgamated)	1.37 volts.
Zinc (pure)	1.32 "
Cadmium	.95 "
Iron	.85 "
Copper	.56 "

The values for the positive materials vary somewhat with the method of preparation and conditions of use. In alkaline hydroxide solutions the values are approximately as follows:

Positive Material.	*E. M. F.*
Nickel peroxide (NiO_2)	+ .4 volts.
Silver peroxide (AgO)	+ .15 "
Silver oxide (Ag_2O)	0 "
Copper peroxide (CuO_2)	(?) "
Cupric oxide (CuO) (Black oxide)	— .4 "
Cuprous oxide (Cu_2O) (Red oxide)	— .47 "

The lead cell has the advantage of a high voltage—average about 1.9.

A copper peroxide-zinc couple (with electrolyte of potassium hydroxide solution) should give a high voltage, but this has not been determined experimentally.

Black oxide of copper (CuO), having a theoretical capacity of 304.74 ampere-hrs. per lb., gives a voltage of from .8 to .9; yet with this low voltage its watt-hour capacity is greater than that of lead peroxide. This copper-zinc combination has been given considerable attention by investigators. The chief difficulty seems to lie in the deposition of the zinc.

Cuprous oxide (Cu_2O) has a low capacity and gives a low voltage, and is not considered practical.

Nickel peroxide gives a voltage of about 1.5 with an iron negative at the beginning of discharge. During the discharge the voltage gradually falls below 1, so that the average is little better than 1 volt. The ampere-hr. capacity is rather high, if Mr. Edison's theory of discharge is the correct one, namely:

$$NiO_2 + Fe = NiO + FeO.$$

The writer's theory* is represented by the equation:

$$Ni_2O_4 \text{ (or } 2NiO_2) + Fe = Ni_2O_3 + FeO.$$

The watt-hour capacity in the latter case is rather low, the advantage in weight over the lead accumulator being due, chiefly, to the iron negative and the smaller amount of electrolyte required.

The capacity of silver peroxide is quite high, and the electromotive force which it is capable of producing is only a little lower than that of nickel peroxide and does not drop rapidly until almost discharged.

A recent invention by Signor Pisca makes use of liquid chlorine as depolarizer in contact with a conducting plate of carbon. A disc of zinc is used for the negative. The e.m.f. of this cell was not given, but it should be about two volts. The inventor claims a greater capacity for this cell than that given by other types in use, and, indeed, a much greater capacity is theoretically possible. This type of cell would have to carry enough electrolyte to hold the zinc in solution, and would be subject to the same difficulty as all zinc accumulators in the matter of redepositing the zinc in a compact and coherent mass. Moreover, chloride of zinc solution is a poor conductor of electricity compared with sulphuric acid or alkaline hydroxide solutions, and the high internal resistance would involve a loss.

Of the negative materials listed, iron has the greatest ampere-hr. capacity, and at the same time gives a sufficiently high electromotive force. It is not probable that under ordinary conditions of discharge the oxidation proceeds to the formation of the ferric oxide, though this would be possible with an excess of a powerful oxidizing agent for the positive electrode. In any case the capacity of iron is high and matches well the high capacity of a copper peroxide positive.

Under certain conditions, soluble ferrates of sodium or potassium are formed. Under the working conditions of a cell such reactions should not be prominent and probably do not occur. The peculiar property of inertness of iron and its oxides may be overcome, and will probably not prove to be a serious obstacle to their use in storage cells.

Cadmium has a much smaller capacity than iron, and is much more expensive. Its e.m.f. is a trifle higher than that for iron.

Copper has a rather high capacity as negative material, but presents the difficulties of slight solubility in the electrolyte and low e.m.f.

In a recent cell due to Michalowski, zinc is employed as the negative in an electrolyte of sodium or potassium aluminate solution. It is claimed that zinc is insoluble in this electrolyte, and may therefore be substituted for cadmium, over which it possesses the advantage of higher e.m.f. and greater capacity per unit of weight. Zinc is a very desirable metal to use in storage cells on account of its abundance and low cost as well as its higher e.m.f. and great capacity.

Another important factor in devising a lightweight accumulator is the grid. In the best pasted-plate cells of the lead-sulphuric acid-lead type the grid is about half the weight of the formed plate, and in many of the more durable varieties the grid forms a much larger proportion of the weight. This proportional weight of the grid is necessary to give the required supporting strength to the active material. A much less weight of iron or nickel will support the same weight of active material found in the lead grid, thus making the proportion of grid to active material about 1 to 2. The percentage weight of grid may be made even lower than this. Iron

and nickel also show a much greater durability than lead when subjected to electrolytic oxidation.

Lead accumulators have shown themselves to be well adapted to the requirements of central station work, but for traction purposes a cell of greater durability and lightness is demanded. In the solution of this problem more inventive energy should be applied to the study of those metals and compounds which present greater possibilities than lead.

The 50,000-volt Transmission Plant of the Missouri River Power Company.

By W. G. McConnon.

MUCH interest is being manifested in engineering circles in regard to recent developments in electrical power transmission over long distances and in the attendant use of higher and higher voltages. Although several plants have been proposed for the use of voltages higher than 40,000, the distinction of being the first to place in actual commercial service a large plant employing 50,000-volts transmission belongs to the Missouri River Power Company. This installation was completed and the apparatus placed in operation about the first of March, and much credit is due to the general manager and engineer of the company, Mr. M. H. Gerry, Jr., who planned and executed the work, as well as to the Westinghouse Company, which furnished the electrical equipment. Some earlier details of the work have already appeared in these pages.



FIG. 4.—MAIN AND EXCITER SWITCHBOARDS.





FIGS. 1 AND 2.—GENERAL VIEW OF POWER HOUSE, DAM, ETC., CANYON FERRY.

It is to be noted that since the starting of the plant there has been no mishap of any kind to the line or apparatus. This, the writer believes, is somewhat exceptional in undertakings of this magnitude and character, since it is reasonably expected that at the start minor

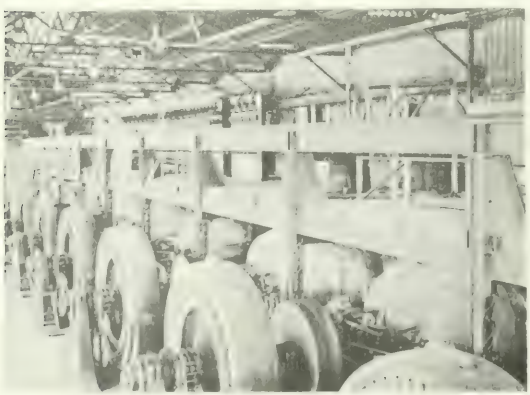


FIG. 3.—INTERIOR OF POWER HOUSE.

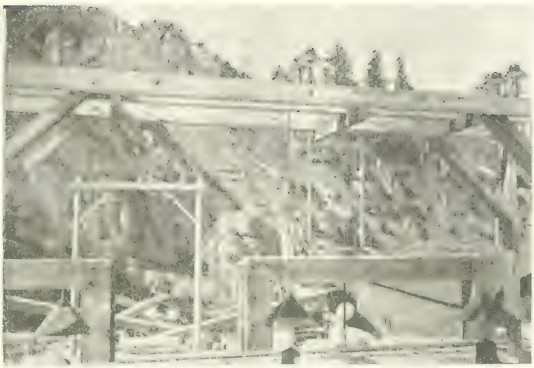
difficulties are liable to be met with, which, though possibly not serious, will nevertheless affect the continuous service of the plant.

The present power-house of the Missouri Power Company is located on the Missouri River about twenty miles almost directly east of Helena, Mont. To those who are familiar with the early history of the Northwest it will be recalled that in the famous Lewis & Clarke expedition of 1803-4 up the Missouri River and across the continent to the Pacific, one of the resting places and points of interest spoken of is Black Rock Canyon, met with soon after entering the Rockies at the "Mouth of the Mountains," which is some miles to the east. Black Rock Canyon is not now known by this name, but at the mouth of the canyon lies the present little town of Canyon Ferry and the power house of the Missouri River Power Company. A general view of the power house and town is given in Figs. 1 and 2, which show them located in a country not as rough as some parts of the Rocky Mountain district, but by no means level. The district immediately about Canyon Ferry has been one of the famous gold-mining camps of the West, the discovery of gold having been made there in 1863. Placer mining is the more common way in which mining has been carried on, and it can be seen to-day to a limited extent within a mile or so of the power house.

At the mouth of the canyon a dam has been thrown across the river, about 480 ft. in length and designed to give a 30-ft. head of water. The location of the dam at Canyon Ferry had enabled the company to take advantage of a low-lying valley just above the entrance to the canyon, in which to hold at all times a large volume of water in reserve. At the upper end of the canyon the water spreads out over this valley, forming a lake about seven miles long by two to three miles wide. The canyon by which the water comes to the power house is from 400 ft. to 700 ft. wide and less than one-half mile long. The water in it does not freeze over in winter, and although the lake above freezes over, water flows to the power house as free from ice in winter as in summer. The amount of water in the river at this point is considered sufficient to develop 10,000 hp the year around.

The project for a power plant at Canyon Ferry was first started about ten years ago. The men who have taken a continuous and extended interest are Mr. Barton Sewell, of New York City, and ex-Governor Hauser, one of the pioneers of Montana, and more thoroughly identified, probably, than any other living man with her history and interests. About four years ago the decision to carry out





FIGS. 6 AND 7.—VIEW OF HIGH TENSION BUSES AND LINES LEAVING [illegible] BUILDING



FIG. 5.—GENERAL VIEW 50,000-VOLT TRANSFORMER ROOM, FROM NORTH END



FIG. 8.—[illegible] BAY GATES, TRANSFORMER BUILDING, [illegible]



FIG. 9.—HIGH TENSION LINES [illegible] [illegible] STATE [illegible]





FIGS. 10 AND 11.—INTERIOR AND EXTERIOR OF [illegible] STATION

MISSOURI RIVER [illegible] VOLT TRANSMISSION PLANT

the work at Canyon Ferry took definite shape, and work was started on a plant of 4,000 hp. This plant consisted of four 750-kw, 550-volt, two-phase Westinghouse generators, driven by Dayton Globe Iron Works water-wheels, with two 90-kw exciters driven by independent wheels. The current from these generators was raised by eight oil-cooled transformers from 550 volts to 10,000 volts, and sent to Helena and East Helena, 20 miles and 14 miles away, respectively. At Helena the current was used, after transformation to 2,200 volts, for driving induction motors direct connected to arc light machines supplying city lights, and for distribution for general incandescent lighting. Two rotary converters furnishing current to the street car system of the city were also supplied. At East Helena the current was used mostly for driving induction motors in the large smelter lo-

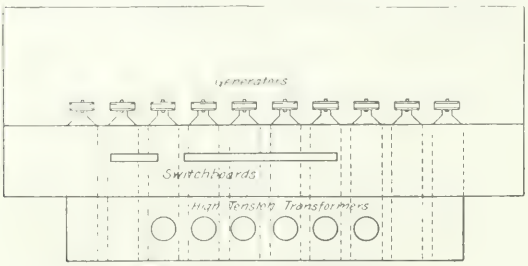


FIG. 12.—PLAN OF POWER HOUSE.

cated there and for general lighting about the works. One line from Canyon Ferry also furnished power and lights to a large ore concentrator between Helena and East Helena, known as the Peck concentrator. The line between Canyon Ferry and Helena consists of but one pole line, carrying, however, four independent circuits—one to East Helena, one to the Peck concentrator, and two to Helena, one of the latter for lighting and the other for railway work.

In the fall of 1900 work was begun at Canyon Ferry with a view of making a very considerable extension of the company's plant, the plan being to enlarge the plant to a capacity of 10,000 hp by putting in additional generators, with exciters, transformers, etc., and to extend the service to Butte, Mont., where it was expected that all the power the company might furnish could be sold. To this end the company has installed six additional 750-kw Westinghouse generators, with the necessary transformers, exciters, etc. These generators, are of the same size and voltage as the first four, but are three-phase instead of two-phase. The water-wheels are 45 ins. horizontal McCormick wheels, furnished by S. Morgan Smith, of York, Pa. All generators in the power house are direct connected to the wheels, flexible couplings being used throughout. With the new generators there was also installed a 225-kw, 150-volt exciter, driven by a separate wheel, and a 115-kw, 150-volt exciter driven by an induction motor. To sum up, the power plant now consists of ten 750-kw direct-connected generators, with four exciters, of which two are 90-kw machines direct connected to separate wheels, one a 225-kw machine with a separate wheel, and one a 115-kw, motor-driven generator. To make the plant uniform throughout, the four old generators have been overhauled and changed from two-phase to three-phase. The general plan of the station is shown by the outline sketch, Fig. 12, the switchboard gallery being on the right and directly over the water-wheels. Each water-wheel has its own governor; all the new and one of the old wheels having Lombard governors, and the remaining old wheels Replogle governors.

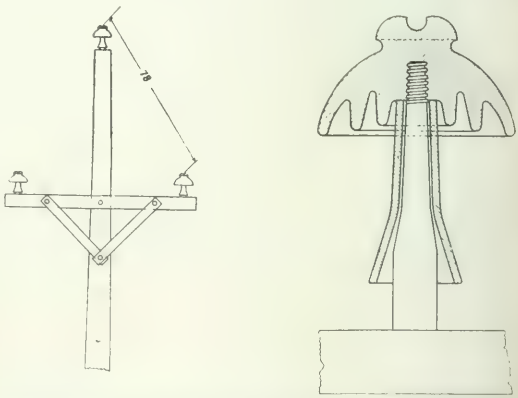
The switchboard gallery, shown on the right of Fig. 3, extends the whole length of the building, and, besides carrying the switchboards, carries also twelve 550 to 10,000-volt, oil-cooled transformers for the Helena and East Helena service, as well as a plugboard for connecting these circuits as needed under various conditions. The offices of the company will be located on the floor, extending across the building at the end from which the view is taken.

The main switchboard and exciter switchboard, shown in Fig. 4, are both relatively simple boards in design, but massive and substantial in construction. The main board is 47 ft. 5 ins. long, and consists of seventeen panels of blue Vermont marble, 2 ins. thick. The weight of the board complete is about 20 tons, the copper alone being one-half of this weight. The general arrangement is as follows: The first five panels at each end are generator panels. The next two panels are feeder panels, and are intended for use with the 550 to 10,000-volt transformers. The eighth panel from the end on each side supplies a bank of transformers, 550 to 50,000 volts, for the Butte lines. The middle panel is a junction panel, so that any set of bus-bars on the two ends of the boards can be thrown together, there being three sets of bus-bars an each end of a board. The instruments mounted on the board consist of eight 750-volt, alternating-current voltmeters, one for each set of buses and one at each end for the machines, independently of the buses; ten direct-current field ammeters; twenty-eight alternating-current ammeters, with sixteen indicating polyphase wattmeters, and six recording polyphase wattmeters. The recording wattmeters are behind the board. The exciter board consists of four panels of blue Vermont marble, similar to the main board, one for each exciter, with two sets of bus-bars. All field rheostats are mounted under the gallery floor and are controlled by hand-wheels, the shafts of which come up through pedestals in front of the boards.

The feature distinguishing the Missouri River Power Company's plant is the high voltage employed on its new lines to Butte. This is 50,000 volts. The distance by pole line from Canyon Ferry to the Butte sub-station is 65 miles, the route corresponding nearly with that taken by the Great Northern Railway between East Helena and Butte. The line starts out at an altitude of about 4,000 ft. above sea-level at Canyon Ferry and gradually rises until it reaches an altitude of 7,300 ft., where it passes over the Great Divide, a few miles east of Butte.

The line itself (Fig. 9) consists of two lines of poles about 50 ft. apart, the cables being arranged in an equilateral triangle, with a spacing of 78 ins. between centers (Fig. 13). Each line consists of three seven-strand copper cables, each cable having a cross-section of slightly over 106,000 circ. mils. These cables are transposed five times between Canyon Ferry and Butte. The average distance apart of the poles is 110 ft. Fig. 14 shows a view and cross-section of the insulator used on the line, together with the glass sleeve fitting over the pin below the insulator. It has been found, after making exhaustive tests, that a thoroughly dry oak pin of the length used in this installation boiled in paraffin will readily hold up alone under 50,000 volts. Hence the object of the glass sleeve below the insulator is to keep as great a length as possible of the pin dry under all conditions of weather.

The transformers at each end of the line consist of six 950-kw oil-insulated transformers, with water-cooling coils in the cases. Those at Canyon Ferry transform from 550 to 50,000 volts, and at Butte the step-down transformer is made from 50,000 to 2,200 volts. The



FIGS. 13 AND 14.—ARRANGEMENT OF TRANSMISSION CONDUCTORS AND INSULATOR WITH GLASS SLEEVE OVER PIN.

secondary circuits at Butte consist of 600,000 c.m. bare copper cable. All electrical apparatus in this plant was furnished by the Westinghouse Company.

The customers of the Missouri River Power Company at present number nine, as follows: At Helena and East Helena—Helena Power & Light Co., Helena & Livingston Smelting & Reduction Co., American Smelting & Refining Co., Big Indian Mining Co. At Butte—Anaconda Copper Co., Butte & Boston Copper Co., Colorado Smelting & Mining Co., Boston & Montana Copper Mining Co., Washoe Copper Co.

The general offices of the company are at Helena, Mont., and the New York office is at 71 Broadway. The officers of the Missouri River Power Company are: President, Barton Sewell; vice-president, W. S. Gurner, Jr.; secretary and treasurer, H. Suhr; general manager and chief engineer, M. H. Gerry, Jr.

European Polyphase Railways—II.

(*Concluded.*)

OTHER European polyphase railways described by Mr. Carl L. De Murault before the American Institute of Electrical Engineers, at its last regular meeting, in addition to those described in our last issue, were the following:

Burgdorf-Thun Railway.—The Burgdorf-Thun Railway, which was opened in 1899, and test data of which will be given further on, is not exactly a trunk line. Yet it is of normal gauge and forms a very important link between three of the main steam lines of Switzerland. The service conditions are the same as encountered on the other Swiss railways, and it uses the same size and shape of rolling stock as the main steam roads. The total length of the line is 40.3 km. (25 miles). The main reason for adopting electric traction was that the time-table could be arranged much more conveniently than for steam traction. With steam there would have been five trains per day in each direction, costing per year, at the least, 52,000 francs for coal alone, and each additional train would have cost 10,000 francs more for coal alone. Now, 50,000 francs allows, with electricity as motive power, the running of ten passenger and two freight trains per day in each direction over the whole length of the line, and besides three or four trains per day from Thun to Konolfingen and back. Each train consists normally of one motor car and one or two trailers, with a total seating capacity of 130-140 passengers. This means that not only is the public benefited by a better service, but the number of passengers actually carried is larger, and thus increases evidently the income of the railway by a handsome percentage.

There are sixteen stations, four of which have connection with existing steam lines.

The gauge is normal = 1.435 m.; the minimum radius in curves is 250 m.

The road starts at Burgdorf (536 m. above sea), and ascends with an average grade of 1.144 per cent. to the highest point almost exactly half-way between Burgdorf and Thun (770 m. above sea). Then it descends, with an average grade of 1.051 per cent., down to Thun (561.5 m. above sea). The maximum grade in any place is 2.5 per cent. All stations have a level stretch at least 200 m. long; 64 per cent. of the total length is straight line; 36 per cent. curves; 24 per cent. level; 23.5 per cent. on grades up to 1 per cent.; 31.5 per cent. on grades between 1 and 2 per cent., and 21 per cent. on grades between 2 and 2.5 per cent. Rails are 12 m. long and weigh 36 kg. per metre; 45 per cent. of the track is on iron sleepers weighing 137 kg. per metre track; 55 per cent. on wooden sleepers weighing 145 kg. per metre. The normal speed was fixed at 39 km. (24.2 miles) per hour.

The energy is furnished by the power station on the Kander, about 10 km. (6 miles) beyond Thun. The primary line voltage is 16,000; the number of cycles 40 per second. Fourteen transformer stations reduce this voltage in the trolley lines which was fixed at 750 volts, this being the limit set by the federal authorities at that time. This voltage, however, seems to be increased slightly in actual practice.

The number of transformers along the line was determined by the following considerations:

The distance between two transformers along the line had to be chosen so that the drop in the line voltage did not exceed a certain predetermined value. On the other hand, it was desirable to keep the number of stations within a certain limit in order to make the proportion between installed and actually working transformers as favorable as possible. It will be noticed that at any time only those transformers between which trains are actually circulating are under load, while the rest are not doing any work. Finally, the transformers should be placed as near the railway stations as is practicable, so as to facilitate their inspection. These somewhat conflicting conditions led to the adoption of fourteen transformer sub-stations, with an average interval of 3 km. from one another, the maximum interval being 3.4 km., the minimum 2.4 km. The two end transformers are 500 m. from the terminals of the line.

The size of each transformer would really be dependent on the grades in its vicinity. As these grades are pretty nearly alike in this case, the capacities of the transformers worked out to be very much the same, also, and it was therefore decided to use one size of transformers only, with a maximum output of 450 kw. This is the power required to move two complete trains.

The high-tension line first passes an emergency switch, which permits cutting off the whole station. The transformer is placed in a small iron house containing in its upper part primary and secondary fuses; there is also a lightning arrester on the top of each station. The transformers are of the oil-cooled type, and transform from 16,000 volts down to 750 volts. On the secondary side one pole is connected to earth, viz: to the rails; and the other two are carried over to the other side of the track, where they enter a special little switchboard placed in an iron box, which allows cutting off the transformer from the line, or else either of the two line sections meeting here from the transformer. The whole length of the line is thus effectively cut up into fifteen sections. The secondary box also contains a secondary lightning arrester. Most of the substations are also equipped with a small 2-kw lighting transformer, furnishing the current for lighting the neighboring railway station.

The trolley line consists of two copper wires of 8 mm. diameter, suspended by means of steel cross-wires from wooden poles placed on both sides of the track. These poles are normally about 35 m. apart; somewhat less in curves and grade crossings. The height of the trolley wires above the rails is 5.2 m. (16 ft.) at the most, and at least 4.85 m. The rails form the third conductor, and are bonded by means of a special metallic paste.

The contact devices of the cars consist of four steel frames per car, as shown on Fig. 4, two on each end of the car roof at a distance of about 9.5 m. (31 ft.) from the other two, the contact bar being a brass roller of special shape. This double set was found to



FIG. 4.—MOTOR CAR, BURGDORF-THUN RAILWAY.

be necessary in order to facilitate the passing of switches without breaking the current. At the switches the two outer trolley wires are carried right through, while the two inside ones terminate in insulated sections, prolonged into a common meeting point, and there anchored by insulated guy wires. The distance of 9.5 m. between the two sets of contact devices is just long enough to allow three of the four bars making contact under any condition. There is, therefore, no sparking at switches, and it is possible to stop a car underneath a switch and to start it again in the same or the opposite direction.

There are two kinds of motor cars, the passenger automobile and the reguar locomotive for freight trains. If this railway had been entirely independent the passenger trains would perhaps consist of one car alone. As it is, the traffic to be handled at the stations having connection with the steam roads necessitated larger carrying capacity of all the trains. The normal train composition comprises one motor car weighing 32 tons, capable of pulling a weight of about 20-24 tons in trailers on all grades and at normal speed. The motor car has seats for sixty-six passengers and the trailers for sixty to seventy more, making a total seating capacity for between 130-140 passengers.

A general view of a motor car is given on Fig. 4. It is a double bogie car, with a 64-hp. three-phase motor geared to each axle. The gear ratio is 1 : 3, and the speed of the motors 600 r. p. m., equivalent to a train speed of 39 km. (24.2 miles). The four motors are connected with their stators in parallel. The line current passes first

through one of the two controllers, placed one on each car platform, then through automatic cut-outs to the motors. The first motion of the controller handle serves to close the switch, thereby connecting the stators to the line, at the same time cutting in four rheostats, one into each rotor circuit. Subsequent turning of the controller handle works a combination bevel and chain gear, through which three carbon brushes are moved on a sort of commutator attached to each rheostat, whereby all the resistance is gradually taken out and the rotors left short-circuited. A second handle on the controller reverses the direction in which the car is going by changing two of the main leads. Each car platform is equipped with two ampere-meters, one voltmeter and a recording tachometer. A Westinghouse brake and an electric lighting and heating installation complete the equipment.

One freight locomotive is shown in Fig. 5. The [illegible]

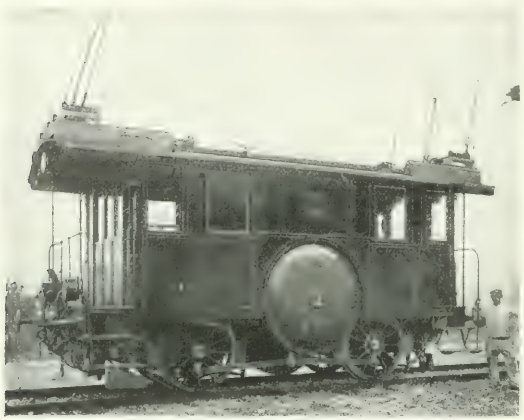


FIG. 5.—FREIGHT LOCOMOTIVE BURGDORF-THUN RAILWAY.

signed for a speed of 19½ km. (about 12 miles) per hour, and will haul a weight of 100 tons (not including their own weight) up the steepest grade of 2.5 per cent. The weight of a locomotive complete is 30 tons, equally divided between two axles. Two motors of 150 hp each are mounted on a common shaft half-way between these two axles, and drive by means of a reduction gear first an intermediary axle, and from this axle by means of connecting rods all four driving-wheels. These are 1.23 m. (almost exactly 4 ft.) in diameter. A common rheostat serves for starting both motors, and there is a controller on each platform, as in the case of the passenger cars. The same measuring instruments are also to be found, as well as a Westinghouse and an additional hand brake.

This railway has now been in successful operation for almost three years. It was equipped by Brown, Boveri & Co., of Baden, Switzerland, as well as the other Swiss lines mentioned. Later on some actual results obtained on this road will be given, but attention is directed first to three experimental lines recently installed for the purpose of ascertaining the conditions met on long trunk lines with higher voltages and very high speeds.

Lecco-Calico-Sondrio-Chiavenna Railway.—In 1901 Ganz & Co. of Budapest installed the electric equipment of what is usually called the Valtellina Railway, in the northern part of Italy.

The length of the line from Lecco to Chiavenna is 65 km. (40 miles), the branch from Calico to Sondrio 41 km (25 miles). The gauge is normal = 1.43 m. The normal speed is 60 km. (37 miles) per hour for passenger trains and 30 km for freight trains. It is evident that under these conditions it would have been somewhat difficult to handle the traffic with 750 or even 1,000 volts, and it was therefore decided to adopt a higher voltage. Tests made in the Alt-Ofen shipyard, near Budapest, showed 3,000 volts to be very suitable for the purpose, and this is the line voltage definitely chosen for this road. The power station generates 20,000 volts at 15 cycles per second; twelve transformers of 300 kw each, along the line about 10 km. from each other, reduce this to 3,000 volts. For short periods these transformers can give three times their normal output with a 6 per cent. drop in voltage. There are two 8-mm. trolley wires, the track serving as a third conductor. The rolling stock shows passenger automobiles weighing 50 tons, and freight locomotives weighing 40 tons each. Both are of the double-bogie type, with one motor of 150 hp on each of the four driving axles. The motors are mounted direct on hollow shafts on the axles, driving the latter by means of a flexible coupling. For the passenger cars the so-called "cascade" connection is made use of, two of the motors being connected to the 3,000 volts directly, the other two to the 300 volts induced in the rotors of the first two. Thus half normal speed is obtained and a certain economy in starting. The freight locomotives, however, use resistances only for starting purposes.

Fig. 6 shows one of the passenger cars with a trailer. The contact device is of the roller type, two copper rollers, 40 cm. long, being separated by a piece of hard wood 12 cm. long, saturated with paraffin under pressure. In the interior of the cars the high tension is carried in iron pipes, insulated inside and connected to earth. The current enters the stators of the motors after passing a high-tension switch placed in a separate chamber. Thus all possible means have been employed to insure absolute safety to the passengers. Trial runs have been made on this line, but several details seem to need to be perfected, and the line is not yet open for traffic.

Tests at Grosslichterfelde.—Still higher voltages were used by Siemens & Halske in 1899 and 1900 during extensive tests made on the Teltower Road, between Grosslichterfelde and Zehlendorf, on a specially constructed test track a little over one mile long, normal gauge, with curves 200, 100 and 40 m. radius. On account of the traffic on this public road the contact line had to be placed on one side of the road, and for the same reasons a guard wire net had to be fixed under all wires. The main object of these tests was to find a suitable contact device and the best possible line construction to handle a current of 10,000 volts and at car speeds up to 60 km. (37 miles).

The first tests were made with a device making contact with the line from above. The line wire was fastened to triple petticoat porcelain insulators by means of special brass pieces. The insulators were mounted on wooden cross-arms of different lengths, which were hinged to iron poles in such a way as to permit the tension in the wires to be equalized without difficulty. The three wires formed an inclined plane.

Later the line construction was changed and arranged for making



FIG. 6.—CAR AND TRAILER, LECCO-CHIAVENNA RAILWAY.

contact from the side. The three wires were placed in a vertical plane, with distances of about one yard from one another. The wooden cross-arms were replaced by elliptically curved angle irons provided with a guy wire, to which the insulators were fastened, inclined towards the track.

In both cases tests were made with line voltages of 750, 2,000 and 10,000 volts. The locomotive was fitted with two three-phase induction motors, one on each axle and each for 30 hp normal and 120 hp maximum output at 650 volts. With 850 volts the output would be increased to 200 hp per motor. These motors had interchangeable armatures, so that they could be used for 750 or 2,000 volts directly with the line voltage. For the tests with 10,000 volts on the line, a transformer was installed on the locomotive to transform down to 750 volts. There were two different reduction gears, which could be

inserted alternatingly, one for 40 km. an hour, the other for 60 km. an hour. The total weight of the locomotive completely equipped was 10 tons.

From the tests made the following results were deduced:

1. It is entirely feasible to use line voltages up to 10,000 volts, and the necessary energy could be taken from the line in each case without difficulty.

2. The contact from the side is rather the better of the two.

The Zossen Railway.—These results were availed of for the tests which are now being made on the normal gauge line from Marienfelde to Zossen, about 15 miles long, where the line voltage is 10,000 volts at 45-50 periods per second and the speeds attempted up to 220 km. (135 miles) an hour.

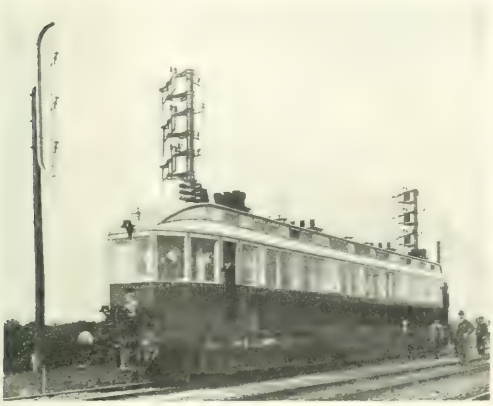


FIG. 7.—CAR ON ZOSSEN RAILWAY.

It would lead too far to go into details regarding these tests, which have not yet been completed. Suffice it to say that as far as the electric equipment is concerned, they have been entirely satisfactory. The maximum speed obtained up to now is 160 km. (100 miles) per hour.

Fig. 7 shows one of the cars employed, and it will be noticed that line and contact device are shaped after the models used during the tests carried out on the Teltow road. There are four motors per car, each of 250 hp normal and 750 hp maximum output. The car, when completely equipped, weighs 90 tons, and is designed to take fifty passengers.

Tests on the Burgdorf-Thun Railway.—Some special tests made on the Burgdorf-Thun Railway will here be described.

First, the overload capacity of the passenger cars was tried. These cars were designed to haul normally a total train weight of 50 tons on all grades at a speed of 39 km. (24 miles) an hour.

A test train was put together to weigh 70 tons total, *i. e.*, 40 per cent. overload, and the motors did their work very well indeed, starting on the 2.5 per cent. grade without any trouble whatever. If, therefore, one of the four motors of a car should ever be temporarily out of order, the other three motors will be able to deal with a normal train alone.

In actual service neither the motors nor the transformers show any appreciable rise in temperature. The transformers are, of course, under load for short periods only, say 10 minutes at a time. Their size was therefore evidently not determined by their heating, but by the maximum drop in voltage, which in this case was not quite 10 per cent.

Fig. 8 shows in curve form the results of some starting tests made under three different conditions:

a. One motor car alone, weighing 32 tons. *b*. One motor car hauling two trailers, total weight 55 tons. *c*. One motor car hauling three trailers, total weight 70 tons.

The curves show speed, amperes per phase and volts as functions of time. The tests were made on the level and the controller manipulated so as to keep the current as nearly as possible constant at 200 amps. This represents actual working conditions.

Readings were taken on the instruments mounted on the car at regular intervals of 5 seconds, the usual employee of the road acting as motorman. The automatic speed record made by the speed indicator corresponded very closely in each case with the curves thus obtained.

It will be seen that a weight of 32 tons was brought up to a speed of 24 miles an hour in about 32 seconds, a weight of 55 tons in about 57 seconds, and a weight of 70 tons in about 78 seconds.

The total energy input up to the point where full speed was reached is something like 1,600 watt-hours in the first case, 3,000 watt-hours in the second case, and 3,900 watt-hours in the third case, or approximately 52, 55 and 56 watt-hours per ton, respectively, a power factor of 0.8 being used to calculate real energy.

These results appear to compare very favorably with such as have been recently obtained with continuous-current motors, and this in regard to time in getting up speed as well as in regard to energy consumed during acceleration.

By the use of the series parallel controller continuous-current motors can be made to consume, I believe, as a minimum about 40-45 watt-hours per ton under similar conditions, which would be a little less than 80 per cent. of the energy consumed by the above alternating-current motors. There is, however, this point to be taken into con-

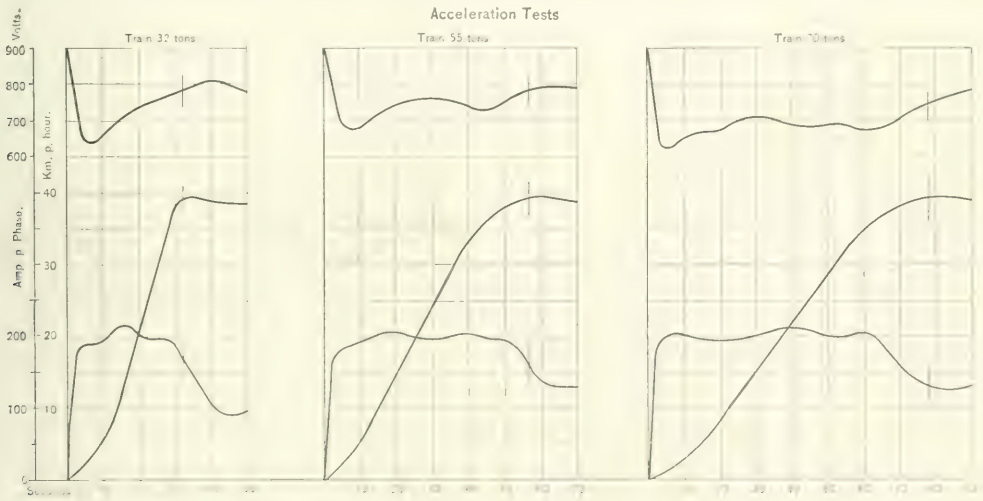


FIG. 8.—CURVES PLOTTED FROM STARTING TESTS, BURGDORF-THUN RAILWAY.

sideration, that the maximum power input in the case of alternating-current motors is not very much above the average input, while in the case of the continuous-current motor the energy curve has a very decided point, making the maximum input always more than 50 per cent. and often 100 per cent., more than the average input. The times given above for getting up full speed are rather better than has been obtained so far with continuous-current motors.

Fig. 9 represents some readings taken during a regular time-table run of a normal passenger train weighing 50 tons, from Walkringen to Konolfingen, viz: up and down over the highest point of the road.

It will be noticed that very severe grades were encountered. The curves show the normal speed up the grade to be about 38 km., on the level stretch on the top about 39 km., and on the down grade about 40 km., or a slip of about 2 per cent. both ways.

The amperes curve clearly shows the difference between energy consumed in going up and energy returned when coming down. Of course, the power factors will be different in the two cases, and the real amounts of consumed and returned energy cannot be calculated from this curve. It is, however, interesting to see how the voltage increases on the down grade, thereby clearly indicating that the load is taken off. This test was made with the brakes wide open all the time, and the motor resistances were used for starting purposes only.

A further test showed that by inserting resistance in the motors while on the down grade the speed can be increased materially, and

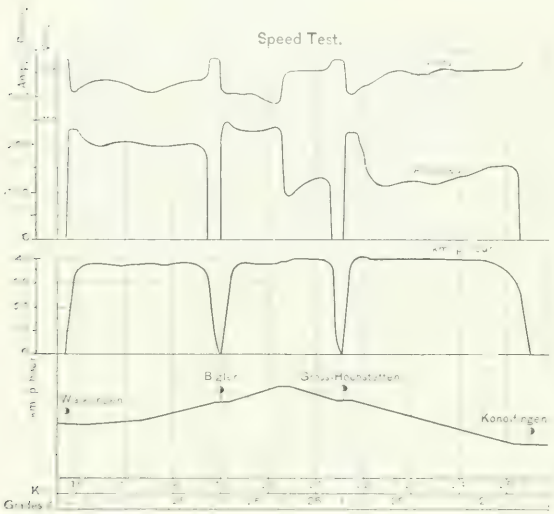


FIG. 9.—READINGS TAKEN DURING A RUN ON EUROPEAN-THUN RAILWAY.

the speed reached on this occasion was about 44 km. on a down grade of about 1.4 per cent.

Finally, a test was made on a fully loaded train which was going up hill on a 2.5 per cent. grade. It was suddenly changed to going down. All brakes were left open, and yet the train settled on its downward trip at the normal speed of about 40 km., which was not exceeded. Then its direction was changed again, and the start was made without any difficulty whatever.

From these tests Mr. de Muralt drew some interesting conclusions, as follows:

1. If properly designed, alternating-current motors can be made to start under full load with not more than normal full load running current. They will also start under a considerable overload. The only condition which has to be strictly observed in the case of alternating-current motors is that the drop in the line voltage may not exceed a certain percentage, say 15 per cent., to be on the safe side. In this respect the continuous-current system is more elastic, and a cotinuous-current motor will start with full torque even under very low voltages. In practice there is, however, no reason for allowing excessive drops in the line. Besides, it would be easy to install on particularly exposed points transformers giving a somewhat higher secondary voltage in order to increase the torque of the motors in these cases.

2. In regard to acceleration, it may be said that alternating-current motors are well adapted for accelerating quickly and uniformly up to full speed. Compared with continuous-current motors, they show a somewhat shorter time to get up full speed, a somewhat increased amount of energy consumed during the acceleration and a smaller maximum energy input.

3. During the run the speed of the alternating-current motor was found to be practically constant on the level as well as on all grades, as it is dependent practically only on the number of cycles of the generators. This means that alternating-current motors must be proportioned so as to be able to draw the maximum weight at normal speed on the maximum grade. Continuous-current motors need not have the same output, as it is possible, especially in the case of several motors per car, to give the motor momentarily a greater torque by reducing the speed. This, however, is only feasible within certain limits, and actual practice has shown that the gain in weight of motor thus obtained is very small compared with the weight of an alternating-current motor running always at the same speed. In most cases it will hardly exceed 10-15 per cent. Besides, as pointed out above, the voltage of the line might be increased at the grades in order to increase the capacity of the alternating-current motor.

4. On down grades the alternating-current motor acts as a generator, returning energy to the line. This recuperation of energy is not only theoretically feasible, but is of actual interest in the case of prolonged down grades where the motors thus automatically brake themselves and where the descending trains greatly relieve the power station. In Siemens & Halske's tests the alternating-current generators were driven by continuous-current motors from a storage battery. When the car was going down grade, energy was returned and the storage battery actually charged. The Swiss mountain lines have installed water resistances to use up the excess of energy set free by descending trains.

5. In a mechanical way the alternating-current motor is, of course, superior to the continuous-current motor. The absence of the commutator alone is an advantage. Then the voltage in the rotor can be chosen as low as convenient, which makes the rheostats better and safer. All the Swiss roads, which have been operated now between 3 and 4 years—the Lugano Tramways even 7 years—report having had practically no repairs whatever on any parts of the electrical equipment, none whatever on the motors, which is more than can be said of the usual continuous-current equipment.

6. Finally, the manipulation of the cars is greatly simplified by the constancy of speed, which in this connection is a decided advantage. All the motorman has to do is to start his car and bring it up to speed. The car itself will do the rest until it is stopped by the application of the brake. The concatenated motor control, although showing a slightly bettter efficiency during starting, makes the controlling apparatus more complicated, and it is therefore preferable in most cases to adhere to the ordinary resistance control, which has really showed up to be pretty efficient after all.

7. The increased voltage admissible for alternating-current systems reduces the dimension of the line wires. If carried beyond a certain point the insulation will, however, have to be increased. In cases where the energy used is so large that it cannot be taken off the line at voltages below 1,000 volts, alternating current becomes a necessity. A current of from 100-150 amps. per contact device is just about the maximum permissible, although in some cases, especially in American practice, as much as 300 amps. have been taken off by one trolley-wheel.

8. The transformation of the high-voltage alternating currents universally used for transmission on long roads into continuous current means the installation of rotary converter sub-stations. For transformation into alternating currents stationary transformers are used, which do not call for any particular attendance and, having no rotating parts, do not show any deterioration from use.

In conclusion, Mr. de Muralt made some general remarks regarding the applicability of the two systems for traction purposes. Both systems are probably capable of satisfactorily doing the work demanded by any traction problem, but each case ought to be studied for itself in order to find out which system presents the greater advantages.

Very irregular profile and frequent stops, especially if combined with greatly varying speeds, as found, for instance, in congested city street traffic, make a line generally more suitable for continuous current, while a regular profile, even in the case of steep grades and

long runs between stations, would make it bettter fitted for alternating currents.

Those cases are rare, however, which allow of an *a priori* decision in this respect, and a discussion on the merits of the two systems in general is a difficult thing. Attention to the fact that the Burgdorf-Thun Railway answers a whole series of questions relating to the application of three-phase alternating current to electric traction, and proves without doubt the possibility of replacing the present steam locomotive by electrically driven vehicles. This, of course, is of special interest to countries like Switzerland, possessing natural resources in the way of water-power, but large coal fields may also be put to bettter use by erecting electric central stations in their immediate neighborhood and transmitting the energy thus generated electrically to the places where it will be used on the cars.

Electricity in the Navy. *

By WALTER M. MCFARLAND.

IN discussing the applications of electricity in the navy, my remarks as to specific installations will be mainly with respect to power plants and motor installations on shore, both on account of the fact that the company with which I am identified has done virtually no ship work for the navy, and because my own duties while a naval officer had little connection with such work. My experience, however, has suggested some points in connection with the use of electric apparatus on war vessels which may be of interest and possibly may afford some information.

The use of electricity in the navy was at first for purposes connected with the torpedo service, and when electric lighting became practicable its exploitation for the navy was taken up by the officers who had been devoting their attention largely to torpedoes. After some preliminary installations had been made, a board of officers investigated the conditions for lighting on war vessels with considerable care and formulated certain rules with respect to voltage, temperature limits, etc. Until very recently the general rules formulated by that board have governed all installations on our naval vessels.

The standard voltage was put at 80, and in discussing the reason for the choice of this figure some time ago with the Naval Inspector of Electric Lighting, he informed me that it was virtually determined by the requirements of the search-lights. It had been found that it was impracticable to use two of them in series, and as they only required 50 volts each, it was felt that a higher voltage than 80 for the standard would cause too much loss due to resistance of the searchlight circuit.

The limits for temperature rise were considerably lower than have been found entirely practicable for standard practice on shore, and the explanation for using these lower limits was that the temperature conditions on board ship were much more arduous than on shore owing to the location of the dynamo room below the protective deck, which involved a very much higher initial temperature than that usually found on shore. Not to go into other details, it may be said at once that these requirements of low voltage and very low temperature limit, made the generators for naval use entirely special, with the result that unless some one concern could secure practically all the work and thus build enough of these machines to cover the development changes, naval work from a commercial standpoint would not be at all desirable. This explains why the company with which I am connected has made no effort to secure any ship work in the navy. Another large company, however, went systematically into the business of preparing to meet the demands, and as a result has installed the great bulk of electric machinery on our naval vessels. In view of the foregoing facts, it was somewhat surprising to read in the annual report of the officer having charge of electric matters in the navy a few years ago, the statement that he was in the hands of a monopoly, and that he advocated building electric machinery in the navy yards. As I told him when I once spoke to him about the matter, if the navy were satisfied to accept what everybody else found efficient and thoroughly satisfactory, there would be no trouble with respect to competition. As a matter of fact, government inspection is rigid and exacting to a degree which is not dreamed of in ordinary transactions, with the result that a machine, admirable in all respects but one, might be rejected on account of a slight excess in temperature rise in some one part. If the machines were standard in every way this would not make such a great difference, as such a trifling variation would not carry any weight with the ordinary customer; but when the machines are of such an odd voltage there is, of course, no way of selling them as they stand to any other customer, and consequently if rejected by the government they would have only a scrap value.

In the report of the Bureau of Equipment of October, 1900, it was recommended the the navy standard of voltage be raised from 80 to 110 volts, and that special dynamos of 55 volts be employed for running searchlights. The recommendation states that one of the advantages will be to increase the field of competition, and that facilities for obtaining supplies will be improved on account of the commercial voltage being 110. This, of course, is true, but it is only carrying the change half way. What should be done is to adopt the commercial standards throughout, which would enable the apparatus installed to be of the type that is steadily manufactured in large quantities at very moderate cost and for which repair parts could readily be obtained from the storehouses of the different companies located at the principal ports.

If the claims that the dynamo-rooms of war vessels are so abnormally hot as to represent conditions very much harder than any to which dynamos on shore are subjected were accurate, there would, of course, be ample justification for the low limits of temperature rise, but, as a matter of fact, there are places on shore where the temperature conditions of the dynamo-room are worse than on naval vessels. I have in mind a case where there was some delay in testing an installation in which I was interested, and the reason given for the delay was that the engineers who were to make the test were unwilling to stay in the dynamo-room long enough during the summer season to make the test, and insisted on waiting until cold weather had set in. Anyone familiar with conditions obtaining on shore can undoubtedly cite cases in his own experience where the temperature of the dynamo-room would run up to 140 or 150 degrees at times, which is a higher temperature than I have ever heard cited for the dynamo-rooms of naval vessels. In all these cases, standard machines with the usual limits for temperature rise have given satisfaction.

There is another very decided objection to the use of non-standard apparatus due to the low limits specified for temperature rise, namely, that the machinery must inevitably be considerably heavier. This is a point which appeals to me very strongly, on account of the fact that the main machinery in naval vessels is rigidly limited in weight, and the unfortunate contractor is compelled to pay a penalty for all overweight. It always seemed to me absurd that when such vitally important things as the propelling engines for driving the ship had a weight limit put upon them, the electric equipment was either not limited or, on account of peculiarities in the requirements, was allowed to be much heavier than it might have been if made according to the best standard practice.

As you are all aware, the use of electricity on board ship for power has been of comparatively recent introduction, the first important case being the turret-turning machinery of the *Brooklyn*, which was installed about 1896. This was followed by the more elaborate installations on the *Kearsage* and *Kentucky*, where all the turrets were turned electrically and motors were also used for ammunition hoists, boat winches, ventilating blowers, and some other purposes. While I have not personally served on board of ships with electric power apparatus I understand that it has generally given satisfaction.

Among the chief reasons which appeal to the layman as well as the engineer for the use of motors rather than steam engines is the absence of long lines of piping, which unduly heat the spaces through which they pass in hot weather, and the avoidance of the chance of leakage. It would seem that on this line of thought, the two places of all others where motors should have been installed are for the capstan and steering engines, but while there have been a few officers in the navy to advocate this, the concensus of opinion has been against it. I do not know the exact reasons assigned further than a sort of dread that the motors would be unreliable, but I presume that where the objection was made by officers acquainted with electric apparatus, it was due to the fear that in both of these places there would be times when the motor would be brought up standing under load, and under such circumstances direct current motors, unless protected by external safety devices, would be burned out, and these external devices would add to the complication and chance of derangement. It is undoubtedly a fact that both the capstan and the rudder are at times subjected to

* A paper presented at the 1902 meeting of the American Institute of Electrical Engineers, at New York, May 28th, 1902.

conditions where the motive power will be brought up standing, so that unless safeguards were provided there certainly would be danger of serious damage.

This last consideration leads me to bring up the point of the adaptability of alternating current apparatus to use on shipboard. Indeed, I may say that although I had thought about it a great deal myself, the question was asked me by a naval officer during a recent visit to one of our large battleships, why alternating current was not used. Of course the immediate answer is that the naval authorities in charge of electric apparatus still limit all electric machinery on shipboard to that operated by direct current. It seems to me, however, that the conditions on shipboard are such as to make the points which constitute the advantages of alternating over direct current apparatus of unusual weight. From the very nature of things the electric apparatus is to a considerable extent handled by men without a great deal of skill, a point to which attention has been called by the chief of the Bureau of Equipment in some of his annual reports, where he laments that the supply of trained men is not sufficient. Further than this, the induction motor with its extreme simplicity and ability to withstand abuse and neglect seems much better adapted to the general run of conditions on board ship than the more delicate direct-current motor. With its ability to stand a tremendous overload and even temporary stoppage, it would answer for driving capstans and steering gear, from which the direct current motors have thus far been barred out. It would also seem admirably adapted for such work as driving the forced draught blowers for the fire-rooms, which are usually located in almost inaccessible places and where the steam engines now used to drive them can rarely receive adequate attention when the blowers are driven at full power. Only recently I heard one of the ablest engineers in the navy comment on this very point, of the adaptibility of the induction motor for this particular service. The only objection to the use of alternating current that occurs to me is the requirements in searchlights, but, as I remarked above, it is already proposed to install a special generating set even where direct current is used, to supply the searchlights, and it will be perfectly practicable to put in a motor generating set giving direct current for searchlights, while alternating current would be used elsewhere.

While speaking about this use of motors in the department of the propelling machinery of the vessel, it seems pertinent to call attention to the fact that claims have been made for the adaptibility of motors to drive the motive machinery which seem ill-advised. These claims are based largely on tthe admitted high steam consumption of many of the steam auxiliaries against which a much lower steam consumption could be figured where these same auxiliaries were driven by motors. The fact must not be overlooked that on war vessels, as at present designed, the dynamo room is at a considerable distance from the boilers, involving long lines of steam and exhaust piping, while the steam auxiliaries in engine and fire-rooms are so situated that the steam and exhaust connections to them are very short. Further than this, while the steam consumption of these auxiliaries, considered alone, is undoubtedly very high, the fact was overlooked by those advocating the use of motors, and who were not familiar with the details of propelling machinery, that provision has for some years been made for turning the exhaust from these auxiliaries either into the receivers of the main engine, or into the feed water heater. In either case the steam expenditure was enormously reduced and the heat in the steam utilized to the fullest extent possible, under which circumstances their steam consumption per horse-power would be lower than that with the motor drive. It is sufficient to note that where the steam is turned into the receiver, the cylinders of the auxiliary become in effect an extension of one of the cylinders of the main engine and, consequently, the steam consumption becomes the same as that of the main engine, which even at reduced power is considerably below that of the small engines driving the dynamos.

There are enough places on board ship where motors can be used with great advantage, convenience and economy to make it unnecessary to urge their installation in places where they could not hope to give the satisfaction that is given by the steam auxiliaries, with respect to speed regulation, economy and weight.

My attention was recently called by a prominent officer of the navy department to a proposition made for sub-dividing the dynamo-room and having two, located in different parts of the ship, with the object of preventing the complete disablement of such vitally important a shell getting into the one dynamo room as now arranged. I was very much surprised to learn that objection had been made to this on the score of complication, and I cited the case of the Explotadora system in Mexico, where there are seven a. c. generating stations scattered along the mountain side at distances of from ten to twenty miles from the receiving station, where the current from the different stations is brought together on the same bus-bars and transmitted to the city of Mexico. It seems to me that this proposition is an eminently sound one, and while there would of course be a slight increase of complication, it would be as nothing compared with the increased safety against total disablement.

Installations on Shore.—Naval requirements for electric machinery on shore are practically for standard apparatus, so that here the criticisms which I have made do not apply. Each bureau decides on the apparatus which it deems best for its own purposes, and all who make apparatus of the class wanted have an opportunity to bid. This brings up the natural inquiry from those not familiar with naval matters as to why there should not be a central plant for each navy yard supplying all the current needed for use in the yard, whether for lighting or power. The reason why this has not obtained is, primarily, that all of our large navy yards have been established for some time, and that they were at first entirely steam-driven plants. As the yards are of large area, with the different shops scattered, it was, of course, the best practice at the time they were laid out to have individual power plants for each set of shops. Under the existing system of appropriations some bureaus were able to install an electric drive earlier than others, and in this way we have the present condition, where in a single navy yard there may be several power plants, each for its own particular set of shops. I think there is little doubt that in any new yards that are established the tools will be entirely motor-driven and the current will be derived from one or more power plants. I say one or more, because it would depend on the location of the yard. Where a yard is isolated, as in the case at Mare Island near San Francisco, or the proposed station in the Philippines, it would seem unsafe to put the whole power plant in one locality, for the reason that any damage such as that caused by a fire, earthquake, or other disaster, would lay up the whole yard. Where a navy yard is near a large city or other establishment having a large power plant, arrangements could probably be made, in case of damage to the yard's power plant, to rent current for a time.

Most of the apparatus installed in the navy yards is of the direct current type, probably because the earlier installations were made before the induction motor had become so prominent as it has in recent years, and consequently as installations were increased the direct current was necessarily adhered to. In some recent plants, however, while direct current is used, the installation has been on the three-wire system from a single generator on the Dobrowolski system. This has enabled larger and fewer units to be used, with resulting satisfaction.

In two very interesting plants alternating current has been used, with induction motors of course, the first at the ordnance proving grounds and powder factory, at Indian Head, Md., and the other at the steam engineering plant at the Brooklyn Navy Yard.

At Indian Head the induction motors commended themselves on account of their simplicity and absolute immunity from sparking, but as it was desired to have a short line of railway with an electric locomotive for hauling guns from tthe dock to the proving range, and for other purposes, some direct current was also necessary and the generators installed are of the double-current type. The railway is driven by what is known as the "button system," or electromagnetic traction system. It was undesirable to have overhead wires, and an underground trolley would also have been objectionable, while the button system answers the requirements of the case admirably. This plant has been installed about three years and has given great satisfaction.

The plant at the Brooklyn Navy Yard has been only recently put in operation, although the contract for it was made in 1899, the delay being due to the fact that the power house was not completed until last fall. In this case the Bureau of Steam Engineering detailed an officer who visited important manufacturing establishments all over the country to find the general opinion as to the best type of apparatus to install. He also visited various electrical manufacturing concerns to discuss with their engineers the merits of the different systems. As a result of his report, it was decided to use alternating current generators with induction motors for the tools, and the

plant is an excellent illustration of the most advanced practice in the powering of a modern engine-building plant. Just about the time when this contract was placed, the large ship and engine-building establishment at Camden, N. J., known as the New York Shipbuilding Company, was also considering the question of electric driving, and after going into the matter very carefully under the guidance of a prominent electrical engineer, also decided for alternating current with induction motors. In this plant there is an unusually large number of cranes, and as the crane builders generally charge a considerably higher price for alternating current cranes, it was decided to drive them by direct current. As a result, the two 500-kw generators are of the double-current type, like the much smaller ones at Indian Head.

A comparatively new field for the application of electricity in the navy yard is in the dry-dock machinery, and in all the contracts made since the early part of 1899, it has been arranged that the pumps are to be driven by motors and that the capstans and winches around the docks are also to be electrically driven. Power drive for the latter would be practically impossible except by the use of electricity. Thus far all of these installations have been by direct current, but I believe there is little doubt that as the naval authorities who have charge of these matters become more familiar with the advantages of alternating current apparatus, this form will be used, because it seems much better adapted to the circumstances of the case than direct current.

Naval work on shore where electricity can be applied is largely in the nature of manufacturing and repair establishments, and consequently we should expect that the equipment which commercial manufacturers find to give them the best results would be adopted for the navy. This is, indeed, the case, and just as no large manufacturing establishment under private auspices now dreams of using anything but the electric drive for its tools, so the same thing is true of naval establishments.

With respect to the application of electricity on shipboard, the circumstances are such as to give a very promising field for the application of electricity, and my own opinion is that if alternating current were adopted there would be a much greater number of motors installed than at present.

Electricity on Warships—I.

In a paper read at the recent special May meeting of the American Institute of Electrical Engineers, Lieut. Harry George, of the U. S. Navy, described in detail the electrical equipment of war ships. Mr. George considers that the advantage of the electric drive for shipboard auxiliaries appears to be as evident as the superiority of the incandescent lamp over the oil lamp or candle for illumination. The confidence engendered by the use of electricity in the early ships and the rapid commercial development of motors and their controlling apparatus gave an impetus to the use of the electric drive on shipboard, and at the present time we find motors installed for ventilating blowers, ammunition hoists, turret turning, elevating and loading of guns, workshop machinery, and the handling of boats and heavy weights. Steam or hydraulic power for auxiliary power has been relegated to the background, and the day is not distant when auxiliary machinery of all descriptions will be operated by electricity.

The motor is peculiarly adapted to ships' use. Compared with steam, the cutting of bulkheads and decks is reduced to a minimum, and hence the water-tight system is more efficient, the circuits may be better protected than in the case of steam pipes and offer a smaller target. The cutting of a circuit by shot involves no danger to the personnel, and to surrounding appliances, and in case of accident is more readily repaired. There is no leak from joints and valves, and no appreciable loss of energy in elbows and turns. No loss by condensation; and much less by radiation. The motors are more efficient and there is relatively less loss in small motors than in small steam engines, they are less liable to get out of order, there are no reciprocating parts to adjust and their operation is simpler and requires less supervision.

The advance of electricity for naval purposes may be illustrated by a comparison between the electric plant of the "Indiana," one of our first battleships, completed and commissioned in 1895, and the "Kearsarge," one of our latest battleships, commissioned in 1900. The displacement of the "Indiana" is 10,200 tons, and she is equipped with three 24-kw, 80-volt generators for supplying current to 500 incandescent lamps, four 60-centimeter search-lights, two 2-hp ventilating motors for dynamo room, four ¼-hp portable ventilating blowers, with winches and ammunition hoists, covering about 36 hp. or a total output of 67 kilowatts, about 7 watts per ton of displacement.

The "Kearsarge," with a displacement of 11,525 tons, is provided with seven 50-kw generators, compound wound, direct-connected, 80 volts, to supply the following demand for lighting and power:

	Watts.
700 incandescent lamps	48,000
Four 30-in. search-lights	6,000
Ventilating motors and portable fans	98,000
Ammunition hoists and whips	115,138
Training, elevating and rammer motors	171,580
Boat cranes and winches	216,350

or a total of 665,240 watts, or approximately 57 watts per ton of displacement.

In this connection the practice abroad is shown in representative vessels of the German, Russian and French navies:

GERMANY.

"Furst Bismarck."—Battleship, 10,650 tons displacement, with an electric generating plant of 325-kw output, supplying current to 900 incandescent lamps, 44 motors for ventilation, drying room, ammunition hoists, gun training gear, coal winches, refrigerating plant and search-lights.

"Kaiser Frederick III."—Armored cruiser, 11,130 tons displacement. Five generators, with output of 324-kw supplying power in watts as follows: Incandescent lighting, 38,260; search-lights, 55,500; ventilation, 28,340; ammunition hoists, 78,440; gun training gear, 8,880; coal winches, 7,400; refrigerating plant, 4,500.

RUSSIA.

"Retvizan."—Battleship, built at Cramps Shipyard, Philadelphia, Pa. Electric installation, three 132-kw, four 66-kw and one 60-kw generators as a maximum output of 588 kilowatts. These generators supply current to 1,167 incandescent lamps and six 30-in. projectors, and the following auxiliaries:

4 turret turning motors.
4 elevating motors.
4 rammer motors.
4 turret ammunition hoists.
12 60-in. blowers for forced draft system.
18 motors for hull ventilation.
6 pump motors.
2 boat crane motors.
1 capstan motor.
8 ash hoist motors.
1 steering motor.
30 ammunition hoist motors for battery.
2 submerged torpedo motors.
1 workshop motor.
1 torpedo lathe motor.
1 bread mixing motor.
1 laundry motor.

Also a number of portable fans, helm indicators and other electrical signaling devices.

FRANCE.

"Jena."—Battleship, 12,052 tons displacement. Two generators of 98.4-kw capacity, and two of 49.2-kw capacity; total output, 295.6 kilowatts.

The general subject of electrical installations was taken up under the following headings: Dynamo Rooms and Accessories, Generators, Circuits, Wire and Wiring Appliances, Motors, Interior and Exterior Signaling or Communicating Systems, Search-lights and Incandescent Lamps.

DYNAMO ROOMS.

For security in time of action, the dynamo room is located below the water line underneath the protective or armored deck, in close proximity to the source of steam supply. The chief considerations are protection, ventilation, accessibility and a central position for the economical distribution of electrical energy. The compartment as-

tight bulkheads, or may consist of two or more such compartments in the larger vessels. In the U. S. S. "Alabama" there are four dynamo rooms between two transverse water-tight bulkheads. The dynamo room is generally provided with its own ventilating system, and contains the switchboards, search-light panels, rheostats, tool boards, work benches, oil and waste tanks and the accessories necessary for the efficient operation of the plant.

Heretofore, the dynamos have been located in the same portion of the vessel, the dynamo rooms forming subdivisions of one general compartment between transverse water-tight bulkheads. The rapid development of the electric drive and its application to ammunition hoists and gun operation has made the question of dynamo rooms and their location one of the most important in ship design. In the proposed 16,000-ton battleships, recently authorized by Congress, it is proposed to install the generators in two separate compartments, each dynamo room to be entirely independent of the other electrically, and to be situated at opposite ends of the vessel. Each dynamo room is to be supplied with four 100-kw sets, which will supply the output necessary to handle the battle load, for lighting and all auxiliaries. All forward circuits will be supplied by a distributing board located near the forward dynamo room but separated from it; all after circuits from the after distribution board, similarly situated. By suitable transfer switches both the distributing boards may be electrically connected and the entire load thrown in either dynamo room at will. This will increase the military efficiency of the installation, as in case of accident rendering either dynamo room uninhabitable, the battle load may be thrown on the remaining room.

Tandem compound engines for driving the dynamos have been used extensively, and were first installed on the U. S. S. "Chicago." They have given excellent results, although not as efficient nor as accessible as the cross-compound engine required by the present specifications. The excessive height of this type of generator, not only assembled, but the additional head-room necessary to remove pistons and rod, prohibit their use in naval installations with the comparatively small height between decks. Fifty kilowatts would seem to be the maximum capacity allowable in generators of this design, and they could only be used in a majority of vessels by making special provision for the removal of pistons.

Lubrication in the steam spaces is not allowed, as the auxiliary boilers in some cases have been injured and the crown sheets dropped in spite of the precaution of removing oil from condensed steam. To further lessen the liability of oil working into the cylinders, the stuffing boxes are specified to be at least as long as the length of stroke of engine. These boxes are to be accessible from the outside of the enclosing casing of the engine to facilitate adjustment.

Forced lubrication is an essential factor in attaining satisfactory operation of a generator, and is now required on all sets furnished the navy. A pressure of from 10 to 20 pounds is prescribed in the lubricating systems, but the bearings are to be so designed that forced lubrication is not a necessary feature to insure cool running.

The smaller sets, 2½ and 5 kw, for torpedo boats and destroyers are designed for high speed, in order that reduction in weight may be attained. This involves a rather uneconomical steam consumption, but inasmuch as these sets are not subjected to continuous running as in battleships and cruisers, the increased weight of steam required for their operation is not considered in the attempt to reduce all torpedo boat weights to a minimum.

The 2.5-kw sets give an output of 5 watts per pound; the 5-kw sets, 3.865 watts per pound, although some 5-kw sets have been installed with an ouput of 5 watts per pound weight of set.

The 16-kw sets, although of comparatively high speed (400 to 500 r. p. m.) show a weight efficiency rather lower than would appear consistent with other types. These sets give 2.86 watts per pound, whereas the 32-kw sets give 3.14 watts and the 100-kw sets 4.55 watts per pound. The specified water consumption of all sets is rather liberal, as it is the aim to secure fair efficiency with great durability, and sacrifices are made to ensure the latter characteristic in naval installations.

Generators have improved step by step with the commercial type, and the specifications now in force embody no requirements that are not fulfilled by the best types of commercial machines, excepting that the rating of these generators must be changed to conform to the specified heating limits and overload requirements. An allowable temperature rise of 33½° C. in armature appears at first sight rather low, but taking under consideration the high temperatures in many of the dynamo rooms in tropical service, the low heating limits assigned are justifiable.

The specifications require that the speed variation must not exceed 2½ per cent. when load is varied between full load to 20 per cent. full load, gradually or in one step, engine running with normal steam pressure and vacuum. A variation of not more than 3½ per cent. will be allowed when full load is suddenly thrown on or off the generator, with constant steam pressure either normal, 20 per cent. above, or 20 per cent. below normal, and exhaust either to condenser or to atmosphere. No adjustment of the governor or throttle valve during the test shall be necessary to ensure proper performance under any of the above conditions. The engines are required to operate satisfactorily without the use of lubricants in the steam spaces. The lubrication for all other working surfaces is of the most complete character, not depending on squirt-can lubrication. Forced lubrication is used wherever practicable, which includes engine shaft, crank pins, crosshead bearing, eccentric, etc.

Massachusetts Electrical Systems In 1901.—Finances.

By Alton D. Adams.

ELECTRIC lighting companies in Massachusetts, doing only an electrical business, had issued capital stock to the par value of $12,764,351.62 on June 30, 1901. This amount is greater by 8.5 per cent. than the capital of these companies on June 30, 1900. At the close of the fiscal year first named the bonds of these companies outstanding amounted to $3,615,100, and the notes payable to $2,965,662.75. These figures show a decline during the year of 6.2 per cent. in the amount of bonds, but an increase of 46.9 per cent. in the notes payable.

At the close of the fiscal year under consideration all the gas companies of the State had outstanding $18,796,500 in stocks, $2,168,250 in bonds, and notes payable to the total of $5,456,382.01. Measured by issues of stocks, bonds and notes, the investments of the gas are thus greater than those of the purely electric companies, but thirteen of the gas companies in cities and nine of these companies in towns operate electric as well as gas plants. It is not possible to state just how much of the investment of the gas companies is represented in their electric plants.

The surplus of the purely electric companies was $2,735,270.74 at the date first mentioned, an increase of 22.3 per cent. over the surplus for the previous year. The surplus just named for 1901 was 21.4 per cent. of the capital of the electric companies.

All of the central electric lighting stations in the State, by whomsoever operated, earned an income of $6,217,804 during the year of 1901, and this amount exceeded that for the previous year by 9.5 per cent. Of this income 99 per cent. was from sales of electrical energy, and the remaining one per cent. from the rent of meters and motors and from steam heating. The income from sales of electrical energy, amounting to $6,159,205.59, was made up of 8.8 per cent. from service to commercial arc lamps, 3.5 per cent. from commercial incandescent lamps operated at contract rates, 44.0 per cent. from incandescent lamps at meter rates, 22.9 per cent. from public arc lamps, 5.7 per cent. from public incandescent lamps, and 14.9 per cent. from electric power. It thus appears that 28.6 per cent. of the energy income was from public and 71.4 per cent. from private service. The income from electric street lamps amounted to $1,764,176.77.

In this same year the total sales of gas amounted to $7,057,858.52, and only $172,828.75 of this sum was derived from gas street lamps. It thus appears that the income from sales of electrical energy was 87.2 per cent. of that from gas, but that gas street lamps yielded only 9.8 per cent. as much income as electric street lamps.

During the fiscal year of 1901 the total expenses of all electric lighting systems were $3,922,403.08, or 63 per cent. of the gross income. These expenses were greater by 10.6 per cent. than the amount for the previous year. Of the total cost of operation, 49.1 per cent. was expended at the stations, 24.1 per cent. in distribution, 13.0 per cent. for office expenses and management, and 13.6 per cent. for miscellaneous expenses. The expenses of operation at the stations amounted to $1,929,605.43. Of this sum 48.4 per cent., or $934,448.20, went for fuel. The percentage of this fuel item was 23.8 compared with the entire expenses of the electric systems, showing that efficiency of operation might be increased with marked advantage.

Other expenses at electric stations were: for rent of real estate, 3.2; oil and waste, 2.2; water, 3.0; wages, 28.2; repairs of station, 2.2; steam plant repairs, 6.7; electric plant repairs, 5.0, and appli-

ances, 0.6 per cent. of the total cost of operation there. When the total expenses are deducted from the entire earnings of operation of electric systems, as just given, there remains a net profit of $2,295,401.74 for the year. Of this amount the electric stations operated by gas companies earned $342,056.17, so that there remains the sum of $1,953,345.57 as net profits for the purely electric companies. In addition to earnings previously stated, these electric companies received $356,302.02 from rents, jobbing, and other sources, which, added to the sum last found, gives a total net profit of $2,309,647.59 for the electric companies. From this sum there was deducted $314,512.49 for the payment of interest and $464,269.06 for sundry other items, leaving $1,530,378.53 that might be devoted to either depreciation, surplus or dividends, at the election of the companies.

This $1,530,378.53 equals 11.9 per cent. on the $12,764,351 of capital stock issued by the electric companies. As a matter of fact, the sum of $1,006,350.57 was paid in dividends, leaving $524,027.96 for surplus and depreciation charges.

On June 30, 1901, the electric lighting stations of Massachusetts contained 928 dynamos, including 114 power generators. The total capacity of these dynamos amounted to 69,434 kilowatts, of which 12,234 kilowatts were in arc and 43,097 kilowatts in incandescent dynamos, and 14,103 kilowatts in power generators. The average capacity was 74 kilowatts each. From these figures it appears that the power generators represented 20 per cent., the arc dynamos 17 per cent., and the incandescent dynamos 62 per cent. of the total station capacity.

The increase of capacity for all dynamos during the year was only 493 kilowatts, the smallest amount added in any year since 1883. Only the incandescent dynamos gained in capacity during the year, and their increase amounted to 1,384 kilowatts. Meantime the arc dynamos lost 439 and the power gnerators 452 kilowatts of capacity.

The decrease in capacity of arc dynamos began in 1900, and is no doubt due to the substitution of service from incandescent or constant-pressure machines, particularly by the use of constant-current transformers. Decline in capacity of power generators seems to be due to the removal of such machines from electric lighting stations, where they have been employed to supply power for street-car motors, to separate street railway plants.

At the close of the year under consideration the steam engines in electric lighting stations numbered 344, so that there were 2.7 dynamos to every engine on an average. These 344 engines had a combined capacity of 89,348 horse-power, and the average capacity was 260 horse-power each. The capacity of all dynamos in electric lighting stations, reduced to horse-power, is 93,075, so that the ratio of dynamo to engine capacity was 104.1 per cent.

Besides the engines, electric lighting stations contained 42 water-wheels, with an aggregate capacity of 9,432 horse-power, or 224.5 horse-power each on an average.

The combined rating of steam engines and water-wheels in electric lighting stations was 98,780 horse-power, and of this capacity the water-wheels represented 9.6 per cent. These stations contained 359 steam boilers, with a total rating of 60,323 horse-power at the close of the year. The average rating of these boilers was thus 168 horse-power each. It may be noted that the number of boilers exceeds that of engines by 4 per cent., but the engine rating is greater than that of boilers by 48 per cent. Evidently there is less tendency to large sizes in boilers than in engines. As a boiler horse-power is usually based on the delivery of 30 pounds of steam per hour, while an engine should consume steam at a less rate, the boilers may have been able to operate all the engines.

There were 7,967 electric motors connected to the circuits of lighting stations at the close of the fiscal year under consideration. Of these motors 5 were on circuits operated by arc dynamos, 5,230 were on incandescent circuits, and 2,732 motors were supplied from electric power generators. Fan motors are not included by these figures. The increase in the number of motors during the year was 1,649, and this number was made up by the addition of 160 motors to power circiuts, 1,495 to incandescent circuits, and the loss of six motors from arc circuits. The 7,967 motors had a combined capacity of 31,426 horse-power, corresponding to an average of 3.9 horse-pewer each. The number of motors on power circuits was 34 per cent., and that on incandescent circuits 65 per cent. of the total. Motors added to the service of lighting stations during the year had a total capacity of 4,293 horse-power, an increase greater than that in any other year, except that of 1900, in the history of the State.

Of the combined capacity of all the motors in Massachusetts on the circuits of lighting stations Boston had 56 per cent. in 1901. The number of these motors for Boston was 4,793, and their total capacity 17,785 horse-power. These motors were made up of 5 on arc circuits, 1,086 on power circuits, and 3,702 on incandescent lines. For all these motors the average horse-power was 3.7. During the year 1,279 motors were added to the circuits of lighting stations in Boston, and the capacity of these motors was 2,826 horse-power, or 2.2 horse-power each on an average. This increase in the number and capacity of motors at Boston was greater than that of any previous year.

Electric lighting systems included among their equipment 25,779 arc lamps throughout the State in the year under consideration. Of these lamps 2,280 were single open arcs, 7,787 were double open arcs, and 15,712 were enclosed arcs. During the year the number of single open arcs declined by 635 and the number of double open arcs by 665, but the number of enclosed arcs went up by 3,724. The net result of these changes was a gain of 2,424 in the total number of lamps. The most notable feature of this showing is the rapid conquest of the field by enclosed arcs. Circuits of lighting stations were supplying 11,219 commercial arcs and 14,080 arc street lamps at the close of the year, a total of 25,299 lamps. The difference between this total and that previously given for all arc lamps of lighting systems seems to be due to the fact that all arc lamps owned by lighting stations are not in constant use. Arc street lamps formed 55 per cent. of the total number of street and commercial arcs.

Commercial arc lamps increased in number by 1,417 and street arcs by 618 during the year. In Boston the total number of arc lamps was 8,434, or about one-third of that for the entire State. Of these lamps 303 were single open arcs, 308 were double open arcs, and 7,823 were enclosed arcs. It follows that more than one-half of the enclosed arcs in the State are at Boston, where they have displaced nearly all of the other types.

Where the rating of arc lamps was given in candle-power, the energy capacity of lamps has been computed on the basis of 0.25 watt per nominal candle-power. In cases where lamps were rated in amperes, the figures for amperes have been multiplied by 80 to get the watt capacity per lamp. Results obtained in this way are not highly accurate, but probably involve no serious errors. The numbers of commercial arc lamps for each of the several ratings are as follows:

Candle-power.	Number of lamps.	Candle-power.	Number of lamps.
800	6	1,400	105
1,000	9	1,600	61
900	9	1,800	2
1,200	2,004	2,000	4,314
1,300	2	4,000	6

Ampere rating.	Number of lamps.	Ampere rating.	Number of lamps.
3	448	6	1,069
4	825	7.5	7
4.5	131	8	8
5	2,174	10	27
5.5	10	18	2

Of the total number of commercial arc lamps 18 per cent. were rated at 1,200 candle-power, and 44 per cent. were rated at 2,000 candle-power each. Lamps with a rating of 4 amperes formed 7 per cent., lamps rated at 5 amperes 20 per cent., and lamps rated at 6 amperes 9 per cent. of the total number of commercial arcs.

The combined capacity of all commercial arc lamps at the close of the year was 4,672 kilowatts, on the basis already stated. Of this total, 1,200 candle-power lamps represented 13 per cent., and 2,000 candle-power lamps 46 per cent. Lamps of 1,200 candle-power represented 601 kilowatts, 2,000 candle-power lamps 2,157 kilowatts, 5-ampere lamps 869 kilowatts, and 6-ampere arcs 513 kilowatts.

Arc street lamps were divided among the several ratings as follows:

Candle-power.	Number of lamps.	Ampere rating.	Number of lamps.
1,200	[illegible]	[illegible]	[illegible]
1,500	[illegible]	[illegible]	[illegible]
1,600	[illegible]	[illegible]	[illegible]
2,000	7,089	7.5	1

Of the total number of arc street lamps those rated at 1,200 candle-

power formed 46 per cent., and those rated at 2,000 candle-power were 50 per cent. The capacity of all arc street lamps was 5,732 kilowatts, and of this 1,952 kilowatts was in 1,200 candle-power, and 3,544 kilowatts in 2,000 candle-power arcs.

Commercial incandescent lamps connected to the circuits of lighting stations throughout the State numbered 1,117,707 at the close of the fiscal year. The number of these lamps of each candle-power was as follows:

Candle-power.	Number of lamps.	Candle-power.	Number of lamps.
[illegible]	[illegible]	[illegible]	598
[illegible]	[illegible]	[illegible]	35
[illegible]	[illegible]	[illegible]	9
10	4,564	32	248
[illegible]	[illegible]	[illegible]	22
14	6	65	1
[illegible]	[illegible]	15	27
20	2,835		

Lamps of 16 nominal candle-power far outnumbered all others, standing at 1,103,133. Next in importance come lamps of 8 and 10 candle-power.

In this same year 18,301 incandescent street lamps were operated by the lighting stations of Massachusetts.

The numbers of these street lamps were distributed among the different candle-powers as follows:

Candle-power.	Number of lamps.	Candle-power.	Number of lamps.
[illegible]	219	32	1,482
[illegible]	169	40	530
20	861	50	23
24	168	64	9
25	14,001	65	17
[illegible]	821	75	1

Of all the incandescent street lamps 14,001, or 76 per cent., were of 25 nominal candle-power. The size of next importance is the 32 candle-power, with 1,482 lamps.

Allowing 3.5 watts per nominal candle-power, the 1,117,707 commercial incandescent lamps have a combined capacity of 62,419.5 kilowatts. Of this capacity the 16 candle-power lamps alone represented 61,775.4 kilowatts, or 99 per cent. Making the same allowance per candle-power, the 18,301 incandescent street lamps have a total capacity of 1,656.9 kilowatts. Of this total the 25 candle-power street lamps represent a capacity of 1,225 kilowatts, or 74 per cent. Adding the figures for incandescent lamps in street lighting and commercial service, their total capacity amounts to 64,076.4 kilowatts. The 62,419.5 kilowatts of commercial incandescent lamps represent 97 per cent. of this total capacity

At the end of the fiscal year electric lighting systems had 105,601 poles set in streets throughout the state, and 4,440 poles set on other property, a total of 110,041 poles. With 50 poles per mile, this number of poles would suffice for 2,200 miles of pole line.

At the same date the electric lighting systems included 1,128,907 feet, or 214 miles, of underground conduit. It thus seems probable that the length of underground conduits was about one-tenth that of pole lines. The total length of wire in underground conduits was 8,177,364 feet, so that each conduit carried 7.2 wires on an average. Assuming an efficiency of 74.6 per cent. for all electric motors, their total capacity in kilowatts is represented by the number previously given for their horse-power capacity. The capacities of the several elements of the connected load of lighting stations are combined to determine their total capacity:

Arc street lamps	5,732	kilowatts
Incandescent street lamps	1,656	"
Commercial incandescent lamps	62,419	"
Commercial arc lamps	4,672	"
Electric motors	31,426	"
Total connected load	105,905	kilowatts

Dividing the income of $1,410,812.06, derived from arc street lamps, by the number representing the kilowatt capacity of these lamps, shows the income per kilowatt of their capacity to have been $246. Incandescent street lamps earned $353,364.71 during the year, or $213 per kilowatt of connected capacity. Income from commercial incandescent lamps amounted to $2,927,774.03 during the year, and this sum corresponds to $45 per kilowatt of their connected capacity. The earnings of commercial arc lamps were $545,468.75, and the average income per kilowatt of their capacity was therefore $117. Service to electric motors brought $921,786.04 to lighting stations, or $29 per kilowatt of motor capacity. Considering the entire connected load, the income was $58 per kilowatt. Public lighting yields a larger rate of income than private service per kilowatt capacity of connected lamps, in part because street lamps are operated more hours per year than are private lamps.

Of the 105,905-kilowatt capacity of lamps and motors connected to lighting systems the percentage in arc street lamps was 5.4, in incandescent street lamps 1.6, in commercial incandescent lamps 59, in commercial arc lamps 4.4, and in electric motors 29.7.

As the total capacity of dynamos in lighting stations was found to be 69,434 kilowatts at the close of the year in question, the connected load of 105,905 kilowatts in lamps and motors was 1.52 times this dynamo capacity.

Special May Meeting of American Institute of Electrical Engineers.

A special meeting of the Institute was held in the hall of the American Society of Civil Engineers, 220 West Fifty-seventh Street, New York City, on Wednesday, May 28, for the purpose of discussing the general subject of Electricity in the Army and Navy. Two hundred and fifteen members and guests were present, President Steinmetz being in the chair.

The following papers were presented: "Electricity in the Signal Corps," by Lieut.-Col. Samuel Reber, United States Army; "Emergency Engineering for Harbor Defense," by Dr. Louis Bell, of Brookline, Mass.; "Electricity in the Navy," by Mr. Walter McFarland (late United States Navy), of the Westinghouse Electric Manufacturing Co., Pittsburg; "Electricity in the Navy," by Lieut. Harry George, United States Navy; "The Reasons for the Change of the Navy Standard Voltage from 80 to 125," by Lieut. W. Van N. Powelson, United States Navy; "The Military Cable System of the Philippines," by Capt. Edgar Russel, Signal Corps, United States Army; "Submarine Cable Testing in the Signal Corps, United States Army," by Mr. Townsend Wolcott, of New York; "Wireless Telegraphy—United States Navy," by Lieut. A. M. Beecher, United States Navy; "Electricity in its Application to Submarine Mines," by Capt. John Stephen Sewell, United States Army; "Civilian Co-operation in the Development of Electrical Devices for Military Purposes," by Mr. Caryl D. Haskins, of the General Electric Co., Schenectady, N. Y.; "Electricity in Permanent Seacoast Defense," by Major George W. Goethals, United States Army.

The papers of Col. Reber, Captain Russel and Mr. Wolcott were supplemented by an exhibition of lantern slides. The discussion was participated in by Col. Reber, Lieut. George, General Griffin, Mr. Abbott, Lieut. Beecher, Mr. Hanchett and Gen. Greeley.

The paper by Caryl D. Haskins on "Civilian Co-operation in the Development of Electrical Devices for Military Purposes" set forth the desirability of closer co-operation between civilian electrical engineers and officers of the United States Army and Navy. Referring to the fact that the details of mining systems have been regarded necessarily as an official secret of a certain branch of the army service, he considered that nevertheless proper official secrecy does not bar the mining system from such benefits as might result from civilian co-operation. The rapid and accurate transmission of angles in connection with base line, range and position finding is, in particular, a field in connection with which civilian engineers of wide experience might be of material aid. Another field in which such engineers might be of material aid. Another field in which such engineers might be of material service is in connection with the elaboration of plans, and in the locating of materials, for emergency projects. Mr. Haskins considers that some comprehensive plan should be elaborated for the finding, organizing and concentrating of a volunteer force of trained electricians, officered in part by electrical engineers, and commanded by officers from that branch of the regular establishment responsible for work under execution. A systematic study of this problem will almost certainly result in recommendations for the establishment of a permanent reserve force, possibly taking

the form of a national militia and comparable with the Royal Volunteer Electrical Engineers of Great Britain. It is even conceivable that such a system might very properly be in the form of a skeleton organization attached to the regular establishment.

Lieut. Col. Samuel Reber, in his paper entitled "Electricity in the Signal Corps," devoted attention more particularly to the special telegraph and telephone apparatus employed for fortress and field work, the main characteristics of which are compactness and portability. The paper contains illustrations of several forms of such apparatus. A field searchlight equipment was also described.

Mr. Townsend Wolcott read a paper on "Submarine Cable Testing in the United States Signal Corps," which was prefaced by the statement that the methods used are not peculiar to the testing of government cables. The chief features of the method are a preliminary breakdown test at a high voltage, followed by the time-honored measurements of electrostatic capacity, insulation and conductor resistance, these comprising the electrical testing. The armor is submitted to mechanical tests, and there is a chemical test for galvanizing; while other materials entering into the cable may be subjected to test, their quality can usually be determined pretty well simply by inspection. Mr. Wolcott in his paper gives in detail the methods of applying the above tests in the inspection of submarine cables for the United States Signal Corps.

Capt. Edgar Russel, of the United States Signal Corps, gave an account of the military cable system of the Philippines. A table shows that there are now in the Philippines forty-one cable stations, with 1,297 miles of cable connecting the same. A historical resume is given of the development of the Philippine cable service, with accounts of some of the cable-laying expeditions. The paper includes some illustrations of cable instrument circuits.

Capt. John Stephen Sewell, of the United States Army, presented a paper on "Electricity in its Application to Submarine Mines," in which some hints are given of the manner in which such mines are laid and exploded. Details of apparatus, however, are not given, it being stated that these are classed as confidential. It is customary to plant mines in smaller and larger groups, and usually more than one torpedo will be attached to a single cable core, the various cores as they approach the shore being gathered into a multiple cable of several cores. Thus, starting with a cable of ten cores, it is laid by the most direct line from the operating casemate to a convenient point in the rear of the line of mines it is to serve. There, by means of a large junction box, it is connected with ten single-core cables, each leading to one of a line of smaller junction boxes; at the latter each single conductor branches into perhaps three other single-conductor cables, each of which goes to a torpedo. By this arrangement when firing is by judgment, and thus involves some uncertainty as to the actual distance of the hostile vessel from the mines, the defense explodes three charges at once, thereby increasing the probability of an effective blow. If, on the other hand, the hostile vessel strikes a torpedo, only that one will explode, which ought to be sufficient to destroy the vessel. As daily electrical tests of the mine circuits is necessary, there is a continuous circuit through the torpedo, and this is of high resistance, so that even if the firing battery is on it cannot fire the mine. There is also a circuit closer in series with the detonators and in parallel with a high resistance. When the mine is struck, the circuit closer acts, and opens up a circuit of lower resistance through the detonators, which latter may be of the type having a continuous bridge of fine wire surrounded by some fulminating substance.

It is desirable, however, to know when a torpedo is struck, or whether a circuit-closer acts from any other cause, even if the mine is not to be fired. Moreover, it is objectionable to keep cables under such high voltage as is necessary in a firing battery. It therefore becomes desirable to have another battery of very constant e.m.f. always on the circuit, which will cause a tiny current always to flow. When, however, a circuit-breaker acts this current increases to such a point that it will drop a signal showing to which triple group the torpedo belongs, and also closing the circuit of the firing battery through the corresponding cable core. In case the torpedo is fired, the explosion from it may cause the circuit-closers of neighboring mines to act, and thus explode the whole system. To prevent this a device is employed which allows a firing current to flow long enough to explode certainly the mine that is struck, but which will break immediately thereafter, and remain broken long enough for neighboring mines to right themselves. If ground mines are used, in automatic firing the circuit-breaker is carried in a buoy anchored to the ground mine, and having electrical connection with it, the requirement for ground mines thus being the same as for buoyant mines. The paper describes various other general details of mining circuits and apparatus.

Major George W. Goethals, of the United States Army, gave an account of the use of electricity in permanent sea-coast defenses, together with the recommendations recently made by a board of officers on this subject. There are three services to be provided for at any military post, consisting of a search-light service, emplacement service and garrison service. The emplacement service requires current for lights in the various parts of each emplacement, on each main platform and in the range-finding stations; also current to work the motors for amunition service, for manipulating the guns and to operate a machine shop for minor repairs of the guns and carriages; and finally, for a recently adopted telautograph system, connecting the range-finder stations with each other and with their respective batteries. To supply these three services current is generated in a central power station, the minimum capacity of which should be twice the normal demand for search-lights. The plant should be in two equal, wholly independent parts, either or both of which may be subdivided, as local conditions indicate. In addition to the mechanical reserve, there is also an accumulator in reserve for the emplacement and search-light service, which battery is also available for garrison service. The board has suggested for the supply of garrison service the conversion of direct into alternating current, the latter being boosted up by a transformer, and thus distributed, or the employment of a double-current generator.

The navy was represented by four papers, one of which—that by Mr. Walter M. McFarland—we reprint elsewhere in full, and another—by Lieut. Harry A. George, U. S. Navy—will be reprinted in these columns in abstract. Lieut. W. V. N. Powelson read a paper giving the reasons for the changing by the navy of the standard of voltage from 80 to 125. The reason given for the adoption some years ago of 80 as the standard of navy voltage was that this voltage was selected as a compromise between the standard voltage of the day—110 volts—and the voltage necessary for search-lights, or 50 volts. The gist of the reasons given for the adoption of 125 volts as the standard service voltage is that, since this is the commercial voltage, it involves a quicker delivery of parts and supplies, decreased cost and a closer selection. Moreover, it involves a less weight of electrical machinery, and lessens the cost of installation of the distributing system. Calculations in detail are given of the saving in weights and costs. Lieut. Powelson says that while at first sight it might appear that the arc voltage could be raised to approximately the line voltage, this in practice is not permissible, for the reason that it is absolutely essential for good regulation of the lamp that the arc voltage should be considerably below the line voltage. It was decided that in using 125 volts aboard ship it would be less economical to have a low-voltage generator for the arc lights than it is to dissipate in resistance the energy necessary to obtain the voltage required for search-lights. It was finally decided to adopt 123 volts for circuit voltage instead of 125 volts, on the ground that since this voltage is not very largely used in shore plants, the navy will be able to obtain 123-volt lamps more quickly from stock than 125-volt lamps!

Lieut. A. M. Beecher considered the subject of wireless telegraphy in the United States Navy. The paper is largely confined to an account of the theory of wireless telegraphy, and is accompanied by diagrams of wireless telegraph circuits. As to wireless telegraphy in the navy, it is stated that the masts of all ships are now being altered and prepared for the installation of wireless apparatus. This is a work of some magnitude, as it necessitates increasing the height of the masts formerly used from about 120 ft. to about 135 ft. The old height of 120 ft. had been fixed as the maximum which could safely pass under Brooklyn Bridge. In the new arrangement provision is made for lowering the mast for this purpose. The upper portion of the mast, at least 50 ft., is of wood, and is stayed with hemp rigging, or, in the case of rigging coming lower down than 15 ft. from the masthead, it may be of wire set up with hemp lanyards.

Wireless telegraphic masts have also been erected at the Navy Yard, Washington; at the Naval Academy, Annapolis, and are being erected at the Navy Yard, New York, the Naval Station, Key West, and at Dry Tortugas. It is proposed to test thoroughly all the various kinds of wireless telegraphic instruments at these several shore stations and on board naval vessels, and after determining upon the system best adapted to varying service conditions, it will be adopted as the standard for the service, and all naval vessels will be supplied with it.

Lieut. Beecher says it is needless to point out how greatly this new

system of signalling will facilitate fleet manœuvers and operations, particularly in the way of supplying and communicating information gained by scouts, and the greatly enlarged field of action in which a single commander can, at all times, be promptly supplied with all important information, and can at the same time control and distribute his fleet to the best advantage.

An Inspection at Niagara.

On Sunday, June 1, the Niagara Falls Power Company shut down its great power installation and took occasion to make a complete inspection of the tunnel and wheel-pit, also of all the apparatus in use. They also broke away the bulkhead in the tunnel extension between wheel-pit No. 1 and wheel-pit No. 2, so that now both of the great wheel-pits are connected with the tunnel.

In order to effect the total throwing off of the load, it was necessary for the Power Company to notify each of its tenants and consumers of power that the shut-down was about to occur. Ample notice was given, and on Saturday, May 31, only a partial load was carried. The time selected for the total shutdown of the great installation was when there was the least demand for power, both locally and on the transmission line. This was after midnight Saturday, and by 1:30 A. M. every turbine and dynamo of the plant was at a standstill. In order that the wheel-pit might be illumined, power was turned in from the generators of the Canadian Niagara Power Company, located in the station of the Niagar Falls Park & River Railway, on the Canadian side. In Buffalo the trolleys were operated by the steam plant, while the Buffalo General Electric Company also got current from the steam plant of the electric lines. At Niagara, all the big electrochemical plants were closed, and naturally the various companies took occasion to inspect all parts of their installations.

It is fully five or six years since the tunnel was previously inspected, and for all these years the powerful stream from the turbines had been plunging through it to the lower river, it being estimated that 4,600 cubic feet of water go through it every second. The number of persons who went down into the tunnel was between 30 and 50, the majority of them employees of the company, who were to aid the engineering force in making a thorough examination. A few others joined with Edward D. Adams, Vice-President William B. Rankine, Resident Engineer William A. Brackenridge and Clemens Herschel, consulting hydraulic engineer, in entering the tunnel to see just how it had withstood the wear and tear of the waters and time. All were dressed in rubber clothing and boots, and they passed down the old wheel-pit to the connecting tunnel about 1:30 A. M. Sunday. Going through the connecting tunnel they made their way to wheel-pit No. 2, at which point they entered the big tunnel. Thus they were able to inspect the new as well as the old work.

Torches supplied the necessary illumination. About a foot and a half of water flowed along the tunnel bottom, owing to leakage of the gates. From the new wheel-pit to the lower river the tunnel is 7,436½ feet long, over a mile, and it took Vice-President Rankine's party an hour to walk this distance in the water of the tunnel. They moved along slowly in order that they might examine the walls and study features that attracted their attention. At no point was the least break or weakness in the walls found. Every part was in as perfect condition as the day it was pronounced completed. Not a single brick of the 19,000,000 used was out of place or broken, or even worn. The condition was simply perfect, so much so that Mr. Rankine stated that he felt his examination would suffice for all time, as the demonstration of perfect workmanship was satisfactory to him. Engineer Brackenridge and Engineer Herschel, as well as Mr. Adams, were also delighted with the perfect condition in which they found the tunnel and pit.

When the party reached the portal of the tunnel they found Engineer R. S. Buck and Superintendent Rothery, of the International Traction Company, already at work inspecting the north American abutment of the upper steel arch bridge. This abutment stands very close to the stream that pours with such fury out of the tunnel, but despite this it was found to be in perfect order and wholly satisfactory. The trip back up the tunnel against the flowing water was slightly more difficult than going down stream. The engineering parties that entered the tunnel devoted several hours in making a complete inspection of all parts of the main tunnel, the paper mill lateral and the pit, and everywhere the work was found in perfect order. At 7 o'clock Sunday morning water was once more turned onto the turbines in wheel-pit No. 1, and the flow of watter from them will rush through the tunnel a great many years before there will again be a total shutdown. Power from the new pit will be delivered in August next, it is expected.

Another Large Generating Station for Chicago.

Public announcement was made last week of what has been rumored about quietly in the engineering field for some months past, namely, that the Commonwealth Electric Company, of Chicago, plans the erection of a large generating station which will rival the Waterside Station in New York in capacity when finally completed. Approximately, 14 acres of land have been purchased on the south branch of the Chicago River, near Centre Avenue, or, to be more exact, at Fisk Street. The property purchased is about a quarter of a mile south of Twenty-second Street on the north side of the river. A small strip has also been purchased on the south side of the river for coal storage. The main property is bounded on the south by the Chicago River, and on the east and west by slips or canals, so that it has water frontage on three sides. Railroad sidings enter both pieces of land.

The location is two miles south and a mile and a half west of what is commonly considered the business center of the city. It is not adjacent to any important part of the company's load, but was selected mainly on account of its suitability for a large power plant with economical supply of fuel and condensing water, and the reasonable price of the land which averaged $54.80 per square foot. The cost of the tract, including the price paid to vacate certain streets, was $353,300.

Although the station is to be built by the Commonwealth Electric Company, a large part of the power will be taken by the down-town district through the Chicago Edison Company. Indeed, it is notable that it is the present intention to make the entire output of the plant 25-cycle, 9,000-volt, three-phase currents, the standard of the two companies for transmission to rotary converter sub-stations and conversion into direct current.

The growth of the plant will be according to demands, but it is expected to spend $1,000,000 a year at least until the investment reaches $6,000,000 and the capacity reaches 75,000 kw. The equipment has not been officially announced, but some revolutionizing changes from former central station practice as regards large units of a new type are expected. A contract for boilers of 6,000-hp capacity has been awarded to the Babcock & Wilcox Company, including superheaters and stokers. It has been reported in the press that Curtis vertical steam turbines will be used, this part of the steam plant to be furnished by the General Electric Company.

This will be the first large electric generating plant in Chicago to be built for exclusively polyphase transmission. The large railway plants of Chicago were built just before polyphase current power distribution for large cities became established. The Harrison Street main generating station of the Chicago Edison Company was originally started as a purely direct-current station, but in the last few years several double-current generators have been put in, adapted to either purpose.

In this connection it is interesting to note that it is just about an even ten years since the Harrison Street Station was planned, and at that time it was considered a monster, the capacity of which would not be soon reached. The capacity afforded by the new plant will enable the Washington Street Station ultimately to be shut down, and will provide for the growth of the Edison and Commonwealth systems for many years.

The new station, together with the power soon to be received by a 33,000-volt transmission from the water-power plant of the Economy Light and Power Company, of Joliet, next fall, will make an important revolution in the power generation of the two allied central station companies which cover the Chicago field. This Joliet power will, as noted in a previous issue, operate centrifugal pumps for supplying the Illinois and Michigan canal at Bridgeport in Chicago, and power will also be supplied to the Commonwealth Electric Company in sufficient quantities so that it can shut down its Fifty-sixth Street Station during the day.

Boston Meeting of American Society of Mechanical Engineers.

The programme of the meeting of the American Society of Mechanical Engineers, held at Boston, May 27 to 30, included 22 papers, of which several dealt with electrical subjects.

Messrs. I. E. Moultrop and R. E. Curtis read a paper entitled, "Recent Construction at the Atlantic Avenue Station of the Edison Electric Illuminating Company, of Boston." This plant was elaborately described in these columns about a year ago, and the authors of the paper referred members to this description for a fuller account of the plant.

Mr. Wm. H. Bryan, of St. Louis, in a paper entitled, "Some Details of Direct-Connected Generator Sets," gave the results of a recent investigation into some details of design and construction of steam-driven, direct-connected generators. Correspondence was conducted with a number of leading engine and generator builders, and supplemented with personal interviews. Mr. Bryan found that there seemed to be a practically unamimous agreement to follow the general design and dimensions recommended by the Society's committee on Standardization of Engines and Dynamos in its final report of December, 1901. The paper deals principally with relations between the dynamo designer and the engine builder, and gives information as to what drawings and data should be furnished the latter. Mr. Bryan considers that the overload limit of 25 per cent. recommended by the committee might be increased to 50 per cent., since most generator builders now guarantee their standard machines for that amount of overload. There appeared yet to be a difference of opinion as to whether it is preferable to mount the armature on conical collars instead of the usual press fit. Mr. Bryan considers that the engine shaft carrying the armature should be continuous, and was surprised to find a large and growing sentiment among builders of center-crank engines in favor of the coupled shaft.

Mr. Geo. H. Barrus gave an account of tests recently made, of steam-pipe coverings, of which 17 different kinds were submitted for test. Full details were given of the method of tests and the manner in which the final results were calculated. Tables are included, giving in detail the dimensions of the pipes upon which the coverings were tested, data regarding the covering, and cost of the same. With 2-in. pipes and 150 lbs. pressure, the thermal units lost per deg., per sq. ft., per hour, with bare pipe, were 3.366, while the loss with different kinds of covering varied from .462 to .606 unit. The loss with 2-in. bare pipes under 80 lbs. pressure was 3.081 thermal units, and with the several kinds of covering tested, the corresponding loss varied from .728 to .793 thermal unit.

The subject of "Liquid Fuel Combustion" was considered in a paper presented by Mr. Chas. E. Lucke. The principles of fuel combustion were outlined, and an account given of experiments with various types of vaporizers and burners. The object of the paper was to point out the merits of a particular method of burning fuel oil.

Mr. R. A. Fernald described a method of determining the temperature of the exhaust from gas engines. A receiver is placed close to the exhaust port of the engine through which the gas is emitted, and the pressure allowed to fall to that of the atmosphere, when the desired temperature is ascertained. Mr. Fernald also presented a paper on the working details of a gas engine test, in which all the methods of such a test are outlined and the method of calculating the data given.

Perhaps the most valuable contribution presented was the final report of a committee appointed in June, 1898, to codify and standardize the methods of making engine tests, the results of its work being given in the above-mentioned report. The whole subject of engine and steam plant testing is systematized, and 23 rules are given for conducting such tests. The rules deal with the following subjects: Object of test; general condition of the plant; dimensions, etc.; coal; calibration of instruments; leakage of steam, water, etc.; duration test; starting and stopping test; measurement of heat units consumed by the engine; measurement of feed water or steam consumption of engine, etc.; measurement of steam used by auxiliaries; coal measurement; indicated horse-power; testing indicator springs; brake horse-power; quality of steam; speed; recording the data; uniformity of conditions; analysis of indicator diagrams; standards of economy and efficiency; miscellaneous; report of tests. Five tables are given, consisting of forms for recording the data and results of steam-engine tests. The rule on the analysis of indicator diagrams is particularly valuable, being accompanied by forms of cards illustrating all the various points considered. The analysis of diagrams is considered under the following heads: Steam accounted for by indicator; heat analysis; sample indicator diagrams; the point of cut-off; ratio of expansion; diagram factors and total losses. An appendix to the report gives a code of rules for conducting tests of gas and oil engines.

Power Transmission to Montreal, Canada.

With regard to our recent article on the power development at Shawinigan Falls, and Mr. Wallace C. Johnson's work there as hydraulic engineer, that gentleman has kindly favored us with the following data as to the contract between the Shawinigan Water & Power Co. and the Lachine Rapids Hydraulic & Land Co.:

The generators at Shawinigan are two-phase, 30-cycle, 2200-volt machines of a capacity of 3,750 kw. This frequency of 30 cycles was adopted because at that time I thought we should enter Montreal as an independent company, and in view of the local distribution at Shawinigan and the long transmission line I adopted 30 cycles as the best frequency. By this contract with the Lachine Co., however, we are obliged to deliver to them current at a frequency of 60 cycles, as they already are using 60-cycle current in distribution. It therefore becomes necessary either to install 60-cycle generators at Shawinigan Falls or to install frequency-changers at the Montreal end of the line. As we have undertaken to deliver power by the first of January, it is impossible to install additional water wheels and generators at Shawinigan Falls in time, and it becomes necessary to transmit 30 cycles and put in frequency-changers or motor-generators in the terminal station at the Montreal city line. We have adopted as a unit of transmission 4,000 hp delivered, and we are installing the first one, to deliver current at 30 cycles, 40,000 volts and step down to 2,300 volts, installing frequency-changers or motor-generators to transform to 60 cycles.

The line will run along one or the other of the two railroads connecting Shawinigan Falls with Montreal, namely, the Great Northern or the Canadian Pacific. It is likely that the route along the Canadian Pacific will be chosen on account of the several towns along the line at which power could be delivered. The distance by either route is about 85 miles.

An order has already been placed with the Pittsburg Reduction Company for aluminum cables for the transmission line. These cables will consist of seven strands of No. 6 wire, and will be manufactured from the ore at Shawinigan Falls, where the Pittsburg Company has works.

Rating of Incandescent Lamps.

At the Cincinnati convention of the National Electric Light Association, the Committee on the Rating of Incandescent Lamps, consisting of Messrs. Louis Bell, Jas. I. Ayer and Calvin W. Rice, reported that while preliminary arrangements had been made to have the work of standardizing incandescent lamps done at Columbia University, it soon became evident that under the able and energetic administration of Director Stratton, the National Bureau of Standards would actually be able to provide certified incandescent lamps, which, moreover, would carry greater weight as standards that an unofficial institution could hope to give, within a reasonably short time. It therefore seemed best to avoid the expenditure that would have been necessary to prosecute the work in behalf of the institution, and inasmuch as the Bureau of Standards is now substantially ready to take up the work of supplying lamps, the Committee recommended that the Association shall adopt the certified standards of the United States Bureau of Standards as the basis of rating for incandescent lamps.

With respect to the manner in which incandescent lamps shall be tested, the Committee adhered to the opinion, that while in theory the mean spherical candle power should be the final test for luminous radiation of incandescent lamps or other lamps until such candle power can be determined by more correct and precise processes than are now commercially available, it is best to depend upon the mean horizontal candle power, to be determined by rotating the lamp in the manner heretofore suggested and in general use. Obviously such a measurement does not place lamps with all possible shapes of filament on a parity, but it does treat with substantial justice ordinary commercial incandescent lamps; and

moreover it corresponds to the way in which other illuminants—competitors of the electric lamp—are habitually measured.

Cases will undoubtedly arise in which candle power in some specified direction may demand the consideration of the members of the Association. In all cases where directed candle power—as contra-distinguished from distributed candle power—is to be considered, the only possible way of placing various illuminants on a parity is to measure their intensity in the direction in which a specialized radiation is wanted, including in such measurement the effect of all devices intended to produce directed illumination, such as reflectors, special globes and special positioning of the light-giving parts of the lamp with reference to intensity in particular directions. The great bulk of all lighting done by members of the Association is distributed lighting, and for this purpose the Committee believes that the mean horizontal candle power rating should be adhered to; while for the special problems of directed lighting all means for securing unusual intensity of illumination in some particular direction of the lamp ought to be included and placed on a parity.

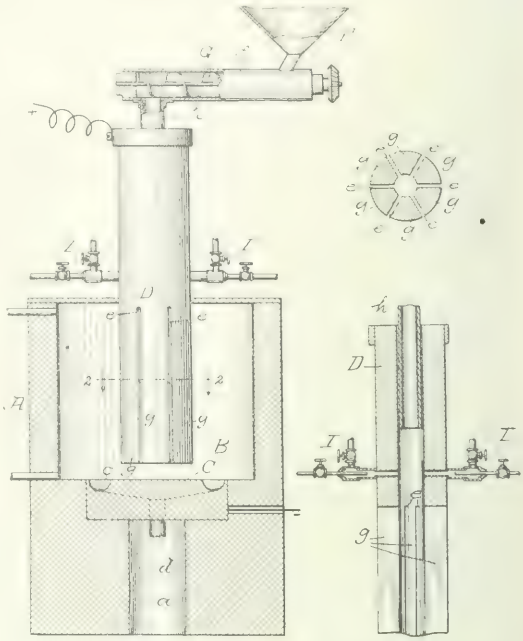
For example, rating a Nernst lamp—which is deliberately intended to give a downward hemispherical distribution—on its mean horizontal candle power would be manifestly unfair; while if a lower hemispherical distribution is for any particular purpose desired, it would be equally unfair to deny to incandescent lamps the privileges of using reflectors or similar means of turning downward the luminous energy, which would otherwise not be radiated in the direction contemplated. In other words, the Committee considered that a logical distinction can be drawn and should be made between general and directed illumination. Lights designed for the former class of work can be conveniently measured in a single conventional zone, while in directed illumination the only fair programme is to compare lights on the basis of the directed beam which is desired for practical use.

Electric Furnaces—Separation of Metals.

BY CLINTON PAUL TOWNSEND.

IN electric furnaces, the bar which supports the pendant electrode usually serves also to transmit the current. For furnaces of moderate size this is simple and convenient, but for the heavy currents of the present installations it is at least open to question whether two functions are properly performed by a single element; the size of the support is governed by its strength, that of the lead by its conductivity, and both support and lead are limited in size by their capacity for conveying heat from the furnace. A system of connections patented by Fausto Morani, of Rome, Italy, employs a conductor and a separate supporting yoke, each of the minimum size to permit a proper performance of its function, and each provided with a circulating system for water. Other features of the furnace are a vertical discharge slit between water-cooled walls and a water-cooled fore-hearth—both mere adaptations from ordinary metallurgical practice.

William P. Parks, of Chicago, patents the carbide furnace herewith illustrated. The lower carbon electrode *C* is embedded in the hearth of the covered furnace *A;* the upper surface of this electrode is flush with the furnace base and is channeled to provide an annular gutter *c* for the molten carbide, which is drawn off through a tap *d* in the body of the electrode into the tunnel *a*. The upper electrode, shown also in horizontal and vertical section in Figs. 2, 3, is a tubular carbon *D* divided as at *e* along radial lines to form separate terminals, *g*, and to insure, so far as may be, a plurality of separate arcs at the working terminal. This electrode serves also as a feeding conduit for the charge, the latter being introduced into the hopper *F* and transferred by the conveyor *G* in the casing *f* to the charging tube *h*. Hydrocarbon burners *I*, mounted in the sides of the electrode *D*, serve for preliminary heating the descending charge.



FIGS. 1 TO 3.—PARKS ELECTRIC FURNACE.

Dr. Nathaniel Shepard Keith described, at the inaugural meeting of the American Electrochemical Society, a striking method for the treatment of metallic solutions with insoluble anodes. In work of this character the concentration of the cations constantly decreases, and in order to secure a uniform reguline deposit the current density must be correspondingly reduced. This is usually accomplished by controlling the current through the vat—an obviously uneconomical expedient, since the capacity of the generator is fully utilized only in the early stages of the operation. Dr. Keith's solution, as indicated herewith, consists in circulating the electrolyte through a number of vats in series, indicated from G^1 to G^7 in Fig. 4, the electrodes therein being connected in multiple and the number of plates increasing in successive members of the series. As the same current passes through each vat, it is clear that the electrolyte is subjected to a current of diminishing density, and that if the strength of the incoming electrolyte be maintained constant and the numbers of electrodes in successive vats properly proportioned, a regular deposit may be obtained throughout the series and the full capacity of the generator utilized.

Dr. Ludwig Mond, of London, whose name is chiefly associated with the "Carbonyl" method of extracting nickel, patented abroad some years ago a method for the electro-deposition of zinc from alkaline solutions upon rotating cathodes of iron, the distinctive feature being the employment of sodium amalgam, produced according to the electrolytic method, as the anode. In other words, the inventive conception was the electro-deposition of zinc instead of the decomposition of water in the oxidizing compartment of a Castner cell.

Zinc so deposited is spongy, and in two recent patents Dr. Mond returns to the old expedient of compressing the deposit as formed.

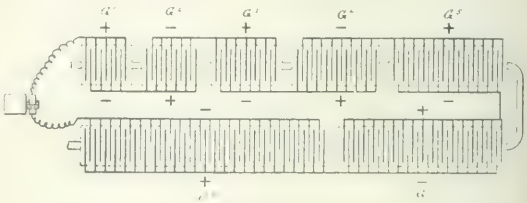
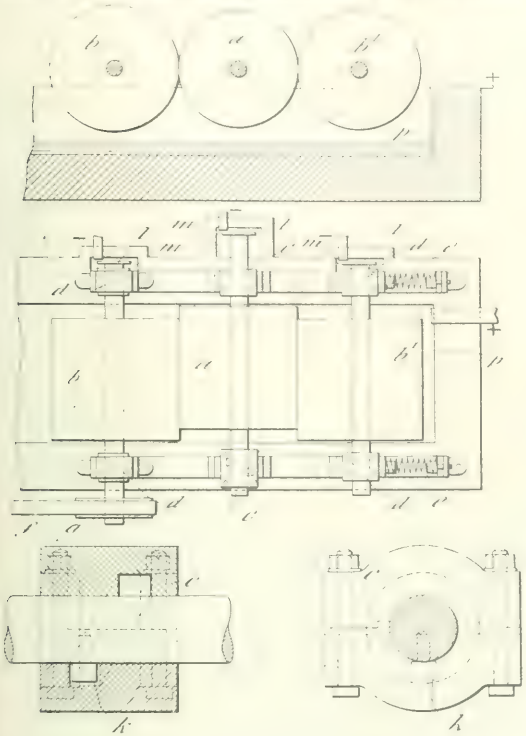


FIG. 4.—KEITH'S ELECTROLYTIC VAT.

This is effected by the arrangement shown in vertical section in Fig. 5 and in plan in Fig. 6; a series of cathodes, *b*, *a*, *b*¹, are rotatably mounted above the amalgam anode *p*, and driven by a belt *f* and pulley *g*, upon the axle of a member of the series. The several cylinders are mounted in sliding bearings *c*, *d*, and held in proper contact by springs *e*. Cathode connection is made through discs *l* revolving in mercury cups *m*. The cathode cylinders may be vertically or horizontally mounted, and either superposed or hori-

zontally aligned as shown. The cylinders a, b^1 are revolved by frictional contact with the driven cylinder a, and to insure an even compression of the deposit the intermediate cathode a is of slightly reduced diameter, the effect being to bring different portions of the deposit into contact in successive revolutions. This is further assured [illegible] of the intermediate



FIGS. 5 TO 8.—MOND DEPOSITING VAT.

cylinder, imparted by the cam-groove c and roller k, shown in detail in Figs. 7, 8.

Francois Urruty, in 1895, described a somewhat similar disposition of large and small cathode cylinders for compacting electro-deposited copper; in accordance with this prior art all of the claims of the present patents are limited to both longitudinal and transverse rubbing of the electro-deposit.

New Telephone Patents.

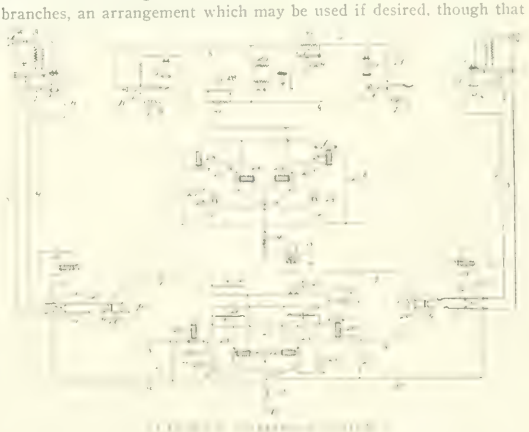
The issue of the Patent Office of May 27 contributes directly to the telephonic art but two patents, and one of those is of that numerous class which appears to have little prospect of success. This particular invention is entitled a "signalling and telephoning apparatus," and the drawings show a wall telephone set equipped with a reel, on which is wound a flexible cord terminating in a plug for the object of connecting the instrument to a rod (made in sections with bayonet joints), by means of which the instrument may be connected to the line wire to be tapped. The generator is designed to give a pulsating or intermittent current, so that a special signal may be sent. Just where the novelty of the invention lies is beyond the reviewer's power to discover.

The second patent is due to Mr. Henry P. Clausen, of Chicago, assigner to the American Electric Telephone Company, and covers a telephone system with common battery signalling, but local battery transmission, in which the principal novelty is the placing of the supervisory relays in bridge and the provision of auxiliary relays which open the cord circuit to prevent the operation of the second supervisory signal when the condition of the connection requires that only the first shall be shown. Mr. Clausen claims for his system that it provides a complete supervisory system of signals for established connections, as well as means for automatic signalling of the exchange by sub-stations, and, in general, is efficient and economical. A grounded signalling bell is provided at the sub-stations, which may be a low-wound bell, and therefore cheap.

Referring to the diagrams, A and B represent sub-stations equipped with grounded bells and local battery transmitters. The battery at station B is omitted, evidently by a draughtsman's error. On taking the receiver off the hook the common signalling battery 14 is grounded through the line signal 13 by way of wire 30, line 9, the sub-station circuit, line wire 8 and spring 11 of the answering jack. When the plug is inserted in the answering jack the line signal is disconnected, as shown. The usual listening and ringing keys are shown conventionally at 21 and 22, the circuits not being shown in full; 22 puts the grounded generator to line 8 to signal the sub-station. The supervisory signals 23 and 24, preferably lamps, are controlled by relays 25 and 26, connected in the bridge 16 across the cord circuit, the bridge being connected to common battery 14 by the wire 14′. The supervisory lamp circuits are extended through the front contacts and armatures of relays, 25 and 26, by conductors 23′ and 24′ to a common conductor, 27, that includes the relays 28 and 29 and connects with the common battery lead 30; these relays 28 and 29 serve by their armatures and back contacts to open the cord strands 17 and 18 at the points indicated.

In the operation of the system, assuming A to be the calling station and B the called, when the plug p' is inserted in the jack the relay 26 is energized, a path for the grounded battery being made by wires 14′, 16, relay 26, cord strand 18, line 8 and to ground through the bell at B. The lamp 24 is then lighted. The lamp circuit, 30, 27, 24′, also includes in its parallel paths the relays 28 and 29, which are then energized, and open the cord strands 17 and 18 at the points shown, the said strands including the armatures and resting contacts of said relays in the end portions over which the relays 25 and 26 are not operated. The function for so opening the cord strands on the other side of the bridge 16 from that over which the said relays are operated is to prevent the operation of the other relay—in this case 25—over the cord strand 17, line wire 8 to station A and back over conductor 9, strand 18 to ground at B, which would light lamp 23, to the confusion of the operator; the opening of strand 18 by relay 28 prevents this undesired operation of 23, but leaves intact strand 17 from bridge 16 to plug p, over which by line wire 8 relay 25 may be operated when A places the receiver on the hook. This circuit is illustrated more simply in Fig. 2, where A is shown with the hook up and B with it down.

In one of the figures the auxiliary relays are shown in separate branches, an arrangement which may be used if desired, though that



shown in the principal figure is preferred. The break in the cord circuit produced by the action of relays 28 or 29 is bridged for talking purposes by condensers 40, as shown in one figure; or, if preferred, high resistances may be used, as shown at 41 in another. Mr. Clausen has worked out his system with considerable ingenuity, but two points strike one from the practical point of view; one is that a system employing common-battery signalling and local battery talking is a trifle out of date, and the other is that the auxiliary relays merely provide a remedy, at the price of additional complication of apparatus and circuits, for the defect inherent to the system, of operating both supervisory signals when only one is required.

Fatal Accident with a High-speed Electric Automobile.

Under the auspices of the Automobile Club of America, a series of speed contests with automobiles were given on Saturday, May 31, on the Southern Boulevard, Staten Island. A finer day could not have been wished, and the attendance was very large, both of automobilists and of the public, but the sports were brought to an untimely close by the "going wild" of an electric automobile, which broke from the track, and plunging into the serried ranks of the crowd near the finish line, killed two persons and wounded seriously several others. It had been rumored that an attempt was to be made to lower records, not only for steam and gasoline, but for electricity, and a great many electric people had gathered, among them being Thos. A. Edison, W. S. Mallory, F. C. Phillips, J. C. Reilly, T. C. Martin, H. Ward Leonard, F. Ott, J. M. Hill, etc., most of these being congregated at the club headquarters at the Boulevard Hotel, while Mr. Hill was the official starter, Mr. Bee was timer, and Mr. Leonard had two or three of his gasoline vehicles competing on the track.

For a few days previous to the contests, Mr. W. C. Baker, of the Baker Motor Vehicle Company, of Cleveland, had had in storage at one of the trolley company's car barns along the route leading to Midland Beach a vehicle with which he hoped to eclipse all vehicle speed records of any kind whatsoever; and the batteries were charged at this point, about a quarter of a mile from the torpedo, extended the full length, the nose and tail protruding. At the centre was a small conning tower for the drivers, windowed with mica, and provided with straps. As the shell was covered with black shiny canvas, or oil cloth, its appearance justified the name that had already been popularly applied to it of "demon" and "freak." It cleared the ground barely five or six inches, and its movement had somewhat of a similarity to flight.

Between 12 and 1 the sport was in full swing, and the crowd near the finish had become so dense on both sides of the track as to push away the police. One side was roped in, but the other, on the left, was open; and there the people massed just beyond the Midland Beach trolley car tracks. The vehicle, with Mr. Baker and his chauffeur, Denzer, got away safely from the starting-post, and Mr. Baker states that they were making a speed of about 75 miles an hour as they came abreast of the Boulevard Hotel. It is even alleged that there the speed was "hit up," and that the automobile began to wobble on the curved roadbed. Be this as it may, when she struck the raised car tracks and went up in the air something was wrong with one of the wheels when she fell to the ground again; and, moreover, she had swerved. Like a flash she swung away to the left and bored a bloody path into the shrieking crowd, dealing death and terror even before anyone could realize what had occurred. Fortunately there were an ambulance tent and doctors near by, and fortunately also the riders, who even in the excitement had set the brakes, were extricated from the wreck with



HIGH SPEED ELECTRIC AUTOMOBILE.

Southern Boulevard paralleling the high road. The thousands of people present had learned of the presence of this vehicle and had heard that in Cleveland it had made speed at rates up to 80 or 90 miles an hour; hence the great curiosity to see it.

The machine, which is here illustrated from an excellent photograph secured on the track by the "New York Tribune," was designed by Mr. Baker for a minimum of wind resistance, and was built broadly on the lines of the Serpollet machines of the steam type, which hold the world's record of a kilometer in 29 4-5 seconds. It weighed about 3,000 pounds, and the shell housed two chauffeurs as well as the steering gear and switches, etc., besides hiding completely the motor and batteries. While everything was as light as possible, it was not thought by Mr. Baker that any undue concession of needed strength had been made; but the accident disclosed the fact that the wheels under their cheeks of oiled silk had only wooden rims and wire spokes. The motor built by the Elwell-Parker Company, of Cleveland, for the machine, was of 7 hp, capable of developing easily up to 12, and the 40 cells of battery had been furnished by the Gould Storage Battery Company. The tires were 3½-inch Palmer. The equipment, in fact, had been well tested as to its constituent parts, and the popularity of the Baker automobiles has been due to it; while Mr. Edison himself has been trying the "low-volt" Baker vehicles in his own automobile battery experiments. The wheels above referred to were about 36 inches in diameter and about 6 feet apart, while

but few injuries. The sports ceased immediately, and Messrs. Baker and Denzer were put under arrest, although on Monday they were acquitted by the coroner's jury. A cursory examination of the automobile would lead one to infer that very little injury had been sustained by its mechanism. But whether she ever takes part again or not in speed contests it is certain that they will not be under the supervision of the Automobile Club of America on public roads. President Shattuck and other conservative officers have always been opposed to road racing, and this tragic incident settles the matter.

Honors for Prof. Bovey.

Prof. H. T. Bovey, LL.D., Dean of the Faculty of Applied Science of McGill University, Montreal, has, we are glad to note, been elected a Fellow of the Royal Society, in recognition of his admirable work in applied science, civil engineering, etc. His papers cover a wide range of topics, embracing much original research of a high order. Prof. Bovey, in addition to his membership in other societies, is an honorary member of the National Electric Light Association, and has a host of friends in scientific, educational and electrical circles in the United States, all of whom will learn with pleasure of this latest, well-deserved honor. His splendid success in building up the endowments of science at McGill, giving it a foremost place on the American continent, has already been described in

CURRENT NEWS AND NOTES.

SHAWINIGAN TRANSMISSION PLANT.—The Shawinigan Water & Power Company will shortly construct a 50,000-volt transmission to Montreal, about 90 miles from the generating station. Mr. Ralph D. Mershon will act as consulting engineer for the transmission plant. The plans involve transmitting 20,000 hp to Montreal, beginning with 4,000 hp, to which additions will subsequently be made in 4,000-hp units.

NEW TYPE OF COHERER.—A patent issued May 20 to Harry Shoemaker, Philadelphia, describes a coherer in which small steel balls are employed in connection with granulated particles of carbon. The small steel balls are so placed in the coherer tube as not to be in contact with each other, and are surrounded by the carbon particles. The specifications state that by the employment of the carbon particles and the steel balls, no decohering is necessary, as carbon and steel contacts have a property of destroying themselves without the use of a tapping or shaking device.

TESLA PATENT LITIGATION.—Judge Lacombe, in the United States Circuit Court, New York City, on June 4, denied the application of the Westinghouse Electric and Manufacturing Company for an injunction to prevent the Stanley Electric Company from manufacturing apparatus claimed to come under certain Tesla patents. The refusal was made on the ground that the Stanley company manufactured the appliances in Pittsfield, Mass., and that, therefore, the matter was not within Judge Lacombe's jurisdiction. The question of the alleged infringement of the patents was not considered. The case was argued last week, the defendants being represented by ex-Speaker T. B. Reed, ex-Patent Commissioner Mitchell, and Mr. W. H. Kenyon.

A CORRECTION.—On account of a misplaced word in the article by Mr. F. G. Baum on "Synchronous Reactance," in the issue of April 26, the method given for measuring the synchronous reactance is apt to be misinterpreted. The beginning of the eighth paragraph should have read as follows: "Run the generator as a synchronous motor, but with no load. Set the excitation for normal working value. Now raise the *voltage* applied to the motor until one-half the full load current flows in the motor." In place of the italicized word "voltage" in the last sentence, the word "excitation" appeared in the article. By setting the excitation of the motor for different values of induced pressure, and then raising the voltage applied until full load current is forced through the motor, the synchronous reactance may be obtained corresponding to any degree of magnetization of the generator.

ARC LAMP CARBIDE ELECTRODES.—A patent granted May 20 to Robert Hopfelt, of Berlin, Germany, describes several forms of a new type of electrode for arc lamps. In each case the material of the electrode consists of calcic carbide, coated with a water-proof compound or sheathed with a metal such as aluminum. It is stated that metallic carbides, such as calcium carbide, gives a much more powerful arc than do ordinary carbon electrodes, but that this material has not been employed in arc lighting heretofore because of decomposition incident to the presence of moisture in the air. By covering the surface of the carbide with a layer impervious to moisture, it is claimed that this objection is obviated. In another form of the electrode there is a core of metallic wire, and in still another form, a core of carbon dust. A solid electrode is also described, consisting of a mixture of carbon and carbide.

RELATIVE HEATING EFFECT OF ALTERNATING AND DIRECT CURRENT UPON LEAD-COVERED CABLES.—In reply to a question, at the recent Electric Light Convention, as to the relative heating effect of alternating and direct current upon lead-covered cable, Mr. Calvin W. Rice said: There is relatively no difference. If a simple rule be followed there will be no heating whatever—namely, the outgoing and returning cables of all alternating circuits should be inclosed in the same sheath. For instance, a single-phase alternating circuit should have a twin cable inclosed in one lead cover. A two-phase circuit can be considered as made up of two single phases, or if operated on the three-wire system, then all three wires should be within the same lead cover; likewise, the three-phase circuits should be in a three-conductor lead-covered cable. With direct current there is absolutely no heating in the lead or iron-pipe conduit. With the outgoing or incoming wires of any alternating circuit assembled in the same sheath, there will be absolutely no heating. Therefore, there is no heating effect of either alternating or direct current when installed as above explained.

SINGLE-PHASE RAILWAY MOTOR.—Among the patents of May 20 is one issued to the estate of Rudolf Eickemeyer, the application for which was filed August 10, 1893. The motor described is intended more particularly for railway service, and several of the 35 figures accompanying the specifications shows it applied to a railway car, the motion of the armature being transmitted to the wheels by means of connecting rods. The motor is very complicated in both its magnetic and electrical elements. Briefly, it consists of a four-pole commutator alternating-current motor, every other bar of the commutator being "dead." On the field, the magnetic portion of which is of complicated shape, there are three separate coils, one of which is denominated a field coil, another a counter-field coil, and the third an isolated or counter-balancing coil. The armature reaction is neutralized by the counter field coils; the counter-balancing coils are of higher resistance, their function being to counterbalance the e. m. f. induced in the armature coil or coils which are just passing under the brushes. The current passes through these coils in different order according as the brushes are on live or dead bars. The speed and direction of rotation of the motor are varied by shifting the brushes. It is stated that a motor thus constructed will work with almost equal efficiency at any desired speed.

NEW TYPE OF LIGHTNING ARRESTER.—A lightning arrester is described in a patent issued May 27 to Giovanni Gola, of Genoa, Italy, which is stated to be based on the following principles: First, the tendency of static electricity and high-frequency alternating currents to avoid the central portion of conductors and accumulate for the greater part on superficial portions (skin effect); second, the tendency of the electric lines of force acted upon by a magnetic field perpendicular thereto, to be displaced in a direction perpendicular to their own, as well as to the direction of the magnetic lines of force; third, the difficulty met with by atmospheric discharges on their path from conductors of large surface to ones of small surface and small cross-section, especially when the direction is to be abruptly changed. The apparatus illustrated consists of a hollow body, the outer surface and the cross-section of which are by far larger than the cross-section and outer surface of the conductor to be discharged. This body has preferably the form of a solid of revolution and is made of a magnetic material coated with a layer of non-magnetic material, the latter being of zinc. The lightning arrester is placed in series with the line to be protected. The outer surface is connected with the part of the overhead wires subjected to atmospheric discharges, and its inward surface with the part of the conductor which the apparatus is intended to protect.

MOTOR COMPENSATOR.—A patent was issued May 27 to C. P. Steinmetz on an application filed Aug. 16, 1897, on an alternating-current motor compensator, the object of which is to reduce the starting torque of a synchronous or induction motor only in proportion to the reduction of current taken from the mains, the torque per ampere of the main current remaining unchanged. After the motor is started the regulator can be adjusted so as to raise the voltage at the motor terminals until full voltage is reached. The regulator comprises a magnetic structure consisting of a fixed and a movable part, provided with compensator coils, one for each phase when used on a polyphase circuit. The compensator coils are connected across the mains, and the motor or other regulated circuit is connected to corresponding intermediatte points in these coils. The coils have a series branch or portion in series with the load, and a shunt branch or portion in parallel with the load. One form illustrated for use in connection with a three-phase motor consists of a 6-pole ring, every alternate pole having coils. Within the ring is a movable magnetic iron shuttle with three poles. By changing the relative positions of the poles of the shuttle, the magnetic circuit can be varied so as to include both the series and shunt branches of the compensator-coils in a closed magnetic circuit, and therefore in a position to transfer energy from one branch to the other; or to withdraw the series shunt branches from inductive relation by opening the circuit of the series branches and leaving the magnetic circuit with the shunt branches closed.

BRAUN WIRELESS TELEGRAPH PATENTS IN GERMANY.—A cable dispatch from Berlin states that on May 30 a court handed down a decision sustaining the Braun claims in an action brought by the Allegemeine Elektricitats Gesellschaft, owner of the Slaby-Arco system, against Siemens & Halske, which represented the Braun system. The dispatch adds that the case may be brought before the Supreme Court of the empire for final adjudication.

TRANSFORMER BREAKDOWN TESTS.—In the article by Mr. R. F. Schuchardt on page 855 of ELECTRICAL WORLD AND ENGINEER of May 17, 1902, a printer's error in figures in regard to the proper voltage to be applied to the primary of a transformer made Mr. Schuchardt say that for a transformer with 2,000-volt primary the voltage applied between the primary and secondary and between primary and core is generally not less than 2,000 volts. This should read, "for a 2,000-volt primary transformer this voltage is generally not less than 8,000 volts between primary and secondary and between primary and core."

DEVELOPMENT AT THE SOO.—Note was made recently in these columns of a large contract for Stanley generators at the Soo. A special dispatch from Sault Ste. Marie of May 26 says: Another great water-power canal is to be dug by the Clergue Syndicate here. It will be the third to use the water of Lake Superior for the Consolidated Lake Superior Company, and will increase the company's power to about 110,000 hp. The canal will require the removal of 400,000 cubic yards of earth and 600,000 yards of stone, and will be several years in building. This canal will provide power for a great metallurgical plant to treat ores of copper, zinc, silver and gold electrically. The ores for treatment are expected to come from Western Canada and from the region to the north of the Sault, where extensive developments are now in progress. Paper mills are also to be erected under this new power, and contracts for the first of these, a very large plant to make news print, etc., are already closed, it is stated.

THE TROLLEY IN MASSACHUSETTS.—Within the last six or eight years the Massachusetts steam railroads have suffered seriously from trolley competition. Up to 1894 their revenue was larger from their passenger business than from carrying freight. All this has changed, figures showing an excess in revenue from freight in 1901 of over $6,000,000, while in 1894 the excess in revenue from passengers was $3,440,526. An encouragement to the steam roads, however, is to be found in figures showing that the electric street railway lines have steadily been carrying fewer passengers per mile since 1895, while the former have recovered some of their previous losses during the same time. It is now generally admitted that while the street railways of Massachusetts made quite considerable inroads into the business of the steam lines when electricity first became an important factor, which has only been during the past eight or nine years, the latter have proceeded to make some recovery of lost patronage, and that the street railway has become less rather than more threatening. In other words, the trolleys, while establishing a traffic of their own, are now creating new traffic for the steam roads, as it was predicted they would do.

LETTERS TO THE EDITORS.

Improvements in Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—The letter of Mr. J. C. Barclay, in your issue of May 24th, in answer to Prof. Pupin's criticism of the unprogressive spirit of the large telegraphic companies calls for a reply in order that the ideas of those who stand for developments in telegraphy commensurate with the advancements of recent years in all other branches of electrical industry may have expression.

Mr. Barclay maintains that Prof. Pupin has not had practical experience in telegraphy, but it likewise appears, judging from the contents of his letter and the example cited by him of a particular automatic system found to be insufficient, that Mr. Barclay is unacquainted with what has been actually accomplished by some of the advanced methods in telegraphy. Speaking from both theoretical knowledge certain new methods in telegraphy that have been tested. I trust these facts will argue the question: "Have telegraphic methods, as commercially practiced, kept apace with other branches of electrical industry?" It is thought these facts will refute the statement of Mr. Barclay that Prof. Morse "invented the best, cheapest and quickest system of telegraphy that has been introduced up to the present time."

It may be admitted that a system of telegraphy, to be an improvement upon the Morse, should operate better, cheaper and more rapidly than the Morse in one important condition. This condition is that the transmission of the messages may be immediately effected by a single manual operation and that they be either automatically received at the other end of the line ready for delivery, or be at once recorded by pen or typewriter.

The essential feature and the great possibilities of progressive methods in telegraphy are based upon the use of the alternating current for transmitting the signals. By using the alternating current, telegraphy and its possibilities have been as much advanced as light and power distribution by the use of the same current. The alternating current gives a theoretical and practical signalling capacity to long telegraph lines about three or four times as great as the direct current used in the Morse system. Messages can be transmitted over a 1,000-mile duplexed line, without relaying, at a speed of about 650 telegrams of twenty words each per hour. As a single operator cannot transmit messages at such a speed, the operation of transmitting the messages is divided among eight operators, each one simultaneously sending a different message.

The particular method of transmitting and receiving these messages is optional. The messages may be transmitted by operating eight typewriter keyboards and automatically received in printed form on telegraph blanks ready for delivery. Or, by methods known to the writer, any existing telegraph line can be converted, by the use of the alternating current and simple, inexpensive terminal instruments, into an octoplex line, over which eight messages may be transmitted in the form of Morse signals in the usual way and at the same speed per message.

By the use of the alternating current, which will work through condensers and transformers, the main line can be entirely isolated from earth, and thus protected from all disturbances due to earth currents. Other methods enable induction effects to be cut off. By the use of the alternating current complex systems of telegraphic distribution can be established, which are wholly impossible with the Morse system using direct currents. For example, four stations, which may be 100 miles apart, near Chicago, can be in simultaneous communication with four stations 100 miles apart and near New York. For this only one long wire is necessary between the two sets of stations.

The above is but a brief and true outline of some of the advanced telegraphic methods now available for use. Radical changes, which would lead to the destruction of the present system, are not to be expected or desirable. But a progressive spirit on the part of the telegraphic companies which would lead them to investigate and gradually introduce on their lines advanced telegraphic methods would be in keeping with that shown in other electrical fields.

PHILADELPHIA, PA. EDWIN F. NORTHRUP.

Potential of the Clouds.

To the Editors of Electrical World and Engineer:

Sirs.—I trust you will pardon my calling your attention to an error in one of the editorials of the last issue of the ELECTRICAL WORLD (May 24, page 896). I do so, not because it is of any great importance, but because I became interested some time ago in that particular matter, and you may be interested, as I was, to see how little foundation some of our generally accepted ideas really have.

I refer to the statement that the potential of the clouds is raised by the combining of many particles into a few. This explanation is given in almost all the text-books, and has been assumed as correct by many able writers; but it is, nevertheless, incorrect. That part of the potential of a drop of water which is due to the charge which the drop the potential at any particular point is not due to any appreciable extent to the charge which may happen to be on the drop of water at that point. The potential at a given point is equal to $\Sigma \frac{q}{r}$ when q is the charge at any point and r the distance from the point having this

there are charges affecting the given point. The high potential at any point in a cloud is not so much the effect of the electricity in the immediate neighborhood as to the great amount in all the space about it, and it will make little difference in the value of $\Sigma \frac{q}{r}$ whether the electricity in a cubic kilometer is distributed over a billion or a hundred billion particles.

You will find this discussed by Lodge in "Lightning Conductors," page 5, and more fully by Everett in "Nature," 38, 343.

HAMILTON, N. Y. C. D. CHILD.

[Our correspondent's criticism appears to be valid in so far as relates to the magnitude of the electric potential of an electrified collection of minute spherical particles. The potential at any particular point not near the edge of a cloud of electrified vapor particles will be practically the same whether the particles remain indefinitely segregated or merge and coalesce into larger spheres. On the other hand, however, that part of the potential of a particle which is due to the charge of its own parts will increase according to the rule, as stated in our editorial referred to, and as given in the usual text-books on the subject. The tendency to discharge, and the electrostatic force, will depend on the surface density of the charges, on their potential upon themselves, and on the degree of coalescence. Consequently, although our correspondent is right in regard to the general potential of the cloud, yet we consider that we are also right in regard to the effect of coalescence and condensation upon the production of the ordinary phenomena of atmospheric

Electrical Works In Germany.

To the Editors of Electrical World and Engineer:

SIRS.—In your issue of April 19th, we find on page 690 a reprint of a consular report, entitled "Electrical Works in Germany." For the sake of the correctness of the data contained in this report I would say that the electric street railway cars of Berlin were built by the Union Elektricitäts-Gesellschaft, whereas the electric current is supplied by the "Berliner Elektricitäts-Werke," a company which is closely connected with the Allgemeine Elektricitäts-Gesellschaft

DR. MAX HAMBURGER,
Engineer of the U. E. G., Berlin.

BERLIN, GERMANY.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Torque of Tramway Motors.—DODD.—A further communication on this subject. The greatest variation in the torque per ampere at half-load and at full load that is possible is in the ratio of 100 to 200. To have this value it is necessary that the saturation curve of the motor up to the point of rated full load be absolutely straight. To have sparkless running with such conditions, or under anything approaching such conditions, means winding the armature so that the iron section, and consequently the weight of the motor, be practically doubled. A motor designed according to Carus-Wilson's ideas would increase the dead weight by one-fifth of the entire weight of the car, as the ordinary tramcar weighs, loaded, about 11 tons, one-fifth of this being the motors. Further, for roads giving a fast service with a great number of stops, the rate of acceleration is limited by the adhesion of the drivers, and in the greater number of cases only by this. Motors which are not worked to saturation cannot keep to this rapid acceleration long, as they quickly reach the speed corresponding to the starting current. With motors worked to saturation, the initial acceleration is continued to a speed which is well up toward the maximum speed of the trains. For motors which are not worked to saturation, the speed attained by the time the acceleration falls off is only a fractional part of the final speed. It is time that with motors worked to saturation the starting current is greater than with motors designed differently, but the speed cannot be obtained by any other means. For this class of service there is also the fact that motors in which the magnetic circuit is brought to saturation will run at a more nearly constant speed under all conditions of load. Motors operating tramways in the center of a crowded city run at a slow speed, and must be continually slowing and accelerating; for this reason a heavy torque is desired. On the other hand, the weight of the motor must be kept down, as the cars themselves are fairly light. The ordinary tramway motor is more or less of a compromise between these two considerations. The torque per ampere varies between half-load and full load usually in the ratio of 100 to 160, or thereabouts. It is usually found, however, even in this class of service that when slow-speed motors and high-speed motors are installed on the same road the high-speed motors are in great favor with the tramway authorities. For electric railroads operating under steam railroad conditions a heavy weight is not such a great objection. The other two points are, however, of great importance, *i. e.*, ability to attain a high speed quickly and keeping a constant speed under all conditions of load. These two points can be met only by the motor which is worked to saturation.—Lond. *Elec.*, May 16.

REFERENCES.

The Single-Phase Induction Motor.—MCALLISTER.—An article in which an attempt is made to outline the characteristic features of the single-phase induction motor, to ascertain the similarities and the differences between the performances of the single-phase and the polyphase machine, and to investigate the methods by which the single-phase motor may be operated under various conditions.—*Amer. Elec.*, June.

Form-Winding.—DAVIES.—In continuation of his illustrated article on forms and form-winding, he describes forms for field-magnet coils.—Lond. *Elec. Eng.*, May 16.

The Drum Armature.—A didactic article treating of the drum armature. The direction of current flow and e. m. f. generated in each wire are explained and a formula given for the calculation of the latter. The article is copiously illustrated.—*Amer. Elec.*, June.

POWER.

REFERENCES.

Steam-Piping Systems.—ROBBINS.—An article, with diagrams, comparing the steam-piping systems of the four large electrical stations of New York, *i. e.*, the Edison Waterside Station, Manhattan Elevated, Metropolitan Street Railway and the Third Avenue Railway power stations. The plans and cross-sections are given on a very small scale, everything being omitted but the engines, boilers and connecting pipes, together with the outlines of the buildings.—*Amer. Elec.*, June.

The Hartford Steam Turbine Installation.—PERCY.—An illustrated article discussing some of the features which practical industrial tests have developed with regard to the turbine installation of the Hartford Electric Light Company.—*Amer. Elec.*, June.

TRACTION.

Houghton County Street Railway.—PARKER.—A long illustrated description of this road, which has just been constructed. The farthest point reached is 18 miles from Houghton, which is the headquarters of the system. There is also a sub-station at Laurium, about 12 miles from the main station. The power plant comprises two 500-kw direct-connected units, one for railway work and the other for supplying power to three-phase transmission line. The railway generator is rated at 910 amps. and 550 volts at full load, and is guaranteed to stand an overhead of 50 per cent., showing an efficiency of 94 per cent. at full load. The generator for the transmission line is a three-phase, 25-cycle, 500-kw separately-excited machine, running at 100

r. p. m. It has a revolving armature, and develops 500 kw continuously at 380 volts, with an efficiency of 94 per cent. and 750 kw for two hours, with an efficiency of 94½ per cent. There is also a 250-kw, three-phase, 25-cycle Westinghouse synchronous converter rated at 420 amps. at 600 volts on the direct-current side. This converter and those in the sub-station have a full load efficiency of 93 per cent., and were designed for 50 per cent. overload for two hours without injurious heating. The transformer room contains six 100-kw, 25-cycle, oil-cooled step-up transformers, the primary of each being wound for three-phase current at 380 volts and the secondary for 11,000 volts.—*St. R'y Jour.,* May 3, and *Int. Ed.,* May.

Repair Shop.—An illustrated description of the new repair shop of the R. I. Suburban R'y Co. in Providence. The electrical repair room contains pits where repairs to the motors, wheels, etc., can be made, and a new hydraulic hoist is used for removing and replacing the same. There is a transfer table large enough to accommodate a 40-ft. car and operated by an electric motor. There are two air-hoists for carrying wheels and other heavy parts. The winding room has accommodations for re-winding, building and repairing armatures and fields as well as repairing controllers, testing instruments and cash registers. Magneto bells connected with a motor-driven alternator are used for testing the work. There is a hydraulic press for forcing on and off pinions, rings and commutators, operated by a pump having a capacity of 50 tons. The winding room contains three drying ovens, two of which are arranged to contain five armatures each, and a third reserved for drying fields. The ovens are heated electrically. Throughout the entire shop the machines are all motor-driven, power being taken from the 550-volt circuit, two special cables being run from the company's power station.—*St. R'y Jour.,* May 3, and *Int. Ed.,* May

Motor Troubles and Trolleys.—An article in which, as a result of the experience of the present management of the Cincinnati Traction Company, it is announced that the motor troubles and repairs on overhead single trolley systems and on the conduit trolley are much greater than on the overhead double trolley system. Schoepf, Todd aand Dunning, who are now in charge of the management and operation of the Cincinnati lines, have had extensive experience in Washington with the underground conduit road and in Pittsburg with the single overhead trolley road. It is suggested that the trouble on the underground conduit road may be due to the strain on the insulation when the car passes a section insulated with the controller turned full on, as in such a case the sudden breaking of the circuit may cause an "inductive kick" in the field coils. It is also suggested that as the single trolley has a grounded circuit there is a greater strain on the insulation between windings and motor-frames, and that consequently there is greater danger of the insulation breaking down.—*St. R'y Jour.,* May 3, and *Int. Ed.,* May.

Italian Tramway.—An illustrated description of the Bordighera and Ventimiglia tramway in the Riviera. It is 3½ miles long; the overhead trolley system is used. The power station is half a mile from the one terminal of the line; there are two dynamos of 55 kw at 650 volts, driven either by turbines or gas engines. The turbines develop 75 hp, and the gas engines, with Dawson producer gas, 90 hp each. There is also a storage battery, with a capacity of 128 amp.-hrs. —*Lond. Elec.,* May 6

Rail Bond.—An illustrated description of a new bond. The plugs are of hard bronze and cast into the terminal. One plug has a flange which spreads out the copper of the bond terminal, so as to form a rivet head. After the bond is placed in its hole in the rail the two plugs are pressed toward each other with a screw clamp, and the copper of the web between the plugs is forced out laterally.—*St. R'y Jour., Int. Ed.,* May.

Putting up Trolley Wire in Geneva.—An illustrated note. The Geneva tramway is being changed from horse and steam to electric power, and about 140 km of track has recently been electrified. The old steam dummies were used for this purpose. A construction car carrying a tower and two reels of wire were attached to the dummy, and as the car was drawn over the route the wire was paid out. At intervals the reels were stopped while the locomotive backed slowly to haul the wire taut, after which it was attached in position to the overhead insulators.—*St. R'y Jour., Int. Ed.,* May.

REFERENCES.

Extra Heavy Double Truck.—An illustrated description of this truck, which is especially intended for high-speed electric cars having long car bodies, and is so designed that it will run at an extremely high rate of speed even around curves. It conforms very closely to steam railway practice, having a swing motion and equalizer bar, making a very easy-riding truck. All parts are made extra heavy, and the truck is made for various gages, to suit the requirements of different roads. Each truck is intended to receive two motors.—*St. R'y Jour.,* May 3, and *Int. Ed.,* May.

Birmingham Car Equipment.—An illustrated description of the equipment of the cars to be used in Birmingham. Twelve electric heaters are furnished under the seats, an enclosed arc headlight is provided and there are four dusters of five lights each for interior illumination.—*St. R'y Jour., Int. Ed.,* May.

Open Cars for Lisbon.—A description of these cars, a large number of which have recently been shipped to Lisbon. They are typical open American cars.—*St. R'y Jour., Int. Ed.,* May.

Overhead and Track Construction for Interurban Railways.—HODGES.—A paper read before the New England St. R'y Club. He discusses in detail the mechanical part of the construction.—*St. R'y Jour., Int. Ed.,* May.

Baltimore.—An illustrated description of the Pratt Street station of the United R'y & Elec. Co., of Baltimore.—*The Eng.,* May 15.

Multiple Unit Systems.—P. L.—A continuation of the illustrated serial. This part gives a very well illustrated description of the Thomson-Houston system.—*L'Ind. Elec.,* April 25.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Selector System.—An illustrated description of a "selector" system whose primary application is the control of sub-station and arc-circuit switches from a station. An arc lighting system is considered in which the arcs are connected nine in series across the 440-volt distributing mains. To switch these circuits on or off, it is ordinarily necessary to bring a switching wire back to the works from each series of nine lamps. In the system described, one wire only is to be used, and a "selector" is placed in series on this wire at each of the switching points. A transmitter is used at the works to send different series of electrical impulses to line corresponding with each of the selectors, and the latter are so designed that they close the switch of the arc circuit, which they control, only when the particular series of impulses is received to which they are designed to respond. Ob-

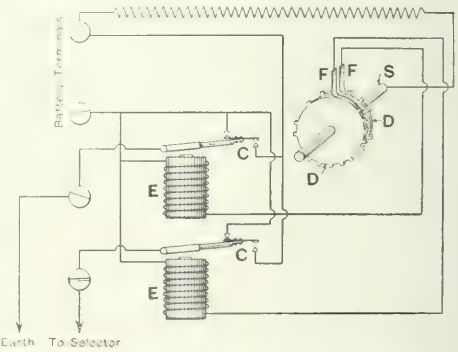


FIG. 1.—DIAGRAM OF TRANSMITTER CONNECTIONS.

viously the same arrangement may also be used for other purposes, such as in connection with individual transformers banked at sub-stations. The transmitter which is placed in the central station, is illustrated in Fig. 1. A number of pairs of brass discs, *D*, are mounted on a spindle, *S*, which rotates one revolution when a handle is pulled forward and released; a spring pulling the lever back, drives the spindle through an ordinary train of wheels. There is only one pair of discs shown in the diagram, but in practice there are as many pairs as there are distant switches to be acted upon. Each of the discs has a number of projections on it which make contact with the springs *F, F*. Every time a contact is made, the circuit is closed through one of the electromagnet coils, *E*. These electromagnets act as relays, and when their armatures are attracted, they close the contacts *C, C* of the selector circuit, sending a positive or negative current to line. Each of the different pairs of discs, *D*, corresponds to one selector on the line. Each pair of discs sends a number of impulses in one direction and a smaller number in the reverse direction to the line. But the moments at which the reverse impulses are sent, between two ordinary impulses, differ for the different

pairs of discs. Each of the selectors on the line is so designed that the corresponding switch is only actuated when this particular series of impulses is received. A sketch of a selector is shown in Fig. 2. An electromagnet, *A*, is placed between the two poles of a horse-shoe magnet and is free to move either to the left or right. Each time it is attracted to the left it pulls with it the link *B*, and the pawl *G* pushes the ratchet wheel, *H*, one tooth forward against the action of a spring. The detent *J*, which is also kept bearing on the ratchet wheel by a light helical spring, prevents the wheel from turning back. After a number of impulses, attracting *A* and *B* to the left, a reverse current is received from the transmitter. The arm *B* then moving to the right, *G* comes in contact with the pin *K* and is lighted, and the pin *L* engages with the detent *J* and releases the ratchet wheel. This happens at any selector which is not tuned to the transmitter

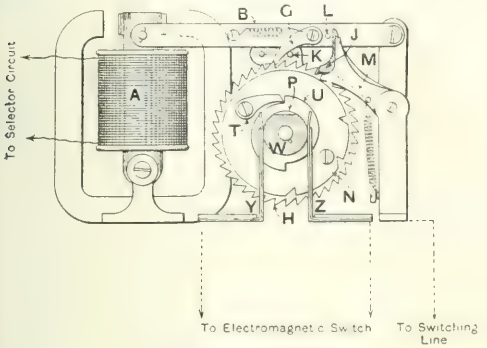


FIG. 2.—DIAGRAM OF SELECTOR.

series of impulses. At the one selector, however, which is to be actuated, a second detent, *M*, is engaged in one of the notches in the plate *N*, which is fixed to the wheel *H*, at that moment and prevents the wheel from returning to its initial position. On the same spindle, but loose on it, is a small barrel of vulcanized fiber, *W*, to which is fixed a small brass plate, *P*, and a snail, *U*, with two notches at opposite diameters. A pawl *T*, fixed on the larger snail wheel, *N*, engages in one of the notches in *U* after the wheels *H* and *N* have made a half revolution forward, and the next impulse being a reverse one, the barrel *W* revolves back with the other wheel. In rotating, the plate *P* makes contact with one of the flat springs, *Y* or *Z*; this closes the circuit of either the switching on or off coil of an electramagnetic switch on the circuit or transformer which the particular selector controls.—Lond. *Elec.*, May 16.

Electric Lighting by Street Railway Systems.—ADAMS.—An article in which he discusses the growing tendency of traction companies to look out for a lighting and power load. Such a load would often be of great advantage, as it would afford a source of large income at a comparatively small increase of fixed charges. Taking the present generating equipment of street railway systems, general demands for electric light and power may be safely supplied in either of the following two ways: If the terminals of each 500-volt d. c. dynamo are brought to a double-pole switch, trolley feeders and track may be connected to one side of this switch and an entirely independent set of circuits for general light and power service to the other. A single throw of the switch for any dynamo connects it to either the traction or the lighting system, so that any of the station dynamos may be operated singly or in multiple on either the lighting or the traction load. The 500-volt current would be at once suitable for motors and for enclosed arc lamps, connected four or five in series. For incandescent lamps a three-wire system would be most suitable, a motor-generator being used for balancing; such a system with 500 volts between the outers could economically distribute energy for lighting and power to a distance of at least three miles from the station. This system, however, requires a separate set of conductors for the lighting service, which, in many cases, would mean a large increase of investment. To make use of existing 500-volt dynamos and of feeder circuits in traction systems for electric lighting at any points to which these circuits extend, small sub-stations are necessary, containing one or more motor-generators and a storage battery.—*St. R'y Rev.*, May 20.

An Up-to-Date Newspaper Plant.—An illustrated article describing the plant of the Lynn *Item*. A large battery is used in connection with the generator and the power bus-bars, which are separated from the lighting bus-bars. All of the unsteady power is taken from the bus-bars to which the battery is connected, and all of the steady power is taken from the bus-bars which are fed directly from the generator. The voltage is thereby kept constant to within 2 per cent. The booster, through which the power and lighting busses are connected, is a motor-driven machine of about 8-kw capacity, and the battery has a capacity of 200 amperes. The generator is a 35-kw machine. The battery is placed under the sidewalk, and is separated from the engine room by a glass partition.—*Amer. Elec.*, June.

Electric Plant of Riva.—An illustrated description of the hydro-electric plant of the city of Riva, in the Tyrol. There are four turbine-driven, three-phase generators, three of 150-hp each, the fourth of 300-hp. The voltage generated is 3,460; the frequency, 50. The electric power is transmitted to Riva and to three neighboring places, where there are 15 transformer stations in fire-proof rooms in houses. The incandescent lamps are connected between a phase and the neutral conductor, the voltage being 110. The motors are operated at 190 volts.—*Elek. Neu. Anz.*, May 1.

REFERENCE.

German Central Stations.—An illustrated description of the electric plant of Karlsruhe, where the three-phase, high-pressure system is used for distribution of electricity for light and power; the power station contains three steam alternators, each of 560-kw, at 4,000 volts per phase and 50 cycles per second. Also a brief description of the small direct-current station of Mosbach, where the two-wire system, at 220 volts, is used; it contains a 90-kw dynamo, a battery of 130 cells of 600-amp.-hours capacity and a booster set of 18 kw; the small cables or feeders consist almost entirely of aerial wires, carried on poles and over the tops of the houses. Lond. *Elec. Rev.*, May 2.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Determining Wire Sizes for Alternating-Current Motor Circuits.—An article with comprehensive diagrams and tables for calculating the sizes of wire for alternating-current motor circuits with various drops. The diagrams are plotted for power factors from 80 per cent. to 98 per cent. in steps of 2 per cent., and for wires three inches apart. The tables are for wire sizes up to No. 10, and are applicable to both 200 and 400-volt circuits of 60 cycles frequency, with the wires three inches apart, and cover single-phase, two-phase and three-phase circuits.—*Amer. Elec.*, June.

ELECTRO-PHYSICS AND MAGNETISM

The Role of Water-Vapor in Gaseous Conduction.—LEWIS.—A note in which he discusses the opinion expressed by Trowbridge that pure gases, hydrogen in particular, are perfect insulators, and that the presence of a trace of water-vapor or oxygen is necessary to produce the dissociation or other conditions upon which conduction depends. He agrees that this view does not seem improbable, when one considers the more or less analogous phenomena of electrolytic conduction in solutions. He, nevertheless, hesitates to accept Trowbridge's conclusion. He says that some of the reasons given for believing pure hydrogen to be an insulator are not conclusive. It seems impossible to eliminate all traces of impurity from vacuum tubes, and it may be that one or more such impurities may take a very active and essential part in the processes which transform a gas into a conductor; but as, under conditions described by him, comparatively small electromotive forces can drive a current through hydrogen or nitrogen, it seems at least doubtful whether water-vapor is necessary to gaseous conduction.—*Phil. Mag.*, May.

Preparation of Radio-Active Surfaces.—ELSTER AND GEITEL.—A description of the preparation of radio-active surfaces. The best form of conductor to be made radio-active is that of a wire, either copper or aluminum, about 0.5 mm. thick, and not shorter than 10 meters. All that is required is an influence machine or induction coil for maintaining the wire at a negative potential of about 3,000 volts for three or four hours. At the end of that time the wire has acquired a radio-active surface layer capable of discharging an electroscope or producing a photographic impression through black paper or aluminum foil. The activity is only temporary, but lasts for several hours. The active surface of the wire may be rubbed off and so transferred to leather, and obtained in a concentrated form for photographic purposes. They have succeeded in preparing active surfaces on leather in the manner indicated, whose activity equals

that of uranium ore.—*Phys. Zeit.,* April 15; abstracted and commented upon editorially in Lond. *Elec.,* May 2.

Invalidity of Ohm's Law.—Stark.—A paper in which he discusses Ohm's law from the point of view of the electron theory. He formulates an equation, stating that the current density of the negative ions is proportional to their charge, their specific velocity and the force moving them. He shows that the limit of the validity of Ohm's law is reached as soon as the difference between the driving forces at the beginning and at the end of the mean free path ceases to be small in comparison with the driving force itself. This may happen whenever, owing to some sudden change of medium, there is a surface accumulation of ions producing a strong electric field, or where, owing to exhaustion, the mean free path of the electrone is of visible length. It is well known that in the vacuum glow discharge the electric force is very great immediately at the cathode, whereas in the negative glow light it is little more than zero. The distance between the cathode and the negative glow light is smaller than the mean free path of the negative ions. There is, therefore, a steep slope of electric force just in that locality, and hence also the well-known invalidity of Ohm's law in the same place.—*Ann. d. Phys.,* No. 4; abstracted in Lond. *Elec.,* May 2.

Faraday Effect.—Du Bois.—A paper in which he says that the Faraday effect of a magnetic field on light is either positive or negative for the compounds of the different metals of the erbium series. The salts of cerium, praseodymium, neodymium, samarium, gadolinium, erbium and ytterbium are strongly paramagnetic, and the absorption spectra of cerium, gadolinium and yttterbium show peculiar lines and bands. He believes that researches made upon these three metals in connection with the magneto optic properties, are bound to yield valuable data for theoretical progress. He has not yet succeeded in finding any effect of a magnetic field upon the very characteristic absorption of the strongly magnetic erbium chloride solution. Experiments should be made, if possible, upon the absorption bands themselves.—*Ann. der Physik,* No. 4; abstracted in Lond. *Elec.,* May 2.

Electro-Chemistry and Batteries.

Temperature Variations of Specific Molecular Conductivity and of Fluidity.—Lyle and Hosking.—An account of experiments made to test the statement often made that the temperature variations of electrical conductivity and fluidity are identical for a given electrolytic solution. They investigated sodium chloride solutions. From the results obtained, they are able, by interpolation, to compare the electric conductivity and the fluidity over the range of temperature between 0° C. and 100° C. of solutions of constant concentration; *i. e.,* they compare the conductivity and the fluidity at different temperatures of such solutions as contain, say, 1 grammolecule per liter at each of these temperatures. The curves obtained by them are remarkable in that they indicate that for solutions of the strengths experimented with both the fluidity and the specific molecular conductivity vanish at a temperature of – 35.5° C. The temperature coefficients of fluidity and specific molecular conductivity are not identical, though the two sets of curves possess considerable similarity.—*Phil. Mag.,* May.

Design of a High-Capacity Storage Battery.—Brocksmith.—An article describing and giving working drawings of a high-capacity storage battery, to be used in connection with an electric motor cycle, described in previous issues. The cell has three positives and four negatives, giving a total positive active surface of 136 sq. ins. The weight of the cell complete is 9½ lbs., and gives a current on short circuit of 375 amperes, or 14.2 watt-hours per pound of complete battery.—*Amer. Elec.,* June.

Units, Measurements and Instruments.

Measuring the Temperature of Furnaces.—Fery.—A description of a radiation scale of temperature in the form of a practical method of aping Stefan's law to the measurement of temperatures. Stefan's law states that the radiation of an absolutely black body is proportional to the fourth power of its absolute temperature. A temperature may thus be measured in the same way as a brightness. By an absolutely black body is meant one which absorbs all the heat it receives and gives it out again by radiation, and not by reflection. Kirchoff has shown that the interior of an enclosure whose walls are at a uniform temperature behaves as an ideally black body. A furnace with a small opening is practically such an enclosure, and since it is usual that the temperature which is wanted is that of a furnace, the application of Stefan's law becomes at once a matter of great value. Fery uses a kind of telescope with fluorspar objective, which concentrates the radiation upon a thermo-couple. He has found that the absorption of radiant heat by the fluorspar increases in proportion to the amount of incident heat at temperatures above 900 degrees. Hence, the only noxious effect of the fluorspar is to reduce the sensitiveness by about 10 per cent. The lens is focused for parallel rays, and an inner diaphragm is so arranged that only a certain cone of rays is received upon the thermo-couple, thus rendering the range independent of the distance of the hot body. A comparison between the new thermometer and a Le Chatelier pyrometer shows an error well below 1 per cent. at temperatures from 914 up to 1,450 degrees, the highest temperature of comparison. The indications are very rapid, the mass to be heated being less than a hundredth of a milligram. The zero is also very exact and constant. He has measured the temperature of the positive arc carbon by his instrument and found it to be 3,490 degrees. The chief attraction of the new instrument is its enormous range. At temperatures at which platinum melts and all thermo-couples forsake us, and even air-thermometers lack a fire-proof enclosure, the radiation thermometer only needs a readjustment of sensitiveness to make it perfectly correct. This assumes, of course, the universal applicability of Stefan's law, which appears to be guaranteed, as it is based upon well established principles of thermodynamics. The only limit we can assign to its range is the capacity of the ether to convey electromagnetic waves of high amplitude in accordance with the law of inverse squares.—*Comptes Rendus,* April 28; abstracted and editorially discussed in Lond. *Elec.,* May 16.

Calibration of Thermo-couples.—Berthelot.—A paper in which he gives some valuable hints with regard to the use of thermo-couples in pyrometry. The cheapest and most satisfactory combination appears to be that of platinum with a 10-per-cent. alloy of platinum and iridium. He believes that the anomalies sometimes encountered in the behavior of this and other couples are due entirely to a chemical change which they undergo in a reducing atmosphere, such as exists in some parts of a Bunsen burner. In any case, these irregularities are never seen in an atmosphere of air, nitrogen, or carbonic acid. Within the temperatures of 400 and 1,100 degrees, the curve representing the relation between the e. m. f. and T is practically a straight line. The fixed points used by him are the melting point of zinc, 419 degrees, and the melting point of gold, 1,064 degrees. The latter is best applied by inserting a piece of gold between the elements at the hot junction, and taking the reading at the instant when the gold melts, and thus breaks the contact. The melting point of sulphur, 445 degrees, is not to be recommended unless the minute precautions prescribed by Heycock and Neville can be fully observed.—*Comptes Rendus,* April 28; abstracted in Lond. *Elec.,* May 16.

Electricity Meter.—An illustrated description of the Mordey-Fricker meter, which is intended either for direct or alternating current. It is a combination of an ordinary clock with a galvanometer coil surrounding a soft iron needle. The clock is deprived of its hair-spring, and carrying on its balance-wheel shaft a disc of slate, on which a few pieces of iron wire or iron strip are fixed in the manner of a compass card. This disc is surrounded by a fixed coil of wire, conveying the current to be metered. The disc acts as a variable hair-spring. The iron which it carries is magnetized more or less strongly by the current, a directive action being exerted in an opposite sense to that acting on a galvanometer needle—that is to say, tending to bring the iron needle to a central or axial position in the coil. This action, in conjunction with the ordinary action of the driving spring of the clock, causes the disc to oscillate at a rate directly proportional to the current. The meter does not go at all when no current is passing, for there then being no directive action on the iron, the disc comes to rest at one or other extreme of its arc of oscillation. The balance-wheel shaft is carried on a footstep jewel, but in order to relieve that jewel of pressure and prevent risk of injury to it, a tortionless silk fiber suspension is used, attached to the shaft by a bent wire spring; but the meter works quite well without this suspension. The meter is an ampere-hour meter, but for use on constant-pressure circuits the counter, which is geared to the clock, is arranged to indicate the consumption directly in kw-hours. The meters may be wound for any pressure, and, moreover, it is asserted that with alternating currents there is no frequency error, the constant being the same for all practical frequencies. The starting current is said to be extremely small, corresponding to a single 5-cp or 8-cp lamp, but the

total capacity is not given. The pressure drop due to the resistance of the coil is about 0.7 per cent. at full load. One winding of the clock-work is enough to last for about three months; it has not been thought necessary to introduce the complication of an automatic self-winding gear. An ordinary eight-day clock movement is used. The instruments are intended especially for small installations, say, of 12 to 30 lamps.—Lond. *Elec.*, May 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—A note on an "illustration," by Fleming, at the recent conversazione of the (Brit.) Royal Society, of Zickler's proposed method of wireless telegraphy, which utilizes the fact that ultra-violet light promotes electric discharge. There are two spark-gaps in parallel. The larger one is made to spark more easily than the other, by exposing it to the feeble ultra-violet glow of a Leyden jar; but when, on the shorter gap, a distant naked arc light is focused by means of a concave mirror, the sparking action is transferred from the long gap to the shorter. Interruption of the arm beam by a glass plate, which robs it of its ultra-violet rays, restores the original state of things, which would thus be set up and maintained for long or short periods. Thus we have dots and dashes carried along the light beam and recorded on moving paper submitted to the burning action associated with the longer spark-gap.—Lond. *Elec.*, May 16.

Cable Relay.—A note on an exhibition, by Muirhead, at the recent conversazione of the (Brit.) Royal Society, of a cable-relay operating between two circuits of artificial cable, each representing 1,250 nautical miles, with an automatic transmitter at the sending end of one circuit and a siphon recorder at the receiving end of the other circuit. "In the relay the local contacts are made between a metallic arm, which is connected by fibers to the signal coil, and a vibrating body whose metallic surface is divided by thin insulating partitions into three sections, to constitute the two terminals of a local line or re-transmitting battery with a zero section between." This issue contains also the first part of an illustrated reprint, in full, of Brown's paper on a cable-relay, an abstract of which was recently noticed in the Digest.—Lond. *Elec.*, May 16.

REFERENCES.

Telephone Engineering.—DOMMERQUE.—Another article of the series on telephone engineering, dealing with the preliminary considerations as to the wire plant. The three classes of wire plant are considered: the overhead, the partly overhead and partly underground, and the underground.—*Amer. Elec.*, June.

Cable Steamer.—A brief illustrated description of the new twin-screw cable steamer "Colonia," which is the largest cable ship afloat, and has a carrying capacity of 4,000 nautical miles of cables in her four tanks.—Lond. *Elec.*, May 16.

MISCELLANEOUS.

Radiation Cures.—An editorial note stating that there can be no doubt that pathogenic germs, active upon the human organism can be exterminated, if only they can be reached and persistently acted upon by intense radiation. Herein lies the supreme obstacle to the application of radiation cures; only when the seats of the disease are upon the surface of the organism can this remedy be found effective, but not for deep-seated diseases. "In the early days of the glow lamp, it used to be a popular experiment to light up a tiny lamp inside the stomach of a fish. Possibly in this harmless experiment lay the beginning of a new and now only partially developed method of treatment of organic disease." The same issue contains an illustrated description of some light baths and light cure apparatus, made by a London firm.—Lond. *Elec.*, May 16.

Self-Electrification of the Human Body.—HEYDWEILLER.—An account of experiments in which he found that charges of opposite sign may exist on different parts of the body without giving rise to a neutralizing electric current. He charges the needle of a quadrant electrometer to several hundred volts. One of the pairs of quadrants is put to earth, while the other is joined up to an insulated metal plate. If now one hand is held in the neighborhood of the plate, without touching it, and the operator mounts upon an insulated stand, the electrometer gives a considerable deflection, showing a negative charge of the hand, which only disappears slowly. The deflection indicates a charge of nearly 1,000 volts. This charge is not due to the friction of the clothes, as it is the same without them. Bending the knee produces an opposite charge. The charges correspond in every case to the well-known muscular currents. But the novel observation is that these charges can exist for some time without neutralizing each other. This is attributed by the author to the existence of badly conducting layers in the epidermis. The energy displayed in producing these charges is very small in comparison with the mechanical work. He puts it at about 250 ergs.—*Ann. d. Phys.*, No. 5; abstracted in Lond. *Elec.*, May 16.

Electricity and Plant Growth.—A brief note stating that Lemstroem has recently carried out some experiments in Helsinfors, in which the growth of vegetable and other crops was stimulated by means of electricity. The crops obtainable from arable land of medium quality showed an increase of 45 per cent., while on poor soil the effect was trifling. Peas, cabbages and turnips among certain plants were only affected after being watered, but most plants were injured, if submitted to the influence of electricity during hot sunshine. No further information is given, but it is estimated that the method can be made to pay when applied to agricultural purposes.—Lond. *Elec.*, May 16.

Electro-Therapeutics.—MRS. MAUREL.—An account of the use of electrical methods in therapeutics at the General Hospital of Tours during the last six years. There are four wards for this purpose; one contains the old apparatus for treatments with inductive coils and influence machines; the second is furnished with X-ray apparatus and high-frequency machines, together with an Oudin resonator; the third and fourth are set apart for gynæcology and galvanocautery, respectively. In five years, up to July, 1901, 717 cases have been treated, 207 of which were sent for electro-diagnosis, while the rest consisted largely of cases of hemiplegia, rheumatism, uterine affections and constipations. The radiographs taken numbered 217.—*Arch. d'Elec. Med.*, April; abstracted in Lond. *Elec.*, May 9.

New Books.

KONSTRUKTIONSTAFELN FUR DEN DYNAMOBAU. By Prof. E. Arnold. New Edition. Stuttgart: Ferd. Enke. Two board portfolios of 60 sheets each. Price, per portfolio, 20 marks.

As the title implies, these are loose sheets of engravings reproduced from scale drawings of electric generators, motors, transformers, etc. The sheets of one portfolio are devoted to direct-current machines, and those of the other to alternating-current designs. Each portfolio contains also an index sheet and a data sheet, the sheets of drawings showing only dimensions and general data, such as output, voltage and speed. The designs covered are mostly of thoroughly modern types, and many of them might readily be taken for standard American machines. They are all taken from actual European practice, the machines having been built by such establishments as Allgemeine Elektricitäts-Gesellschaft; Siemens & Halske; Oerlikon Works; Brown, Boveri & Co.; Lahmeyer & Co.; Ganz & Co., etc.

A disappointing feature is the absence of detail data for some of the design sheets. Only the drawings, and some of these not completely dimensioned, are given for thirty-two of the direct-current and twenty-five of the alternating-current designs, the remainder, however, being made complete by the data sheet. The designs that are given in full should be of immense advantage to designers who desire to avoid most of the preliminary experimentation that invariably accompanies the preparation of new lines. The data are extremely full—in fact, the electrical and magnetic data are absolutely complete. Among the induction motor designs one finds litttle difference from American practice, the only noticeable difference being in the use, by one maker, of stator teeth overhanging the slot on one side only, and by another of a hole winding. In the transformers there are many differences, the most radical being three-phase apparatus. The alternators are themselves closely similar to the best American practice, but many of them differ from that practice in having their exciters mounted on the generator shafts.

TRANSACTIONS OF PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Fifth Annual Convention, 1901. San Francisco, Calif. 209 pages, illustrated.

This volume contains 17 papers, and several discussions, at the San José Convention of the Association, June, 1901. The Association has 62 members on the list, divided with even-handed partiality between 31 associates and 31 members (six of whom are honorary members). Twelve of the papers are on high-potential switches, showing the importance of those articles in the business

to whose fostering the Association is devoted. Two papers are on pole-lines, one on electric pumping, one on telephone service, and one on climatology of California from the standpoint of the meteorologist interested in lightning. All the papers are well insulated, and the transactions in general are very interesting, with a distant far-western flavor that is both characteristic and delightful.

As regards high-potential switches, the consensus of opinion seems, from the discussion, to have been against employing them, or, where they may be employed, against using them. The high-potential switches seem to require a very large amount of free space in which to break the arc at rupture. Oil switches, remote from the switchboard, buried in brick vaults and governed by pilot-switches from the switchboard, seemed to meet with favor.

BOOKS RECEIVED

Physical Determinations. Laboratory Instructions for the Determination of Physical Quantities. By W. R. Kelsey, B. Sc., A. I. E. E. London: Edward Arnold. 316 pages, illustrated. Price, 4 shillings and sixpence.

Das Elektrotechnische Institut Zu Carlsruhe. By Prof. E. Arnold. Berlin: Julius Springer. 60 pages, 29 illustrations.

The Arithmetic of Electrical Measurements. By W. R. P. Hobbs, R. N. Revised to date by Dr. Richard Wormell, M. A. Ninth edition. London: Thomas Murby. 112 pages, illustrated. Price, 50 cents.

Directory of Electrical Societies, Etc.

American Association for the Advancement of Science. Next meeting, Pittsburg, June 28 to July 3, 1902.

American Electochemical Society. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Institute of Electrical Engineers. Annual convention, Great Barrington, Mass., June 18-21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Independent Telephone Association of the United States. Next meeting, Philadelphia, Pa., June 24, 25 and 26, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association. Next meeting, Chicago, May, 1903.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Ohio Street Railway Association. Next meeting, June, 1902.

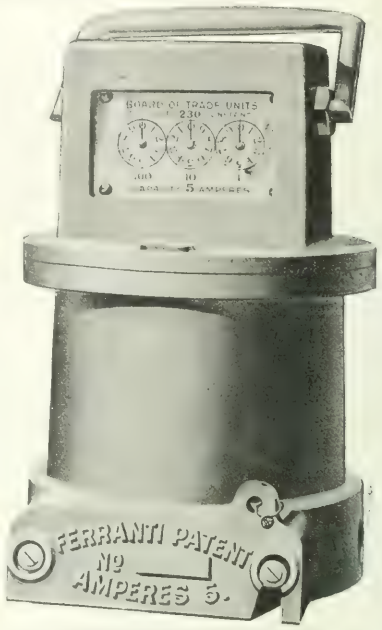
Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Society for Promotion of Engineering Education. Next meeting, Pittsburg, June 28 to July 3, 1902.

Ferranti Direct-Current Meter.

The accompanying illustration shows a type of direct-current meter made by S. Z. de Ferranti, London, Eng., which has been laregly adopted in British central station. The meter illustrated is for 6 amperes, and is provided, as will be seen, with a handle, which is fitted to all meters of this type of 100 amperes and under. This is found of much convenience in handling the meters, and prevents the spilling of mercury when the meter is being carried; when not in use the handle turns down.

The meter is of the mercury motor type. The current is conducted to the center of a mercury bath, through which it flows radially to a contact ring which is connected with a coil surrounding a pole piece immediately under the mercury bath. The bath is insulated on the top and bottom by means of fiber, and is thus the armature of a motor of the unipolar type. The electromagnet action between the magnet and the current passing through the mercury causes the latter to revolve. The driving torque set up by the current varies as the square of the number of amperes, but as the resisting torque set up by the



FERRANTI DIRECT-CURRENT METER.

fluid friction varies as the square of the velocity, the result is a velocity directly proportional to the number of amperes passing through the meter. A light fan, consisting of four vanes, is completely immersed in the mercury and moves with the mercury, the motion of the fan being communicated by means of a worm and gear to a registering mechanism.

Improvement in Field-Magnet Construction.

In a paper read at a recent meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers, Mr. S. E. Huenerfauth described a method adopted by the Phoenix Electric Manufacturing Company for obtaining sparkless commutation without excessive weight of material or expenditure of power. The method consists broadly of the use of slotted magnet poles, without pole shoes, commutating tips being formed by hollowing out the cores just above the pole face on each side of the magnet core. The accompanying illustration, reproduced from a photograph of a rough casting, shows a field of this form.

With this form of pole, the hollows above the pole tips reduce the cross-section of the steel so that at no load the outer ribs are highly saturated magnetically at the hollows; consequently the magnetization of the pole tips varies very little from no load excitation to maximum, and the commutating fringe under the pole-tips remains nearly constant. This construction, combined with the use of slots nearly across the pole face, prevents distortion of the field flux by armature reaction, and allows the brushes to remain fixed between no load and full load.

The slots in the pole-face further serve to connect the wider slots on the body of the pole with the armature chamber and supply superabundant ventilation to the field coils, carrying away heat from the inside of the coils, whence it is ordinarily least able to escape. Moreover, the use of polar horns or extensions being rendered unnecessary, the outline of the body of the pole is made the same as a projection on the pole-face outline, so that the field-magnet coils may be slipped off without using removable poles—the poles being cast integral with the yoke-ring.

It was stated that a 150-kw Phoenix machine with a reactive

voltage of 11½ volts per coil is running in an adjacent city without showing the slightest indication of sparking at the brushes. The advantage in carrying the reactive voltage up is that it reduces the cost of construction. A reduction of reactive voltage means increased armature diameter, increased number of armature coils and consequently commutator segments. Anyone who has tried



NEW FORM OF FIELD MAGNET.

to build a 24-inch commutator with 600 or more segments will appreciate the removal of the necessity for a large number of coils.

Still another benefit derived from the use of the slotted form of magnet core is that the metal of the pole-face is highly saturated, while the density in the air-gap is quite normal. This supplies an additional barrier to the distortion of the field by armature reaction, without resorting to highly saturated armature teeth, with the accompanying hysteresis loss. A 200-kw machine recently built showed a total armature core and friction loss of 2¼ per cent., and a practically distortionless field was obtained with an excitation of less than 1 per cent.

From an actual test made of a 150-kw generator, after a five hours' run, the field-coils were cooler by 5 degrees on the inner surface of the coil than on the outer. It was also discovered that by holding a small strip of paper at the opening of the slots at the top of the field-coils the current of air would draw the paper toward the opening. When the armature is in motion, the tendency is to draw the air through the opening at the top, down through the slots on the face of the pole-block, where it has the effect of materially cooling the face of the armature.

Charlestown Power Station of the Boston Elevated Railway.

The surface and elevated lines included under the corporate management of the Boston Elevated Railway are furnished motive power from eight power stations, viz., the Central, Harvard, Lincoln, Dorchester, Allston, Charlestown, East Cambridge and East Boston stations. These stations, as will be seen, are quite widely distributed, although all are operated in parallel except the East Boston station.

Especial interest centers at present in the Charlestown station, where the first of two large power units, recently installed, is shortly to be put in operation. In order to accommodate this unit an addition to the original power house was necessary. The equipment of the old station consists of three 500-hp boilers of the Babcock & Wilcox type and two horizontal cross-compound Allis engines rated at 1,000 hp each. These engines are direct-connected to multipolar generators of 800 kw capacity.

In order to take care of the largely increased demands of the public service it was found necessary to enlarge the power equipment at Charlestown, and it was determined to install an engine of sufficient size and stability to meet at all times the severe demands of high-class service under the existing conditions. A Westinghouse vertical cross-compound engine was chosen as the best type obtainable for this work, the order being placed through the Boston office of Westinghouse, Church, Kerr & Co. This engine has two cylinders, 44 and 87 inches in diameter, with 60-inch stroke,

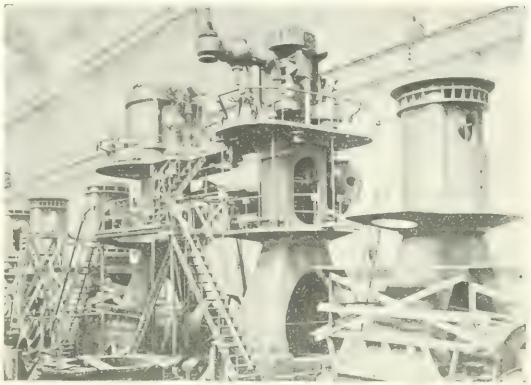
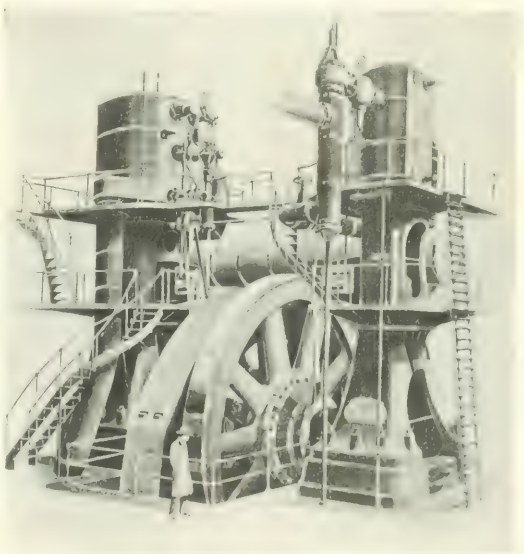


FIG. 1.—CHARLESTOWN ENGINES IN COURSE OF ERECTION.

and runs at 75 r.p.m. It is guaranteed to develop 4,300 hp using steam at 160 pounds initial pressure with a vacuum of 26 inches, and has an ultimate capacity somewhat exceeding 7,000 hp.

The high-pressure cylinder is fitted with poppet valves for use with superheated steam, and the low-pressure cylinder with a Corliss valve gear of Westinghouse design. The cast-steel fly-wheel is 28 ft. in diameter with 26-in. face, and weighs 150,000 pounds. The shaft is of hydraulically forged steel, 37 in. in diameter, with an 18-in. hole in the centre. The total weight of the complete engine is, approximattely, 1,125,000 pounds.

The armature of a Westinghouse direct-current generator is car-



ried on the main shaft between the high and low pressure cylinders. This is one of the four largest direct-current railway generators in New England. It is a 24-pole machine of 2,700 kw capacity. The commutator and armature are 12 and 15 feet in diameter, respectively, and the total weight of the generator is about 338,000 pounds.

An interesting feature of the switchboard installation, which was

also designed by the Westinghouse Company, is to be found in connection with the circuit breakers, which can be thrown out from any portion of the building by means of electric buttons.

The condensing system includes two Allis condensers for the small engines built by the Allis Company, and a Bulkley jet condenser for use with the Westinghouse engine.

The capacity of the boiler room has been increased by adding four 500-hp water-tube boilers, built by the Aultman & Taylor Company, of Mansfield, O. Coal is supplied to the power house direct by rail and loaded from cars into overhead hoppers, although the power house is located so that coal can be brought by either water or rail. The boilers are equipped with Green economizers, arranged in the usual manner with by-pass flues for leading the gases direct to the stack, should occasion require. The method employed for the removal of ashes is of particular interest. The overflow from the condensers and pumps is carried through trenches, which pass under the ash-pits of the boilers. The ashes can be dumped at will into these trenches, and are carried off with the overflow to flats or meadows, which are being filled and enclosed.

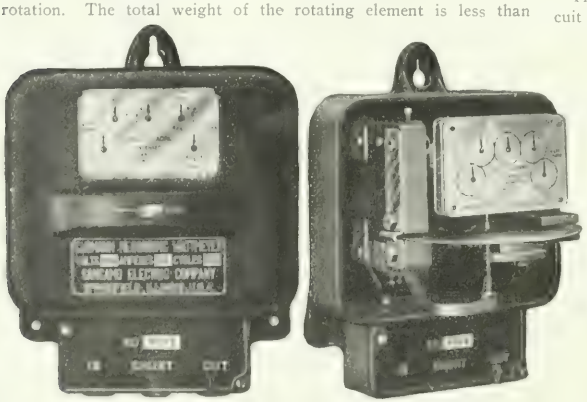
While the new boilers were primarily installed for the purpose of furnishing steam to the Westinghouse engine, the scheme of piping has been carefully arranged so that the boilers may supply steam to any engine. Cylinder oil for the entire station is forced by city water pressure from a tank located in the basement.

The scheme of electrical distribution and auxiliary equipment has been carefully worked out. The details of this as well as the general installation of the additional power equipment has been under the direct supervision of Mr. C. S. Sergeant, vice-president, and Mr. C. F. Baker, superintendent of motive power and machinery for the Boston Elevated Railway Company.

The Gutmann Wattmeter.

A new type of Gutmann integrating wattmeter for alternating current has been designed to replace an earlier form, which has been on the market for three years, and has met with excellent results. The new meter, however, is superior to it in several important points. It is a sealed type induction wattmeter, very small, simple and durable, and, it is claimed, lighter than any other meter on the market, its weight being 10½ pounds.

Fig. 1 shows the meter with the aluminum case or cover in place, and Fig. 2 shows it with case removed. Fig. 3 shows the rotating element, a very light aluminum disc mounted on a short steel spindle, the disc being slotted in certain spiral curves, which define the paths of the currents induced in the disc so as to cause rotation. The total weight of the rotating element is less than



FIGS. 1 AND 2.—INTEGRATING WATTMETER.

¾ of an ounce, and by the use of a broad-rounded pivot and carefully selected jewel with so light a rotor, any danger of injury to the jewel or spindle in shipment is eliminated.

Owing to the large number of turns in the shunt coil and the unusually low reluctance of the shunt magnet, the constant loss in a 100-volt, 133-cycle meter is less than one watt, and less than 1½ watts in a 100-volt, 60-cycle meter. The series coils of the meter, located exactly opposite each other, above and below the disc, have as few turns as possible to produce a strong torque on the disc; so that the drop through any size at full load is only a small fraction of a volt. The torque in the meter is high, as it is necessary to preserve its accuracy in service.

The damping magnet is the same in design as that which gave excellent results in the first Gutmann meter, and is easily adjusted in calibrating the meter. On the shunt magnet is an ingenious adjustment for "light load" or friction, and also a device by which every meter is exactly "compensated" for inductive load of any power factor, so that neither leading nor lagging current affects its accuracy. The "compensation" is effected by adjusting a small loop of iron or copper wire, which closes a gap in a copper band about the shunt magnet. It is thus very easy to change a 133-cycle meter to 60 cycles, or vice versa, by first altering this loop, and then readjusting the permanent magnet, the entire operation requiring but a few minutes.

The connecting box is a particular feature of the meter, being very simple, and convenient for installation. The box is part of the

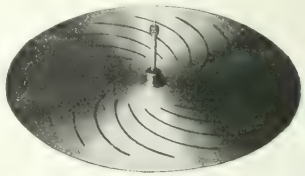


FIG. 3.—ROTATING ELEMENT.

meter, but separated from the sealed working portion by a dust-proof and water-tight wall.

All sizes of the new meter, up to 200 lights capacity, read direct in watt-hours upon the dial, without a multiplier, and the enameled dial is large and easily read in dark corners. For three-wire single-phase circuits the meter is made with four binding-posts, two for each of the outer wires, there being no shunt post, as the shunt coil is connected inside. All sizes record accurately from a very small percentage of full load to a large overload, the accuracy being unaffected by wide variations in frequency or voltage. The three-wire meters are also correct under any conditions of unbalanced load. For sizes above 100 amperes, the meters are furnished with series transformers, and for primary circuits, with potential transformers. The Gutmann meter is manufactured by the Sangamo Electric Company, Springfield, Ills.

New Forms of Circuit Breakers.

The Cutter Company, of Philadelphia, is making a type of circuit breakers, illustrated herewith in Fig. 1, having, in addition to

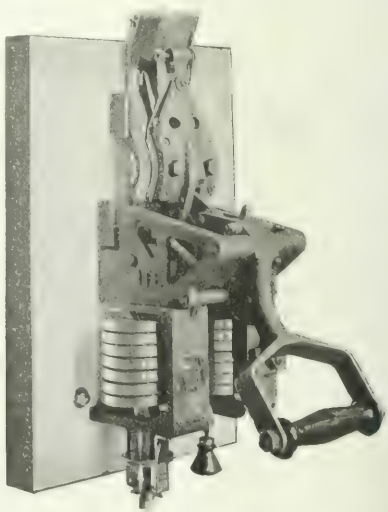


FIG. 1.—REVERSE CIRCUIT-BREAKER.

the regular overload function, a "reversal" feature. Where generators are operated in parallel, a slowing down of the prime

mover of one or more of them, or an interruption of any one of the field circuits, is apt to cause serious disaster if not properly guarded against, the tendency of the generator with which the difficulty begins being to run as a motor, naturally resulting in mechanical injury to it, and often causing the overloading of the others. The "Reversal Feature" prevents such damage by forestalling its cause, effecting the operation of the circuit breaker, with which it is connected, as soon as the reverse current through it reaches a measurable value. The I-T-E reversible circuit breakers can be made to operate on the "reversal" only if desired. The capacities are from 5 to 5,000 amperes.

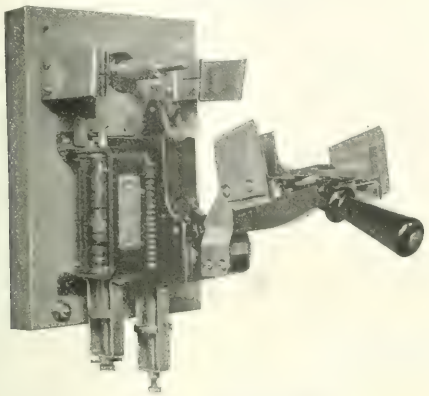


FIG. 2.—SINGLE POLE CIRCUIT BREAKER.

Fig. 2 shows a type of circuit breaker, made by the same company, which is particularly adapted for use in connection with motor-driven tools, printing presses and traveling cranes. In addition to the usual overload coil, it is provided with an auxiliary coil of high resistance, by means of which the instrument may be opened by closing a local circuit, either at a point near or at a distance. It is frequently used as a "limit switch" in the circuit of the hoisting motor of cranes, to prevent the hoist block being carried too far. The circuit of the auxiliary coil is arranged to be closed by the movement of the hoist chain when it reaches the safe limit of its travel.

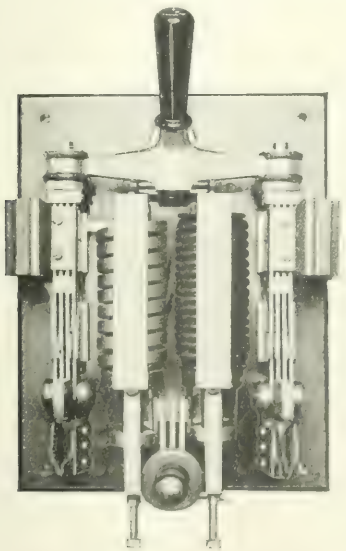


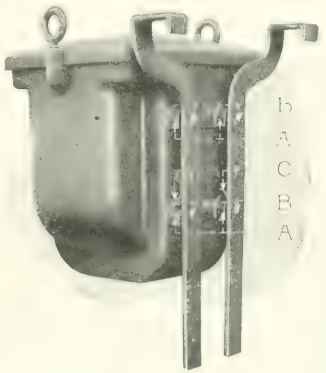
FIG. 3.—WIDE RANGE CIRCUIT BREAKER.

The growing use of circuit breakers in laboratory work has caused The Cutter Company to design a special type of double-pole circuit breaker having a range of adjustment through two coils, from 25 to 1,000 amperes; a small switch short-circuits the low calibration coil when larger currents are employed than it may safely carry. An instrument of this type is shown in Fig. 3.

Suspension Hook for Transformers.

One of the most annoying incidents attendant on the installation of new for old transformers is the difficulty sometimes experienced in detaching the transformer case from the suspension hooks on the pole or building. This is caused by the rusting of the hook to the case, or in most cases by the rusting of the bolt and nut usually employed to fasten the hook to the case, making it impossible to separate the two without the use of a cold chisel.

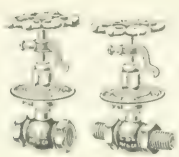
In connection with its new line of oil transformers, the Fort Wayne Electric Works has introduced an effective device, which is especially convenient in application. The illustration shows the ordinary hooks used in mounting the transformer box or cross-arms.



TRANSFORMER SUSPENSION HOOK.

etc., but, instead of separate machine bolts there are riveted studs on the hook shank which engage with the pocket in the lugs and an eccentric cam locking device. These permit the hooks to be readily attached to the transformer before it is elevated to its position; or the hooks can be set in place on the pole and the transformer raised by means of eye-bolts in the case until the pockets *AA* on the back of the case engage with the rivets or studs *BB* on the hanger irons. In either case the eccentric cams *C* can be driven home with a hammer, with just sufficient force to drive the studs well up into the pockets. By this means the transformer is rigidly and strongly attached to the hanger irons, but it is very easy at any time to detach and remove the transformer without disturbing the hooks and without the use of tools.

Dial Needle Point Valves.



NEEDLE-POINT VALVES.

The use of gasoline continues to grow rapidly, and it is now being used to do all manner of work about the house or factory, furnishing heat, light and power. It is a well known fact that ordinary valves suitable for use on water or steam are not suitable for the handling of gasoline. Ground key valves are also of little value, as they do not give proper control of the flow, and soon leak. Fifteen years' experience and an effort to secure the best gasoline fires has enabled the Clayton & Lambert Manufacturing Company, of Detroit, Mich., to make "needle point" valves that are efficient in every way. We illustrate here two new dial needle point valves which they have recently added to their line. By their use a close regulation can be had, so that the flow of gasoline can be controlled. The valves shown are ¼-in. globe and ¼-in. male and male.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was easier and there was more borrowing. The closing rates were 4 per cent. for 30 days to four months, 4¼@4½ per cent. for five and six months. Dulness pervaded the stock market throughout the week, the occurrence of two holidays, Friday and Saturday, checking speculation somewhat. The tone of the market on Thursday, however, was stronger on account of reports of the promised ending of the coal strike. The United States Steel stocks were rather quiet and somewhat heavy on fears that the coal-miners' strike might unfavorably affect the steel industry. Amalgamated Copper was strong and rose to 71¼ on continued favorable reports about the copper situation. Among the outside securities, General Carriage was one of the most active stocks. The announcement that a large majority of General Carriage stockholders had deposited their stock under the plan to subscribe for Manhattan Transit shares by the payment of $2 on each share of the former, caused the old stock to sink to 1⅞, while the stock, assessment paid, brought $2.37 more, or $4.25, thus offering a temporary inducement to shareholders to deposit their holdings. In the traction list Brooklyn Rapid Transit and Metropolitan St. Ry. were both dull, each closing with slight net losses, ⅞ of a point in the former case and 1⅝-points in the latter, the closing prices being 67⅜ and 148⅜, respectively. In the electric list, Westinghouse com. closed at 212, a net loss of 3 points, and Western Union is off ⅜ of a point, the closing quotation being 99¾. Am. Tel. & Tel. closed at 180, making a net gain of 2 points. General Electric was practically neglected during the week, no quotations being established. The closing price on June 2 was 321½, a net gain of 6½ points over the previous quotation. Following are the closing quotations of June 3:

NEW YORK.

	May 27.	June 2.		May 27.	June 2.
American Tel. & Cable.	90	87	Gen. Carriage (n. stk.)	4	4¼
American Tel. & Tel.	176½	176	Hudson River Tel.		
American Dist. Tel.	—	37	Metropolitan St. Ry.	147¾	150
Brooklyn Rapid Transit	66⅞	68	N. E. Elec. Veh. Trns.		
Commercial Cable	151	169	N. Y. E. V. T. Co.	13¼	13¾
Electric Boat	25	30	N. Y. & N. J. Tel.	—	—
Electric Boat pfd	45	47	Tel. & Tel. Co. Am.		
Electric Lead Reduc'n		3¼	Western Union Tel.	99½	99¾
Electric Vehicle	7	7	West. E. & M. Co.	212	208
Electric Vehicle pfd	14¾	14	West. E. & M. Co. pfd.	216	210
General Electric	315	321½			

BOSTON.

	May 27.	June 2.		May 27.	June 2.
American Tel. & Tel.	178	175	Mexican Telephone	2¼	2¼
Cumberland Telephone	—	—	New Eng. Telephone	147	147
Edison Elec. Illum.		—	Westinghouse Elec.		
Lake Telephone	—	—	Westinghouse Elec. pfd		
General Electric pfd.	315½	—			

PHILADELPHIA.

	May 27.	June 2.		May 27.	June 2.
American Railways	46	45	Phila. Traction	97¼	97
Elec. Storage Battery	88	89	Phila. Electric	5¼	5¼
Elec. Storage bat'y pfd.	88	88½	Pa. Elec. Vehicle	—	1¼
Elec. Co. of America	7	7⅛	Pa. Elec. Vehicle pfd.	—	3

CHICAGO.

	May 27.	June 2.		May 27.	June 2.
Central Union Tel.	—	—	National Carbon pfd.	93	93
Chicago Edison	175½	179½	Northwest Elev. com.	37	37¼
Chicago City Ry.	207	205	Union Traction	18⅜	18⅝
Chicago Teleph. Co.	175*	170	Union Traction pfd	52½	52½
National Carbon	94½	94			

* Asked.

WESTERN UNION BONDS.—We are informed, says the *Wall Street Journal*, that several local banking interests are picking up Western Union 4½ per cent. funding and real estate gold bonds at present quotations, believing them a particularly attractive investment with good speculative prospect. In 1900 the issue of $20,000,000 of these bonds was authorized, and of that amount $13,000,000 have been issued bearing the date May 1, 1900, and maturing May, 1950. The bonds are now quoted at 107, making them an income yield of 4.17 per cent. These bonds, which are both coupon and registered, are secured by a first mortgage lien upon all the company's real estate in Chicago and New York, together with all buildings, fixtures and telegraphic equipments thereon, and hold the company's agreement that no future lien or charge shall be created having priority to or preference over the security of this issue or other lien upon its real or personal property without recording a prior lien against the same as security for the payment of the principal and interest of the bonds. The purpose of the issue was to retire $5,681,000 6 and 7 per cent. bonds which matured in 1900, payment of indebtedness incurred from 1895 to June 30, 1900, for new property and new lines, and about $2,000,000 for the physical betterment of the property from June 30 to date. The balance to be used for extension and improvements to be authorized by the directors and the retirement of $1,163,000 7 per cent. real estate bonds which matured this year. The company's outstanding capital stock is $97,340,589, on which 5 per cent. diviends have been regularly paid. It is said that the company will soon begin the construction of 18 new copper circuits between New York and Chicago.

BELL TELEPHONE OUTPUT.—The instrument statement of American Telephone and Telegraph for the month ended May 20 shows:

	1902.	1901.	Changes.	
Gross output	104,661	85,118	Inc.	19,543
Returned	32,441	37,744	Dec.	5,303
Net output	72,220	47,374	Inc.	24,846
From Dec. 20, 1901, to May 20:				
Gross output	492,456	373,623	Inc.	118,833
Returned	184,526	160,348	Inc.	24,178
Net output	307,930	213,275	Inc.	94,655
Total outstanding	2,833,942	2,166,091	Inc.	667,851

AMERICAN STEEL FOUNDRIES.—The announcement of the formation of the American Steel Foundries Company has been made. The six companies which will consolidate are: American Steel Castings Company, of New Jersey; Reliance Steel Castings Co., Limited, of Pittsburg; Leighton & Howard Steel Company, of St. Louis; Franklin Steel Casting Company, of Franklin, Pa.; the Sargent Company, of Chicago, and the American Steel Foundry Company, of St. Louis. The president will be taken from among the officials of United States Steel, and most of the underwriters and promoters, who include Charles M. Schwab, E. H. Bary, Max Pam and others, are closely identified with United States Steel. There will be only $15,000,000 preferred and a similar amount of common stock. The preferred stock will bear 6 per cent. cumulative dividends.

MASSACHUSETTS ELECTRIC.—Stockholders of the Massachusetts Electric Company have held a special meeting to authorize an issue of $5,500,000 preferred stock. Lee, Higginson & Co. and the Old Colony Trust Company offered to purchase as follows: $1,375,000, July 1, 1902, at 93 flat (a 2 per cent. dividend comes off July 1); $1,375,000 on or before October 1, 1902, at 93 and accrued dividend, and $2,750,000 on or before January 1, 1903, at 93 and accrued dividend. The stockholders unanimously voted to sell the stock upon these terms.

MAHONING VALLEY BONDS.—N. W. Harris & Co. offer $1,750,000 first and refunding mortgage 5 per cent. gold bonds of the Pennsylvania and Mahoning Valley Railroad Company, maturing May 1, 1922. The company's system consists of the lines connecting the principal cities and towns in the Mahoning Valley, Ohio, with New Castle and adjacent cities in Pennsylvania, and it owns the entire electric light, power and manufactured gas business of New Castle, Pa.

AMERICAN TELEPHONE.—At a meeting of the directors of the American Telephone and Telegraph Company, held in Boston on May 29, it was voted to issue $21,000,000 of new stock. Stockholders will have the right to subscribe on the basis of one share of new stock for four shares now held. Payments are to be made half in September and one-half in January next.

ELECTRICAL SECURITIES.—Note is made of the listing of the Philadelphia Stock Exchange of $700,000 first mortgage 5 per cent. gold bonds of the Michigan Traction Company. Statement is also made that the $20,000,000 securities of the New Union Electric Light and Power Company of St. Louis will be issued about September 1.

MANHATTAN TRANSIT COMPANY.—A London dispatch refers to a report there that persons identified with the South African syndicate and the London Omnibus Company have bought the control of the Manhattan Transit Company, of New York. The purchasers intend to carry on extensive operations in New York.

NIAGARA POWER.—The stockholders of the Niagara Falls Power Company are voting this week to increase the capital stock of the company from $6,500,000, consisting of 65,000 shares, at the par value of $100 each, to $9,500,000, to consist of 95,000 shares of the par value of $100 each.

NATIONAL CARBON COMPANY is reported to be doing a business this year larger by 20 per cent. than that of last year.

DIVIDEND.—The Chicago City Railway declared a quarterly dividend of 2¼ per cent., payable June 30.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade developments during the week were in the main favorable. The labor situation, particularly in the coal trade, has improved to some extent. General activity still rules among the industries, being especially notable in iron and steel, hardware, lumber, etc. Iron and steel are quieter as regards new business in finished products, but there are reports of large transactions pending in the cruder forms. In finished products, new business is generally small, but the mills are crowded with orders. The gross railway earnings for the third week of May, as indicated by the returns to Bradstreet's, showed an increase over a year ago of nearly 9 per cent. The business failures for the week, as reported by Bradstreet's, numbered 163, as against 152 the previous week, and 144 the same week last year. The copper market was subject to the manipulations of the interests concerned in a new copper company. Early in the week the market showed some strength and prices advanced, but support was withdrawn later, and a distinct weakness prevailed, with lower prices. The closing quotations were 12⅜@12⅝c for Lake, and 12⅛@12.35 for electrolytic. The exports of copper during the week were better than was generally expected, and bring the total for the month to over 13,000 tons.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week just ended: Antwerp—1 pkg. machinery, $75; 9 pkgs. material, $1,063. Argentine Republic—44 pkgs. material, $853. British West Indies—13 pkgs. material, $314; 1 pkg. machinery, $19. Berlin—3 pkgs. material, $105. British Possessions in Africa—474 pkgs. material, $9,737; 39 pkgs. machinery, $1,742. Barcelona—17 pkgs. material, $260. Brazil—33 pkgs. material, $1,353; 3 pkgs. machinery, $900. Bremen—4 pkgs. material, $1,102; 1 pkg. machinery, $75. British East Indies—1 pkg. machinery, $25. British Guiana—37 pkgs. material, $1,069. Cuba—34 pkgs. material, $1,291. Central America—25 pkgs. material, $1,931; 21 pkgs. machinery, $1,785. China—1 pkg. machinery, $1,280; 20 pkgs. material, $1,534. Copenhagen—2 pkgs. material, $191. Chili—75 pkgs. material, $2,894. Glasgow—4 pkgs. material, $371; 1 pkg. machinery, $75. Hamburg—70 pkgs. machinery, $7,665; 13 pkgs. material, $711. Hayti—2 pkgs. material, $29. Havre—28 pkgs. material, $475; 13 pkgs. machinery, $639. Hong Kong—8 pkgs. machinery, $4,650; 13 pkgs. material, $206. Inverness—10 pkgs. machinery, $908. Japan—89 pkgs. material, $6,960; 6 pkgs. machinery, $1,008. Liverpool—151 pkgs. machinery, $11,568; 18 pkgs. material, $439. London—211 pkgs. machinery, $15,073; 162 pkgs. material, $14,009; 15 pkgs. motors and parts, $180. Manchester—7 pkgs. material, $780. Mexico—52 pkgs. material, $1,940; 81 pkgs. machinery, $1,670. Marseilles—1 pkg. machinery, $516. Newcastle—10 pkgs. machinery, $675. Nova Scotia—26 pkgs. material, $380. Newfoundland—4 pkgs. material, $26. Philippine Islands—227 pkgs. material, $5,597. Peru—63 pkgs. material, $2,107. Rotterdam—3 pkgs. machinery, $738; 8 pkgs. material, $110. Southampton—1 pkg. material, $21; 94 pkgs. machinery, $4,872. Siam—54 pkgs. material, $2,200. San Domingo—17 pkgs. material, $268. Uruguay—1 pkg. material, $45. U. S. Colombia—17 pkgs. material, $838; 34 pkgs. machinery, $1,359. Venezuela—57 pkgs. material, $255.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports a very satisfactory increase in orders received during the month of May over those for the preceding month. The company is making extensive preparations to accommodate the increasing business, which during the past year has pushed the present shops to their utmost. A new building is under construction, which will enlarge the present floor space by 60,000 square feet, and will be occupied by the winding department, a part of the office force and additional machine shop space. Some of the orders booked during May were: Whitman Mills, New Bedford, Mass, one 200-kw generator; Hanover National Bank, New York, three generators, 100-kw each; American Colortype Company, Chicago, Ill., consignment of 9 motors; Albert Saxe, New York City, two 50-kw and one 75 kw generators; Descubridors Mining and Smelting Company, one 150-kw generator; James McKane, Coney Island, N. Y., one 60-kw generator; Grasser & Brand Brewing Company, Toledo, O., one 75-kw generator and 6 motors; W. H. Wagner & Sons, Freeport, Ill., one 30-kw generator and several motors; J. L. Mitchell, Philadelphia, Pa., one 200-kw generator; Marshall Field & Co., Chicago, Ill., 6 motors, aggregating 150-hp; Naomi Coal Company, Fayette City, Pa., one 110-kw generator; Ingersoll Sargent Drill Company, one 80-kw generator; D'Olier Engineering Company, Philadelphia, Pa., one 100-kw generator; Craig Shipbuilding Company, Toledo, O., two 150-kw generators; Maher & Flockhart, Newark, N. J., one 100-kw generator and one 45-hp motor; Vandergrift Construction Company, Mattewan, N. J., one 200-kw generator; Niles-Bement-Pond Company, Philadelphia, Pa., 50 crane motors, of outputs ranging from 1½ to 50 hp.

ELECTRIC POWER AT GREAT FALLS.—The Boston and Montana Consolidated Copper and Silver Mining Company is making considerable additions to the electrical equipment of its smelters and refineries at Great Falls, Mont., having recently purchased eleven 15-hp and three 40-hp Westinghouse, 500-volt, shunt-wound, direct-current motors. About four years ago this company installed a number of Westinghouse 180-volt, electrolytic generators, and at the same time put in a large number of Westinghouse and other motors for driving ventilating fans and other machinery about the smelters. Although the smelters are filled with sulphur dust and are extremely dirty, the Westinghouse motors have given excellent satisfaction, and the commutators have proved sufficiently insulated between bars to prevent bad grounds.

DENVER POWER AND IRRIGATION COMPANY'S POWER PLANT.—The General Electric Company has secured the contract to furnish the electrical machinery for the extensive power plant to be constructed in Platt Canyon, on the south fork of the Platt River, for the Denver Power and Irrigation Company, of Denver, Colo. These contracts are said to aggregate $350,000. The total cost of the entire system complete and ready for operation will be about $3,000,000, including 28 miles of transmission lines, which will cost about $700,000 alone. The power-house will be double brick and stone structure, 60 x 200 feet in dimensions. The south fork of the Platt River will be dammed at this point.

SUPPLY DEALERS' TRUST.—The Chicago newspapers to hand have a great deal to say about the attack on the Electrical Supply Dealers' Association, made by the independents in that city. It appears that President Burns, of the American Telephone Company, is at the head of the movement, and proposes to make things warm, alleging serious discrimination against concerns outside the "trust." The allegations made are such, it is said, as to bring the organization under the operation of the Sherman Anti-Trust Law, and it is reported that the agitators are taking the necessary steps in the proper legal quarters to set the national machinery in motion.

THE BOSWORTH-HOLDING COMPANY has opened an office and ware-rooms at 26 Merwin Street, Cleveland, O., where it will handle a line of new and second-hand steam and electrical apparatus and machine tools. Mr. W. H. Bosworth, who is well known in the machinery trade, and Mr. H. H. Holding, equally well known in electrical circles, will conduct the business. During the past week the company reports a sale of five carloads of machinery, to parties in Mexico City, Mexico, the purchaser being an iron operator.

ROSSITER, MacGOVERN & COMPANY, New York, have recently bought the greater part of the machinery, including engines and generators, of the One Hundred and Forty-sixth Street (New York) station of the Metropolitan Street Railway Company. Rossiter, MacGovern & Company have also sold to the Boston & Northern Railroad Company and are installing in their station two 850-kw General Electric generators, direct connected to Pennsylvania Iron Works engines.

MICA INSULATION.—A report from Newark, N. J., of May 29, says: The stockholders of the Electric Insulation Company, a New Jersey corporation backed by New York people, voted to-day to dissolve. The statement was made by L. A. Ziegler, the legal agent of the company, that it had bought a secret process which had turned out a "gold brick." Elijah Woodward, of New York, is president. Further details as to this alleged state of affairs are not forthcoming.

CINCINNATI PLANT.—In the recent article in these pages on the equipment of the Cincinnati Gas and Electric Company, it was stated that the arc lamps of the General Incandescent Arc Light Company are being run off General Electric tub transformers. Such was the information furnished, but we are now advised that the transformers are those of the Wagner Electric Mfg. Co., of St. Louis.

JOHNSON & MORTON, the electrical manufacturers of Utica, N. Y., have opened a New York office at 232-234 Greenwich Street, where they will be represented by Messrs. Frorup & Levy, and where a complete stock will be carried of all their copper panel boards and switches.

CATALOGUES REQUESTED.—Mr. Bert H. Shephard has recently assumed charge of the fixture department from Mr. C. H. Thompson, contractor and dealer in electrical supplies, at Syracuse, N. Y., and makes a request for catalogues, price lists, etc.

THE GARRETT-CROMWELL ENGINEERING COMPANY, Cleveland, O., is preparing plans for a large open hearth steel plant for the Alabama Steel and Wire Company. A large electric power-house will be included in the equipment.

C. J. TOERRING COMPANY, the well-known Philadelphia manufacturers of enclosed arc-lamps, have had to secure more room, and have taken new quarters in the Warden Power Building, Nineteenth Street and Allegheny Avenue.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., makers of electric traveling cranes and hoists, advise us that the condition of business remains entirely satisfactory. The orders recently booked are partly represented as follows: The Falk Company, Milwaukee, one 30-ton, with 5-ton auxiliary hoist; Best Manufacturing Company, Pittsburg, one 2-ton; American Foundry and Construction Company, Hazelwood, Pa., two 10-ton; Fairbanks, Morse & Co., Beloit, Wis., one 15-ton; Warren City Boiler Works, Warren, O., one 10-ton; McClintic-Marshall Construction Company, Pottstown, Pa., one 25-ton; Colorado Fuel and Iron Company, Bessemer, Colo., one 20-ton; Kutztown Foundry and Machine Company, Kutztown, Pa., two 10-ton; Jas. B. Clow & Sons, Chicago, one 3-ton; Modern Steel Structural Company, Waukesha, Wis., one 15-ton; Nordberg Manufacturing Company, Milwaukee, one 2-ton jib; Pennsylvania Railroad Company, Altoona, Pa., two 12½-ton; the Chapman Valve Manufacturing Company, Indian Orchard, Mass., one 20-ton, with 2-ton auxiliary hoist; the Milwaukee Electric Railway and Light Company, Milwaukee, one 30-ton; Warren Steam Pump Company, Warren, Mass., one 15-ton; Allis-Chalmers Company., Edw. P. Allis Works, West Allis, Wis., two 5-ton wall, and one 2½-ton wall; the Lodge & Shipley Machine Tool Company, Cincinnati, O., one 12-ton; American Bridge Company, Pencoyd plant, Pa., one 25-ton; Baldwin Locomotive Works, Philadelphia, six 10-ton; Gardner Governor Company, Quincy, Ill., one 5-ton; American Sheet Steel Company, Scottdale Works, Scottdale, Pa., two 5-ton specials; the Stilwell-Bierce & Smith-Vaile Company, Dayton,O., two 20-ton, two 10-ton, four 5-ton; the Bucyrus Company, South Milwaukee, one 3-ton; Midvale Steel Company, Philadelphia, one 10-ton.

SOME LIDGERWOOD HOIST CONTRACTS.—The Lidgerwood Manufacturing Company, 96 Liberty Street, New York, have recently been awarded several orders for electric hoisting equipments for shipment to various parts of the world. The United Engineering Company, of Johannesburg, has requisitioned for three double-drum hoists, each of which are to be operated by 25-hp motors built by the General Electric Company. These equipments are intended to be utilized in South African mines. The General Electric Company has ordered three hoists for the English market, which will be driven by General Electric motors of 25-hp. The same concern has also placed orders with the Lidgerwood Company for 10 hoisting equipments for the domestic market. These machines will be worked with General Electric motors, varying from 10 to 100 hp. Contracts for the American market lately taken by the Lidgerwood people include one for 10 double-drum machines, to be operated by General Electric motors of 25-hp each. This contract was placed by Norcross Brothers. The hoists will be used in the building operations of the new library, at Forty-second Street and Fifth Avenue, New York. The Columbus Construction Company, of Weston, Mass., have called for a double drum equipment, to be driven by a 25-hp General Electric motor. The New York Dock Company has ordered three single and one double equipment, each for direct connection to 25-hp General Electric motors. The Lackawanna Iron and Steel Company, of Buffalo, N. Y., is to be supplied with three double drum hoists, to be operated by 50 hp General Electric motors, and the Union Pacific shops at Omaha, Neb., will be equipped with a single drum electric hoist, to be driven by a 50-hp General Electric motor.

VARIOUS HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry and Machine Works, of Harrisburg, Pa., have been awarded a contract for furnishing a 300-hp tandem compound standard engine, which is to be direct connected to a 200-kw generator built by the Crocker-Wheeler Company for installation for power purposes at the latter concern's works at Ampere, N. J. One 225-hp, one 150-hp and one 120-hp standard simple engines are to be installed in the new apartment house now under construction by the Thompson-Starrett Company in Sixty-seventh Street, New York. The engines will be direct connected to 150-kw, 100-kw and 75-kw General Electric generators, respectively. These equipments will be utilized for both light and power purposes. The Mergenthaler Linotype Company has ordered a 300-hp tandem compound standard engine for direct connection to a 200-kw Sprague generator for power uses at its Brooklyn plant. For light purposes three 75-hp standard simple engines, direct connected to 50-kw generators, manufactured by the General Electric Company, are to be installed in the new Pennsylvania Building, Philadelphia. A 120-hp, also a 75-hp, standard simple engine have been ordered for light and power use in the new Childs Building on Thirty-seventh Street, New York. The engines will be direct connected to 75-kw and 50-kw General Electric generators. The Webster Coal and Coke Company, of Ehrenfeld, Pa., has ordered a 300-hp simple standard engine for direct connection to a 200-kw generator, built by the General Electric Company. This equipment will serve for power purposes in the Pennsylvania plant.

SHAW CRANES FOR P. R. R. SHOPS.—Manning, Maxwell & Moore, of 85-89 Liberty Street, New York, have just closed a substantial contract for the supply of four electric traveling cranes to the Pennsylvania Railroad Company. Two cranes of 75-ton capacity each are to be installed in the new shops of the company, at Columbus, O. They will be operated by 5 motors each, having an aggregate capacity of 325 hp. Two 6.5-ton cranes have also been ordered for installation in the railroad shops about to be constructed at Renovo, Pa. They will each be driven by motors having a total capacity of 300-hp. The span in both shops is to be 74 feet 5 inches, and each crane is provided with two 7½-ton auxiliary hoists. The value of the contract exceeds $60,000.

HUGE SHIPMENTS OF EQUIPMENT FOR BRITISH WESTINGHOUSE COMPANY.—Over two and a quarter millions of dollars' worth of electrical equipment and various machinery have been shipped so far this year to England on behalf of the British Westinghouse Electric and Manufacturing Company, Limited, the major portion of which will serve as equipment for the company's new plant now all but completed at Trafford Park. The machinery bought in the open market here for the British plant, consisting principally of a $500,000 lot of the most up-to-date machine tools, has already been forwarded to the other side. Besides the company's purchases from different machinery concerns throughout the United States, it is calculated that the Westinghouse shops at Pittsburg have shipped fully a half a million dollars' worth of engines and various electrical equipments for the Manchester plant. The total expenditure in the way of American equipment for the British works will, it is now reported, exceed $1,500,000. Each of the next four Lambert & Holt steamers leaving this port for Manchester will carry over $50,000 worth of different machinery for the British Westinghouse works. To help fulfil contracts awarded to the British company, a round $1,000,000 worth of various electrical equipment has been shipped within the past five months from this side—chiefly from the Westinghouse plants at East Pittsburg.

WESTINGHOUSE TURBINE AND MOTOR ORDERS.—Westinghouse, Church, Kerr & Company have obtained a contract from the Wilmington, N. C., Gas and Light Company, calling for a 400-kw Westinghouse steam turbine unit with an alternating-current generator. J. K. Robinson, of Iquique, Chili, who represents the Westinghouse interests on the west coast of South America, and who is now in the United States and can be found at the offices of the William E. Peck Company, 100 William Street, New York, has ordered several Westinghouse multipolar direct-current motors of various sizes, for use in the Chilian nitrate fields.

BOOK TYPEWRITERS FOR ABROAD.—The Elliott & Hatch Book Typewriter Company, 256 Broadway, New York City, has, within the last few days, received contracts for book typewriting machines, to be forwarded to Germany, for use in the govermnent railway offices; to the Philippines, for the military authorities, and to Mexico, for utilization in the various departmentss of the government of the Southern Republic. The company also reports receipt of substantial orders from Canadian sources and from the Illinois Central, the Michigan Central and the Pennsylvania railroad companies.

MORE MEXICAN WATER-POWER PROJECTS.—The Jalapa Railway and Power Company, Jalapa, State of Vera Cruz, Mexico, which derives its power from the Falls of Teocelo, is about to increase its plant for the purpose of furnishing the City of Vera Cruz, some 40 miles distant, with current. Alexander Kinnell, of the latter city, has been granted a concession for utilizing the waters of the Antigua River, near Jalapa, up to 40,000 liters per second, for a distance of about 80 miles, for motive power.

COAL FOR PORTO RICO PLANT.—The San Juan Light and Transit Company, of San Juan, Porto Rico, whose system was constructed by J. G. White & Company, has recently been shipped some 1,500 tons of Pocohontas coal for its power plant, and has just given an order for a similar cargo, which will be forwarded within the next few days, from Norfolk, Va.

PLANT FOR WEST TAMPA, FLA.—An electric power plant will be installed by the city of West Tampa, Fla. The Ball Engine Company, Erie, Pa., furnishes the complete steam plant. The generator will be furnished by the Westinghouse Electric and Manufacturing Company.

CRANE PIPE SHIPMENT FOR SOUTH AFRICA.—The Crane Company, of Chicago, Ill., has made shipment of 10 carloads of pipe, etc., to the South African port of East London. The material is intended to be eventually forwarded to Johannesburg.

POWER APPARATUS WANTED.—The Maumee, O., Electric Company is in the market for new turbines, gearing, shafting, pulleys and floor stands. D. W. Tryon is president, N. E. Tryon, vice president and A. C. Tryon, secretary and treasurer.

CALL & COMBS, of Wilkesboro, N. C., are moving their insulator pin factory, and are making considerable improvement in their plant. As soon as settled, they will be in a better position than ever to fill orders promptly.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The Board of Trade of Birmingham has passed resolutions denouncing the present telephone service as unsatisfactory, and a committee has been appointed to investigate the matter and suggest remedies.

DENVER, COLO.—The Colorado Telephone Company will furnish the city with 75 telephones free. The consideration asked was that the city use the telephones of no other company during the life of the company's franchise.

OLIVER, GA.—The Oliver Telephone Company will soon complete its line to Halcyondale. It will then be extended to Hugginsville.

COLUMBUS, GA.—A petition for a telephone franchise has been presented to the city council. The proposed system will be connected with a number of other independent systems throughout Georgia.

DECATUR, GA.—The Southern Bell Telephone Company has for many months been trying to secure an extension of franchises from both towns without success. Several propositions have been made and rejected either by the cities or the company. Several other companies are negotiating for franchises.

PEORIA, ILL.—The Interstate Telephone & Telegraph Company has received permission to construct its underground conduit plant.

MOUNT VERNON, ILL.—The Talbot-Frost Telephone Company has been incorporated with a capital stock of $2,500. S. T. Maxey is president, C. B. Boots, secretary, and M. A. Barber, Treasurer.

SPARTA, ILLS.—The Gordon Telephone Company has completed its long-distance line to Sparta, and is now preparing to lay a cable from Chester to the Missouri shore, when connection will be made by the Bell system with a large number of permanent towns.

VALPARAISO, IND.—The Northwestern Indiana Telephone Company, of this city, has increased its capital stock to $15,000.

ELWOOD, IND.—The new telephone company of this city expects to have its exchange ready and all wires up in shape for business by July 1.

PORTLAND, IND.—A telephone war at this place has been avoided by the Home Telephone Company buying the exchange owned by the United Company, of Bluffton.

TERRE HAUTE, IND.—The Citizens' Telephone Company, which now has nearly one thousand city subscribers, has made connection at the Illinois line with the system of the independent company lines in central Illinois.

ELKHART, IND.—The Home Telephone Company expects to have communication with the independent company of South Bend within sixty days. The Home Company is to build to the county line to meet the South Bend company's extension.

SHELBYVILLE, IND.—The Central Union Telephone Company has completed extensive improvements in this city and has added 21 new connections. The company has also begun rural development, and will soon take in a score of neighboring towns.

INDIANAPOLIS, IND.—The Eureka Telephone Company, of Titus, capital stock, $10,000; the Pleva Home Telephone Company, of Pleva, capital stock, $5,000, and the Daviess County Home Telephone Company, of Washington, capital stock, $100,000, have been incorporated.

INDIANAPOLIS, IND.—The following telephone companies were incorporated recently; the West Newton Telephone Company, of West Newton, capital stock, $10,000; the Frost Telephone Company, of Hancock county, capital stock, $1,200; and the Shirley Telephone Company, of Shirley, capital stock, $3,000.

CRESTON, IA.—Wm. Bowen, of Des Moines, and the Farmers' Mutual Telephone Company have been granted telephone franchises in Red Oak.

SHENANDOAH, IA.—A special election will be held here on June 28 to vote on the question of granting a franchise to the Independent Mutual Telephone Company.

PORTLAND, ME.—The People's Telephone & Telegraph Company has been incorporated at Kittery with a capital of $500,000. Hammond Braman, of Boston, is president, and F. E. Baldwin, of Boston, treasurer.

BAY VIEW, MICH.—A mass meeting was held here recently and plans made for an independent telephone system.

MILFORD, MICH.—A Michigan telephone solicitor is canvassing the town for a new exchange, and has secured contracts for 45 telephones.

MUSKEGON, MICH.—The Citizens' Telephone Company here is making an addition to its switchboard, accommodating 300 new subscribers.

ALBION, MICH.—The business men's committee has announced that nearly 300 subscribers have been secured for the proposed independent telephone company, and that as soon as that number has been reached the company will be organized and the exchange built.

CENTRAL LAKE, MICH.—Telephone service for the farmers of this vicinty is a possibility in the near future. The manager of the local exchange of the Michigan Telephone Company is planning to enlarge the exchange and connect farmers within a greater or less radius of the village.

LUDINGTON, MICH.—The Michigan Telephone Company is at work among the farmers of Mason county, and a large number of them have been connected with the Ludington exchange within the last few weeks. As soon as the weather becomes settled the company will hang 2,300 feet of new cable in this town.

JACKSON, MICH.—The Jackson Telephone Company, which has recently been acquired by local parties, has placed a contract with the Kellogg Switchboard & Supply Company, of Chicago, for a multiple central energy switchboard of 3,600 ultimate capacity. It is expected the exchange, with 2,000 telephones, will be placed in operation in the fall.

SPARTA, MICH.—Manager Bolander, of the local Independent Telephone Company, has been in conference with the officers of the Citizens' Telephone Company, of Grand Rapids, in reference to the absorption of the local company by the larger one, and the arrangement, which is in the interest of better service here, will very likely be consummated within a few weeks.

BEAR LAKE, MICH.—The Benzie County Telephone Company has arranged for the construction of a number of copper circuits to nearby towns and villages, and plans to make this town a central telephone point for the county of Manistee. Farmers throughout this part of the county are now being connected with the exchange and thus with the merchants of Bear Lake, with whom they are doing business, as well as with the independent systems of the State. Forty business men and farmers of Benzie and Manistee counties comprise the company.

SAULT STE. MARIE, MICH.—A war is on between the Michigan Telephone Company and the common council here. The company refused to place a telephone in the new water works plant on the ground that it would cost $500 to make the extension. The franchise provision requiring the company to furnish the city with all telephones ordered was pointed out, but the company retorted that it was not operating under that franchise but under one secured by purchase of the Citizens' Company. The council thereupon repealed and annulled all telephone franchises and ordinances, and so the merry war goes on.

GRAND RAPIDS, MICH.—The number of subscribers to the Michigan Telephone Company's system in this city has steadily decreased since Jan. 1, when the rates were advanced. This is admitted, and is ascribed to the advance in rates. The service at the exchange is the very best, and the most improved form of lamp signal switchboard is in use. The company's new substations, of which there are two, are not yet occupied, although they have been completed for some months, and it is explained that this is because action on the part of the new company in control, the Western Telephone Company, is awaited. There is a strong sentiment in this city in favor of the independent telephone company, the stock of which is held locally, and this sentiment appears to be steadily growing. The local retail grocers' association and the organized meat dealers have taken up the matter of using but one telephone and discarding the other and while no formal action has been taken as yet, the independent company is the favorite. There appears to be a strong wave of independent telephone sentiment moving over the State at present.

MINNEAPOLIS, MINN.—The Bell Telephone will construct a line south from Winnipeg.

RENO, NEV.—The Sunset Telephone Company expects to spend $8,000 on improvements to the telephone system in Reno.

EAST AURORA, N. Y.—The Haines Telephone Company, of Buffalo, has been granted a franchise in this place.

GOLDSBORO, N. C.—A petition has been asked for a franchise for the Southern Bell Telephone Company, at Goldsboro.

GREENSBORO, N. C.—The Southern Bell Telephone & Telegraph Company has made application for a franchise for a local exchange in this place.

WILMINGTON, N. C.—The Southern Bell Telephone Company will extend its service to Carolina Beach this summer for the convenience of city patrons.

TARBORO, N. C.—The Carolina Telegraph & Telephone Company has bought the Dunn and Smithfield exchanges, with their toll lines, and a new copper line will be built from Salem to Raleigh, N. C.

DEMOCRAT, N. C.—The Ivy Telephone Company, of Democrat, has eighteen miles of line running from Mars Hill to Stocksville. Its aim is to get connections with Asheville as soon as possible and also with Cane River.

PITTSBORO, N. C.—The stockholders of the Chatham Telephone Company have elected Mr. B. M. Poe as president and business manager. The company will establish an exchange in Pittsboro, and extend its system to Bynum, five miles north.

WILMINGTON, N. C.—The desired franchise has been granted at Wilmington to the Telephone Company of America, with some modifications protecting the city from loss and with an amendment whereby not more than one cent can be charged for each coll.

LEBANON, OHIO.—The Central Union Telephone Company has been granted a franchise to maintain a system in the town.

BEREA, OHIO.—The Citizens' Telephone Company has increased its capital stock from $20,000 to $40,000, to provide for improvements.

TROY, OHIO.—The Troy Telephone Company is installing a new switchboard. Indications are that 1,000 telephones will be in service this summer.

GARRETTSVILLE, OHIO.—The Garrettsville Telephone Company has 127 subscribers, and is building farmers' lines, which will increase its capacity considerably.

ALLIANCE, OHIO.—The Alliance exchange of the Stark County Telephone Company was opened to the public a few evenings ago. Several hundred people attended the reception.

CANTON, OHIO.—The Central Union Telephone Company has changed its Cleveland rate from 40 cents for three minutes to 25 cents for one minute and 5 cents for each additional minute.

ADA, OHIO.—A. A. Geiger has been elected secretary and director of the Ada Telephone Company. Mr. Geiger was formerly in charge of construction work for the Norwalk & Huron County Telephone Company.

AKRON, OHIO.—The statement of the Akron People's Telephone Company for the first quarter of 1902 follows: Gross earnings, $16,195; expenses and taxes, $7,465; net earnings, $8,730; interest, $3,644; surplus, $5,086.

ELYRIA, OHIO.—The Elyria Telephone Company will increase its capital stock from $20,000 to $40,000. This was made necessary to take care of the additional service required. The company will increase its rates at once.

MANSFIELD, OHIO.—L. S. Hartman and J. P. Rummel, general manager and contract manager respectively of the local Bell Company, have accepted similar positions with the Mansfield Telephone Company, the new independent company.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Telephone Company has increased its capital stock to $30,000, and has sold part of the stock to leading local business men. The company has 400 subscribers connected up, and it is growing rapidly.

PORTSMOUTH, OHIO.—The statement of the Portsmouth Telephone Company for the first quarter of 1902 follows: Gross earnings, $4,569; expenses and taxes, $2,697; interest, $874; surplus, $999. The company has about 920 telephones in operation.

XENIA, OHIO.—H. C. Dean, of Jamestown, has been appointed manager of the lines of the Springfield-Xenia Telephone Company in Greene county. The company has about 1,000 subscribers in the county, and is contemplating building a number of farmers' lines.

COLUMBUS, OHIO.—The statement of the Columbus Citizens' Telephone Company for the first quarter of 1902 follows: Gross earnings, $44,296; expenses and taxes, $27,752; net earnings, $16,645; interest, $8,125; surplus, $8,519. The company has about 5,975 telephones in operation.

TOLEDO, OHIO.—The Central Union Telephone Company is preparing for the competition of the new independent company by reducing its rates. The residence rates have been dropped from $48 to $36 per year, and it is stated that there will be a corresponding drop in the business rates. This is for full metallic service.

WEST UNITY, OHIO.—The Stryker Telephone Company has acquired the franchise granted some time ago to the Williams County Toll Line Company and will operate under it. Contract has been placed with the Northwestern Construction Company, of Bryan, to build and equip the lines in this town and throughout the surrounding country.

CLEVELAND, OHIO.—The bankers' committee, in charge of Everett-Moore affairs, has arranged for the disposal of the exchanges at Jackson, Mich., and Galion, O. The Jackson exchange will be completed by a syndicate composed of Jackson parties, who will advance $70,000 for the purpose, placing the exchange on an earning basis. The exchange at Galion has been sold outright to Galion and Bellevue parties.

CLEVELAND, OHIO.—The report of the earnings of the Cuyahoga Telephone Company for the first quarter of the year shows net earnings of over $4,000, or over $50,000 per annum after taking care of all fixed charges. The gross earnings for January, February and March, 1902, were respectively: $30,252.51, $30,352.46 and $31,757.78. The total expenses and taxes were: $16,258.68, $16,799 and $18,218.66. The net earnings were: $13,993.83, $13,552.87 and $13,589.12. Total deductions for interest and bonds and ground rent: $9,512.51, $9,512.49 and $9,512.49. The surplus was, $4,481.32, $4,040.38 and $4,026.63.

COLUMBIA, S. C.—The Consolidated Telephone Company, of Columbia, has been chartered preparatory to commencing business in this city.

COLUMBIA, S. C.—According to the last report of the State Corporation Commission, there are 70 incorporated telephone companies in the State, operating 5,193 business telephones and 5,739 residence instruments.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company has completed its line toward Augusta by connecting with an independent line out from that city, thus establishing communication between Columbia and Augusta.

COLUMBUS, S. C.—Mr. S. L. Miller, of the Independent Telephone Company, states that there are now in South Carolina two independent telephones to one of the Bell Company. He states that by the end of the year there will be three to one.

McMINNVILLE, TENN.—The Citizens' Telephone Company has been recently organized here and is pushing construction work. The poles are all erected, and the stringing of wires is rapidly going forward.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will at once begin on the Thunder Mountain line, following the Boise-Thunder Mountain road, starting from Boise, Idaho.

PROVO, UTAH.—The Telluride Power Company, of Provo, has applied to the Salt Lake county commissioners for a franchise to operate a telephone system in the county. It is reported that this move is a part of the Jones-Fenton scheme to do a suburban business.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has issued an order that all telephone operators in the Missoula (Mont.) exchange must learn telegraphy. The company will arrange the long distance lines so that they can be used either for telephoning or telegraphing.

SALT LAKE CITY, UTAH.—Exchanges will be soon installed by the Rocky Mountain Bell Telephone Company at Billings, Bridger, Boulder, Fort Benton, Sheridan and Virginia City, Mont. In Utah work has started on exchanges at Beaver, Milford and Payson, and an extension of the toll line south from Beaver, Parawan, Cedar City, Washington and St. George will be soon connected with the general telephone system.

GLOUCESTER, VA.—The Board of Directors of the Tidewater Telephone Company decided to accept the offer of the Citizens' Company, of Newport News, to connect with the company's exchange at Gloucester.

SPRAGUE, WASH.—The Farmers' Telephone Company has been organized at Sprague, with a capital of $5,000. About 75 miles of line will be built.

SPOKANE, WASH.—The Spokane city council has turned down the application for a franchise for a second telephone company to do business in Spokane, on the ground that the people consider that one telephone company is enough for the town.

MILWAUKEE, WIS.—The Milwaukee Independent Telephone Company has incorporated with a capital stock of $50,000. E. Reynolds and others are interested.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Oregon General Electric Company has secured the control of a piece of property on the upper Clackamas river, near the site of the company's power house, which is in course of construction. Power will be generated for railway and lighting purposes.

SAN FRANCISCO, CALIF.—An electric power plant, which will transmit current to Ukiah, Calif., will be installed by O. E. Williams and associates. They expect to build a dam near the mouth of Cold Creek, whence the water will be piped 3 miles to the power station, which will be erected at the mill site.

SAN FRANCISCO, CALIF.—The Pioneer Mill Company, of Honolulu, H. T., has closed contracts with Grimwood, Richardson & Holloway for the installation of an electric power plant, which will use water from the streams in the mountains near Lahaina. The contract price is placed at $35,000. Additional plants will be installed later on.

SAN FRANCISCO, CALIF.—The General Electric Company has closed a contract with the American Steel & Wire Company for a number of induction motors, aggregating 400-hp in capacity, for its new plant in San Francisco. These are slow speed motors, several being direct connecteed to machines. Those that are not direct connected will be placed on the ceiling.

SAN FRANCISCO, CALIF.—Alum Rock Park, eight miles from San Jose, Calif., is now lighted by electricity, supplied from the power station of the electric railway. The Santa Clara & Alum Rock Railroad was recently changed over to electric power. Remarkable spectacular effects are produced by the lights in the natural park with its picturesque canyon.

SAN FRANCISCO, CALIF.—The Standard Electric Company is improving its great Bear river dam in Amador County, Calif. A great deal of hydraulic work will be done in the future on the company's storage reservoirs, although there is ample capacity for the present necessities. The new plant at Electa is now in operation, transmitting current to San Francisco and way points.

SAN FRANCISCO, CALIF.—The Colorado Pacific Gold Dredging Company is building a dredger costing $60,000, and remodelling an old one for electric power at Mississippi Bar. The Syndicate Dredging Company is also building a $60,000 Risdon dredger for use near Teat's Flat. Electric power for the operation of these dredges will be supplied from the transmission lines of the Sacramento Electric, Gas & Railway Company.

SAN FRANCISCO, CALIF.—The Mt. Whitney Power Company, which transmits current to Visalia, Calif., is doing hydraulic work for the auxiliary plant which is to be constructed on the middle fork of the Kaweah river one mile west of the present power station. Near Sequoia Park 2,000 inches of water will be diverted and conducted 4½ miles to a point where there will be a working head of 325 feet, giving a capacity of over 1,000 hp. The growing demand for motor pumping for irrigating citrus fruit land necessitates an increase of the company's generating capacity. The new plant will probably be completed this summer.

SAN FRANCISCO, CALIF.—The San Francisco Gas & Electric Company has closed a contract with the General Electric Company for two additional 1,250 kw direct connected 3-phase generators and five 250 kw motor-generator sets. Switchboards and other appurtenances are included. A Union Iron Works engine of about 1,600-hp will be direct connected to each generator. The motor-generators will be operated as synchronous motors at 4,150 volts, which is the voltage of the generators, therefore no transformers will be required. It is understood that contracts have been closed for about 1,800 hp of Heine boilers, through the Risdon Iron Works. The new apparatus will be installed at the Gas & Electric Company's arc and alternating station on Townsend street. The first unit will be installed before the close of this year.

SAN FRANCISCO, CALIF.—The Stanislaus Water & Power Company, a new San Francisco corporation, capitalized at $2,500,000, is planning to install an electric transmission system at an expense of $2,000,000. It is proposed to transmit 20,000 hp to San Francisco and intermediate points from the plant which will be located in Calaveras county, about 6 miles from Murphy's. An inverted syphon will carry 6,000 inches of water across a canyon which has almost vertical walls 1,500 feet in height. Two lines of steel pipe 30 inches in diameter will conduct the water down one side of the canyon and up the other. At the power plant there will be an available head of 1,500 feet, which, with 7,000 inches of water, will develop about 21,000 hp. The mining regions of Central Hill, Cataract Channel and the San Domingo property will have the use of electric power and water from the system. W. Frank Pierce, president of the Standard Electric Company, and H. G. Veder, the Pittsburg capitalist, are connected with the new concern, which has ample backing and business prospects.

BOULDER, COLO.—The Boulder Railway & Utility Company and the Boulder Light & Power Company are about to consolidate.

ALAMOSA, COLO.—The Alamosa Electric Light Company has awarded the contract for the erection of the entire works to the Gilbert-Wilkes Electrical Company, of Denver.

TALLAHASSEE, FLA.—The Tampa Municipal and West Coast Development Company has been chartered at Tallahassee with $1,000,000 capital to operate railways, electric light plants, telephone lines, etc.

ALBION, IDAHO.—The electric light plant here is to be closed temporarily on account of not paying expenses. This is a private company.

WEISER, IDAHO.—The city council has granted to H. V. Gates, of Hillsboro, Ore., a franchise to install an electric lighting plant. The city is to own the plant, giving Mr. Gates a lease for 15 years at $1.00 per year rental. The city will vote $25,000 in bonds for the plant.

UPLAND, IND.—Steps have been taken by the town board to put in an electric light system for this place.

SEYMOUR, IND.—The Seymour Electric Light Company has been organized. The capital stock is $75,000. John H. Brown is president.

EVANSVILLE, IND.—The property and franchise of the Evansville Electric Light Company passed into the hands of Farson, Leach & Co., brokers, of Chicago.

CRAWFORDSVILLE, IND.—The municipal electric light plant of this city is proving a failure. The cost of municipal lighting is so great as to cause the people to complain.

RICHMOND, IND.—It is now to be a war to the finish between the Richmond municipal electric light plant and the local Light, Heat & Power Company. The old company has cut its rate in two, making them slightly lower than the rates fixed by the council for the municipal plant.

VINCENNES, IND.—The city council has passed, over the mayor's veto, an ordinance granting a 30-year franchise to J. L. Bayard and others to erect and operate an electric light, power and heating plant in the city; and also the right to consolidate with any concern that may hereafter put in a plant.

ENFIELD, MASS.—The Mill River Electric Light Company has been organized at Williamsburg. It will build a power house and supply light to Williamsburg and Haydenville.

SOUTH HAVEN, MICH.—The South Haven Fuel, Light & Power Company will build a $40,000 electric plant. A. C. Runyon is president of the company, and Bascom Parker, Niles, Mich., is engineer.

ST. LOUIS, MO.—The Missouri & Meramec Water Company is asking permission to construct a canal between the Missouri and Meramec rivers for furnishing power for manufacturing purposes.

ST. LOUIS, MO.—The Union Electric Light & Power Company, with a capital stock of $20,000,000, will be the successor of the four merged electric light companies. The Imperial Lighting, Heat and Power Company, the City Lighting Company, the Seckner Construction Company and the Citizens' Electric Lighting & Power Company are the four companies concerned. It is stated that Mr. Julius S. Walsh will be president. The plan laid before the stockholders calls for an issue of $10,000,000 in bonds and $10,000,000 in stock. The bonds will bear 5 per cent. interest. The preferred stock will amount to about $2,000,000, and will also bear 5 per cent. interest. It is stated that at the outset only $4,000,000 of the issue will be used. The effect of the consolidation will put three powerful lighting corporations in the St. Louis field. The two rivals are the Missouri-Edison Company and the Laclede Gas Light Company. It has been predicted that eventually all these interests will unite. The Citizens' plant, at the foot of Ashley street, will, when finished, be one of the largest in the west. Immense buildings are under construction, though strikes and injunctions growing out of a difficulty with the city about taking water direct from the Mississippi river have delayed work greatly. The present plans call for an expenditure of $2,000,000 on the Citizens' plant, and this will be increased. The company made a contract with the World's Fair Company to supply electric light and power for the Fair, and this will require a vast outlay for machinery, orders for which must be placed months in advance. The Citizens' Company has its wires in the conduit district, between Beach street and Clark avenue and east of Jefferson avenue, and is now supplying all customers in the business district. The Imperial is already operating in this territory, but not beyond. Back of this big deal besides St. Louis capital are the interests represented in the North American Company.

BILLINGS, MONT.—The meetings of the Citizens' Electric Company, of Billings, elected officers for the ensuing year as follows: C. Yegen, president; L. H. Tenske, vice-president; J. E. Kurtz, secretary.

HELENA, MONT.—The street railway, electric light and gas plants of the Helena Power & Light Company were sold at auction on May 20. T. A. Marlow, representing a number of Eastern capitalists, was the only bidder, his offer being $200,000, which was accepted. The new owners will make extensive improvements to the plant, also extend the street railway.

CARSON CITY, NEV.—Articles of incorporation of the Nevada Construction Company have been filed at Carson City. Capital, $100,000. W. E. Sharon, C. A. Lux, J. N. Gardiner are the incorporators. The objects of the company include the installation of electric power and electric light plants for mining camps.

ALBUQUERQUE, NEW MEX.—The New Mexico Light & Power Company has been incorporated in New Mexico with a capital stock of $50,000, by C. D. Cochrane, of Boston, and E. L. Medley, of Albuquerque.

ALBANY, N. Y.—The Queens' Borough Gas & Electric Company, of Queens county, has been incorporated with a capital of $2,000,000. The directors are John L. Lockwood, Jr.; H. Julian R. Lockwood, Frederick P. Delafield, Lewis D. Delafield and Thomas Ferry, of New York, and John Joseph Reedy and Charles E. Wilson, of Jersey City.

ALBANY, N. Y.—The Union Gas & Electric Company, with a capital stock of $2,000,000, has been incorporated to operate in New York city, counties of New York, Queens and Nassau, town of Hempstead and the villages of Freeport, Rockville Centre, Lawrence and East Rockaway. The directors are John L. Lockwood, Jr., H. Julian R. Lockwood, Frederick P. Delafield and Lewis L. Delafield, of New York City; John Joseph Boody and Charles E. Wilson, of Jersey City, and H. Thomas Ferry, of Tomkinsville.

MADISONVILLE, OHIO.—The village lighting plant was damaged by fire recently. New machinery which was being installed was damaged slightly.

EAST LIVERPOOL, OHIO.—Harry Boals, of Salineville, has the contract for installing an electric light and power plant in the new sewer pipe works at Irondale, Ohio.

TOLEDO, OHIO.—A. B. Sturgis, of Toledo, is preparing plans for the St. Paul Building, to be erected in this city. An electric lighting plant and material will be required.

KENTON, OHIO.—The Kenton Gas & Electric Company is installing a new 250-hp engine, and will shortly add to its boiler capacity. A 2,400-light generator was recently installed.

COALTON, OHIO.—The Coalton Light & Power Company, capital stock $7,000, has been incorporated by W. D. Hazard, J. H. Ray, Wm. Ruckbaugh, G. M. Scott and H. W. Ray.

COLUMBUS, OHIO.—The Central Heating & Lighting Company is endeavoring to secure a general franchise permitting it to extend its heating and lighting service throughout the city.

COLUMBUS, OHIO.—Stribling & Lum are preparing plans for an electric lighting plant, to be installed at the State Institution for the Blind at Columbus. New boilers will also be installed.

EAST LIVERPOOL, OHIO.—The Ceramic City Light Company is endeavoring to induce customers to sign a yearly contract for current at 15 cents per kw-hour. The minimum rate is 60 cents per month.

COLUMBUS, OHIO.—John D. Karns, representing the Citizens' Heating & Lighting Company, has applied for a franchise to furnish electric light and steam heat in the residence portion of the city. The company will incorporate with $300,000 if it gets the franchise.

CAREY, OHIO.—Municipal ownership is proving satisfactory in this place. Last year the total income from the lighting and waterworks plant was $11,458 and the expenditures $9,805. The outstanding liabilities are $29,000. Formerly the town paid $1,000 per year for illumination.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company is using three Baker electric vehicles in renewing carbons in the business section of the city. The vehicles average between 40 and 50 miles per day, and are giving excellent service. They were designed especially for the work, having large battery capacity.

CLEVELAND, OHIO.—George S. Ryder & Company, Cleveland engineers, have completed the installation of a power plant for the American Crayon Company, Sandusky, Ohio. It consists of a 200-kw Westinghouse 2-phase alternating current generator, a 400-hp Allis-Chalmers engine and Erie City tubular boilers. The firm is preparing plans for several power plants in the vicinity of Cleveland.

NEW LEXINGTON, OHIO.—The New Lexington Electric Light & Power plant has secured a ten-year contract and franchise from the city council for street lighting, at $78.82 per lamp per year, all-night service. Mr. T. J. Smith, proprietor of this plant, will make some improvements, and is in the market for supplies, poles, etc.

FREMONT, OHIO.—The Home Light & Power Company has presented an ordinance to the city council. It agrees to furnish 16-cp lamps at 50 cents per month; when six or more are used, 40 cents per month. The company will build a plant and compete with the Fremont Electric Light & Power Company if the grant is secured.

CLEVELAND, OHIO.—The American Stove Company, which has recently acquired the three leading vapor stove plants in Cleveland, will enlarge the power plant installed two years at the Dangler Stove & Manufacturing Company's plant, with a view to furnishing power for the other two large plants located not far distant. An additional boiler, engine and generator will be installed.

COLUMBUS, OHIO.—The Pennsylvania Railroad Company is making important improvements at its Columbus shops, and contracts have been closed for the following equipment, to be placed in the new power house: Three 300-kw Westinghouse direct-current generators and three 500-hp Ball & Wood vertical non-condensing compound engines. All machinery in the new shops will be electrically driven.

BEAVER, UTAH.—A franchise has been granted to E. A. Hodges to build an electric light plant here.

SALT LAKE CITY, UTAH. The Telluride Power Company has been granted a right of way through Ogden canyon and Ogden valley, to construct an electric line east from Ogden to Logan.

SALT LAKE CITY, UTAH.—Current from the Hercules generating plant, at Logan, Utah, was turned on recently to the Telluride Company's line. This system, of 150 miles in length, now makes a complete circuit, taking power from what may be termed its two extremeties. The merging of the two companies makes it one of the first plants in the west.

RICHMOND, VA.—A very sensational turn of affairs has taken place at Richmond, in regard to city lighting. At a recent meeting of the Light Committee it was announced a new company was being formed to light the city, which company was represented by William Jenkins. It is understood that the company is backed by several millionaires, and that a million-dollar plant is being erected. The three bids presented by the Passenger & Power Company, of Richmond, were not even opened. It is said that the new company will apply for a charter. The Virginia Electric Railway & Development Company is doubling its capacity, at a cost of about $200,000.

BALLARD, WASH., adjoining Seattle, has advertised for bids for a municipal electric light plant.

WALLA WALLA, WASH.—The Mill Creek Light & Power Company has been granted a franchise in this city.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company, Guanajuato, Mexico, will begin the construction of its $1,000,000 power plant by July 1. It will start with an initial capacity of 3,000 hp, which will be increased to 7,000 as soon as needed. The distance of transmission is 110 miles. Mr. Henry Hine is president and general manager of the company.

ST. CATHERINES, ONT.—The factory formerly occupied by the Co-operative Cycle & Motor Company was sold for $10,000 to Manager William C. Bullock, of the Industrial Financial Company, which is financing the Consolidated Electric Railway, of Toronto. The new company is capitalized at $100,000, and will employ about 40 hands, to manufacture electrical appliances.

MONTREAL, QUE.—The Shawinigan Water & Power Company will use aluminum conductors for its transmission lines from Shawinigan Falls to Montreal. The distance of transmission will be about 84 miles, and the Royal Aluminum Company will supply 250,000 lbs. of wire for the first lines. Altogether 1,000,000 lbs. of aluminum will be required. The Royal Aluminum Company will establish a new plant at Shawinigan Falls for the manufacture of wire.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Washington & Oregon Electric Railway, Light & Power Company has been granted a franchise for an electric railway and electric lighting in Walla Walla, Wash.

DOVER, DEL.—The Mexican Railway Construction Company, of Philadelphia, has been incorporated to operate electric railways in Mexico. Incorporators: F. Rogers Donahue, L. C. Haag, Philadelphia; Gardner W. Kimball, Wilmington, Del. Capital, $10,000,000.

KOKOMO, IND.—The Kokomo Street Railway & Traction Company has been reorganized. The new officers are: President, G. J. Marott; vice-president, L. J. Kirkpatrick; secretary and general manager, T. C. McReynolds.

RICHMOND, IND.—The Richmond & Northwestern Traction Company has been organized, with a capital stock of $50,000. The officers are: G. M. Hodges, Dayton, Ohio, president; Thos. Milliken, New Castle, vice-president, and Wm. Jessup, Richmond, secretary.

WABASH, IND.—Stockholders of the Wabash & Logansport Traction Company have elected the following officers: Dennis A. Blakeslee, New Haven, Conn., president; Fred C. Boyd, New Haven, vice-president; John S. Bradley, secretary, and Samuel C. Moorehouse, treasurer. The company will build a line from Wabash to Peru. The Logansport extension will probably be in operation about Sept. 1.

GREENSBORO, N. C.—There is a talk of a street railway to connect Greensboro, Winston and High Point.

BURLINGTON, N. C.—The Graham, Burlington and River Falls Street Railway Company has been chartered, with an authorized capital stock of $100,000. The principal office is to be at Graham, and the incorporators are: J. W. Menefee, J. A. Long and J. C. Simmons, all of Graham.

RALEIGH, N. C.—A charter has been granted to the Consolidated Railway, Light & Power Company, of Wilmington, the capital stock being $500,000—$350,000 in preferred stock. The new company is a consolidation of the Wilmington Gas Light Company, the Wilmington Seacoast Railroad Company and the Wilmington Street Railway Company.

TRENTON, N. J.—The Point Pleasant Traction Company has been incorporated with a capital of $200,000. The incorporators are: Q. N. Evans, Juan Almiral, William C. Adams, of Brooklyn, and Francis C. Chamberlain, of Point Pleasant.

MT. VERNON, OHIO.—The Mt. Vernon Electric Railway Company has secured a franchise to build an extension of its local line.

MARION, OHIO.—C. C. Stolts, a wealthy citizen of this place, is securing right of way for a line to extend from Marion to Urbana.

STEUBENVILLE, OHIO.—The Steubenville Traction & Light Company is installing a 500-hp engine and a 300-kw generator in its power station.

CINCINNATI, OHIO.—The Cincinnati Traction Company has accepted franchises granted by the councils of Norwood, Oakley and Hyde Park.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Traction Company has awarded a contract for the erection of new car barns at Findlay.

DAYTON, OHIO.—H. Randall and other local people are securing rights of way and franchises for a line to extend from Evansville, Ind., to Boonsville.

CINCINNATI, OHIO.—Capitalists of Cincinnati and Ripley are taking preliminary steps to build a road from Ripley to Columbus, a distance of nearly 100 miles.

FREMONT, OHIO.—High winds of the past week blew trees across the tracks of the Lake Shore Electric Railway, breaking the high-tension and trolley wires and tying up the line for an entire day.

DeGRAFF, OHIO.—The Dayton & Kenton Traction Company has agreed to locate its power house and car barns in DeGraff. The town has given 25 acres of land and agreed to take $22,500 of the capital stock.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company has placed a contract with the Electric Storage Battery Company, of Philadelphia, for a storage battery equipment of 400 ampere-hours capacity.

HAMILTON, OHIO.—The Cincinnati, Hamilton & Indianapolis Traction Company has been incorporated with $10,000 capital stock by J. C. Hooven, C. C. Hooven, C. E. Hooven, W. C. Shepard and S. Shaffer.

TOLEDO, OHIO.—It is reported that the Toledo, Bowling Green & Southern Traction Company has secured an option on the Toledo & Maumee Valley Railway with a view to securing an independent entrance to Toledo.

MANSFIELD, OHIO.—Citizens along the route are endeavoring to induce the Citizens' Electric Railway, Light & Power Company to extend its Mansfield-Shelby line to Plymouth, New Haven, Chicago Junction, Steuben, Fairfield and Norwalk.

BELLEFONTAINE, OHIO.—The Bellefontaine & Sidney Traction Company has been incorporated with $10,000 capital stock. Incorporators: Warren P. Freeman, William S. Defees, Robert P. Kennedy, Walter L. Plim, Frank [illegible] L. [illegible] Peter.

HAMILTON, OHIO.—The Hamilton, Eaton & Richmond Traction Company proposes to extend its road from Richmond east to New Castle and Middletown, connecting at the latter point with the Merchants' Traction Company's line for Anderson.

CANTON, OHIO.—Messrs. Welty, Kolp and Hoover, who owned franchises for an electric railway from Canton to New Philadelphia, have sold the grant to Tucker, Anthony & Company, owners of the Akron-Canton and Canton-[illegible] [illegible] [illegible] [



Edwin Epstein, Treasurer. H. T. Richards, Secretary. B. M. Whitlock, President. [illegible] W. [illegible], Vice-President. [illegible]

OFFICERS OF THE SAFETY INSULATED WIRE AND CABLE CO.

buildings are of brick, two stories high, each having a length of 500 feet, with an aggregate floor space of 150,000 square feet. The power plant, dry rooms, etc., are in separate buildings. Several of the departments of the new factory are already in operation, and the company is completing at the Bayonne works, a large contract for submarine cable for a foreign government. This factory, being just completed, has the advantage of the latest machinery known to the art. As the property covers some thirteen acres, ample room is provided for additional buildings when required. Aside from the extensive manufacture of power, house, telegraph and telephone wires and cables, this factory has been particularly planned to meet the increasing demand for submarine cable. Its location at tide-water, with ample docking facilities, new cabling machine, recently imported from England, and a large working capital renders the company capable of producing all the above types of insulated conductors as well as submarine cable of any required length for domestic and foreign markets. The new company will be represented as formerly in Boston by F. B. Parsons; Chicago, M. B. Austin & Co.; St. Louis, Col. E. J. Spencer; Detroit, Henry L. Walker Company.

Trade Notes.

THE WOTTON ELECTRIC & MANUFACTURLING COMPANY, Atlanta, Ga., has doubled its capacity, and is now prepared to furnish alternating and direct-current loud-ringing bells.

THE VARLEY DUPLEX MAGNET COMPANY has opened a New York office at 26 Cortlandt Street. Mr. J. M. Knox, the firm's former western agent and engineer, has taken up its work in this branch office.

THE NEW HAVEN NOVELTY MACHINE COMPANY has issued a catalogue and price-list of brass fittings for telephone. telegraph and high-tension conductors. These include slidable sleeves, Y-branches and pot and terminal heads.

WATTMETERS.—C. Olivetti, Ivrea, Italy, has issued a handsome catalogue describing the various types of wattmeters of his manufacture. These wattmeters are of the registering type, and the pamphlet contains a specimen record of full size.

TELEPHONE APPARATUS.—The telephone department of the Electric Appliance Company, Chicago, has been increasing its facilities to such an extent that the company is now in shape to keep up with its orders for switchboards, telephones, and parts.

CROCKER-WHEELER CO., Ampere, N. J., has issued a very pretty little pamphlet relative to small motors and entitled "Our Bread Winners." The illustrations show a large range of its popular smaller machines and considerable data is given as to their capacity and work.

THE BRYAN-MARSH COMPANY has secured a long lease on a ground floor office at 136 Liberty Street, New York, with an entrance from 141 Cedar Street as well. It is carrying a large supply of incandescent lamps in the basement wareroom of its new quarters.

THE AMERICAN SCHOOL OF CORRESPONDENCE has made an important arrangement with the Armour Institute, of Chicago, with regard to co-operation in studies, so that the faculty of the Institute becomes a board of instruction, revision and examination for the School.

THE BURT MFG. CO., of Akron, O., recently made a large shipment of its Cross oil filters and Burt exhaust heads to Buenos Ayres, Argentine Republic. It reports an unusually active foreign demand for its goods, other shipments having been lately sent to England, Austria, Belgium, Mexico and countries in the Far East.

THE SUNLIGHT LAVA MFG. CO., Chattanooga, Tenn., through its manager, Mr. Paul J. Kr[illegible] calling particular attention by announcement letter to the trade of its specialization in lava pieces for electrical purposes. Because of the constantly widening field for its material as electrical insulation, this concern is introducing considerable new equipment.

RECENT TRANSFORMER LITIGATION.—With this title the Stanley Electric Manufacturing Company, Pittsfield, Mass., has issued a folder in which a statement is made concerning the recent transformer litigation, and giving a history of the development of the S. K. C. type of transformer. The latest form of this apparatus is also illustrated and described in detail.

MR. THOMAS D. WATSON has opened an office in the Electrical Exchange Building, 136 Liberty Street, New York. He is representing and carrying a full line of knife switches, plug cut-outs, rosettes, Edison attachment plugs and other products manufactured by the Trumbull Electric Co., of Plainville, Conn., also desk, ceiling fans and incandescent lamps manufactured by the Colonial Electric Co., Ravenna, O.

THE AMERICAN INSULATING MACHINERY CO., 940 No. Third Street, Philadelphia, Pa., announces that it is closing its New England office, formerly located at New Haven, Conn., and requests that all inquiries be directed to Philadelphia. The company has been in existence but a very short period—over one year—but at the present time it has on hand actual orders sufficient to keep it steadily employed for six months to come, in addition to which, inquiries that have developed in regard to its machinery promise as much more business.

THE MACKAY ENGINEERING COMPANY, 149 Broadway, New York, is installing a 50-hp Walrath gas engine for Eimer & Amend, the New York manufacturing chemists. It has also received an order for a 73-hp three-cylinder Walrath engine direct connected to a generator, for Tokio, Japan. The same company is installing an Akron 400-kw lighting and power plant in the New York and Brooklyn establishments of the Trow Company, two 50-kw Akron units for the Ordnance Department of the New York Navy Yard, and two 50-kw Akron units for the Construction and Repair Department of the same yard.

PARAGON FAN & MOTOR CO., of 572 First Avenue, New York City, have just issued a bulletin devoted to their Paragon sewing machine transmitter for direct and alternating current to go with their small motors for use on apparatus of such size. With this transmitter, the machine head is driven positively at all times; and the variable speed is obtained by means of a variable leverage, so that any degree of work is obtainable by allowing the machine to operate at a sufficiently low speed. These ingenious and satisfactory appliances are made in two sizes for both classes of current, and can be readily attached to any well known sewing machine. The bulletin gives full details about them and about the motors.

SUPERHEAT AND SUPERHEATERS.—With this title the Cruse Controllable Superheat Company, 5 Blackfriars St., Salford, Manchester, England, has issued a model pamphlet descriptive of the superheating apparatus of its manufacture and on the principles of superheating. The first division of the pamphlet consists of a thorough treatise on the principles of superheating, following units, thermometer scales, specific heat, etc., which includes a large number of tables on the properties of saturated steam, factors of evaporation, etc. The description of apparatus is accompanied by a number of large folding sheets of engravings, showing in detail the "Controllable Superheater and Dry Steam Generator."

CONTRACT FOR CONDUIT.—The firm of C. J. Harrington, 15 Cortlandt Street, New York, has received a contract for 250,000 feet of conduit, to be shipped to Seattle for Stone & Webster, Boston, Mass. There are other large contracts in view. This firm has but recently taken up the management of the sales for the Scranton Fire Brick & Conduit Co., Scranton, Pa., and is doing an unusually large business in this line, and the indications are that they will become one of the largest dealers in conduit in the country. The inquiries have come in so fast that it has been almost impossible to give them the proper attention, but the firm is now ready to furnish conduit very promptly and at low prices. Parties using conduit would do well to consult this firm before closing contracts. The conduit has been tested by one of the most expert electrical engineers in New York and pronounced to be of the very best quality he ever saw.

HUNT APPARATUS AT MANILA.—The U. S. Government, having selected Sangley Point in Manila harbor for a coaling station, extensive wharves and fire proof buildings are being erected there, including two coal sheds each 194 feet wide and 500 feet long with an interval of 50 feet between them, and a wharf is 318 feet in length and 75 feet wide. The coal handling machinery has been designed to remove the coal from colliers by means of hoisting towers and distribute it in the storage sheds by automatic railways; also to coal the war vessels at the wharf from the shed. To do this to best advantage, required two steeple towers, equipped with steam hoisting engines and duplex steam shovels, twelve automatic railways and over a mile of track. All this coal handling machinery together with accessories such as railway equipment, cars, coal tubs, etc., is being built by the C. W. Hunt Company, New York. Recently thirty-six flat-top, four-wheel cars were completed and shipped to the Philippine Islands. Each car is of one-ton capacity to be used on the Hunt Industrial Railway. Standard gauge for this railway is 21½ inches, out to out of rail heads, and is admirably adapted for transporting material on wharves, warehouses, docks and shops.

Record of Electrical Patents

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

11,997. INSULATED CONDUCTOR; E. Thomson, Swampscott, and J. G. Callan, Lynn, Mass. App. filed March 11, 1902. An insulating compound consisting of an adherent non-explosive cellulose ester attached to a support.

700,619. ELEVATOR SIGNAL DEVICE; S. D. Collett, New York, N. Y. App. filed Feb. 10, 1902. Apparatus to enable the elevator "starter" to communicate with the attendant in any car after it has left the starting floor. (Issued May 20.)

700,763. TROLLEY CATCHER; A. W. Ham, Lansingburg, N. Y. App. filed Oct. 23, 1901. A winding drum controlled by pawl and ratchet.

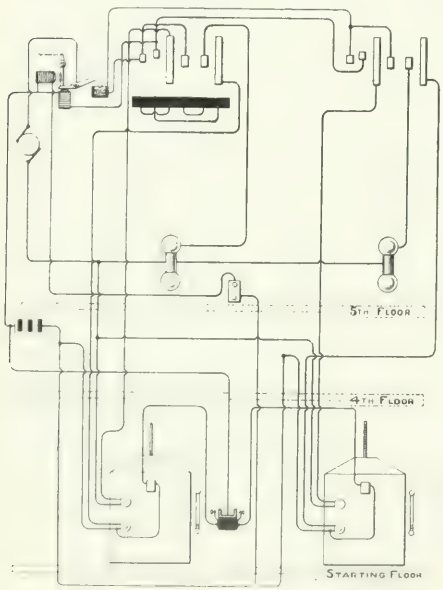
700,783. GALVANO ELECTRIC THERAPEUTIC CHAIN; A. Kruger, Stettin, Germany. App. filed March 19, 1902. The links of a chain are made in two parts forming the couples of a cell, there being moisture absorbing material between them.

700,800. MULTIPLEX TELEGRAPH CIRCUIT; L. A. McCarthy, Brooklyn, N. Y. Nov. 18, 1901. The object is to combine the receiving instrument and controlling device at one end of a quadruplex circuit, such as shown in patent No. 693,530, with shunting magnets so arranged that the incoming current will not be able to interfere with the resistance of the artificial line, and thereby throw the receiving instrument out of balance.

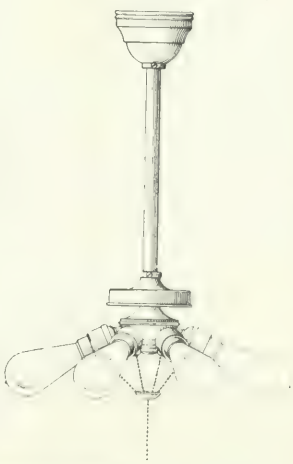
700,808. ELECTRIC FURNACE; W. R. Parks, Chicago, Ill. App. filed July 22, 1901. (See page 1014.)

700,812. ELECTRIC ALARM; G. M. Peyton, Salt Lake City, Utah. App. filed June 1, 1901. A permanent magnet in the sash normally holds a circuit open, but when moved allows a spring to close the alarm circuit.

700,839. MAGNETIC CLUTCH; F. L. Sessions, Oakpark, Ill. App. filed Sept. 9, 1899. A free rotating part between two other rotating parts are provided with pole pieces and two stationary coils are arranged so that when one coil is energized, the freely rotating part will move in one direction, and when the other coil is energized it will move in the other direction.



Elevator Signal Device.



Switch Cluster Operating Device.

700,847. REGULATOR FOR ALTERNATING CURRENT CIRCUITS; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 16, 1897. (See Current News and Notes.)

700,[illegible]. ELECTRIC SIGNAL; R. L. Storm, Waterloo, Iowa. App. filed [illegible]. A railway signaling device to the motorman how many cars have entered a block ahead of him.

700,869. ELECTRODE; K. A. Wilde, Glinde, Hamburg, Germany. App. filed Sept. 22, 1900. A flat electrode for secondary batteries comprising a carrier provided with substantially helical grooves for the active material.

700,898. ELECTRODE FOR ELECTRIC ACCUMULATORS; E. J. Clark, [illegible]. The plate is made up of a series of horizontal gutters into which the active material is deposited.

700,912. SIGNALLING AND TELEPHONING APPARATUS; E. L. Grauel, Carthage, N. Y. App. filed Jan. 24, 1902. (See Current News and Notes.)

[illegible]. METALLIC YARN AND TEXTILE FABRIC; L. Harmel, Boulogne-sur-Seine, France. App. filed April [illegible]. A fabric adapted to produce voltaic action in which electro-positive and negative wires are interwoven with the textile material.

700,941. PROCESS OF TREATING COPPER OR OTHER ORES FOR OBTAINING THEIR CONTENTS OF METALS; N. S. Keith, Arlington, N. J. App. filed Dec. 7, 1901. (See page 1014.)

700,980. ELECTRIC SAWING MACHINE; C. Partington, Newport, Ky. App. filed Nov. 2, 1901. The saw and feeding mechanism are driven by independent motors, so that the saw can be driven at a very high rate of speed and quickly controlled.

700,989. AUTOMATIC FUSE SWITCH FOR TELEGRAPH OR OTHER CIRCUITS; C. A. Stimpson, Philadelphia, Pa. App. filed Aug. 28, 1901. The destruction of one fuse allows an arm to automatically complete a second circuit containing a second fuse, and thus avoid delay in the service.

701,012. RHEOSTAT; R. W. Brown and C. A. Rhine, Milwaukee, Wis. App. filed Dec. 16, 1901. Details of construction.

701,016. ELECTRIC ARC LAMP; J. L. Davies, Highburg, Eng. App. filed Jan. 15, 1901. Consists of the means for attaching the coils to the frame work, improvements in the frame work and improved means for counter-balancing the cores of the regulating coil.

701,032. LIGHTNING ARRESTER FOR OVERHEAD WIRES; G. Gola, Genoa, Italy. App. filed Dec. 10, 1901. (See Current News and Notes.)

701,063. INSULATOR PIN; F. M. Locke, Victor, N. Y. App. field Nov. 15, 1901. The upper end of the pin is provided with barbs; the insulator knob being of wood.

701,085. TROLLEY WHEEL; J. Preston, Joliet, Ill. App. filed Jan. 29, 1902. The wheel is hung on cone bearings between two pivoted arms of a harp.

701,114. COUPLING AND NIPPLE FOR OUTLET OR JUNCTION BOXES; M. F. Whiton, Hingham, Mass. App. filed Feb. 3, 1902. The outlet box is formed with other than round holes, so that the end of the conduit can interlock with the box by twisting it in the hole.

701,122. COMBINED LIGHTNING ARRESTER AND BINDING POSTS; E. E. Yaxley, Chicago, Ill. App. filed March 13, 1901. A post having an opening for a carbon pencil and also an opening for the wire and for the screw which holds it in place.

701,137. INTERIOR CONDUIT OUTLET BOX; W. F. Bossert, Utica, N. Y. App. filed March 25, 1902. The outlet box is adjustable so that the lamp bracket can be adjusted to any angle with the wall.

701,152. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed April 26, 1901. (See page 1015.)

701,185. ELECTROTHERAPEUTIC APPARATUS; G. W. Euker, Richmond, Va. App. filed Feb. 26, 1902. Relate more especially to the converting and controlling of alternating currents of high pressure such as are usually furnished for commercial use, and rendering the same available for therapeutic purposes.

701,208. CABLE CONNECTION; C. Luke, Milford, Conn. App. filed Jan. 16, 1902. The lead cover is interrupted by a water-tight gland which surrounds a joint in the conductor.

701,209. COVERING MEANS FOR JOINTS IN ELECTRIC CABLES; C. Luke, Milford, Conn. App. filed March 10, 1902. Similar to the preceding, except that the gland is filled with an insulating material.

701,210. CABLE CONNECTION FOR COVERING SPLICED JOINTS; C. Luke, Milford, Conn. App. filed March 10, 1902. Details of construction of a joint similar to the past preceding.

701,215. METHOD OF OBTAINING ZINC BY ELECTROLYSIS; L. Mond, London, Eng. App. filed Aug. 12, 1901. (See page 1014.)

701,216. APPARATUS FOR OBTAINING ZINC BY ELECTROLYSIS; L. Mond, London, Eng. App. filed March 4, 1902. (See page 1014.)

701,218. ELECTRIC FURNACE; F. Morani, Rome, Italy. App. filed July 24, 1900. (See page 1014.)

701,246. INSULATOR PIN AND BRACKET; E. T. Baily, Mount Kisco, N. Y. App. filed March 25, 1902. The pin is formed in two parts fashioned to be forced into contact with the holding support by the application of the insulator.

701,247. TROLLEY; W. I. Baker, Painesville, O. App. filed Jan. 20, 1902. The shaft of the wheel is set in elongated holes in the harp, which permit it to tilt.

701,253. BATTERY; G. S. Bennett, San Francisco, Cal. App. filed Aug. 6, 1901. A cell made up of alternate disks of copper, zinc and absorbent material, strung upon a central rod and all inclosed in a sealed case from which the terminals project near the center.

701,269. SWITCH CLUSTER OPERATING DEVICE; H. Hubbell, Bridgeport, Conn. App. filed Sept. 4, 1901. One chain or cord collects with all of the sockets of a cluster by other chains branching therefrom, so that a pull on the first chain will move the switches of all the lamps at once.

701,[illegible]. AUTOMATIC SIGNAL FOR ELECTRIC RAILWAYS; R. L. Storm, Waterloo, Iowa. App. filed July 25, 1901. Details.

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SMOKE IN MANHATTAN.

Owing to the strike in the anthracite coal field, Greater New York has taken on the atmospheric aspect of Western and European cities, where soft coal is consumed. The complaints are numerous and loud, for one of the charms of New York has always been the absence of the smoke and dirt due to the use of bituminous coal. Particular complaint is laid against the small locomotives of the Elevated Roads, which distribute their fumes impartially from one end of the city to the other. There seems little relief from the situation until the anthracite strike is over, but the lesson has already been taught that electric traction should long ago have been adopted for the elevated system. The contrast between the Second Avenue line, with electricity, and the others with steam, is most striking. The point is also brought out that electricity is a great agency for centralizing power production and for putting the consumption of fuel at places where it can cause least annoyance to a community. Light and power plants to-day go to the outskirts of communities, and the use of fuel in the other localities thus steadily becomes minimized.

THE INSTITUTE MEETING.

Full details were printed in our pages last week with regard to the meeting of the American Institute of Electrical Engineers at Great Barrington next week. It will have been seen that the business programme is strong in features of great interest and importance, while the social features are of great variety. Electricity and electrical engineers have always had a firm hold upon the affections of the residents of the beautiful Berkshire Hills, to which the science and art owe some of their best American representatives, and we do not believe that any body of men could be welcomed with greater enthusiasm than the members of the Institute. In fact, the overflowing programme of hospitality looks almost as though our good Berkshire friends had let their cordiality of welcome run away with them. The guests, to say nothing of the hosts, will certainly be tired when the week is over, if any conscientious attempt is made to participate in every function of business and sociability that the programme provides. We understand that the attendance will be good, and we trust that the members and their friends will turn out in force. It will be in every respect a profitable week, as our details this week show.

INDEPENDENT TELEPHONY.

Now that announcement has been made of the independent telephone convention to be held at Philadelphia in the last week of this month, it will be seen to what extent interest continues in that annual affair, for we can hardly believe that the recent local or interstate meeting at Chicago has had any serious effect in deterring from attendance those who would go. At any rate, we hope such is not the case. If independent telephony is to be a real force in the country—and a large opportunity exists for it in many ways—its practical exponents must get together. We know of no progressive art in which the practitioners do not from time to time get together, and in such an industry as the telephonic it is peculiarly desirable. The independents are scattered, are often without accumulated experience, are not well acquainted with each other, and greatly need the interchange of ideas and sympathies. The recent electric light convention at Cincinnati showed how even after nearly 20 years, there remains work for the National Electric Light Association to do; and curiously enough in the early days that body was regarded by the Edison Companies very much as the Bell Companies now regard the independents—intruders and outsiders not to be associated

with. But we think we can imagine a time in the near future when, having justified itself by good work, the Independent Telephone Association can become a powerful influence for the technical advance of telephony, and when Bell telephone men will readily and gladly belong to it, not because it is "independent," but because it is the national organization of operating telephone companies. This may not happen, but if it did it would not be without precedent. What is necessary, however, above all things, is that not the telephone manufacturers alone, nor the supply men, should get together in convention, but that the managers of the local companies should all turn out and benefit by conference.

Magnetization of Steel at the Temperature of Liquid Air.

A paper by Mr. C. C. Trowbridge recently published by the American Physical Society, on certain brands of carbon steel and tungsten steel, magnetized at the temperature of liquid air (—185° C.) contains results of some practical interest. It seems that the intensity of magnetization induced in these magnets was practically the same as at normal temperatures; also that the warming of the magnets from —185° C to +20° C after initial magnetization in liquid air, caused them to lose an appreciable fraction, 11 to 38 per cent., of their magnetic intensity. It seems, therefore, that no advantage is to be gained by magnetizing hard steel bars at very low temperatures.

Decorative Lighting.

Two of the Electric Light Convention papers are of particular interest as dealing with the temporary and permanent use of incandescent lamps for illuminated signs and for miscellaneous decoration. It is a branch of electrical industry of comparatively recent growth but of very striking developments. To one who can carry a mental picture of the New York of ten years ago, the change in the city's aspect by night is little short of startling. Go across either river in the evening and the eye falls on almost a wall of incandescent signs, proclaiming the transcendent virtues of everything from a transportation line to a new brand of whisky. And within even the last year or two the change has been prodigious. It is hard to place one's finger on any one actuating cause, for there have been several at work. The introduction of good and durable lamps of moderate candle power has been one important factor in the growth of decorative lighting, and another perhaps has been the broad policy inaugurated by the great central stations, which has made it worth while to go into electric lighting on a larger scale than would before have been economically possible. At all events the work has been done and the result is striking, not to say lurid. Several well-defined systems for the convenient connection of incandescent lamps into even very complex decorative forms have been worked out, and they have not only made permanent installations comparatively cheap and easy, but have rendered possible temporary work on a scale that would have been a sheer impossibility even a few years ago. As a case in point, the decorations carried out at the Metropolitan Opera House for the performance in honor of Prince Henry of Prussia would have been virtually impossible save for the improved methods called into service. The public is coming fully to realize that incandescent advertising is tremendously effective, and unless we miss our guess, it will be a branch of that noble art which will have a great future. But providentially, electric lighting does not lend itself readily to elaborate pictorial representations, which robs the possibilities of patent medicine advertising of some of their horrors. Purely decorative work is as much influenced by the improvements in methods as is advertising, so that with the garish and grotesque we may get the artistic and beautiful. The growth in both classes of work will have, and is having, no inconsiderable bearing on the output of central stations and upon their future prospects.

The Possibilites for a Light-Weight Storage Battery.

The article on this subject in our last number by Prof. A. L. Marsh, is suggestive as to the direction in which automobile storage batteries may be improved. There is not only room for improvement, but also weight for improvement, to be considered in these batteries. For central station purposes, the lead battery is satisfactory, although far from perfect. Its depreciation under standard conditions of service is heavy by comparison with the better class of solid machinery, but it is at least definite and capable of being reliably computed. In spite of its depreciation, the lead storage battery is of great importance to central station direct-current distribution, and it could not be dispensed with. In vehicles, however, the lead is a heavy drawback. Theoretically, as Prof. Marsh shows, lead-peroxide can yield over 100 ampere-hours per pound. But not only are the conditions of discharge such that only about one-third of the theoretical electric quantity can be realized, but in order to employ lead-peroxide, a relatively large amount of solid lead has also to be carried, in order to support the peroxide. If lead were not such a heavy metal, and, moreover, if it were not structurally so weak a metal, the supporting grid would not be a severe handicap to the automobile battery. As it is, however, instead of obtaining 80 watt-hours per pound of battery, which would be the approximate theoretical limit for a lead battery, we can only obtain about 12 to 14 watts per pound for a vehicle-battery, with relatively heavy depreciation, and 6 to 7 watt-hours per pound for a stationary battery, where weight is of lesser consequence as compared with duration of life.

Whatever may be hoped for the future, the lead storage battery, heavy as it is, is the only one which has stood the test of time, and which is used commercially in automobiles. But the weight and depreciation of the battery are such as to restrict the range and capability of electric automobiles within comparatively narrow limits. According to the article, the oxidation of iron as the negative material, together with the reduction of peroxide of nickel to the oxide, as positive material, gives the best available ampere-hour capacity per pound of matter. These are the substances in the Edison cell, although it is a moot point as to whether, in that cell, the nickel-peroxide is reduced to the sesqui-oxide, or to the oxide. But if the Edison storage battery comes into successful practical use, it will probably owe its superiority to the mechanical strength of its steel grids and to the small quantity of solution it requires, as much as to its ampere-hour capacity. The competition is not so much that of a 1.1-volt cell of large ampere-hour capacity against a 2-volt cell of lesser ampere-hour capacity, as the competition of two types of cell as regards reliability and absence of depreciation. But even if we obtain 20 watt-hours per pound of battery, this only means the inherent theoretical potentiality of lifting its own weight ten miles against sea-level gravitation as against a lifting potential energy of three thousand miles in petroleum; although the petroleum motor secures but a small percentage of this enormous potential energy. In convenience, simplicity and cleanliness, however, the electric automobile will always excel the petroleum automobile.

Grounding Secondary Circuits.

Elsewhere we print the replies from central station men to a N. E. L. A. query asking if it is desirable to ground transformer secondaries as permitted by a specified rule of the National Underwriters' code. Though none the less interesting, this discussion is somewhat belated, for the subject was most thoroughly threshed out during a period of several years previous to the adoption of the rule mentioned; moreover, the rule secured adoption only after strong and long-continued pressure had been exerted on reluctant underwriters by electrical interests. The discussion at Cincinnati manifested a considerable difference of opinion. The minority

seemed to be opposed to grounding secondary distribution circuits, either for the reason that grounded overhead wires on poles may invite more danger from high-tension crosses; or, for the reason that a ground for a secondary system cannot be made sufficiently good to protect from a high-tension cross, while inviting trouble in the transformers from lightning. The majority of answers are in favor of grounding secondaries, but some are in doubt as to the best method to employ. The arguments on both sides of this question are well known, and have undergone no appreciable change in the light of the most recent practice. It needs no argument to carry the conviction that if primary and secondary distribution circuits could always be kept entirely separate, it would be better to keep the secondary consumption circuits insulated. But, as a matter of fact, transformers are subject to accidental break-downs like all other apparatus, and the liability to fire hazard and to personal danger are lessened if, when the secondary and primary systems are crossed, the secondary circuit is grounded. Moreover, in some secondary systems there are dangers due to electrostatic inductive effect from the primary high-tension system through the transformers, even when the insulation between the circuits is normal. It s generally admitted that if a secondary consumption circuit is effectively grounded, the secondary system will be free from all danger to the consumers should a cross between primary and secondary circuits accidentally occur. The tendency of the cross would naturally be to blow one or both of the primary fuses of the transformer, and thus to call attention to the defect.

The residual question is whether the grounding of the secondary circuits is likely to be a serious drawback to operation by bringing about more frequent break-downs in transformers, due to lightning. Experience has not indicated serious troubles arising from this source. The benefits to be derived from grounding secondaries appear far to outweigh the disadvantages of the practice. Considering the possibilities for fatal accidents that attach to an accidental cross between primary and secondary circuits in or near the transformer, whereby a consumer, turning on an incandescent lamp while standing on a well grounded metal flooring may bring the primary pressure upon his body, it is wonderful how few accidents of this kind do actually occur, and at the same time the fact is a tribute to the manufacturers of the transformers in general use. Some day, perhaps, a prominent citizen may be accidentally hurt in this manner, and the result is likely to be a demand for the general grounding of secondary systems. The principal difficulty in connection with the practice of grounding secondaries, is in establishing a reliable ground. In some localities a hard rock subsoil may practically render local grounding impossible. In most places, however, a good ground can be obtained inexpensively, either by driving an iron pipe or a pointed iron rod vertically into the ground to the level of permanent moisture; or, by burying a copper plate in a mass of coke below the base of the nearest pole carrying the overhead wires.

WIRELESS TELEGRAPHY.

Lieut. Beecher's paper on the naval experiments on wireless telegraphy, read at the recent special meeting of the Institute, is most satisfactory evidence of the progress that is being made on this side of the water. It is the more important from the absence of the "gags for the gallery" that are all too common in the literature of the subject. We are inclined to believe that the work of the Navy and the Signal Corps in this direction is as thorough and fruitful of results as that done by commercial experimenters at large, and we value it the more highly because the officers in charge make no claim of signals reflected from the moon, or direct messages from Manila, or of a universal multiplexing system. Marconi and others have certainly accomplished results of startling significance, but we have nevertheless a grim suspicion that if the whole body of reports published could be put through a sieve which would separate fact from fancy, and things done from things hoped for, we could find use for a larger wastebasket than now adorns our sanctum. In short, we are disposed to believe that there is here, as always, a certain element of bluff in the claims of some rival inventors, which will gradually be eliminated as the details of the art becomes more familiar. Hence a comparatively unbiased study of the subject, with no stockholders to be filled with enthusiasm, has a definite value as mental ballast. Lieut. Beecher's direct confirmation of the generally believed facts regarding the large relative difficulty of sending overland is especially important as bearing on the possibile military uses of the art. It is pretty well understood that the wireless equipments sent to South Africa were comparatively unproductive of useful results, and it may turn out that such an experience was to have been anticipated. The amounts of energy hitherto used in wireless sending have been comparatively small, and it may be that for use on land and for long-distance work at sea, energy must be much more liberally supplied. We understand that the Japanese government has recently ordered, in this country, some coils of extraordinary power, and is preparing to attack the problem on a large scale. In distributing non-directed energy from a point, there should be provision for a large supply if the signals are to be effective over long distances, and here, perhaps, has been a common source of unsatisfactory achievement. At present there is so much secrecy in the whole subject that it is hard to arrive at a more definite conclusion than that the art has a great future.

We have no desire to discourage the real workers in the field, whose feats we are watching with the utmost interest, but on the other hand we are not disposed to toss bouquets at every promoter who can fill a sensation-seeking reporter with alleged great discoveries. We are tired of seeing dispatches from Biertheman Tank relating how Dr. von Katzenjammer and Lieut. Baron von Wurstenkrieg have devised a system quite distinct from those of Marconi and Slaby, which will (please note the tense) permit the reception of 17 messages from different points simultaneously on the same instrument; or have introduced a pocket apparatus with a range of 200 kilometers, which has already been ordered for general distribution to the 41,144th Battalion of Manchurian Sappers. In wireless telegraphy one is dealing with a most interesting and important branch of physical science, which is as yet very imperfectly reduced to general principles, and which needs careful, thorough, scientific work of a very high order. It is at present passing through a stage of development strongly reminiscent of the early stages of telephony, when there was much fumbling in the dark for results, and the most extravagant claims were made for alleged improvements which have long since dropped out of sight. There was a day of "systems," too, in the early years of electric lighting, from which the art emerged only after long and patient work on the part of many experimenters. We are particularly glad that the subject is being so seriously taken up by the military and naval services under the guidance of accomplished experimenters, and we trust that the Government will be most liberal in providing for the support of the work. For military science is every day more dependent on general science. A battleship of these days comes nearer to being a floating machine shop than a ship, and an army is in every stage of its equipment drawing upon all of the resources of applied science. The scientific branches of the service ought to have, therefore, all the aid and encouragement that Congress can afford them. It is of vastly greater national importance that army and navy should be at the highest point of efficiency than that Sculpin Creek should be dredged to admit deep sea commerce, even though the former work gives no job to superfluous heelers.

Meeting of the New York Electrical Society.



The 225th meeting of the New York Electrical Society was held June 4th. Dr. William Hallock lectured on "The Magnetic Deflection of Steel Plumb Lines in Deep Mines." The subject has already been noted in ELECTRICAL WORLD AND ENGINEER. In the course of his lecture, Dr. Hallock said that in the search for copper in the ever-increasing quantities needed for the electrical industries, the Tamarack Mining Company has sunk the deepest shaft in the world in order to tap the vein which slopes downard from the surface. This hole is ell over a mile in depth. In order to connect a point on this shaft with the older workings of the mine, it became necessary to "plumb down" two points so as to be able to start in the right direction to meet the other tunnels. This operation was undertaken at the 29th level, with lines 4,250 feet long, with steel piano wire, No. 24, carrying a fifty-pound iron weight. The two plumb-lines were about 17 feet apart, and it was found on accurate measurement that in one case they were 0.11 feet and in another 0.07 feet farther apart at the bottom than at the top. It was supposed that possibly they might be closer together on account of the convergence of the earth's radii, or the attraction of gravitation between the two weights. Various suggestions were offered for the divergence, air currents, attraction of the walls, etc. Owing to the fact that the weights were in an enclosed space they would not be under any force of attraction due to the surrounding walls, and if the walls did attract it would be quantitatively too small, only about one-hundredth of that observed.

The well-known observations upon the very strong magnetization of the steel casing used in gas and oil wells suggested that the wires were magnetized by the vertical component of the earth's field, and having two north poles at the bottom would repel each other. A series of experiments made in the 100-ft. shaft of the Physical Laboratory, at Columbia University, with plumb lines 75 feet long, showed conclusively that they are repelled from each other and that the bottom is drawn toward the north. The measured displacement was about 0.3 mm., or 0.012 in., which was very easily measured with a microscope. It was found that owing to the lack of homogeneity of the wires irregularities of magnetization were developed, which tended to increase the repulsion.

Prof. F. W. McNair and Chief Engineer Watson, of the mine, have since made a considerable series of experiments with bronze wires and lead weights, which gave results very similar to those originally obtained. This goes to show that a study of the air circulation was necessary, and they concluded that the disturbances were due to air currents. Of course it may be that the deflections were mainly due to air currents, but the observations at Columbia would show that magnetic deflections are to be expected, and, indeed, may have been present with the other in some cases. In Dr. Hallock's opinion the moral of the whole experience should be: use bronze wires and lead weights and do not use such long lines, unless air circulation can be completely stopped.

After the conclusion of Dr. Hallock's lecture the society adjourned to the office of the American Telegraphone Company. The members were received by Mr. E. W. Creecy, the vice-president of the company, who gave an address on the commercial side of the telegraphone. The subject was covered technically by Mr. Wm. J. Hammer. The capabilities of the instrument were practically demonstrated.

The following nomination for officers for the ensuing year has been made by the Nominating Committee: For president, Dr. Samuel Sheldon; for vice-presidents, Henry A. Lardner, George Herbert Condict, H. V. A. Parsell (for re-election), W. I. Donshea, Hobart D. Betts and W. S. Barstow; for secretary, George H. Guy (for re-election); for treasurer, Henry A. Sinclair (for re-election). The annual meeting and dinner is fixed for June 12.

The new badge of the society is now ready for distribution. The comment has often been made that the badges of the leading societies were all very much alike, and that while the members themselves might be familiar with them, the public frequently failed to recognize any material difference between them. The new badge of the society may be welcomed as being one of the most distinctive and original that has been adopted by a technical body in many [illegible] holically the underlying ideas that are broadly connected with the electrical art and industry. The design of the badge is a modified circular medallion five-eighth inch in diameter, representing a compass, the modifications consisting of four semi-circular extensions on the rim equi-distant, and containing the letters N Y E S, of blue enamel, these standing for the four cardinal points. The rim is a gold band 3-32 in. wide on face, and ornamented with engraved scrolls; the center a field of blue enamel containing a vertical compass needle of gold.

The Institute Meeting in the Berkshires.

We devoted a page last week to the Institute programme for the meeting at Great Barrington, on June 18, 19, 20 and 21, and now briefly recapitulate the distribution of the same:

WEDNESDAY, JUNE 18TH.

Nine o'clock. Papers and Discussion upon Alternating Current work as follows: 3.—"Method of Compounding Alternating Current Generators and Motors, Direct-Current Generators, Synchronous Motor Generators and Synchronous Converters," by Mr. F. G. Baum, of Stanford University, Calif. 6.—"Formula for Calculating the E. M. F. at Any Given Point on an Alternating Current Transmission Line," by Mr. Maurice Le Blanc, of Paris, France. 8.—"The Predetermination of Alternating Characteristics," by Prof. L. A. Herdt, of Montreal. 4.—"The New Generating Plants of the Niagara Falls Power Company," by Mr. Harold W. Buck, of Niagara Falls, N. Y. 15.—"Notes on an Experiment with Single-Phase Alternators on Polyphase Circuits," by Mr. C. O. Mailloux, of New York. 5.—"Notes on the Theory of Synchronous Motors, with Special Reference to Surging," by Pres. Charles P. Steinmetz, of Schenectady, N. Y.

THURSDAY, JUNE 19TH.

Nine o'clock. Papers and Discussion upon Electric Railway work as follows: 12.—"A Study of the Heating of Railway Motors," by Mr. A. H. Armstrong, of Schenectary, N. Y. 10.—"Method of Ascertaining from Dynamometer Car Records the Power Required to Operate the Mott Haven Division of the N. Y. C. & H. R. R. R., and the Relative Cost of Operation by Steam and Electricity," by Mr. B. J. Arnold, of Chicago. 16.—"Comparative Acceleration Tests of Steam and Electric Traction," by Messrs. B. J. Arnold, of Chicago, and W. B. Potter, of Schenectady. 9.—"Notes on Railway Speed-Time Curves," by Mr. C. O. Mailloux, of New York.

FRIDAY, JUNE 20TH.

Nine o'clock. Papers and Discussions upon General Topics as follows: 1.—"The Function of Series and Shunt Resistances in Lightning Arresters," by Mr. Percy H. Thomas, of Pittsburg, Pa. 2.—"A New Photometer for Incandescent Light and Similar Sources," by Prof. C. P. Matthews, of Lafayette, Ind. 7.—"A New Type of Current Tracing Instrument," by Prof. R. B. Owens, of Montreal. 18.—"Energy Loss in Commercial Insulating Materials when Subjected to High Potential Stress," by Mr. C. E. Skinner, of Pittsburg. 19.—"The Electrostatic Wattmeter in Commercial Measurements," by Mr. Miles Walker, of Pittsburg.

SATURDAY, JUNE 21ST.

Closing session, 9 A. M. Papers and Discussion upon the Education of an Electrical Engineer: "Opening Address upon the General Subject," by President Steinmetz. 13.—"The Present Status of Electrical Engineering Education in the United States," by Dr. Samuel Sheldon, of the Polytechnic Institute of Brooklyn, N. Y. 14.—"The Electrical Engineering Courses at College," by Mr. E. B. Raymond, of Schenectady, N. Y. 17.—"The Equipment of an Electrical Engineering Laboratory," by Prof. R. B. Owens, of McGill University, Montreal. 11.—"Electrical Engineering Courses at College," by Prof. Wm. Esty, Lehigh University, Bethlehem, Pa. "An Engineer's Views on Electrical Education," by Mr. Harold W. Buck, of Niagara Falls, N. Y.

A special train leaves New York, from the Grand Central depot, at 2 P. M., on Tuesday, June 17, arriving at Great Barrington about 5:30 P. M.

The Pacific Cable Bill.

The Pacific Cable Bill has been killed for this session in the House of Representatives by a vote of 116 to 77.

The Braun and Siemens and Halske Wireless Telegraph System.

By A. Frederick Collins.

THE wireless telegraph suit instituted by Siemens and Halske against the Allgemeine Elektricitäts-Gesellschaft, of Berlin, has called forth considerable comment and aroused great interest, not only in Germany but in England as well, especially since reports have been received that the Braun contentions have been sustained. The systems are those invented by Prof. F. Braun, of Strassburg, who has joined the Siemens and Halske forces, and Dr. A. Slaby, of Charlottenburg, and Count Arco, who have disposed of their interests to the Allgemeine Elektricitats-Gesellschaft.

I have just received from Dr. Braun an authentic description of the apparatus he has invented and the text of his theory of syntonic wireless telegraphy. One of the most striking features of the Braun and Siemens and Halske system, as it is now known, is the absence of all earthed connections, and this original departure from the beaten paths of commercial wireless telegraphy places it at once in a class by itself.

Another clever arrangement takes advantage of the persistent oscillations of the closed circuit and the radiating qualities of the open-circuit oscillator. By a similar construction of the receiver, the transmitter sends out waves of a certain definite length only, and waves of this length only may be received. This harmonization between the two sets of instruments is so carefully planned that the system requires no earthed connection, although that has been found so necessary in all others heretofore invented. Since the earth is charged to the opposite sign to the electrified upper strata of air, it is really the cause of atmospheric disturbances in wireless telegraph apparatus. The supposition that a system in which the earthed connections are eliminated would be free from such untoward influences has found abundant justification in experiment and practice in Dr. Braun's invention.

The difficulties met with in a practical syntonic wireless telegraph system are due chiefly to the enormous capacity loaded upon the oscillator by the grounded arm; this, and the fact that free, *i.e.*, undamped oscillations are required to effect resonance in a properly tuned receiver, have been the stumbling block of inventors who essayed this rôle. Lodge has shown that the closed circuit is a persistent oscillator[1] and a feeble emitter, and that in the open circuit oscillator the damping coefficient is large and its radiating properties are correspondingly great. Fleming has pointed out how these high-frequency, high-potential oscillations may be transformed,[2] just as the ordinary commercial alternating current is stepped-up or stepped-down. Braun has found it convenient to do away with the earthed terminals of the oscillating system, and discovered a method to utilize the persistent oscillations of the closed circuit and then transforming them in a second oscillator of the open-circuit type.

Before describing Dr. Braun's invention, it may be well to explain, in a limited way, the general points. The arrangement combining the open and closed oscillators to produce the maximum number of oscillations per charge and the greatest amount of energy radiated per oscillation is shown in Fig. 1, in which S is the spark-gap, C C condensers of the Leyden-jar type, and L an inductance coil. This constitutes the closed oscillating system. The inductance coil L forms the primary of the transformer, having for its secondary the coil M, by which the periodicity of the high-frequency, high-potential current is stepped-up or down according to the length of electric wave it is desired to operate with. One of the terminals of the secondary coil, M, is attached to the vertical wire, or antenna A, which should be equal to one-fourth the wave length emitted by the oscillations set up in M. The opposite terminal of the secondary coil, M, may be rolled up loosely, to avoid the effect of inductance; or, as Dr. Braun suggests, it may be attached to a metal plate having a large area. Now, let us suppose the closed oscillator S C C L is charged by the secondary of the induction coil J; when this reaches a certain critical potential a disruptive discharge breaks down the dielectric of the air at S, and in the restoration of the potential equilibrium oscillations occur, the frequency of which depend altogether upon the capacity, C C, the inductance of L and the resistance of the whole circuit.

If E is the potential difference between the coatings of the condenser, the intensity of the current caused by its discharge I is as follows:

$$I = \frac{E - L\frac{dI}{dt}}{R}$$

where R is the resistance of the enclosed circuit and L its inductance.

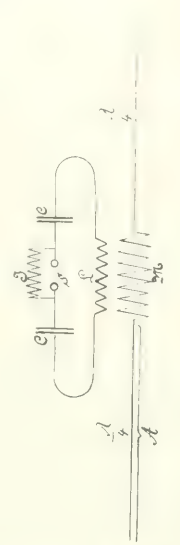


FIG. 1.—DIAGRAM OF BRAUN'S TRANSMITTER.

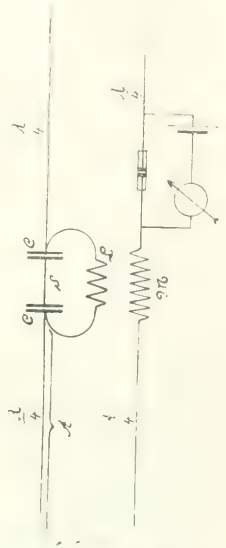


FIG. 2.—DIAGRAM OF BRAUN'S RECEIVER.

Furthermore

$$E = \frac{Q}{C}$$

$$I = \frac{dQ}{dt}$$

and we get by substitution of these values:

$$\frac{d^2Q}{dt^2} + \frac{R}{L}\frac{dQ}{dt} + \frac{Q}{CL} = 0$$

The general integral by this equation is:

$$Q = A_1 e^{a^1 t} + A_2 e^{a^2 t}$$

and a^1, a^2 the roots of the equation:

$$a^2 + \frac{R}{L}a + \frac{1}{CL} = 0$$

Thus:

$$a = -\frac{R}{2L} \pm \sqrt{\left(\frac{R}{2L}\right)^2 - \frac{1}{CL}}$$

If the roots are real, *i.e.*,

$$R > 2\sqrt{\frac{L}{C}}$$

a continuous unidirectional discharge takes place. But if the roots are imaginary, *i.e.*,

$$R < 2\sqrt{\frac{L}{C}}$$

So likewise:

$$Q = e^{-\frac{R}{2L}t}\left(A_1 \cos \sqrt{\frac{1}{CL} - \left(\frac{R}{2L}\right)^2}\, t + A_2 \sin \sqrt{\frac{1}{CL} - \left(\frac{R}{2L}\right)^2}\, t\right)$$

gradually decreasing in geometric progression.

$$T = \frac{2\pi}{\sqrt{\frac{1}{CL} - \left(\frac{R}{2L}\right)^2}}$$

[1] On Wood or Heatz [illegible]

[2] Electric Oscillations. Fleming, Society of Arts, 1901.

If $\frac{\lambda}{4\pi c}$ [illegible] $\frac{1}{\nu}$, which is the case in Dr. Braun's closed oscillating circuit, because the arc of closure of the oscillating circuit consists of very heavy copper wire, and, therefore, the oscillations becomes very rapid, the period of which may be expressed thus:

$$\lambda = 2\pi \sqrt{LC}$$

If L is measured in electromagnetic units (cm) and C in electrostatic units (cm), the wave will form this length as a natural sequence:

$$\lambda = 2\pi \sqrt{L.C}$$

The oscillations set up in this closed circuit are now impressed upon the coil M by the lines of magnetic force linking the coils, and in order that this secondary coil may receive the maximum of intensity it is provided with additional conductors of suitable capacity and inductance, by means of which a regular reflection of the waves is produced. If, therefore, care is taken in damping the primary oscillator resonance effects are brought forth in the line of wave propagation, increasing the intensity enormously. Experiment and calculation have shown that these additional conductors, or, more exactly, resonators, must be equal to $\frac{\lambda}{4}$ or some multiple of it.

One of these additional conductors or resonators are now used as the antenna or vertical wire, by which the waves are radiated in space; the other is formed into a loose coil to reduce its length, or it may be replaced by an isolated plate of great surface.

The receiver is constructed on similar lines. It forms, to a certain extent a counterpart of the transmitter. Fig. 2 is a diagrammatic representation of the receiver. The electric waves impinging on the antenna A follow the reverse process of the oscillations set up in the oscillating systems of the transmitter; that is, they act on the open circuit first and a reaction takes place in the closed circuit, which is pitched down to the length of wave sent out by the transmitter. Here another addition $= \frac{\lambda}{4}$, thus providing the proper resonance, so that strong oscillations may again be produced in L. The latter is now transmitted to M, and by means of the additional conductor $\frac{\lambda}{4}$ a regular reflection is produced in M with great intensity. The additions $\frac{\lambda}{4}$ [illegible] tage, and in far simpler form by plates of a large surface.

With this abridged description of Prof. Braun's theory the construction of his apparatus for fulfilling the theoretical requirements will now be treated briefly.

The transmitter may be divided into two groups of apparatus (a) the inductor with its auxiliary appliance, and the (b) the oscillating systems necessary to excite the antenna. The secondary of the induction coil is wound with comparatively thick wire, and is constructed in such a manner that the magnetic lag of the iron coil effects but a slight reaction on the secondary current. The result of this is that the potential difference at the terminals of the secondary current thus derived is extremely suitable for the heavy loads of capacity that may be required to effect a given periodicity of oscillation, since it is well arranged for a small time-constant of the charged circuit. The inductor or primary winding of the coil is quite long considering the secondary winding, but this gives the latter a minimum resistance. The cross-section of the secondary coil is fairly large, reducing the danger of heating to a minimum. The proper insulation of the coil has been given much consideration and is nearly double that of the ordinary forms, which insures the working of the coil without trouble even in moist places.

The circuit breaker Prof. Braun prefers is a modified form of the (Wehnelt) electrolytic interrupter, known as the Simon interrupter, the principle of which has been so thoroughly demonstrated as not to require further consideration here. Suffice it to say that the one furnished by Siemens and Halske has been simplified, and its construction is such that after the first interruption it is not necessary to alter the e. m. f.; the explosions, which formerly took place so often, are rendered impossible by the addition of a diaphragm in the cover, preventing the upper electrode forming the internal pole of the diaphragm from coming in contact with the acid vapors, and always remaining separated from the secondary pole through a perfectly dry porcelain layer. The mixing and ignition of the electrolyzed gases is eliminated by this arrangement.

If a low-voltage current is the only available source of energy, the electrolytic interrupter cannot be used; and in such cases a mercury radial interrupter is substituted. Though the break of the mercury interrupter is not as sudden as that of the electrolytic type, it is capable of satisfying every demand and requirement in wireless telegraphy. The platinum interrupter has been universally discarded by the makers of wireless telegraph apparatus, since it does not possess sufficient lasting qualities to meet the requirements for continued operation, and the Siemens and Halske company do not any longer recommend either the "Deprez" or the "Wagner-Haumer" device formerly supplied.

For the production of the Morse code, a key of special construction is inserted in the primary circuit. To be able to work with a large volume of current, as may be accomplished by the use of the induction coil of Prof. Braun, an improvement was made in the Morse key or "manipulator," according to the literal translation, hereto



Fig. 3.—Interior of Prof. Braun's Wireless Telegraph Station, Heligoland.

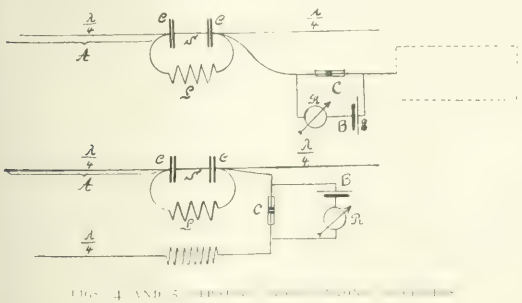
fore employed, which enables the operator to make and break currents of even 50 amperes into dots and dashes, and without danger to the interrupter. For the consummation of this purpose the circuit is made at a point distinct from where it is broken, a device having been invented, so that the place where the break is made always closes first and then the principal contact. This contact, however, opens first in the interrupter, and but one exit is left for the current, and that is through the discharge. The principal contact always remains sparkless, in consequence of the arrangement of the discharger, which is provided with carbon contacts and a magnetic spark extinguisher, so that the interruption may take place with the least difficulty and with the ordinarily required rapidity. The carbon contacts are supplementary and may be replaced when they are consumed.

The closed oscillating system consists of (1) a series of Leyden jars, and (2) a transformer. To bring within as small a space as possible the greatest capacity area, the tubular form was devised by Prof. Braun. The tubes are made of glass, having a diameter of 25 mm., and are 2 mm. in thickness. They vary in capacity, some of them measuring 0.004 microfarad to 0.005 mf. and may be quickly replaced, since all that is necessary is to slip them into the rack as shown in the photograph, Fig. 3, if they should be broken either mechanically or electrically. Reserve tubes are supplied with each set of apparatus. These cylindrical condensers also have the advantage of interchangeability within the limits of 0.0002 m's to 0.0048 m's, and in steps of 0.0002 m's, and the period of oscillation, and, therefore, the wave length is variable in its greatest limits.

The primary winding of the transformer is carefully designed so that it will give the desired wave length together with the greatest capacity. The wave length to be used should be selected, and the apparatus so adjusted that the height of the antenna should be one-fourth its length. The secondary winding is adjusted according to the wave length used, but it must be regulated in connection with the air wire. As the high-frequency, high potential currents set up in this transformer are powerful it is immersed in oil. The diameter of the transformer is 20 cm.

The receiving apparatus is shown to the extreme left of the engraving, Fig. 3. Notwithstanding that the receiver is in construction quite similar to the transmitter, no such powerful oscillations occur in it as in that of the emitter, hence the condenser of the closed circuit oscillating system may be of much smaller dimensions than the one of the transformer just described. In the cut, the oscillating system for the reception of wave lengths of 200 meters is shown.

As the coherer is the vitally essential part of the wireless telegraph system, Prof. Braun has given considerable attention to its development, with the result that he has introduced an innovation in the art by designing one that does not require to be exhausted. He contends that experiment has not shown that the vacuum coherer is more sensitive than unexhausted ones are. It is certain that a vacuum



FIGS. 4 AND 5.—[illegible]

coherer is extremely difficult to keep in adjustment, and is practically worthless when it becomes deranged. The case with which Prof. Braun's coherer may be restored to its initial state of sensibility appeals to technician as well as the practical operator of wireless systems. It may be taken apart, replaced and adjusted in a very short time by any one. The conductor plugs are of steel and the ends forming contact with the filings must have a good polish. The filings consist of hardened and sieved steel powder. The sensitiveness is about the same as the best vacuum silver-nickel coherer, and its accuracy much greater, that is to say, it is not as susceptible to atmospheric disturbances. Its sensitiveness may be increased—at the expense of accuracy—by using rougher steel filings. One of the greatest points in favor of Prof. Braun's receiver is that it is exceedingly strong and cannot be broken, as can the fragile glass forms, and can never wear out.

Prof. Braun has made the observation that the steel-filings coherer does not respond as quickly and is not as reliable when the conductor plugs become magnetic; but that a certain critical magnetism increases its sensibility, without injuring its accuracy to any appreciable extent. These observations resulted in a magnetic regulator, eliminating the lag and uncertainty of the action and increasing the sensitiveness. This regulation is done by means of a permanent ring magnet, and placed between its poles are the conductor terminals of the coherer. By rotating the ring magnet, the north or south poles



FIG. 6.—BRAUN'S WIRELESS TELEGRAPH STATION AT CUXHAVEN.

may be brought as near to the ends of the terminal plugs as desired, and the ends are magnetized or demagnetized to any extent desired. It will not be necessary to go into detail as to the connections of the tapper relay and Morse printer, as in all systems there is little variability.

If a tuned wireless telegraph is not required, the receiving system may be arranged in a more simple manner. This may be done by removing the transformer or by allowing it to co-operate. Thus two other receiving systems result, as shown in the diagrams, Figs. 4 and 5. In the case represented in Fig. 4, where the transformer is rejected, one of the conducting plugs of the coherer is connected directly to the closed circuit oscillator, as shown, and the opposite conductor plug is attached to a plate of metal having a large capacity. In the following case, Fig. 5, the transformer is used without reference to resonance; here one of the conductor plugs is connected to the oscillator circuit, and the other to one terminal of the secondary of the transformer. In either of these forms resonance effects are difficult to obtain, but when the connections shown in Fig. 2 are used the intensity of the impinging waves is such that primary resonance like that in acoustics is brought about.

Another class of instruments have been designed by Prof. Braun for portable use, where writing is not essential and greater rapidity is desired. In this system a telephone receiver is employed instead of the more cumbersome apparatus in the standard stationary sets. The regulation type, however, is much more accurate, and is to be preferred to the latter.

Fig. 6 shows the station at Cuxhaven, Germany. Another station is located at Heligoland, in the German Ocean, 36 miles away, and has been tested in all sorts and conditions of weather, and has answered the fullest expectations.

Some Notes on Synchronizing.

By Joseph Martin Roman.

SINCE the day when two alternators were required to run in parallel on the station load, the question of synchronism has been one of importance to the electrical engineer. Hopkinson, Mordey and others, by their classic experiments have long since pointed out the requirements for successful operation, which have been met by alternator designers. Engine builders have so far perfected the methods of governing that mechanical regulation can be depended upon to insure an equitable and practically steady division of load. Consequently, once alternators are properly synchronized and made to share the station load, they can be depended upon to maintain these conditions constant.

METHODS OF INDICATION.

Lamp indications have always been regarded as the most favorable for synchronizing determinations, the lamps being either light or dark at the critical moment—the latter condition being adopted in America, European practice being the other way.

Many other methods have been proposed. One, an audible method, making use of two resonators, whose emitted notes coincide at synchronism. Another device is an instrument consisting of a combination of a voltmeter and a frequency indicator, having two pointers moving over the same scale. At synchronism the positions of the needles coincide over a marked point on the instrument scale.

As lamps show simply the condition of synchronism, but cannot show which machine is running the faster or give any information regarding the lag an apparatus to indicate the latter was presented in 1894 by Moler & Bedell.* This device consists of two coaxial discs, having properly curved slits in number equal to the number of pairs of poles on the machines being synchronized, and revolving under the influence of these machines in front of a fixed disc, upon which latter is a circular scale. The intersections of these slits appear as holes, and a beam of light reflected from the fixed disc, through these holes, appears, when the movable discs are revolving, as a band of light. The position of this band over the scale gives the angle of lag, the inward or outward movement of the band indicates the relative speed of the machines, and the absence of light denotes the position of synchronism.

Incandescent lamps are now relied upon for synchronizing, though on large boards generally in connection with a voltmeter indication. In many cases a voltmeter alone is used, which is often a special two-scale instrument, one scale reading zero and the other full voltage at the synchronous condition. By properly controlling the circuit, the machine voltmeter may be connected to indicate synchronism, or a special voltmeter may be used, with or without lamp indications. In cases of this kind, the voltmeters used are mounted on the machine panels, there being one for each alternator. On many large boards one synchronizing voltmeter is used and mounted on a swinging bracket at the end, the synchronizing circuit being so controlled that the voltmeter may be thrown between the bus-bars and any starting machine. If a lamp indication is also used the lamp should be placed on the swinging bracket above the synchronizing voltmeter, and there will usually be another lamp in series with this one, placed on the front of the machine panel.

DESIRABLE CONDITIONS.

Synchronizing circuits are always of low tension, and hence usually involve potential transformers. Evidently, to secure a method of control admitting of a variety of connections, some flexible switching system which will reduce the liability of error to a minimum is necessary. If separate devices for each machine are to be used, the most desirable arrangement is such that when starting up the only voltmeter or lamp which indicates is the one on the panel of the machine starting. The advantage of this is that the attendant has his attention attracted only to the panel on which his controlling switches are placed. In some cases, however, a lamp in series with the one on the machine panel is placed on the engine driving that machine, thus giving an additional indication to the engine attendant.

Large station boards are usually designed with a station panel for measuring the total energy delivered, which is placed between the generator and the feeder panels. A switching device on this panel in connection with a similar device on the panel of the starting machine should make such connection in the synchronizing circuit that proper indications will be given only on the machine panel, or on the devices arranged on the swinging bracket; and such connections must be possible from any machine panel. If such station panel is not provided, the starting machine is synchronized with any of the running machines, which, however, amounts to the same thing as synchronizing from the station bus-bars.

THE SYNCHRONIZING CIRCUIT.

Behind the switchboard, synchronizing bus-wires (two or three in number, of No. 8 wire, with rubber insulation) are run, supported on black fibre supports, which last are usually bolted to the iron angles supporting the board. Connections are made between these bus-wires and the synchronizing switching devices on all panels. These switching devices may be of varied design, but the use of plugs fitting into receptacles on the front of the panels has much in its favor, and seems to be the most desirable system.

The receptacle consists of a number of brass tubes (the number depending on the requirements of the case) fitted into small holes in the panel, and terminating behind in a stud, on which fit a small terminal and a nut. Circuit connections are made by means of the terminal, and the whole is held in place on the panel by the nut.

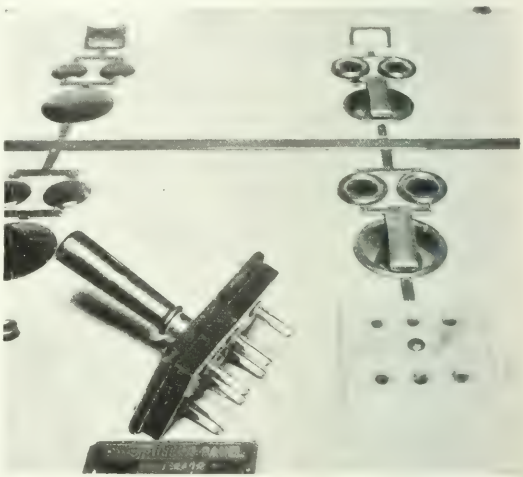


FIG. 1.—PLUG AND RECEPTACLE.

The plug consists of a rectangular piece of black fibre supporting a number of split brass rods, corresponding in number and arrangement to the tubes in the receptacle, into which they fit. These brass rods are properly connected together by copper strips laid in recesses in the fibre supports. A cap of polished hard rubber is then screwed over the fibre, this being marked with a diagram of the concealed connections of the brass rods, and a handle is then secured to the plug. When a plug is intended for a special purpose a nameplate fastened to it defines such use. Evidently extreme flexibility, allowing a great variety of connections, is the main advantage of this system; moreover, all live portions are well insulated, and the circuit connections are readily seen.

When lamps are used for synchronizing, either light or dark, the number of lamps in series should be the same as would be placed on a circuit of voltage double that of the synchronizing circuit. However, on many alternating lines whose voltage is lower than that for which commercial potential transformers are designed, and yet so high as to require an inconveniently large number of lamps, special resistances are used to take care of the extreme voltage when the machines are out of step. One lamp only is mounted on the front of the panel, and any additional lamps that may be required are placed behind the board. The question of light or dark synchronizing is taken care of entirely by the form of plug used. If all connections on the alternator panels are similar, then similar plugs synchronize dark; and plugs with dissimilar connections will synchron-

ize with lamps bright. The simplest connection, using only lamps, is shown in Fig. 2.

For rotaries which start up inverted, the lamps are placed across the main switch, and usually three lamps are placed on the front of the panel, one of which is in each phase.

At synchronism the lamps are all dark. If the rotation of the phases of the rotary is the same as that of the circuit from which it is to be operated, the lamps pulsate together; if, however, the phase rotation of the rotary be reversed—for instance, when the rotary is first started or improperly connected—the lamps will then not be in darkness at the same instant, but in succession. It is for this reason that three lamps are required.

In the selection of a synchronizing arrangement much depends on the taste of the engineer, and special scale voltmeters are made

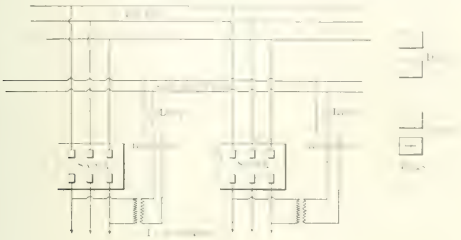


FIG. 2.—SIMPLE CIRCUIT.

to suit all requirements. The usual points on the voltmeter scale at which the needle rests at synchronism are zero, normal and double normal voltage; but wherever the critical point may be, it is desirable to have large scale divisions in the neighborhood of this position.

On many high-tension, three-phase circuits—usually where both lamps and voltmeter are used—two transformers connected to three phases (as shown later) are necessary. The resulting synchronizing circuits are highly ingenious, but would be complex in wiring were it not for the expedient adopted of grounding the common connection on the low tension side of the two transformers. This is both a matter of precaution and tends greatly to simplify the connections. The most widely used of these arrangements are considered in detail.

The connections of a high potential machine synchronizing with the bus-bars, using a lamp and a special voltmeter, are shown in Fig. 4. The connections of the plug are as shown, and but one plug is necessary. If it is inconvenient or undesirable to use a special volt-

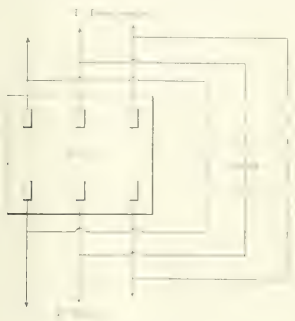


FIG. 3.—ROTARY CIRCUIT.

meter, the machine voltmeter may be used for synchronizing by arranging the proper connections. It is only necessary to insert one plug in the panel of the machine starting to secure proper synchronizing connections, and when the alternator is on the bus-bars another plug is necessary for ordinary voltmeter reading. The connections and plugs are shown in Fig. 5.

In both this and the preceding arrangement the most favorable conditions for observing synchronism are obtained, namely, lamps dark and votmeter-needle steady at normal voltage. For synchronizing, but one plug is necessary, and the operator can confine his entire attention to the panel of the starting machine. Moreover, though two potential transformers are connected to bus-bars, but one is necessary on each machine panel.

The connections shown in Fig. 6 are those of two high-potential machines, synchronizing with each other, using a lamp and a special voltmeter. Two plugs are necessary, connected as shown, and only

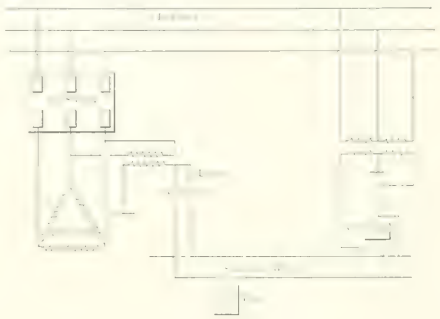


FIG. 4.—HIGH-POTENTIAL SYNCHRONIZING CIRCUIT.

one voltmeter and one lamp, mounted where they can be readily seen, as on a swinging bracket, are required. Synchronism is shown by the lamp being dark and the voltmeter needle steady at normal voltage. With some slight additions, this is the scheme adopted for synchronizing the alternators of the new Manhattan Railway in-

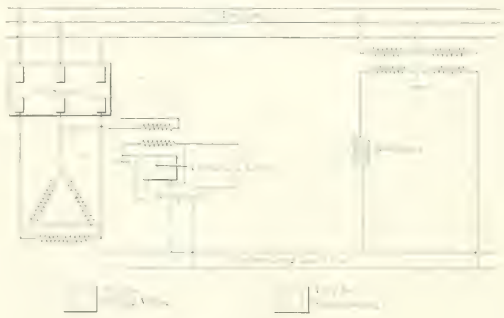


FIG. 5.—HIGH-POTENTIAL SYNCHRONIZING CIRCUIT.

stallation in New York City. The voltmeter is a special two-scale instrument, the needle of one scale being at zero and that of the other scale at normal voltage at the critical instant. This voltmeter is mounted on a pivoted frame at the center of the upper edge of the generator controlling table. Two lamps in series are used (being

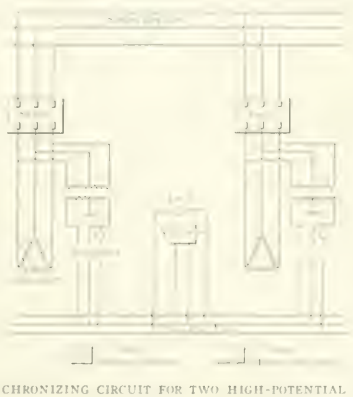


FIG. 6.—SYNCHRONIZING CIRCUIT FOR TWO HIGH-POTENTIAL MACHINES.

dark at synchronism), one mounted on the top of the special voltmeter and the other on the engine driving the starting alternator. The connections of this arrangement are shown in Fig. 7.

A modification of the foregoing scheme, using the machine volt-

meters to indicate—the machines synchronizing with each other—is shown in Fig. 8. The proper plugs being inserted, the critical point is shown by the lamp being dark, the voltmeter then indicating normal voltage on the panel of the starting machine. When running, a third plug is inserted for voltmeter indications. This arrangement is largely used, especially on the switchboards in stations of

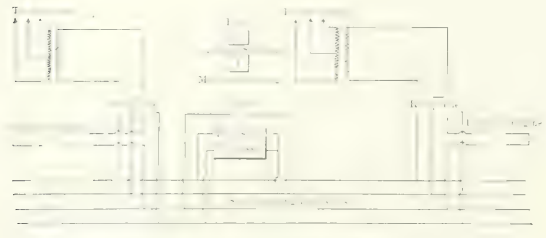


FIG. 7.—CONNECTIONS OF SYNCHRONIZING CIRCUIT OF FIG. 6.

long electric railways. The extreme flexibility is its main advantage, as it allows alternators and rotaries to be synchronized with the line or with each other.

In Fig. 9 is shown an arrangement involving special synchronizing voltmeters, one for each alternator, the instruments reading double normal voltage on the starting machine panel when the machines

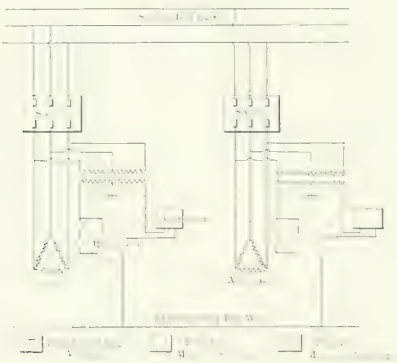


FIG. 8.—MODIFICATION OF FIG. 6.

are properly in step. The machines in this case operate on a four-wire, two-phase circuit.

The most recent form of synchronizing indicator, and one which does not make use of lamps, is the Lincoln synchroscope, the construction and the operation of which have already been fully described.* The accompanying diagram, Fig. 10, shows the circuit

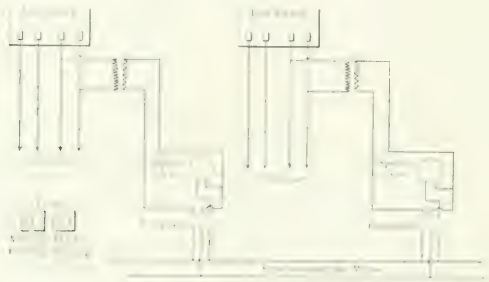


FIG. 9.—[illegible] ARRANGEMENT

arrangement in connection with lamps, which are here used as an auxiliary indication.

As will be noted upon a study of modern switchboard methods, the tendency exists to make the entire operation of switching a generator on or off the line, automatic, the actual connections being shown visually. The most recent switchboards require a synchronizing circuit to indicate the conditions to the eye, and the generator switch is closed through the agency of a secondary electrical circuit, controlled by a snap switch on the generator panel. Recent patents, however, from which the trend of development may be

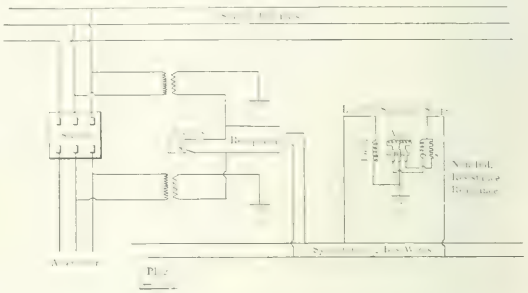


FIG. 10.—LINCOLN SYNCHRONIZER WITH LAMP CIRCUIT.

noted, make a still more radical step than this, for by properly connecting the synchronizing-circuit direct to the line-switch controlling circuit the operation of closing the generator switch at synchronism can be made completely automatic. It is simply necessary to maintain the proper condition, namely—that the voltage and period of generator and line should agree for an appreciable length of time before the switch is closed, and this operation is satisfactorily accomplished.

Long-distance Wireless Telegraphy and Hertzian Waves.

By Edward P. Thompson.

SOME personal experiments in conjunction with those already on record in scientific literature, lead me to conjecture that long-distance wireless telegraphy is not operated by aerial Hertzian waves. I submit an argument tending to prove this statement.

A simple and well known experiment consists in placing a coherer at the end of a long wire, the other end being charged by a spark discharge. This wire may be miles long, and even hundreds of miles long, and the spark comparatively small, and yet the coherer will be effectively operated. I do not explain the details of this experiment, because they are too well known. I mention it simply to call attention to the fact that writers have erroneously, I think (and I have myself done so), assumed, intimated and stated that the coherer in such a case is operated by Hertzian waves. Of course, for a short and direct enough distance, Hertzian waves would be radiated from the spark and act upon the coherer, but suppose the long wire should be conducted around corners of streets and end up behind a huge metal wall through which no Hertzian waves could pass? The coherer would still be operated, but not by Hertzian waves. It would be operated by an oscillatory current conducted by the wire around the corners and to a point behind the metal wall. In wireless telegraphy, a river or bay or ocean, or moist earth takes the place of the long wire. Hence, a coherer is operated in wireless telegraphy by an oscillatory current conducted by a solid or liquid or other conductor, or if you prefer, by the ether in or on or near the conductor. I have conducted an oscillatory current over a wire hundreds of times further than Hertzian waves, from the same spark, could travel. Marconi, therefore, operated the coherer at a distance of 1,500 miles by the conduction of an oscillatory current over the surface of the good conductor—salt water. The Hertzian waves had nothing to do with that wonderful feat. The Hertzian waves, if they can travel through air 1,500 miles, were above Marconi to the enormous vertical distance of about 16 miles. Why? Because Hertzian waves are radically different from oscillatory currents, as far as has been proved. Is it necessary to repeat the definitions of the nature of Hertzian waves? Is it necessary to argue that oscillatory currents on a wire are not radiations moving in a straight line, especially if the wire is zig-zag, or that such oscillatory current has not yet been refracted or reflected while on the wire? When this oscillatory current leaves or separates from or departs from a conductor, it is no longer a current,

simply because it is not conducted, but travels without a conducting medium. Then are aerial Hertzian waves produced. This is a backhanded kind of definition, but still I think it serves to distinguish aerial Hertzian waves from oscillatory currents. As far as their inherent natures are concerned, both are, broadly speaking, identical, both consisting of vibrations of ether, but specifically, aerial Hertzian waves are rectilinear radiations through space, without a conductor, capable of reflection, refraction, interference and polarization, and a coherer, to be operated by such radiations must be in their path. Hertz was the discoverer of and demonstrated the fact of these radiations. This kind of radiation was novel with him as far as absolute proof was concerned; but he did not discover nor demonstrate that oscillatory currents are transmitted along a conductor. This fact is almost as old as Franklin's kite wire.

By bearing in mind, therefore, all the experiments performed thus far, and the argument herein, it seems to be fair to conclude that it is pretty clearly demonstrated that Hertzian space or aerial radiations did not operate the coherer in the 1,500-mile accomplishment of Marconi.

As to overcoming objections to this argument, it should be remembered that no one knows everything there is to be known. Some one may ask, why are aerial wires necessary, if only conduction is the explanation? I answer this by asking, why did early experimenters think it essential that the receiving aerial wire must be high enough to be in the unobstructed line of sight of the transmitting spark? Now we know that the top of the aerial wire may be miles below where the rectilinear radiations ought to be.

The aerial wires, in the absence of aerial waves, may be explained as acting as a capacity, by which the oscillatory earth current is conducted through the coherer. The longer the aerial wire and the further from the earth, the better, up to a certain maximum. The receiving aerial wire not only acts as a capacity to conduct the oscillatory current through the coherer from the earth (instead of from the atmosphere to the earth as heretofore explained by most investigators), but it serves, especially when not terminated by a ball, to dissipate the charge, in a manner similar to that of points on a frictional generator, in which smooth, rounded surfaces, without points, are always used to avoid the leakage or discharge.

I have noticed that writers have tried to explain that these radiations may travel in curved paths by following the water, instead of stating what seems to be clear, that there is not simply one form of energy given off by the spark, but two distinct forms. One form is the ray or series of waves or radiations, traveling, as Hertz showed conclusively, as true radiations, independently of a conductor, and apparently are best transmitted in the absence of both insulators and conductors. They are stopped by metals and absorbed by all substances more or less. I think it has not yet been shown whether these waves really do travel very far before being absorbed, diffused and exhausted in various ways, by transformation into heat, etc. Possibly they do not travel further than that distance at which a coherer is operated without an earth connection and aerial wire. I find that these adjuncts can be omitted only at an enormously reduced distance.

The other force generated by a spark besides the rectilinear radiations is the oscillatory current known long before Hertz, and is now probably the force serving to transmit messages in long-distance wireless telegraphy.

Let me offer an analogy, not to intimate any identity but to illustrate that there are similar distinctions in other departments of science. Take the case of sound. When one puts his ear to a railway tracks, and hears a train too far away to see it, and too far away to hear it, by air vibrations, we have a case similar to a coherer connected to earth, too far away from the spark for receiving rectilinear and much weaker Hertzian etheric waves.

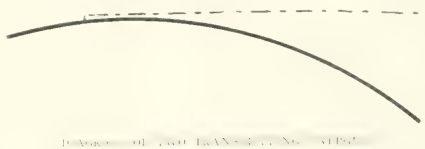
The engineering feature is therefore observed, not in trying to obtain a rectilinear path from the spark, but in securing the best possible conductor, like salt water, or a river, and to avoid frozen or dry ground. A cable itself has been proposed, as the coherer is more sensitive than the Thomson mirror galvanometer apparatus.

If these arguments hold, then long-distance wireless telegraphy is due entirely to conducted oscillatory currents.

Further experimental proof would consist in attempting to refract and reflect the Hertzian waves at long distances. I have attempted this on a small scale. I do not think the true aerial Hertzian waves will be found far enough for long-distance wireless telegraphy. Reflectors and other concentrators for the supposed aerial radiations seem to have been abandoned at the receiving station.

In performing experiments to test the distance to which aerial Hertzian waves may be transmitted, care should be taken not to mistake secondary or local aerial Hertzian waves for those originally transmitted from a distance. I do not remember that Hertz took into account the radiations from the spark produced in his receiving resonator. The caution should aim at the origin of this secondary spark, to discover whether it is produced by a conducted oscillatory current or by aerial Hertzian waves. If a coherer is employed instead of a Hertzian resonator, the same precaution should be taken, for I have learned that a coherer will also generate weak aerial Hertzian waves.

Several practical considerations follow, if my conclusions are correct. Inventors are now working upon the assumption that the coherer and aerial wires are actuated by aerial Hertzian waves. They assume this to be so, regardless of short or long-distance wireless telegraphy. Many syntonizing systems, as I learn from patents and other literature, are based upon the action of aerial Hertzian waves, which if any, are probably a mile or more above the top of their receiving aerial wire. This provision would be like foolishly connecting one ear to an ear tube, and the other to a speaking tube. Tuning systems for long range should be based upon the fact of an oscillatory current conducted over an electric conductor. Incidentally, some tuning systems intended for aerial Hertzian waves will operate



for oscillatory currents, but they were invented to answer only to aerial Hertzian waves.

In one sense, the oscillatory current consists of waves corresponding to Hertzian waves. The nomenclature most exact would be probably, "aerial Hertzian waves" for those transmitted through the atmosphere, and the old term "oscillatory current" (instead of "Hertzian waves") for those waves which may be and are conducted in any direction by a wire, and in all horizontal directions by the earth.

The accompanying diagram serves to indicate the two distinct transmitting energies in short and long-distance wireless telegraphy. The curve represents the conducting surface of the ocean or earth or the path of the oscillatory current. The alternate dots and dashes indicate the rectilinear path of aerial Hertzian waves. At short distances, both forces act upon the coherer. At long distances, only the oscillatory current acts. The short radial lines indicate the aerial wires of the transmitting and receiving stations, respectively. Although so short, they are several miles high, the length of the curve between the aerial wires being about 1,500 miles. It would need too large a sketch to show the true proportion, but in such a sketch the aerial Hertzian waves would appear higher yet above the receiving station.

Success of the Paris Electric Underground Railway.

At the annual meeting of the Paris Metropolitan Railways, the report for 1901, then submitted, covers the first full year in the company's history. Only one line is as yet operated. The number of passengers carried on the Paris Underground during 1901, which was 48,478,116, is almost exactly one-fourth the traffic on the four Manhattan elevated lines. Gross receipts of the Paris line for 1901 were: $1,710,000, as compared with $9,416,887 on the New York elevated lines. Receipts from advertising, etc., brought the year's total revenue up to $1,710,000, from which has to be deducted the working expenses, taxes and maintenance, amounting to $806,500, leaving a gross profit of $903,500, of which the City of Paris, which constructed the lines, received $555,600. To the balance of $348,000 has to be added $64,700 for interest, etc., and the balance carried over from 1900, making a disposable sum of $412,500. Shareholders receive $300,000 in a dividend of 15 francs, or 6 per cent. of the capital in shares of 250 francs, at which price they were taken by a syndicate. Of the remaining net profits of the year, $19,400 was added to the reserve fund and $19,400 paid to the directors. The proportion of working expenses to receipts was 47.16 per cent.

Electricity on Warships—II.

In [illegible] to the recent special May meeting of the American Institute of Electrical Engineers, the general subject of electrical installations on warships was considered under various headings. In last issue the subject of dynamos was taken up. The following relates to the generator, wiring, signalling, lamps, etc.:

GENERATOR.

The specifications require that the generator shall be of the direct-current, multipolar type, compound-wound, long-shunt connection, designed to run at constant speed and to furnish a pressure of 125 volts at the terminals, at rated speed, with load varying between no load and one and one-third times rated load.

The magnet yoke or frame is circular in form, having inwardly projecting pole pieces, and divided in half horizontally, in all generators above 5-kw capacity, the two halves being secured with bolts, to allow the upper half with its pole pieces and coils to be lifted to provide for inspection or removal of armature. Facilities for vertical adjustment of frame are provided in sizes of 16 kw and above.

The testing voltage for sets under 16 kw is 1,000 volts, and for sets of 16 kw and above is 1,500 volts, the source of the alternating e. m. f. being a transformer of at least 5-kw capacity for sets of 50 kw and under, and of at least 10-kw capacity for sets of greater output than 50 kw.

The test for dielectric strength is made with the completely assembled apparatus and not with its individual parts and the voltage applied between the electric circuits and surrounding conducting material. The tests are made with a sine wave of e. m. f., or where this is not available, at a voltage giving the same striking distance between needle points in air, as a sine wave of the specified e. m. f. During the test, the apparatus being tested is shunted by a spark gap of needle points set for a voltage exceeding the required voltage by 10 per cent. With brushes in a fixed position there must be no sparking when load is gradually increased or decreased between no load and full load; no detrimental sparking when load is varied up to one and one-third times rated load; no flashing when one and one-third load is removed or applied in one stage. The jump in voltage must not exceed 15 per cent. when full load is suddenly thrown on and off.

The cross-compound type of engines is now used exclusively in the new installations for sets above 8 kw. Following are the details of a multipolar 8-pole, 24-kw, 400 r. p. m., 80-volt generating set, manufactured by the General Electric Company, for U. S. S. "Olympia." Weight, 9,385 lbs., complete; extreme length, 84 in.; extreme width, 52 in.; extreme height, 77½ in. over all. Number of cylinders, 2; cranks at 180 degrees. Inertia governors; steam pipe, 2½ in.; exhaust pipe, 4 in.; diameter cylinder high pressure, 7½ in.; diameter low pressure cylinder, 12 in.; stroke, 8 in. Dynamo dimensions: Volts, 80 degrees; amperes, 400; r. p. m., 400; pole, 8; number of carbons per brush, 1; dimensions of brushes, 1¼ in. x ⅝ in.

The heat run was for 4 hours at 394 amperes. Terminal volts, 81.8 to 81.5; steam, 100 lbs.; vac., 22 to 21.5; r. p. m., 406; temperature air 28.2° C. at beginning, 30.2° C. at end of run. Temperature at end of heat run: Armature core surface, 51° C.; commutator bars, 55.5° C.; pole tip leading, 47.5° C; pole tip trailing, 48° C.; main bearings, 52° C.

Overload run, two hours at 33⅓ per cent. overload. Temperature of air during run, 30° C. Temperatures at end of run: Armature core surface, 59.5° C.; commutator bars, 59.5° C.; pole tip leading, 53.5° C.; pole tip trailing, 54° C. Average water consumption during four-hour heat run, 33.6 per kw-hour.

The output and efficiency were as follows: $I^2 R$ brush, 768 watts; $I^2 R$ armature, 1,600 watts; $I^2 R$ series, 422.4 watts; C. E. shunt, 753.3 watts; core loss and friction, 1,637 watts; total losses, 5,180.7; volts, 80; amperes, 400; input, 32,000 watts; losses, 5,180 watts; outputs, 37,190.7 watts; efficiency, 86 per cent.

All wires for feeders, mains and branches are installed in enameled steel conduit except in passages and dynamo rooms, when not exposed to mechanical injury, when porcelain racked hangers are allowed. Molding is no longer used except in officers' quarters or over hard wood surfaces, for the sake of appearances. All feeders run below the water line as far as possible. Thorough water-tightness is observed for all leads into wiring appliances and fixtures and [illegible] water-tight decks and bulkheads.

The conduit is secured to the metal of the ship by stout metal straps, and the wiring appliances are usually supported in place by the conduit. Conduit is made water-tight internally when necessary to prevent the flow of water from one compartment to another. For wire of below 60,000 cm, cross-section twin conductor is run in the same conduit; above this size, two leads of conduits are used, one for each leg.

Circuits are divided into three classes, each being entirely distinct from the others: (1) Search-light circuits; (2) lighting circuits; (3) motor circuits.

Each search-light is provided with a separate feeder from switchboard through a double pole switch, fused, rheostat, ammeter and double pole automatic circuit-breaking device direct to terminal lead of search-light pedestal. A rheostat in a non-combustible frame is supplied for each search-light. The rheostat has a dead resistance which, when heated, gives a drop of from 55 to 65 volts, and also an adjustable portion in not less than ten divisions, each giving a drop of one volt for the normal current of the lamp. The value of the dead resistance depends on the size of the search-light, large lights requiring higher voltage across the arc than the smaller ones, and this value is such that with 125 volts on the dynamo side, the variable resistance will give at the search-light of from four volts below the best working voltage of the lamp to six volts above the best working voltage. Maximum allowable rise in rheostat is 75° C.

The feeders are of the following sizes:

13-in.	18,081 cm.
18-in.	30,856 cm.
24-in.	38,912 cm.
30-in.	60,088 cm.

Lighting circuits are divided into two classes, battle and lighting service, each class having separate feeders and separate mains.

The battle service includes every light installed below the protective deck and all lights above the protective deck whose use are necessary during action. This includes lights for operation of guns, at ammunition hoists, boat cranes, at controllers, in military tops, on search-light platforms, in conning tower, in signal tower, in limits, chart house, signal and running lights, compass light, lights at main blowers above the protective deck, and such light as may be necessary to allow access to compartments and passages during action.

The lighting service includes all lights not above enumerated. The maximum load on lighting feeders does not usually exceed 75 amperes. The area of cross-section of the feeders and mains is such that the fall of potential from the dynamo terminals to the most distant outlet is not more than 3 per cent. at the normal load of the feeder. No feeder or main has a cross-section that will give a greater current density than one ampere per 1,000 cm. All reductions in size of feeders or mains are fused and wherever mains are led off from feeders, it is done through standard feeder junction boxes, having double pole fuses, which blow on the basis of one ampere per 500 cm of the main. The branch outlets are fused for the normal rated load of three amperes and blow at six amperes. Fuses for feeders and mains are at the rate of one ampere per 1,000 cm and blow at one ampere per 500 cm.

Motors whose normal full load circuits are less than 50 amperes are grouped on one feeder, and this procedure is followed up to a total load of 100 amperes. Large motors with full working load exceeding 50 amperes are installed with a separate feeder. The area of the cross-section of the feeders for motors is such that the fall of potential from dynamo terminals to motor terminals does not exceed 5 per cent. at normal full load.

Mains from motor feeders pass through feeder junction boxes having double pole fuses. Where several mains lead from the same feeder at one point a distributing panel with double pole fuses is installed. All motor feeders and mains have a cross-section of not less than 1,000 cm per ampere for continuous service and 500 cm per ampere for intermittent service.

The wire in present use conforms to the following requirements: All conductors to be of soft annealed, pure copper wire. When greater conducting area than that of 14 B. & S. G. is required, the conductor shall be stranded in a series of 7, 19, 37, 61, 91 or 127 wires, as may be required; the strand consisting of one central wire, the remainder laid around it concentrically, each layer to be twisted in the opposite direction from the preceding, and all single wires forming the strand must be of the diameter given in the American wire gauge table

as adopted by the American Institute of Electrical Engineers, Oct., 1893.

The material and manufacture of the strand must be such that the measured conductivity of each single wire forming the strand shall not be less than 98 per cent. of that of pure copper of the same number of circular mils, the measured conductivity of the conductor as a whole to be not less than 95 per cent. of that of pure copper of the same number of circular mils. Each wire to be thoroughly and evenly tinned. All single lighting conductors shall be insulated as follows:

First.—A layer of pure Para rubber, not less than 1-64-in. in thickness, taped or rolled on; if taped, the tape to lap one-half of its width. Second.—A layer of vlucanized rubber about 3-32-in. thick. Third.—A layer of commercial cotton tape, lapped to about 1-32-in. in thickness. Fourth.—A close braid to be made of No. 20, 2-ply cotton thread, braided with three ends for all conductors under 60,000 cm, and of No. 16, 3-ply cotton thread, braided with four ends for all conductors of and above 60,000 cm. The outside diameter over the braid to be in exact conformity with that tabulated.

Motor applications on board ships involve the use of all sizes of motors from 1-12-hp to 50-hp. Fans for officers' quarters are of two sizes, 1-12-hp and 1-6-hp, the former for 12-in. desk or bracket fans, the latter for 16-in. bracket fans. Small ¼-hp series motors are used on portable ventilating sets. These sets are necessary for temporary ventilation when working in such parts of the ship as are not reached by the main ventilating system.

The main ventilating system employs motors of all sizes, from ¾-hp, used with small exhausters, up to 15-hp, which are used on the larger steel plate blowers. The controlling panels for these motors contain a double-pole line switch and a rheostatic starting-box with an automatic no-voltage and over-load release. A field rheostat for speed control is also mounted on the panel.

Ammunition hoists for 5-in. and 6-in., and smaller guns, are either endless chain hoists or whip hoists, and are operated by shunt-wound reversible motors. A motor of about 3-hp is used for the endless chain hoist and motors as large as 6 hp are used on the whip hoists. The chain hoist motors as a rule are located below the protective deck. They drive through gearing and are controlled by a panel similar to those described for the blower motors, and in addition by a double-pole, double-throw reversing switch. These motors are fitted with solenoid brakes, which release when the lever is moved to first notch and set up when the lever is thrown to off position. Motors for whip hoists when located in exposed places on the decks or bridges, are made water-tight by means of iron plates over the hand holes set up against sheet-rubber gaskets. They are fed from the line through branch blocks and switches enclosed in water-tight boxes. An enclosed cylindrical reversible controller is used.

For turret guns, chain hoists are also used, the motors being either suspended under the base of the turret or in the turret itself. These motors as a rule drive through a flexible cable, running over a drum on an intermediate shaft. Motors as large as 20-hp are required for 12-in. mounts, motors of about 16-hp for the 10-in mounts, and 8-hp motors for the 8-in. mounts. The first two run at 350 r. p. m., the last at 400 r. p. m. Each gun in a turret has its own ammunition hoist motor. The controllers are operated by a single handle, capable of sudden reversal, and carry the load in either direction without change of speed. Automatic circuit breakers are installed which break armature current only. The guns are elevated and depressed by shunt-wound motors of about 5-hp capacity, controlled in a manner similar to the ammunition hoist motors. For forcing the shell into the breech of the guns, rammer motors are used. These motors are series-wound, and drive through a friction sheave so adjusted that in case the shell is set home before the motor is stopped, the slipping of the driving mechanism will hold the motor load down low enough to prevent the throwing of the circuit breaker. These motors run at about 750 r. p. m., and are of 7-hp output for 12-in. mounts and 5-hp for 10-in. mounts. They carry the load in one direction only. Small motors are used to furnish air blast for clearing smoke out of the guns after firing.

Turrets are turned by motors operated on the Ward Leonard system, as at present installed, the use of a separate generating set being required for turning each turret. A system now under consideration embodies the use of a motor-generator for each turret, several of such motor-generators being supplied by one generating set. For 12-in. turrets, two 35-hp motors are installed, either one being capable of handling the turret alone. These motors, located diametrically opposite each other, drive a common cross-shaft through bevel gears, this shaft carrying near each end a separate worm, which actuates a pinion on a vertical shaft. The lower end of the vertical shaft carries a gear which meshes with an annular gear attached to the inner side of the barbette. The controller, located just under the sighting hood, is operated by one handle, and carries the load equally well in either direction. Automatic cut-outs are fitted at the limits of travel of the turrets.

Recent tests on turrets fitted as above show a nicety of control which is all that could be required. The turret was moved ten successive times, and only turned through an arc of 30.9 seconds. This would mean a single movement of 3.09 seconds, a distance scarcely discernible on the circumference of a 14-ft. circle (the outside of the turret). The turret was turned throughout its range of travel 136 degrees starboard to 136 degrees port, a total of 272 degrees in less than 45 seconds. The weight of the mass moved was about 600 tons.

Boat cranes, as at present installed, have but one motor for both hoisting load and revolving cranes, although on ships now under construction, separate motors will be used for each purpose. About 50 hp. will be used on the larger cranes for hoisting and lowering, and about 25 hp for revolving the crane. The control of the hoisting motor is by means of a resistance continuously across the line, the speed being controlled by the amount of this resistance with which the armature is placed in shunt. With this system, should the load on the crane tend to drive the armature at a speed in excess of that corresponding to the position of the controller handle, the armature will drive a current through the local circuit and run at constant speed until shut down.

In addition to the above-mentioned uses, motors are applied to drive air compressors for use in torpedo work, such compressors requiring about 25 hp, for closing water-tight doors; for lifting hatches; for dough mixers; for driving machine tools in the ships' workshops; for laundry work, etc. Electrically-operated steering gear and electrically-driven pumps are not used in our navy, although some foreign powers have applied the electric drive to such auxiliaries.

The means of interior communication consist of voice tubes, electric call-bells and annunciators, telephones, fire-alarms, general alarms, warning signal, engine telegraph, steering telegraph, helm indicator, revolution and direction indicator, battle and range-order indicators and transmitters. When a limited number of orders are to be transmitted, telegraphs are used; when an unlimited number of orders art to be transmitted and interior communication is necessary, telephones or voice pipes are installed, telephones being used for the longest leads. Between important stations, both telephones and voice pipes are installed. Call bells and buzzers are used without returns for minor purposes.

The fire-alarm system comprises an annunciator, near the captain's cabin (under the eye of the cabin orderly), and thermostats located in coal bunkers, magazines and storerooms near the same. When the temperature in these places rises above 200° F., the alarm is given at the annunciator and the location is indicated. The thermostat in present use consists essentially of a helix of metal ribbon (metal having a large expansive co-efficient) and a terminal block, with an adjustable contact screw. Its operation is based on torsional strain produced in the helix by a rise in temperature, thus completing the circuit through the contact screw in the terminal block.

There is a general alarm signal, which may be set into operation from a number of stations by electrical means. A solenoid whistle is employed to signal for closing water-tight doors. Electrical engine-telegraphs, located in the pilot house and conning tower, are only used to signal an increased or decreased number of revolutions, and are chiefly used in steaming in squadron, the range of signals being sufficient to preserve formation. The speed designated by the flag officer is telegraphed by means of the ordinary mechanical telegraph and small variations from the speed, by the electrical devices. The transmitter consists of a pedestal with a cylindrical case mounted thereon, containing the mechanism for ringing a magneto bell at the indicator station and making an electric light burn behind a figure on the dial of the indicator. Each of a number of lamps is in a separate compartment, so that it can illuminate only one of the perforated numbers. The indicator in the engine room is similar to the transmitter in all respects, with a magneto-bell placed above it.

Steering telegraphs are used to signal the desired degree of helm from the conning tower and the pilot house to all steering stations. Combined transmitters and indicators are located in the conning

tower and the pilot house. Indicators are placed in the communication room, hand-steering stations on the upper decks and steering engine rooms. These devices are exactly similar to the engine-telegraphs described above, except the orders on the dial.

Helm-angle indicators are installed at all steering stations, and indicate simultaneously the rudder angle at these stations. They are similar to the engine telegraphs, except the marking on the dials, and indicate angles of 0 deg., 2½ deg., 5 deg., 7½ deg., 10 deg., 15 deg., 25 deg. and 35 deg., with the center line of the ship.

Revolution and direction indicators are located in the pilot house and conning tower, one for each engine. The indicator consists of a circular water-tight case with glass face. The enamel dial is marked "ahead" and "astern" just over two small pointers. When the shaft revolves a vertical sliding motion is imparted to a rod which is raised and lowered three-quarters of an inch at each revolution. When the shaft is turning ahead, the connection between the end of the sliding rod and the section wire of the "ahead" magnet is alternately made and broken, and the indicators in the conning tower and pilot house will show a deflection of the pointer for each revolution. When the shaft is turning astern, the connection is made and broken between the rod and the section wire leading to the "astern" magnet in the indicator.

Battle and range order telegraphs and indicators are used to signal the orders to the battery, ammunition supply and the range. The principle of the battle-order and range-order instruments is that each order on the indicator is shown by a separate 5-cp lamp, controlled by a separate switch on the transmitter. The orders are marked on the counter by transparent plates on the face of the indicators, each plate having a lamp behind it in a separate compartment. The orders on the indicators are only shown when the lamp behind the order is made to burn by turning the switch of the transmitter. Any number of orders may be shown at the same time. The instruments are wired in parallel, and when a switch of the transmitter is turned, the corresponding order is shown on all the indicators. The orders signalled are, commence or cease firing, character of projectile to be employed, full or reduced charge, direction of the enemy and distance in yards.

The well-known Ardois signalling system is used to transmit rapidly and accurately under suitable conditions, a prearranged code of signals to a distant point, as from one vessel to another, or for squadron and fleet tactics, and for signals between vessels and cooperating commands on shore.

The search-lights have a vertical train of 70 degrees above horizontal and 30 degrees below. Parabolic mirrors are now used and are of highly polished glass, silvered on the back. The mirror is mounted in a separate metal frame, lined with non-conducting material in such a manner as to allow for expansion due to heat, and to prevent injury from concussion. The lamp is of the horizontal carbon type, designed for both hand and automatic control. It will burn for six hours without renewing carbons. The front of the drum contains a door of plain glass strips and a shutter for use in signalling. Until recently, the projectors were fitted with a system of electrical control for training the beam of light, but at present hand control is exclusively installed. The intensity of the beam of light is required to be such that on a clear, dark night a light-colored object, 10 x 20 ft. in size, will be plainly discernible at a distance of not less than 4,000 yards for the 18-in. projector, 5,000 yards for the 24-in. projector, and 6,000 yards for the 30-in. projector. The current required for operation with the voltage across the arc for the four standard sizes is:

13-inch,	18-20	amperes,	45-48	volts.
18	"	30-35	"	47-50	"
24	"	40-50	"	48-52	"
30	"	70-80	"	49-52	"

Smeltzer carbons are used extensively and give good satisfaction, the positive carbon in the larger sizes being cored, with the negative carbon solid, and in some cases having a core smaller than that of the positive carbon.

The following are the standard incandescent lamps allowed: 16 cp, clear and frosted; 32 cp, clear, and 150 cp, clear, in the case of the diving lamp, besides instrument lamps for special purposes of 1 and 5 cp. The average efficiency of the 16-cp lamp is to be between 3.4 and 3.6 watts per candle-power; for the 32 cp between 3.4 and 3.8 watts per candle, and for the 150-cp diving lamp between 2.9 and 3.3 watts per candle-power. The life of an incandescent lamp is an important consideration in naval installation, as the ships are so frequently removed from a source of supply. It is proposed to specify 800 hours for the 16 cp, 500 hours for the 32 cp, and 300 hours for the 150-cp lamp as the average life, with the above efficiencies, the lamps not to have lost more than 20 per cent. of their rated candle-power while burning for these periods at the rated candle-power.

The Nernst Lamp.

At the Cincinnati Electric Light Convention the Nernst lamp was the subject of a topical discussion, partly through written communications and partly by discussion on the floor. A considerable portion of the remarks was contributed by central station men having experience with the lamp, and the discussion thus forms one of much practical interest.

Mr. F. H. Golding, of Branford, Conn., reported that the results thus far from the use by his company of the Nernst lamp have been very satisfactory. The customer is required to furnish the lamp and the station supplies renewals free of charge, as in the case of ordinary incandescent lamps. While he thinks the present price is rather high, yet, on the whole, he considers the lamp a commercial success. Mr. W. J. Greene, of Cedar Rapids, Ia., said 32 106-volt Nernst lamps placed in the office and dining-room of a hotel, have given splendid satisfaction so far as light is concerned. The life of the glowers, however, has been short, averaging less than 100 hours. A recording voltmeter shows an even regulation at proper e. m. f. Mr. Mordock, of Terre Haute, Ind., stated that his company had not gone into the Nernst lamp commercially, but have been burning one for 1100 hours. It was found that as the candle power falls off the current falls off. At the start the lamp consumed 170 watts, and has been burning about 1100 hours, consuming toward the end 140 watts. It is a 60-cycle, 208-volt lamp.

The Union Electric Light & Power Company, of Unionville, Conn., reported that it has installed 125 single-glower and 15 six-glower Nernst lamps on the street-lighting service, these lamps covering all the street lighting that this company does. From the standpoint of the public they are giving excellent satisfaction: the light is a pleasant one, and the fact that double candle power is given for practically the same price is of much satisfaction to the public. From the standpoint of the company, there as yet is not sufficient data to judge of their commercial success, as the lamps have been in use only about five months. It can be stated, however, that the company considers there is no question about the matter, provided a steady voltage is maintained, it having been found that any very serious variations in voltage affect the life of the lamp. The lamps have not yet been run 800 hours, but it is judged that the average life will attain that figure. While the lamps deteriorate somewhat, the deterioration is not so noticeable as it is in an ordinary incandescent lamp.

Mr. J. M. Uptegraff, of the Sewickley (Pa.) Electric Company, reported that his company is using Nernst lamps for street lighting, and is now installing the lamp for commercial and residence service, the customer buying the lamp and furnishing renewals. For street lighting the six-glower lamp is used and gives entire satisfaction. The lamps have been in use since October, 1901. The glowers have given an average life of 1,300 hours. The lamps are inspected but twice a week—Wednesdays and Saturdays—and all burned-out glowers are renewed on these days. The street lamps are furnished and renewed by the lighting company. Mr. J. H. Perkins, of Youngstown, O., did not consider the Nernst lamp in its present shape and at its present price a commercial success. The reason given is that the Nernst lamp has been successfully developed to meet the conditions and standards for but a very few central stations, and if adopted in its present form it would cost a great deal for change of system on the part of an electric-lighting company.

Mr. C. F. Nagle, of Savannah, Ga., reported that experience with the Nernst lamp had thus far been satisfactory to his company and to most of its customers. It was found necessary to use care in supplying glowers of the proper voltage for the current furnished, as excessive voltage will soon destroy the glowers. With normal voltage some glowers will burn out within 100 hours, but if they burn for 100 hours long life seems to be assured. It was found that business can be secured with the Nernst lamp that could not be obtained with either the arc or incandescent, and that it competes successfully with the Welsbach. The cost per kilowatt for supplying current for Nernst lamps is greater than for incandescents, on ac-

count of interest and depreciation in addition to cost of renewals and care of lamps, and it has therefore been found necessary to charge a higher rate per kilowatt-hour if the company furnishes the lamps.

In the oral discussion, Mr. S. T. Dunham, of Hartford, Conn., said that his company has had the Nernst lamp in use for 15 months, but principally for experimental purposes to determine its value. Not having any price for either glowers or lamps, it was not possible to determine the comparative economy of the lamp, but the conclusion has been arrived at that the Nernst lamp is closely related to the arc lamp in the matter of trimming. Every arc lamp is a new lamp every time you trim it; every Nernst lamp is a new lamp every time you trim it, and requires also about the same care in repairing and cleaning, principally cleaning. The question which occurs to everybody is, How often can you afford to trim the lamp, and what will it cost as compared with the arc lamp? As regards the relation of the Nernst lamp to the incandescent lamp, the same socket can be used. That the Nernst lamp gives quality of light cannot be questioned. The light is soft, brilliant, but not too bright, and as compared with the Edison lamp it is a superior light. As to the power question, you make a great saving in the installation of machinery and in all the various line systems and underground work, by putting in half the current. Mr. Dunham said he expects to install this coming year about five thousand Nernst lamps, which shows that he has confidence in them. It is a lamp of luxury, as the Edison lamp was within our recollection, when we paid seventy-five cents for a lamp, and which did not last very long, either; but the Nernst lamp will come within our reach as a bread-and-butter lamp more rapidly than the Edison, because it has severer competition. It must be put in such shape that it can be manufactured on a large scale, but you cannot reduce prices till you do manufacture on a large scale. The deterioration is less than with the Edison lamp. You get all the advantages of distribution in the Nernst lamp that you get in the Edison lamp, and which you cannot secure with the arc lamp. In conclusion Mr. Dunham said he considered that the lamp is certain to prove a success.

Mr. Frank S. Smith reported that the New York offices of his company had used for the purpose of general illumination, 48 single-glower, 3 three-glower and 6 six-glower Nernst lamps (a total of 93 glowers) on a circuit of nominal 216 volts, alternating current. Records show that at times the voltage has been as high as 242 and as low as 194, with an average variation of approximately eight per cent.; that is, four per cent. above and four per cent. below. The character of the light has been all that could be desired. Some little trouble was experienced in the cutout of the single-glower lamps shortly after installation. These were repaired, and since then have operated entirely satisfactorily. In the three-glower lamps a slight humming was noticed when first installed, but that was remedied and there has been no trouble since. Records of the number of glowers replaced were not kept previously to September 1st, 1901. From that date to April 18th, but 68 new glowers had been put in. In one instance, at least, in a single-glower lamp, there has been but one replacement during the year; this was in a lamp that has operated satisfactorily since the beginning, burning an average of four hours per day, with the glower now apparently in good condition. The care of the lamps has been intrusted to a boy about sixteen years old, whose duties have been to light the lamps in the morning and make replacements of burned-out glowers. It is interesting to note that apparently the best service is received from lamps with more than one glower.

As stated above, shortly after the lamps were installed, in May, 1901, some few mechanical defects were noted. It was not surprising that a few defects should be noted in these earlier lamps, as this might naturally be expected while the lamp was in a more or less experimental stage. These troubles have, however, been satisfactorily remedied, and the lamps have, without exception, operated perfectly satisfactorily ever since. As to what is claimed to be the high price of Nernst lamps this is natural in view of the presumably large expense involved in the experimentation necessary to bring the lamp to its present successful form. It would be natural to expect, now that the preliminary work is practically over, that the price of lamps will be reduced, so that there can be no reasonable ground for criticism on this score from now on. In conclusion Mr. Smith said that his experience with the Nernst lamp has been such as to demonstrate that in its present shape it is a commercial success. As to the extent to which the lamps are being used, he said that he had observed them in a great many places, and the replies to inquiries as to their successful operation have always been in the affirmative. The matter of renewals is a very simple one, which any intelligent office boy can successfully carry out.

Mr. E. F. Phillips of Detroit, Mich., contributed a lengthy written communication on the subject. His company, he said, had felt the necessity for some time for a lamp to fill the gap between the ordinary cluster and the 500-watt inclosed-arc lamp. In quite a number of places the cluster would not give sufficient light, while the 500-watt lamp would give more light than was really necessary; and in other cases, one arc lamp would not give sufficient light and two lamps, too much; besides, the cost of current to the customer in both cases would be more than circumstances would warrant. The 350-watt inclosed-arc lamp was tried, but with indifferent success, there being little difference in consumption of current between it and the 500-watt lamp, and also much less power of illumination. The Nernst lamp, therefore, appeared to them to meet the conditions above noted, and also to open a field for use of current which the company could not otherwise obtain. It would be a strong competitor of the Welsbach light and of the Humphrey gas arc. Another consideration was that it would serve as an educator in the use of electric lighting with but small expense to the customer. In one instance a Nernst lamp in a store was using Welsbach burners; after the lamp had been use a little over a month the customer wired his store for eleven inclosed-arc lamps and about 50 incandescent lamps, abandoning entirely the use of gas. In another case a Humphrey gas arc was displaced by a Nernst lamp to the complete satisfaction of the customer, both as to quality of light, and cost.

Following are some observations as to the renewals of glowers and general behavior of the few Nernst lamps Mr. Phillips' company has put in regular service:

Lamp No. 1: Three-glower, installed February 1st; March, all glowers changed on account of burning dim. Current consumed February 1st to April 23d, 117.2 kilowatt hours; cost to consumer, $7.55 net.

Lamp No. 2: Three-glower, installed January 29th. Current consumed January 29 to April 23d, 51.2 kilowatt-hours; cost to customer, $4.77 net. This lamp was burning well May 1st, with no change of glowers, and with apparently small decrease in illumination.

Lamp No. 3: Six-glower, installed January 6th, at a sub-station to burn all night, every night. This lamp was equipped with a small inclosing globe and shade. January 16th one glower burned out and globe badly blackened. January 23d, two glowers burned out. February 28th, put in new set of glowers. May 6th, one glower burned out. Current used January 6th to May 6th, 297.5 kilowatt-hours, with four glower renewals, or one glower to each 74.3 kilowatt hours, or 1486 50-watt lamp hours.

Lamp No. 4: Six glowers, installed March 4th. April 8th, one glower burned out. Current used March 4th to May 6th, 155 kilowatt-hours, or one glower for 77.5 kilowatt-hours, or 1550 50-watt hours.

Lamp No. 5: Three glowers installed February 25th. No renewals. Taken out, and customer installed eleven inclosed-arc lamps.

Lamp No. 6: Three glowers, installed February 26th. March 19th, one glower burned out. Current used February 26th to April 23d, 27.1 kilowatt-hours at cost to customer of $3.20 net. One glower for 540 50-watt lamp hours.

Lamp No. 7: Three glowers, installed March 21st. May 7th, one glower burned out. Current used, 26.5 kilowatt-hours, or one glower renewal for 530 50-watt lamp hours.

Mr. Phillips says he has not been advised as to the price the manufacturers intend charging for new glowers, but figuring on a basis in comparison with lamp renewals at half a cent per kilowatt-hour, in the cases noted, the cost for renewals would be as follows:

Lamp No. 1....	117.2	kilowatt-hours...	$.536....	3	glowers.
" 2....	51.2	" " ...	.256....	0	"
" 3....	297.5	" " ...	.487....	4	"
" 4....	155	" " ...	.775....	2	"
" 6....	[illegible]				
" 7....	26.5	" " ...	.132....	1	"
Total.....	674.5	" " ...	$3.371....	11	"

or an average of $0.306 per glower.

No record has been kept of inspection, or time consumed thereon, it being more the purpose to observe the working efficiency and adaptability of the lamp to commercial service than to obtain an elaborate

record of costs. The conditions observed were that there is a tendency on the part of the glowers to warp, thus bringing them so far away from the heater as to make the lamp very slow in starting up; the shortest time noted being thirty seconds and the longest three minutes.

There has been only one complaint of light becoming dim, and this was only proven when the old glowers and holder were substituted for new ones. It is not thought that this dimming is attributable to the black deposit on the holder, but is due to some defect in the glower itself, as new glowers have been put in partly blackened holders with appreciable difference in the light. Where warped glowers have been found, it has been possible to correct the lighting-up by turning them partly over, or bending up the terminals so as to bring the glowers closer to the heater. There has not been any trouble yet from the giving out of the steadying resistance, or heaters. In conclusion Mr. Phillips stated that to his mind, much the most important obstacle to be overcome is the prevention of the warping of the glowers, for on this depends the satisfactory operation of the lamp. First, because a glower that is warped will not light up quickly, and will consequently cause complaint from the customer. Second, tardy lighting throws the heater into action for a longer period and therefore necessitates its more frequent renewals. If this condition is remedied and no further defects are found in their operation—which, from the limited experience are not looked for—and the cost of glower renewals is not excessive. Mr. Phillips feels sure that, owing to the fact before noted—that there is a field for it—the lamp should come into quite general use.

At the conclusion of the reading of communications and the oral discussion, Mr. A. T. Wurts made a lengthy communication to the subject. Referring to the citation of a life of 1300 hours, he said that the frequency in this case was 125. As to the remark that if a glower survived 100 hours it would have a long life, it was explained that one of the chief causes of early breakage is mechanical strain on the glower. A glower expands and contracts particularly at times of lighting and turning off. The glower should be perfectly free and have an end play of about 1-16 of an inch, when no mechanical strain will be brought on the glower, and the average life, barring a defective glower or accident, should be 800 hours on sixty cycles. With reference to frequency, the life of the glower is 800 hours on 60-cycles, and 400 hours, apparently, on 25 cycles. There are experiments being carried on in Buffalo on the circuit from Niagara Falls, which indicate a considerable longer life than 400 hours, but these experiments have not been completed, and nothing definite can be said at this time. The figure of 400 hours is based on results obtained from about 350 six-glower lamps which are operated in the factory of the Westinghouse Company on 25 cycles. On 133 cycles the life seems to be about 1200 hours. As to the cost of trimming, there is as yet little data. The Westinghouse Machine Company has a large number of six-glower lamps in the factory and has kept a record of the labor required to take care of the lamps. The figures indicate that it requires a one-man-hour for 800 lamp-hours on the six-glower lamp.

As to the direct current lamp the Europeans have labored along the lines of a a direct current lamp, exclusively. They have not made the alternating current lamp, so that the direct current lamp is not only a possibility, but a fact. In this country it has been found that the life of the glower on the alternating current is much greater than with direct current. The Nernst lamp company, however, is now making direct current glowers and proposes to put them on the market very shortly—probably by the first of September. An interesting feature in connection with this subject is that all lamps will be exactly the same, whether for direct current or alternating current, except the glower. The direct current glower will be different from the alternating current glower, and the same remark applies to lamps for different voltages. As an illustration, the six-glower lamp for 220 volts is adjusted for 200, 230, 240, or whatever it is, and the lamps are the same in every respect except the glower.

As to the position which the lamp must occupy, so far lamps have only been made which will operate in a downward, vertical position. The reason for that is the cut-out, which operates by gravity. For any special cases the position of the cut-out could be reversed in the lamp, and in that case the lamp would operate in an upward vertical position; it has been considered, however, that the light should be thrown downward instead of upward and no steps have been taken to make a lamp which will operate in any other position than the downward. An endeavor has been made to produce a "universal lamp" which will operate in any position, but that will require something in the nature of a spring for a cut-out, and it has been found that a spring is not always reliable.

As to the useful life of the glowers, possibly that is a good deal a matter of opinion. The total life of the glower seems to be about 800 hours on 60 cycles. Whether that would be considered the useful life or not, must be determined by the user. Nevertheless, even at the end of 800 hours, the glower still has an efficiency which will compete with other lamps now in use. As to the range of voltage, there appears to be a misunderstanding with regard to the Nernst lamp being very sensitive to changes in voltage. This idea has arisen from the fact, very largely, that in every case the company asks for the accurate average voltage of the circuit upon which the lamp is to be operated, the object being that it could supply a lamp for the best possible satisfaction. In a great many cases where an incandescent lamp is bought and placed on the circuit, and not much attention given to the question of voltage, the life of the lamp is curtailed, but nothing is thought of this and the lamp is replaced; but the Nernst lamp, being new, the customer watches it critically to see whether it lives up to the claims made for it by the manufacturer. As a result, it is thought wise to request reasonably accurate figures with regard to voltage, so that the lamps can be adjusted at the factory for that particular voltage. A large correspondence, extending over six months has shown that very few central station people realize what a very great change there is in candle power for a very small change in the line voltage. There is a drop of forty per cent. in candle power in an incandescent lamp for a drop of five per cent. in voltage. That being the case, it is very important to have the correct voltage if the new lamp is to make a good impression.

The variation of candle power on the Nernst lamp, going upward, however, is exceedingly small, compared with the variation of the incandescent lamp. The variation in candle power for a five per cent. rise in voltage is only twelve per cent. in the Nernst lamp. The effect of an increased voltage on the Nernst lamp has been about as follows: Five per cent. rise for some hours does not seem to materially affect the life of the glower, but a five per cent. increase in voltage running continuously, would make a little difference in the life of the glower. A ten per cent. rise running continuously will blacken the ballast tube. A fifteen per cent. rise will make the ballast tube very black and a twenty per cent. rise will sufficiently heat the ballast tube to soften the containing glass bottle; thus by inspection of the lamp one is able to determine pretty closely how the lamp has been treated. But in the light of his experience with the lamp, Mr. Wurts feels it is impossible, on account of the very high corrective power in the ballast, to burn out a glower within 200 hours with a rise, say, of ten or fifteen per cent. The ballast goes first, but not unless the voltage is raised about fifteen per cent. and run continuously at that increase. Mr. Wurts said he is very confident that if a glower gives out in less than 200 hours, the breakage is due to mechanical strain.

In reply to a question, Mr. Wurts said the efficiency question is a difficult one to answer satisfactorily. He considers that the efficiency of the lamp should be based on its earning capacity. The lamps have been given merely a nominal rating. The one-glower is called a 50-candle power lamp, which figure was arrived at by measuring the candle power on the photometer bar in the direction of greatest intensity, and the one-glower lamp gives fifty candle power in this direction of greatest intensity with a clear glass globe. The company has, however, devised for itself a photometer. In its exhibition-room is a ceiling cluster of four one-glower lamps, with the sand-glass globes, and in four corners of the ceiling there are four clusters of three lamps each, of incandescent lamps, clear glass globes, making twelve- 16-candle power incandescent lamps altogether; it is the opinion of every one who has been in the room that there is a great deal more light, better illumination, from the four one-glower Nernst lamps than the twelve 16-candle power incandescent lamps. Most people say offhand that twice as much light is given out by the Nernst lamps, but a very conservative figure would be that the Nernst lamps are giving one-third more light. The four single-glower lamps take 352 watts. The candle power is measured by the twelve 16 candle-power units in the ceiling, all of which have reflectors over them. That is to say, the sixteen candle power incandescent lamps are taken as the standard, and with that data and the power supplied to the Nernst lamps, the efficiency of the Nernst lamp is estimated to approximate 1 watts per candle

The efficiency could be made a little higher or a little lower, according to the manner in which it might be considered. Taking the six-glower lamp, for instance, which is a large unit, in most cases it is desirable to throw the light down; it has been found that the mean spherical candle power of the six-glower lamp, from a thirty-degree zone, is one watt per candle, and from a sixty-degree zone about 1.23 watts per candle.

The National Bureau of Standards.

At the recent Cincinnati Electric Light Convention Dr. Frank A. Woolf, Jr., read a paper describing the plans of the new National Bureau, which paper we reprint below, in part, together with a view of the Bureau buildings as they will appear when completed.

A beautiful site of 7½ acres, in the northwestern suburbs of Washington, was procured within convenient access, but not too close to the car line to seriously interfere with any but the most precise measurements, which will, of course, constitute but a very small portion of the work to be undertaken. Moreover, this difficulty is easily surmountable by working after midnight when necessary.

The law appropriated $100,000 for a building, the cost of which was limited to $250,000. To meet the demands of manufacturing and technical interests for heavy testing work, and for experimental work requiring extraordinary facilities, a large and well equipped power plant is required, and this makes necessary the erection of a separate power house at some distance from the main building. The elaboration of the numerous details of construction of the two buildings occupied a great deal of time, and as the work progresses its scope broadened with it, so that when the preliminary estimates of the cost of erection of buildings of the necessary size had been made by the supervising architect of the Treasury, under whom the buildings are to be erected, it was found impossible to construct them for the sum specified. An additional appropriation of $75,000 was therefore asked for, and has just been granted.

The main building, as shown in the accompanying illustration, will be four stories in height, approximately 150 feet long, and 50 feet wide; and will contain about 50 rooms, all equipped with apparatus for verification work and for special investigations, and provided with gas, electric light, compressed air, suction, hot and cold water, as well as with a number of independent electric circuits, so that electrical currents of any desired character may be obtained.

The importance of temperature control in a physical laboratory has long been appreciated, and it is especially desirable in an institution where standardizing work is to be done, as nearly every result depends at least to some extent upon the temperature at which the measurements are made. Accordingly, means will be provided for closely regulating the temperature of any room at any desired temperature, both in summer and in winter, as will be more fully described below.

In most laboratories the basement, which, on general principles would really be most suitable for precise measurements requiring the greatest stability and freedom from vibration, has to be devoted to the heating, lighting, ventilating and power plant, and to miscellaneous purposes. As a special power house is here to be provided, the basement of the main building, which is almost level with the ground and well lighted, will be utilized solely for the more precise work. Four of the rooms are to be fitted up as special temperature rooms.

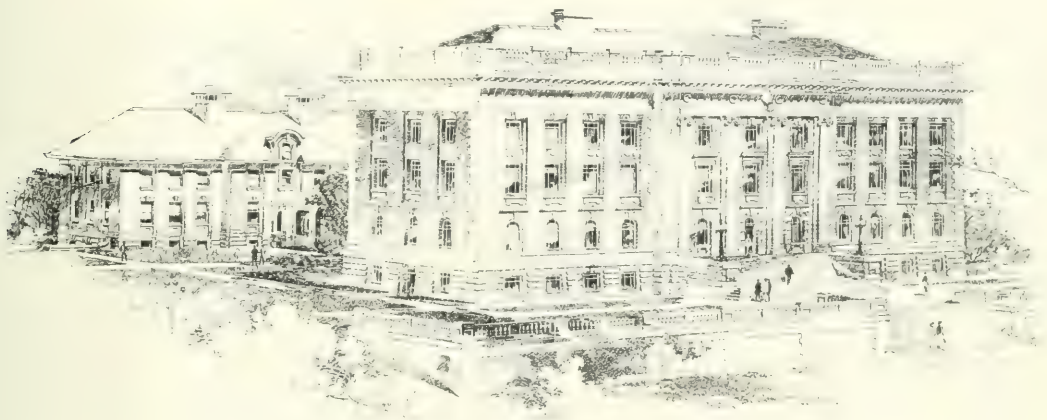
The basement will be vaulted over, so that the first floor rooms will be almost as free from vibration as those on the floor below, and will therefore also be utilized for laboratory purposes.

The second floor will be set aside for the administrative and clerical work, for the library, and for the museum, in which standards and apparatus of historical importance will be preserved.

A well equipped chemical laboratory will be fitted up on the third floor, part of which will accommodate a laboratory for photometric research. There will also be provided on this floor a lecture room with a seating capacity of 150-200. As it will be the policy of the Bureau to keep in close touch with the interests it serves, it is hoped that it may soon be in a position to extend invitations to scientific and technical associations to hold their meetings from time to time in Washington.

THE MECHANICAL LABORATORY.

The mechanical laboratory will be a three-story building, 135 feet long and 50 feet wide, and will contain the power and lighting plant,



BUILDING OF THE NATIONAL BUREAU OF STANDARDS.

storage batteries, special alternating current machines for experimental and testing purposes, the refrigerating plant, the heating and ventilating plant, auxiliary apparatus, the machine shop and carpenter shop, as well as laboratories for heavy electrical testing, photometry, gas and water meter testing.

Boiler Room.—In the boiler room two 125-hp boilers are to be installed, space being provided for doubling this capacity.

Dynamo and Engine Room.—Two 80-hp high-speed engines, each direct-connected to two 25-kw. direct-current generators, will be installed. Additional space will be provided for a unit of double this size as well as for the special alternators referred to below.

The Heating and Ventilating Plant.—In the combined heating and ventilating system to be adopted, the air will be supplied to the various rooms by means of ducts, with the aid of electrically driven fans, the temperature of any room in either building being independently controllable by a thermostatic damper at the bottom of the respective flues, where the heated or artificially-cooled air will be mixed with the air from without. The ducts are so proportioned as to permit a complete renewal of air every fifteen minutes. In winter the air to be heated will be passed over coils fed with exhaust steam, and in summer the air will be cooled by coils through which cooled brine is circulated.

Refrigerating Plant.—To cool the air and to provide artificial ice,

a refrigerating plant of thirty tons ice melting capacity will be installed. Although the building will be used only a portion of the 24 hours, provision will be made for fully utilizing the refrigerating capacity, with the aid of a brine tank of sufficient capacity, the refrigerating machine being operated throughout the whole night when necessary.

Instrument Shop.—The instrument shop, a most important adjunct to a modern laboratory, will be equipped with the latest types of motor-driven precision and engine lathes, milling machines, shapers, drill presses, etc. The shop has not yet been organized, but three or four mechanicians are provided for from July 1, 1902.

A liquid air plant of sufficiently large capacity for all experimental purposes likely to arise, is also to be installed.

The auxiliary apparatus will consist of an exhaust fan for ventilating hoods, the storage battery room, the toilet rooms, etc.; air compressors, vacuum pumps, pumps for circulating the hot and cold water, etc.

As the public gas mains are not yet laid as far as the site, a gas plant will also be installed.

A storage battery room of considerable size is to be provided, and an adjoining room is to be fitted up for heavy current testing. Several of the rooms on the first floor will be used for experimental work, although no doubt as the work of the Bureau develops additional buildings will have to be provided, and the first of these will, in all likelihood, be an electrical laboratory. The mechanical laboratory will then be given up principally to power purposes and to the instrument shop. From present indications this contingency is likely to arise even before the buildings now planned are ready for occupation.

The third floor of the power house will, for the present, be devoted to gas and incandescent lamp photometry, and to gas and water meter testing.

The opinion has been expressed that the Bureau will not be ready to undertake verification work for some years, pending the construction and equipment of the buildings. Recognizing the importance of immediate work along a number of lines, temporary quarters have been secured in the Coast Survey Building, and arrangements are now being made to secure additional quarters nearby. In these apparatus will be installed and put in actual use as quickly as possible. Some of the work is already well under way.

One of the rooms has been fitted up for photometric purposes, and while the Bureau is not yet ready to verify incandescent lamps as photometric standards, the necessary apparatus has been delivered or is about to be delivered so that actual work can soon begin; and it is hoped that an announcement can be made within the next six months that photometric standards will be received for verification. Provision will be made for arc and Nernst lamp photometry, as well as for the photometry of Welsbach and acetylene lamps and other commercial types. The Bureau will exert its efforts to provide for a practical means of determining mean spherical candle power at the earliest opportunity. The question of photometric standards will also receive consideration, it being recognized that while the Hefner lamp is the best standard available, it is more than likely, judging from the researches at the Physikalisch-Technische Reichsanstalt, that a standard superior in every respect may soon be realized.

THE STANDARDIZATION OF ELECTRICAL STANDARDS AND MEASURING APPARATUS.

Pending the construction of primary mercurial resistance standards, a number of 1-ohm manganin coils have been adopted by the Bureau as primary standards of reference. The values of these are *certainly* known to within .002 per cent., in terms of the primary mercurial standards of the Reichsanstalt, and errors due to variations are avoided by periodic reverifications at that institution. The construction of primary mercurial standards and secondary mercurial standards will very shortly be undertaken.

The manganin standards of the Bureau, which range from .0001 ohm to 100,000 ohms, have been subjected to repeated intercomparisons, the value of the multiples and sub-multiples of the units being determined in terms of the 1-ohm coils. The Bureau is thus equipped to undertake the verification of resistance standards, resistance boxes, potentiometers, ratio coils, volt boxes, and ammeter shunts, except for the present in cases where the resistance is to be determined when carrying large currents.

Facilities will shortly be provided for determining the specific conductivity of materials used for electrical conductors, and also for the determination of the tensile strength of such materials. Provision is also being made for the determination of insulation resistance, as well as dielectric strength and capacity of insulated wires and cables. The Bureau is prepared to receive for verification Clark and other types of standard cells, the values of which will be expressed in terms of the mean of about three dozen Clark cells which have been constructed at the Bureau.

The Bureau is also prepared for the verification of direct-current measuring apparatus of limited range, in limited quantity, millivoltmeters and voltmeters up to 150 volts, ammeters up to 100 amperes, and arrangements are being made for increasing the range to 2000 volts and 1000 amperes, when direct current wattmeters, watthourmeters, etc., will also receive attention.

Special facilities will be provided for alternating current testing. The alternators for experimental and testing purposes will all be driven by direct-current motors operated from the generators, or when necessary from independent storage batteries. Thus for investigating the influence of the higher harmonics on measuring instruments, condensers, transformers, arc lamps, etc., a set of motor-driven alternators, having relative frequencies of 1, 3, 5, 7, 9, 11, 13, and 15 times the base frequency, will be provided. All of these machines are to be connected to one shaft, and will be arranged so that the amplitude and phase of any component may be varied independently. The base frequency may be varied between 25 and 125; though for the latter frequency it will not be possible to work in the highest harmonics.

From this necessarily brief outline of the plans of the Bureau it will be seen that provision will be made for the verification of every type measuring apparatus which the electrical engineer is likely to submit, and it is hoped that as soon as the buildings are completed the Bureau will be in a position to undertake for the National Electric Light Association, and for similar bodies, the solution of important technical problems requiring extraordinary experimental facilities, and to co-operate with them in every possible way within its proper scope.

Grounded Secondaries.

A "Question Box" query at the recent Electric Light Convention as to the desirability of grounding secondaries brought forth a number of opinions. Mr. F. Elwood Smith, of Somerville, Mass., said that he believes that secondaries should be grounded, but does not know the best way to do it. Mr. R. G. Patterson, Waterville, Maine, believes it is impracticable, if not impossible, to maintain a ground sufficiently good to protect from accidents, and that even if that difficulty were overcome it would still be a question if the same expense could not be better applied in providing proper precautions to prevent accidents by so arranging that grounds could not be made by users with ordinary care. Grounding puts an unusual strain upon the transformer insulation, especially in lightning storms, and if it must be done, Mr. Patterson considers that the customers should do it and maintain the ground. His company has entirely abandoned the practice of grounding the secondary, owing to its unfavorable experience.

Mr. F. L. Sargeant considered it very important to ground the secondaries, as in the case of a cross between the primary and secondary lines it would prove a protection to the houses, and also in the case of a break-down between the primary and secondary windings. Mr. Jas. E. Pyle, Westchester, Pa., was opposed to grounding where overhead lines are used. He said his company had had several fires on account of the grounded system. When one wire becomes grounded there is a good chance to set fire to a roof if it is also grounded on a wire of different polarity, as when a service wire is pulled down by any cause, or becomes crossed with a telephone or telegraph wire that may be pulled across the main, or break and fall on a service wire. Another source of trouble with the grounded system is the burning of insulation joints. Mr. Pyle's company has had much trouble from joints giving out through fixture wires becoming grounded on the fixture, in which case the joint is sure to ground soon after. In conclusion he stated that he thinks it would be feasible to keep the entire system free from grounds.

Mr. W. J. Greene, of Cedar Rapids, Ia., favored grounding of secondaries, but awaited results from such practice before coming to a definite conclusion. Two secondaries grounded on his system several weeks before, but no trouble resulted; several storms have

prevailed since in which a number of transformers, recently grounded on one leg of the secondaries, were burned out. The writer of an anonymous communication said he had not availed himself of the right to ground circuits as permitted by the underwriters' rules, for he feared it would lead to carelessness on the part of employees. Should a house become grounded, instead of removing the ground, it would be a very natural thing simply to throw the ground on a leg of the secondary system. Aside from this fact, however, he believed that grounding is a wise precaution, and should be adopted.

Mr. P. Junkersfeld said that his company favors the grounding of the neutral on one leg of the secondary system, since this offers better protection to life and property. If one leg is properly grounded the maximum potential between any secondary wire and the ground is practically limited to the lamp voltage, since in the case of a breakdown between the primary and secondary there is a path to ground through the grounded secondary terminal. With an interconnected secondary system, electrostatic capacity might be troublesome and even dangerous, but it is entirely eliminated by grounding one terminal. In Chicago it is a comparatively easy matter to establish a good ground by burying a copper plate at the time the pole is set, or by driving a 1-in. gas pipe to a depth of, say, 6 to 8 feet.

Mr. H. H. Scott, of Lincoln, Neb., considered that if one of the three wires of a secondary system is to be grounded, it should be the neutral, for in this case it is only possible to get 110 volts on a 110-220-volt system in case of a breakdown causing accidental ground on either of the outside wires. Mr. F. L. Sargeant, of Malden, Mass., agreed in this, and also Mr. Jas. E. Pyle, of Westchester, Pa.

Developing a Power Service.

A number of opinions were presented [illegible] vention as to the best manner in which a central station power service may be developed. Mr. R. J. Patterson considered it to be a question of making the price right and letting people know it. He believed that the price should include an installation charge to make up for any loss due to the fact that the motor is only taking current part of the time. Mr. E. H. Mather, of Portland, Me., suggested an arrangements of the plant and distribution which will reduce the manufacturing and distribution cost to a minimum, and to present the advantages of electric power to the public through capable solicitors.

Mr. Chas. H. Peters, of Durango, Colo., suggested selling motors on a small margin of profit, and in case where a customer using steam is thinking of making a change in power, to offer to take a few indicator cards under varying loads, from which to calculate the average horse-power, and then to give the customer an idea of what the power will cost him, approximately; otherwise a rate based merely on kw-hours will not be understood.

An anonymous communication expressed the opinion that the best results will be obtained by employing a competent engineer to encourage power business, and to apply individual methods to each power consumer. The great difficulty in the way of obtaining power consumers is that they always believe power is costing them less than it really is, and that they think they are using more power than they really are. The total power is best obtained by indicating the engine, and the transmission losses are measured by running certain groups of machinery idle some day when the factory is not in operation.

Mr. John Gilchrist, of the Chicago Edison Company, suggested putting in the field as exclusive power solicitors, men who have had some experience in the installation and running of machinery, who will present in detail to the users of power the advantages of electrical machinery. It should be made easy for a man to install the service, either by selling him the motors at cost, or enabling him to buy them upon a time basis of one or two years, with a very small interest charge. It should be assumed that no good business man is going to take up a new thing at a considerable expense unless the concern which is selling it is sufficiently anxious to get the business to do the walking and talking, and is willing to bear at least in part, if not all, the chances of its being unsatisfactory.

Mr. P. G. Glossler, of Montreal, suggested that preliminary to a contract, a customer should be induced to ascertain as nearly as possible what his power under present conditions is costing him. The customer should be favored who will have a high average demand; the rates for the customer who has a very variable load and a very high maximum, and low average demand, would necessarily be higher, but should still be below the cost of power supplied from an isolated plant. A reasonable reduction in rates should be made as the quantity increases, in order to encourage large power users to employ electric power. The basis of measurement should be the volt-ampere and not the watt. There should be several bases for charging, and equivalent rates should be quoted in several ways so that the customer may select the one which he thinks suits his particular case the best. A limited service field should be cultivated as much as possible by offering good discounts to customers who are willing to shut down their motors in whole or in part during the time of peak lighting load. In case of fixed and meter rates, the discount should be taken from the fixed rate, as this would be more attractive to the customer. Power users will be apt to be skeptical as to the feasibility of limited service, but if proper discounts are allowed, many will be found who can take power under this class of contract to the advantage of both customer and station.

Niagara Power for Toronto.

It has been determined that the transmission of the energy of Niagara to Toronto, Ont., is to be accomplished at a voltage of 60,000. For some little time experiments have been in progress at Niagara Falls, N. Y., where a line on which 60,000 volts were carried has been experimented with, the result being that it is announced that this voltage will be applied to the transmission line about 90 miles long, extending from the Canadian side at Niagara to the city of Toronto. In the plant of the Canadian Niagara Power Company the power will be developed at a voltage of 11,000, and in units of 10,000 hp. Details of this have already been given in ELECTRICAL WORLD AND ENGINEER. A contract has been awarded to the Canadian General Electric Company for 12 transformers, to be used in stepping-up the voltage from 11,000 to 60,000. The amount of power to be transmitted to Toronto at the start will be 10,000 hp, the entire product of one of the generators.

While it has not been stated what kind of cables are to be used on the transmission line, the indications are that aluminum will be the metal favored. It will be recalled that the last transmission system installed between Niagara Falls and Buffalo by the Niagara Falls Power Company uses aluminum cables. These have been giving good service, and when it is considered that the use of aluminum will aid in effecting quite a saving in the pole line construction for the distance of 90 miles, there is some reason why the white metal should be used.

Work on the tunnel and wheel-pit of the Canadian Niagara Power Company is moving along at good speed. Over 1,000 feet of the tunnel has been driven, and the pit is being sunk at a satisfactory speed. While the Canadian Niagara Power Company will be the generating company, it is not certain whether it will undertake the Toronto transmission, or whether it will dispose of its current product at the station to another company, which will transmit it to Toronto. At the last session of the Dominion parliament the Toronto and Niagara Power Company was incorporated. So far, little is known of this latter company, but it may be its purpose to participate in the transmission of Niagara power to Toronto.

Toronto has been an eager applicant for the power service of Niagara, and for all the power the Canadian Niagara Power Company may have developed the latter half of next year; there will, perhaps, be little need of Toronto waiting until that time, providing the transmission line shall be completed before then, for the installation of the new wheel-pit and station of the Niagara Falls Power Company, at Niagara Falls, N. Y., will, it is expected, be supplying power this coming fall, and could spare 10,000 for the Toronto transmission if it was desired. In this connection, it is interesting to note that at a meeting of the directors of the Canadian Niagara Power Company held in Toronto Saturday, June 7, W. H. Beatty was re-elected president; William B. Rankine, vice-president and treasurer, and A. Monro Grier, secretary. The executive board is composed of the president, vice-president and Wallace Nesbitt.

Coronation Telephones.

A cable dispatch from London states that all the houses that are being loaned to or hired by the King for coronation guests are being connected with Buckingham Palace by telephone, for convenience in making appointments and ordering carriages.

New Telephone Patents.

Telephony this issue of June 3 contributes five patents, none quite without interest, but none of prime importance to the art. The range of subjects is sufficiently wide, as intercommunicating systems, party-line calls and automatic switches are all represented, and a novel indicator and a new method of telephoning round out the list. An intercommunicating switch, the joint invention of Nathan Bassett, of Philadelphia, and William S. Phoenix, of Camden, N. J., has several ingenious features. The switch contacts are made by means of U-shaped springs attached to plugs 22, sliding in disk 18, the top of the plug 23 projecting above the cover of the base of the instrument. As shown in the detail sketches of Fig. 1, the spring contact-maker is a continuous piece, and the plug may be of metal; in this case the depression of the plug, by spreading the ends 25 of the U-shaped spring 24, brings them in contact with posts 26, so completing the circuit. This is for a common return system; with metallic circuits the form shown in the lower sketches is used, the plug being of insulating material and carrying two springs insulated from each other; the springs make rubbing contact with plates 31, held under screws 30, to each of which one wire of the circuit is attached, the other two wires being connected to posts 29, insulated from screws 30 by the disk 18 of insulating material. The depression of the plug by bringing the springs in contact with posts 29 completes the circuit between 29 and 30 on each side. The plugs are set circularly in a disk, 18, of insulating material, each plug-hole, 20, having gains, 21, in which the springs slide. When the receiver is on the hook all the plugs are automatically locked out of action by the disk 15, attached to bar 13, which passes through the center of the stand and is pivoted to the switch-hook 12 at 14. When the receiver is on, the hook 15 is raised and prevents the operation of any of the plugs.

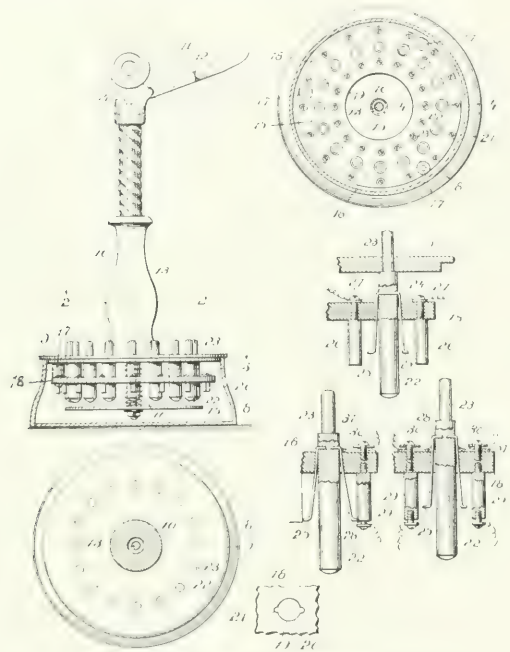


FIG. 1.—INTERCOMMUNICATING TELEPHONE SWITCH.

Mr. Joseph B. Baker makes a highly ingenious application of the properties of translucent material in a signal or indicator, in which the target is moved too and fro behind a translucent screen. The invention is based on the fact that an object placed immediately behind a translucent screen, such as a piece of ground glass, is plainly visible through the ground glass, but becomes invisible on being moved a very short distance away. Mr. Baker embodies this principle in a signal, "the details of construction of which may vary almost indefinitely, but which all have the generic combination in common in which my invention, broadly stated, consists—namely, a translucent body and a movable signal emblem or device moving toward and from it from behind.

"In the posterior position the signal emblem or device may be rendered entirely invisible, if desired, by removing it to a sufficient distance from the translucent body. In the anterior position the signal may be rendered about as clearly visible as if the translucent material were removed by having the emblem contact with the translucent material, or, if a lesser degree of visibility suffices, the signal emblem in its anterior position is made to lie near to without touching the translucent substance. The translucent body may naturally be made of a variety of materials. I have found ground glass to answer excellently."

Mr. Baker further points out that glass coated with a preparation to make it semi-opaque, glass covered with tissue-paper, celluloid with or without glass, are examples of translucent materials that may be employed. The movable signal may be of a variety of shapes and colors, a black or white disk plain, lettered, numbered or marked with a special device. In all cases the movable emblem is nearly or quite invisible through the translucent material in its posterior position, and it becomes plainly visible in its anterior position.

All this being set forth, a description of the embodiment of the

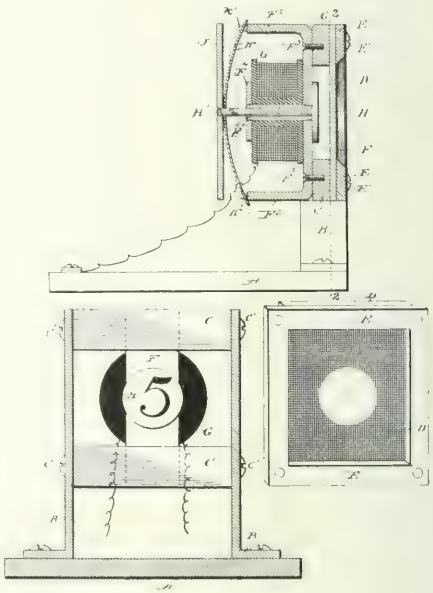


FIG. 2.—BAKER SIGNAL.

invention shown in the drawings is hardly necessary. Referring to Fig. 2, *D* is the translucent screen and *H* the target carried on the rod *H'* of non-magnetic metal projecting from the armature *J* through the core of the magnet. The armature is retracted, holding the target in the invisible position by the blade spring *K*. When the magnet is energized the target is moved forward against the screen, as shown by the dotted lines. A lower figure shows the screen masked by opaque paint except for a circular area the size of the target; this renders the target less visible when retracted, and heightens the contrast when the target is moved forward.

Mr. Nils Emel Norstrom, of Chicago, patents for automatic exchange purposes an arrangement of relays similar to that described in a previous application filed March 31, 1900, but differing in details of construction. The principle is an automatic switch for each telephone, the operating magnets of the switch being controlled by a relay operated by the telephone station. The drawings (Fig. 3) show a side elevation of the relay and connected mechanism together with connection to a battery and one magnet of an automatic switch; a front elevation of the same and a diagram of connections of a series of telephones and relays. The bars *N* and *S* of soft iron are polarized by the permanent magnets *M*. The brackets *N'* on the south bar, *S'* carry the relay magnets *K K''*, and the pivot blocks *V* on the north

bar, N, carry the armatures N^1, which, when attracted, close the circuit of connecting switch, A, as clearly shown in the middle figure. There are two moving magnets, A and B, for each switch, as shown in the lower figure, only one, A, being shown above. From each telephone station having battery, Y, a wire, 10, runs to relay R, and is branched by 11 to R^1, and wire 13 runs to R^1 and is branched by 12 to R, so that current sent over either line divides between both coils, the coils being so connected that current, say on line 10, causes the

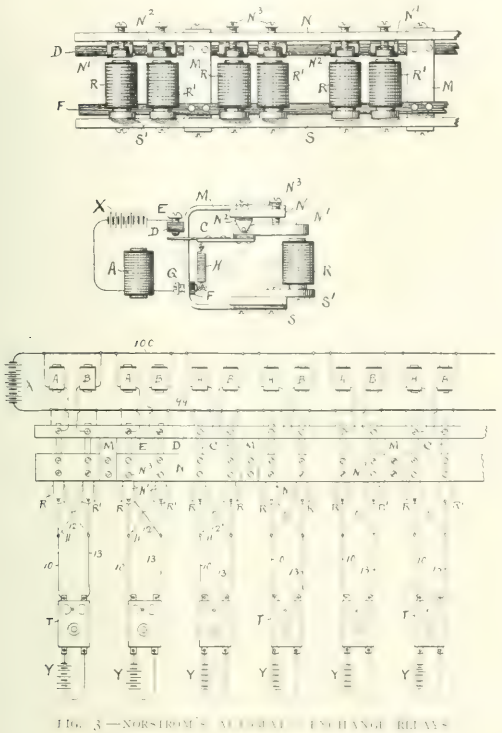


FIG. 3.—NORSTROM'S AUTOMATIC EXCHANGE RELAYS.

upper end of one magnet to be of north polarity and of the other to be of south polarity. The armatures N^1 polarized by N are all of the same polarity, and when R is made south and R^1 north, the armature of R will be attracted and that of R^1 will not. The attraction of the armature of R closes the circuit of magnet A. A reversal of the conditions, caused by sending current on line 13, will cause the armature of R^1 to be attracted, that of R remaining inert, and close the circuit of switch B.

Recent Progress in Electrochemistry.

BY CLINTON PAUL TOWNSEND.

A novel method for the production of calcium carbide is suggested by MM. Vulitch and d'Orlowsky, of Paris, the authors proposing as an alternative to the usual practice of heating a suitable mixture of lime with carbon, to first fuse the lime in an arc furnace, and then discharge the molten mass into an excess of heavy hydrocarbon, such as "masud," or other residue of petroleum distillation. The formation of the carbide occurs within the body of the hydrocarbon and the product possesses, as would be expected, some distinctive properties, it is loose and non-coherent, and is saturated throughout its mass with the hydrocarbon, which modifies its relations with water, rendering it practically non-hygroscopic. It is peculiarly adapted for the intermittent generation of acetylene, since it is not penetrable by water and the evolution of gas continues only during the period of actual immersion. It is asserted also that it is free from phosphorus, which is eliminated by forming with the hydrocarbon volatile hydrides.

METALLIC PAINT.

Hall's improvements in electric furnace methods for the purification of bauxite were described in the ELECTRICAL WORLD AND ENGINEER, issue of July 6, 1901; as will be recalled, the silicon and titanium are separated by reduction, and are collected in iron, either normally present or added in proper quantity. An additional patent issued to Hall, under date of June 3, 1902, deals with the utilization of this alloy as a basis for a metallic paint. An alloy containing about 60 per cent. of iron and 40 per cent. of one or all of the electropositive metals mentioned, is brittle and readily comminuted; mixed or ground with oil it constitutes the paint of the patent.

COLLOIDAL METALS.

The colloidal condition assumed by many metals under special conditions of precipitation is clearly a problem for the electrochemist, and when fully elucidated will undoubtedly throw additional light upon the mechanics of solution. Such metals as gold, silver, platinum, tin and mercury, may be readily obtained in a form soluble in water, but separated therefrom by evaporation, freezing, or the addition of electrolytes. Subjected to the electric current they separate upon the anode, or if a diphragm be employed, upon its negative side. In common with other colloids they are incapable of penetrating a porous membrane, and their solutions may therefore be concentrated by dialysis.

Colloidal silver is well known through the classic work of Carey Lea; colloidal gold has been studied by Zsigmondy, who prepared it by the reducing action of aldehydes upon extremely dilute hot alkaline solutions of chlorid of gold; and colloidal mercury has been prepared by Lottermoser by reduction by stannous chloride. Gold, silver, platinum, cadmium and zinc have also been obtained in this form by Bredig by the action of a luminous arc between metal wires in an extremely dilute solution of caustic potash. Dr. Carl Paal, of the University of Erlangen, has now prepared both gold and silver not only as colloidal solutions, but as measurably pure metallic products. The gold exists as bright scales of bronzy luster containing over 70 per cent. of the metal, and the silver as lustrous blue scales of above 90 per cent. purity. Both metals readily and completely dissolve in water, the silver with a bright yellow-brown coloration and the gold to the intense red solution of Zsigmondy. Both metals are precipitated by dilute acids, but in sharp contradistinction to the forms heretofore obtained, the precipitates readily dissolve again in weak alkali.

The colloidal gold is prepared by pouring the chloride in concentrated aqueous solution into a heated alkaline solution formed by the treatment of albumins with warm dilute alkali; the solution obtained is dialyzed against water, precipitated by dilute acetic acid, redissolved in dilute caustic soda, and the metal recovered by slow evaporation. Colloidal silver is prepared in a substantially similar manner.

Marconi Station at Cape Cod.

It is stated that the new Marconi station at Cape Cod will be ready at the end of this month. The station is on a bluff, about 100 feet above sea level, and is nearly 2,900 miles from Poldhu, in Cornwall, from which point communication with Newfoundland was effected last December. Four square wooden towers have been erected at this point. Each measures 28 feet across at the base, is from 9 to 11 feet across at the top, and attains a height of 215 feet from the earth. The towers stand at the corners of a square, whose sides are 210 feet long. Each one is cross-braced with steel wire rope, such as is used in rigging a yacht. Then all four are connected with each other by diagonal stays. Finally, to render the structure still more rigid and windproof, stout cables are run up over the tops of each pair of towers on all sides, and secured to anchorages in the earth. So much for the architectural features of the station.

From each of the four horizontal bridges which connect the tops of the towers are suspended 50 copper cables. The cables are composed of seven strands, one-eighth of an inch in diameter, tightly twisted together. Outwardly these cables look like single wires at a short distance, but in reality there are 350 wires on a side, or 1,400 in all. Perhaps the reason for using many fine strands instead of

amount of copper. It will thus be seen that the solitary "vertical wire" of the orignal Marconi experiments has now been enormously multiplied. Since the length of a Hertz wave is four times the length of the vertical wire, or antenna, waves not far from 860 feet (or one-sixth of a mile) long should be developed at the Cape Cod station. This corresponds to a frequency of about 1,100,000 a second. The 50 cables of each of the four groups converge a little as they go downward, and also incline slightly toward the center of the quadruplex edifice. The lower ends, therefore, are arranged along the sides of a square much smaller than that formed by their supports at the top. It is expected that Mr. Marconi will retain the coherer as his receiving instrument at South Wellfleet.

In the transmitting apparatus transformers will be substituted for the old-fashioned induction coil. The spark-gap will be scarcely more than an inch long, but the spark itself will be widened, or thickened greatly by the shortness of the interval. It will be produced between globular terminals, two inches in diameter. An alternating current, generated by a 40-hp dynamo, will do the work. The voltage will be raised by the transformers from 2,000, at which the current is to be generated, to 20,000. Condensers and other electrical appliances will increase this still further. Thus a voltage of from 50,000 to 70,000 will be secured. The dynamo will be driven by two 22-hp gasolene engines, run in combination.

CURRENT NEWS AND NOTES.

TIMELY TOPICS.—At the recent Electric Light Convention a vote was taken to ascertain opinion as to relative interest taken in the principal subjects discussed at the meetings. The vote stood as follows: Rates, 27; hot water vs. steam-heating, 13; free lamp renewals, 5; improvements in meters, 5; gas engines, 3.

CANADIAN ELECTRICAL ASSOCIATION.—The Association began its meeting this week at the Chateau Frontenac, Quebec, where 82 members had already registered on Tuesday. The halls and parlors have been specially decorated with garlands of the Elblight cable, holding 2,000 lamps, while a mile of the cable has been festooned along the ramparts with 4,000 lamps in red, white and blue.

MARINE ENGINEERING CONGRESS.—The proceedings of the International Navigation Congress, which will be held in Dusseldorf, Germany, from June 29 to July 5, will be printed in German, French and English for distribution to those who subscribe as members of the Congress. About 100 papers will be presented for discussion. Applications for membership will be received up to the date of the Congress by the Secretary, 80 Wilhelmstrasse, Berlin, W., Germany.

LIGHTNING AND SYNCHRONOUS APPARATUS.—In answer to a query sent out by the National Electric Light Association, as to what effect lightning will have on synchronous apparatus operated from transmission lines. Mr. C. E. Burrows, of Walla Walla, Wash., communicated the answer that with single-phase apparatus, lightning always causes step to be broken, and generally burns out one or more coils of the generator. As a consequence of this, his company has discarded single-phase synchronous apparatus.

TELEGRAPHERS' WAGES.—It is stated that Western Union employes are much disturbed over the wholesale reductions in salaries which are now being made. It is said to be the ambition of the management to increase the profits of the company $2,000,000 a year. It is also noted that reports of a growing uneasiness among the company's operators have been published in some of the daily papers, but Superintendent Brooks states that there is no real cause for it. The shifting of men from the regular force to the waiting list, and other changes of similar nature, are looked upon by the men with disfavor. It is reported that the telegraphers are organizing a union for protective purposes. New York Central Railroad will advance the wages of 2000 signalmen, telegraphers and towermen.

WIRELESS TELEGRAPH PLANTS.—The Marconi Wireless Telegraph Company has completed its new station at Sagaponack, near Bridgehampton, L. I. This will supplement the Nantucket Station's work in furnishing maritime information. The American Line has signified its intention of installing the Marconi system now used on the Philadelphia, on board the St. Louis and the St. Paul. The United States Coast Survey has made arrangements to use the device on board of one of its steamers, and the United States Signal Corps has signed a contract for its employment in Alaska. The towers at Cape Breton, it is reported, have been completed.

DANGER TO CABLE STEAMER.—It will be remembered that the cable steamer "Grappler" was destroyed by the volcanic eruption at Martinique. A dispatch of June 10 from St. Thomas, W. I., says: In the course of the eruption of Mont Pelee, on the Island of Martinique, which occurred June 6, the sea rose about twenty-eight inches at Fort de France and then fell again. The rise of water did not cause any damage. The French cable repair ship "Pouyer-Quertier" was directly opposite the lower crater of the mountain on June 6 grappling for a cable five miles off shore when dense black clouds shot down from the volcano in the direction of the sea. This phenomenon was similar to that of May 8, but the clouds moved in another direction. The "Pouyer-Quertier" fled from the spot at full speed, and the clouds followed the steamer about one mile astern. The vessel's decks were covered deep with ashes, mud, and stones, which rained from a huge cloud that had shot up to a great height from the top of the crater.

INDEPENDENT TELEPHONE CONVENTION.—With regard to the Philadelphia convention of the Independent Telephone Association of the U. S. A., to be held June 24, 25, and 26, we may now add that the headquarters will be at the Hotel Walton. A circular has been issued by President Thomas and Secretary Sheerin inviting attendance. The local Philadelphia committee is S. E. Wayland, R. H. Foederer and C. E. Wilson. Inquiries, names of delegates, etc., should be addressed to Mr. Wayland. The Keystone Telephone Company and other organizations will extend courtesies of various kinds. The convention will be called together at 10 o'clock Tuesday morning, and the sessions will be held in the Palm Roof Garden of the Hotel Walton. Tuesday afternoon will be devoted to sightseeing about the city. Business session will be held Wednesday morning, followed by a tallyho ride up the Wissahickon. Wednesday afternoon. Thursday morning another business session of the convention will be held for the election of officers, etc., and at the close of the convention an excursion will be given to Atlantic City.

A. A. A. S.—The Finance Committee of the coming convention of the American Association for the Advancement of Science has already raised $7,500 toward the expense of the meeting. The largest contributor is Mr. George Westinghouse, who cables from abroad a subscription for $1000. Mr. H. C. Frick and the Carnegie Steel Company each contributed $500. It is expected that the attendance at the meeting will exceed 1000, and every arrangement is being made for the proper reception and entertainment of the visitors. Of the 23 papers to be presented in Section B (Physics) at the Pittsburg meeting of the American Association for the Advancement of Science, no less than 14 are on electrical and magnetic subjects, as follows: "Contributions to the Theory of Concentration Cells," by Prof. H. S. Carhart; "The Oscillatory Charcter of Lightning," by Prof. A. W. Muth; "On the Complex Product of e. m. f., Current and Other Vectors," by Prof. H. T. Eddy; "Direct-Curent Dynamos Arranged in Series for High-Tension Work," by Prof. G. S. Moler; "Results of Recent Magnetic Observations," by L. A. Bauer; "Some Recent Magnetic Disturbances," by L. A. Bauer; "Theory of the Electrolytic Rectifier," by Prof. K. E. Guthe; "Rayleigh's Alternate Current Phasemeter," by Prof. E. S. Johonnott; "Efficiency of the Mercury Arc Lamp," by W. C. Geer; "A New Form of Laboratory Switchboard Jack," by Prof. F. C. Coldwell; "A New Variable Inductance Coil," by Prof. F. C. Coldwell; "Effect of Electrolytic Condensers in Alternater Current Circuits," by A. Trowbridge and E. R. Wolcott; "Emission of a Righi Vibrator and the Measurement of the Length of Electric Waves," by H. R. Willard and L. E. Woodman; "Radiometric Receiver for Electric Waves," by G. F. Hull.

THE PENNSYLVANIA RAILROAD'S TELEGRAPH SYSTEM.—It is reported from Philadelphia that negotiations are in progress between the Pennsylvania Railroad and the Postal Telegraph Company concerning the operation of the railroad telegraph system. As noted in these pages, May 24 last, the existing contract between the railroad company and the Western Union Telegraph Company, which is now operating on the railroad company's right of way, will expire six months hence and the Pennsylvania Company has given the Western Union Company notice that it will not renew the contract.

ELECTRIC ROAD FOR SPAIN.—Mr. Julius G. Lay, U. S. Consul-General at Barcelona, Spain, writes: A royal decree of March 7th grants a concession to Don Teodoro de Mas y Nadal to construct, within the next six years, an electric railway between the towns of Vich and Amer, in the province of Gerona. The capital of about $1,200,000, which is estimated as necessary to build this railway, has not yet been subscribed; but if Señor Mas is as successful in securing capital from foreign countries as other promoters of electric railways have been, it will only be a short time before the road is in operation. I send a memorandum of this project, showing in detail the estimated cost of construction, material required, water power available, cost of maintenance, receipts, etc.

ELECTRICITY FROM AIR.—The London *Daily Mail* hears from its Las Palmas, Canary Islands, correspondent that Señor Clemente Figueras, of that place, has discovered a method of "directly using atmospheric electricity without chemicals or dynamos and practically applying it without any motive force." Señor Figueras is jealously guarding his invention and is not disposed to say anything more about it just now than "that the only extraordinary point about it is that it has taken so long to discover a simple scientific fact." The inventor, who is professor of physics at St. Augustin's College, Las Palmas, will, according to a despatch to a New York paper, soon go to Madrid and Berlin to patent his invention. It is stated in the original communication that Prof. Figueras "has constructed a rough apparatus by which he obtains a current of 550 volts, which he utilizes in lighting his house and driving a 20-hp motor." As usual in such cases, "the whole apparatus is so simple that a child can work it."

CIRCUIT VOLTAGE REGULATION.—In reply to a "Question Box" query at the Cincinnati Convention as to what degree of accuracy in regulation should be required in each part of the distributing system between the station switchboard and the consumers' meters, it was stated in an anonymous communication that in an alternating-current plant it is possible and practicable to maintain regulation within 2 per cent., and the writer considered that this should be the maximum limit allowed. In a direct-current plant it is possible but not practicable, to maintain regulation within these narrow limits, and 2 per cent. regulation in such plants was pronounced a myth in spite of the statements of the engineers of direct-current stations. The writer said that in the latest case of a 2 per cent. station which he investigated, he found that the regulation was about four times this in actual results. By a 2 per cent. regulation he understood that the pressure at any point in the system should not vary more than 2 per cent from the maximum voltage.

TRANSFORMER BREAK-DOWN TESTS.—Among the queries in the "Question Box" considered at the recent Electric Light Convention, was one asking for information as to what break-down tests should be demanded of manufacturers of transformers for 2000 to 2500-volt distribution, where secondaries are to be grounded. Mr. E. H. Jenkins, of San Antonio, Tex., considered that 10,000 volts alternating should be enough between primary and secondary coils, between coils and core and coils and case. Mr. R. S. Kelch, of Montreal, said that when the standard insulation of 2½ times the working pressure is required, the transformer is a better lightning arrester than the instruments generally used for that purpose. For the past two years his company has bought transformers with a break-down guarantee of 12,000 volts on the secondary. He considers that the insulation of the secondary should successfully withstand this high-voltage test to prevent the primary current from reaching the secondary winding and the customer's premises. Oil insulated transformers are used exclusively, but the test is made dry, the oil being intended only for cooling purposes.

TWIN CONDUCTORS FOR SERVICE WIRES.—The query, "Are twin conductors desirable for service wires?" elicited at the Cincinnati Convention several opinions. Mr. Edward Slade said that he had found twin cable expensive, but invaluable for service wires, and much appreciated by customers. Mr. W. E. Holmes, of Newton, Mass., was of the opinion, arising from experience, that twin conductors are not desirable for service wires. He put in for secondary house service wires an iron pipe running from below in the street through the cellar wall, into which were drawn twin rubber-covered solid conductors with heavy outside braid. One of the conductors became grounded in the pipe, necessitating the withdrawal of the twin, and it was not found feasible to return the same when the break was remade and insulated, owing to the increase of size at the joint. Mr. Holmes has also used twin lead-covered cable built for 3,000 volts and used on 2,200. This was installed in an iron tube, but broke down after one year's service. In his opinion it is far better to use single conductors, particularly owing to the greater facility for repairs. Capt. Wm. Brophy said that the great advantage of the use of twin conductors is the reduction of fire hazard incident thereto, but the insulation between the wires should be much lower than the insulation between the same and the pipe in which they are carried.

NEW 10,000-VOLT PLANTS IN EUROPE.—A 10,000-volt plant is being erected at Kubel Herisau, near St. Gallen, Switzerland, which will supply Herisau and 15 surrounding towns with light and power. There will be four turbines direct-connected to polyphase dynamos and having a total output of 1,600 kw at 10,000 volts. Up to the present 101 transformers have been connected up, with a capacity of 3,000 kw, and 60 motors, of an aggregate capacity of 760 horse-power, to supply power for about 25 different classes of manufacturers. At Augsburg, Germany, a 10,000-volt polyphase plant is being installed, of a capacity of 4,500 kw in three turbine-driven units. There are also being installed three turbine-driven direct-current machines for an output of 1,000 kw, each at 220 volts. At Sinaia, Roumania, a 1,250-hp polyphase plant is being installed, the generators being direct-connected to turbines. Current will be transmitted to petroleum refining works 30 miles distant, the voltage being raised for this purpose by transformers to 11,000 volts. Seven turbine-driven polyphase generators of 1,600-hp each are being erected at Wangen, Switzerland, power being obtained from the river Aare, below Solothurn. Polyphase currents will be generated at 10,000 volts for distribution over territory the radius of which is 15 miles. All of the above plants are being erected by the Lahmeyer Company, of Frankfort, Germany.

NEW MEMBERS OF NEW YORK ELECTRICAL SOCIETY.—At the meeting of the New York Electrical Society on June 4, the following members were elected: C. T. Badger, Nutley, N. J.; Peter Bartsch, Governor's Island, N. Y.; W. H. Bradley, 412 Columbus Avenue, New York City; George V. Cooper, 133 S. 9th street, Brooklyn, N. Y.; Burch Foraker, 32 Gold street, New York City; Clarence P. Fowler, care Westinghouse Electric & Manufacturing Company, 120 Broadway, New York City; E. W. T. Gray, 120 Broadway, New York; Charles E. Hague, 39 Cortlandt street, New York; Samuel Hoexter, 609 W. 139th street, New York; Wiliam C. Hubbard, 120 Broadway, New York; Arthur W. Johnston, Prince's Bay, N. Y.; Oscar F. Kinzel, 39 Orange street, Brooklyn, N. Y.; John Langan, Okonite Co., 253 Broadway, New York; R. J. Louis, 25 W. 33d street, New York; Dwight D. Miller, 120 Broadway, New York; A. P. Munning, Cutler-Hammer Mfg. Co., 136 Liberty street, New York; Wm. Creighton Peet, 80 Washington Sq. E., New York; Grant B. Rossman, 209 W. 97th street, New York; Wilson Van Buren, 471 Fourth avenue, New York; Joseph Stehlin, 162 E. 93d street, New York; Harry F. Waite, M. D., 108 E. 23d street, New York; G. Harry Barbour, West New Brighton, N. Y.; Fred S. King, 84-86 Chambers street, New York; Lewis H. Nash, 248 Gates avenue, Brooklyn, N. Y.; Will J. Sando, 114 Liberty street, New York; W. L. Voorhis, 14 Cedar street, West New Brighton, S. I.; Adolph C. Martens and Herman A. Martens, 5 St. Mark's Place, New York; Thomas Kennedy, 2145 Second avenue, New York; Elliott T. Abel, 520 W. 51st street, New York; and Geo. D. White, 23 Manchester avenue, Paterson, N. J.

LETTER TO THE EDITORS.

The Longest Telephone Circuit.

To the Editors of the Electrical World and Engineer:

SIRS: In his answer to Prof. Pupin's criticism on modern telegraph methods, Mr. J. C. Barclay, of the Western Union, makes the statement that the greatest length of one continuous circuit operated by the telegraph company is from New York to San Francisco, 3300 miles, and that the longest telephone circuit operated is from New York to Omaha, 1466 miles. It may be of interest to Mr. Barclay and your readers to learn that the Cudahy Packing Company, from their main office, at South Omaha, Nebraska, have had a telephonic connection with the office of their New England manager, No. 1 Blackstone street, Boston, Mass., every morning, for from ten to twenty minutes, for the past four or five years, over the lines of the American Telegraph & Telephone Company. This makes a thorough circuit, by way of Albany, N. Y., direct to Boston, of about 1540 miles, and, as the circuit is quite often made up *via* Albany and New York, it would make it 150 miles or more, greater Conversation is carried on very satisfactorily, indeed. This South Omaha-Boston telephone circuit is, I believe, the greatest distance that is regularly used, in daily business, in the world. In the case of the New York-San Francisco telegraph circuit, there are automatic repeaters every 300 to 500 miles.

SOUTH OMAHA, NEB. C. O. FITCH,
Chief Electrician, The Cudahy Pkg. Co.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Heyland Motor. HEYLAND.—A communication in which he criticises a special point in the paper of Fleischmann and Orgler recently abstracted in the Digest. The Heyland motor, although self exciting, has all the characteristic properties of an induction motor and does not run synchronously at any load. It has not the disadvantages of ordinary "conduction motors" (called by Steinmetz commutator motors), namely, the pulsations of the field and sparking at the brushes.—*Elek. Zeit.*, April 17.

Osnos.—A communication in which he protests against Heyland's characterization of the old Goerges motor (1891) as a commutator motor; he says the Goerges motor does not belong to the ordinary type of series or shunt commutator motors. The Goerges motor ran at synchronism without phase difference, without sparks at the brushes, and without e. m. f. in the armature. The Goerges motor has a primary structure like the ordinary induction motor, *i. e.*, an iron ring; when it is supplied with three-phase currents, a rotary field is produced, and the effective e. m. f. in the armature becomes proportional to the slip and is zero at synchronism. He then reproduces a diagram of an ordinary commutator series motor from Steinmetz's book, in which the pole system is shown to consist of two diametrically opposite poles, like in a bipolar direct-current dynamo, so that under no circumstances can a rotary field be produced. Niethammer defines a conduction motor "as a motor the fixed and revolving windings of which are connected with the line, while the revolving part has a commutator;" if this definition is accepted, both the Goerges motor and the Heyland motor are conduction motors. Goerges' publication shows that he understood the problem and the means of solving it. It is peculiar that he did not follow up his invention. The writer believes that, eleven years ago, there was no need felt for induction motors and that later Goerges' invention was forgotten.—*Elek. Zeit.*, May 15.

Fleischmann and Orgler.—A reply to Heyland's criticism. They maintain that Heyland motor after it has been brought up to synchronism, will continue to run as a synchronous motor. The load at which it will begin to slip depends upon the rotor excitation and the breadth of the commutator segments.—*Elek. Zeit.*, May 15.

Latour.—A communication in which he refers to his patents for a self-exciting alternator. His first experiments have shown him that the commutation was "quite good for any load." "It is to be noted that on acount of the excitation winding being in short circuit through the brushes, there is a strong damping effect on field pulsations. For this reason, when large resistances are introduced into the excitation circuits, sparking can take place at the brushes."—*Elek. Zeit.*, May 22.

Induction Motors.—BERCKENBRINK.—An article, illustrated by diagrams, on the graphical determinations of starting torque and slip of induction motors as functions of the rotor resistance, by means of the Heyland diagram.—*Zeit. f. Elek.*, May 18.

Direct Current Armatures.—EICHBERG.—A communication referring to Arnold's recent paper on equipotential connections in the armatures of direct-current dynamos. He gives a graphical representation of the theory of the subject.—*Elek Zeit.*, April 17.

POWER.

REFERENCES.

Modern Practice in Rocking Valves and Valve Gears.—SCHMIDT.—An article profusely illustrated, dealing with the different types of valves and valve gears employed in modern steam engine practice, together with the reasons for the modifications of the original Corliss type of valve and gear.—*Amer. Elec.*, June.

Condensing vs. Non-Condensing.—HUBBARD.—An article illustrated with diagrams discussing the value of the condenser, and the advantages to be obtained by its use.—*Amer. Elec.*, June.

Compressed Air in Central Station and Railway Service.—WEEKS.—A short illustrated article giving the various uses to which compressed air may be put in and about central stations and railway repair shops.—*Amer. Elec.*, June.

Practical Polyphase Working.—BELL.—An article for those who know a little about direct-current and alternating-current dynamos and who desire to know something of the practical nature of modern polyphase apparatus. The article deals with the installation and operation of polyphase stations with especial reference to the power transmission work for which such apparatus is most extensively used.—*Amer. Elec.*, June.

TRACTION.

REFERENCES.

Calculating the Feeders for Electric Tramways.—SENGEL.—A mathematical article, illustrated by diagrams. In tramway installations relatively large variations of voltage are permissible and the watt losses are, therefore, of great importance. The cross section of the feeders of tramways is to be calculated from an economical point of view, *i. e.*, so that the sum of the costs for the watt losses in the lines and of the amount of interest and depreciation becomes a minimum. He describes a new mathematical method for calculating the feeders.—*Elek. Zeit.*, April 17.

Sieber.—A communication referring to Sengel's article. He refers to an older paper of his own, and criticises an assumption made by Sengel.—*Elek Zeit.*, May 8

Motive Powers for Launches.—ROBERTS.—A profusely illustrated article on electric, gasoline, and oil motor launches. "Of all the small-power boats, the electric launch probably approaches nearest to the ideal." Its drawback is that it is dependent upon an external source of power and that charging requires time. "Yet for many purposes these objections are not important, and the electric launch has a wide field of usefulness."—*Eng. Mag.*, June.

Surface Contact.—A well illustrated description of the new municipal electric tramway at Wolverhamptom. It is the first in Great Britain on which the surface contact system has been used on more than an experimental scale. The particular system used is that of Brown, constructed by the Lorain Steel Company.—Lond. *Elec. Engr.*

INSTALLATIONS, SYSTEMS AND APPLIANCES.

A Progressive and Profitable Small Central Station.—CRAVATH.—An illustrated article describing the plant of the Whitehall (Ill.) Electric Company. Besides giving an all-day service to a town of

2100 inhabitants, the company supplies the entire community with power, and pumps all of the water for the town by means of an electrically-driven pump situated one mile from the station and operated without an attendant. The generating plant contains one 60-cycle Westinghouse single-phase alternator of 60 kw capacity with a composite wound field. This machine delivers current at 2200 volts and is belt driven from a simple high speed engine. This unit supplies all incandesent lighting and power. Arc lights are supplied from a 220-volt direct-current dynamo. The arcs are operated four in series across the 220-volt mains. Separate half-circuits are run from the power-house for each series of four, and a single common return wire is used for all circuits. The arc lamps are lighted only on nights other than moonlight and then only until midnight. An ingenious arrangement is provided at the pump-house, whereby the motor may be started without load. A double-pole switch at the station throws the motor feeder on the bus-bars. The discharge of the pump is by-passed, which when open, allows the pump discharge to flow directly back to the reservoir with no pressure. The pressure from the waterworks tank and main is kept back from the pump by an ordinary check valve in the discharge. The by-pass valve is of the gate type and is operated by a small hydraulic cylinder and piston. As soon as the motor gets up to speed the action of a governor, which throws the brushes off the commutator, moves a valve which controls the supply to the hydraulic cylinder. The piston then proceeds to slowly close the by-pass valve, and as soon as this valve is sufficiently closed the pump begins to work against the pressure in the mains. The small hydraulic controlling valve is worked by a rod and lever connected mechanically to the brushes of a Wagner motor which drives the pump. The various potteries about the town take a considerable portion of the day-load and in order to offset the effect on the voltage regulation of the system, it was found necessary to provide heavy fly-wheels on the motor shafts and countershafts, besides a regulator at the alternator.—*Amer. Elec.*, June.

Tariff.—CLARK.—An article on "the profitable supply of electricity, and the City of London Elec. Lighting Co.'s tariff." This is one of the very few companies that use a Hopkinson form of tariff without a demand indicator. The present charge, *viz.*: 16 cents per unit for the first six units per quarter per lamp connected during the six winter months, and for the first three units per quarter per lamp for the six summer months, and four cents per unit thereafter, has been in force throughout 1901. Before, in 1900, the charge during the earlier part of the year was a flat rate of 9 cents, and, later, a tariff of 16 cents for the first four units per quarter per lamp in winter, and two units per quarter per lamp in summer, and 4 cents thereafter. The results of the new tariff are analyzed and shown to be very unsatisfactory; the tariff is proving detrimental to the welfare of the undertaking and the absence of the maximum demand indicator is doing a good deal of mischief. The present tariff tends to eliminate all the lamps which can be spared with a little inconvenience and which otherwise would be installed—Lond. *Elec.*, May 23.

REFERENCES.

Electric Installation in a Music Hall.—An illustrated description of the electric installation of the Burk Temple of Music in Chicago. There are two steam-driven 60-kw direct current generators, a straight 110-volt service being supplied throughout the building for lighting and power.—*West. Elec.*, May 31.

Summary of the Alternating Current System.—REIST.—An article reviewing the alternating current field and comparing the different systems of distribution. The author also compares the different apparatus used in the generation, transmission, regulation and application of alternating currents—*Amer. Elec.*, June.

Cardiff.—A very long and profusely illustrated description of the equipment of the Cardiff electric tramway station. There are at present installed four steam driven generating sets, each of 300 kw; also a storage battery of 56 cells, capable of giving 210 amp. for 10 hours or 540 amp. for 3 hours, for station lighting.—Lond. *Elec. Eng.*, May 16.

WIRES, WIRING AND CONDUITS.

Fuses in Branched Circuits.—SENGEL.—An illustrated article in which he discusses the placing of fuses in such branch circuits which are connected to the mains at both ends, and in which the current can flow to the consuming apparatus from the two different ends. He gives the following rules: "All conductors which can be supplied with current from both ends are to be provided at both sides with fuses corresponding to the cross-section of the conductors. The fuses may be omitted on single lines, if their allowed supply current strength at least equals the sum of the supply current strengths of the other conductors leading to the same point. If from such conductors other lines branch off which do not receive current from any other side, then fuses must be provided corresponding to their cross-section, if their allowed supply current strength is smaller than the sum of the current strengths to which the fuses correspond which serve for the protection of the main conductor."—*Elek. Zeit.*, May 1.

Cable Laying Plough.—A description of a new form of plough, devised by Bajac for laying cables over soft ground, chiefly for telegraph work. It is a large and heavy apparatus on two wheels, with a beam sliding in vertical guides, and operated by worm gearing to give the necessary depth to the share. This latter is formed of two steel plates with a cutting edge, and in front are two cutters to loosen the soil ahead of the main share. A cable drum is mounted on the rear end of the plough, the cable passing around rollers to the cutting which has been made by the plough, the drum revolving and paying out the cable as the plough proceeds. A traction engine with winding gear does the necessary hauling, like in steam ploughing, distances of 200 yards being cut and laid in a stretch. A speed of about 1¼ miles an hour is possible over soft soil. The apparatus is to be used by the French government for the laying of a trans-African cable.—Lond. *Elec.*, May 23.

Cable Laying in the Bed of a River.—An illustrated note on cable laying across the river Tawe, in South Wales. This became necessary in order to supply an outlying position of the town; four concentric cables, each of 0.048 sq. in. section, were laid for transmitting single and two-phase currents of 50 cycles at a pressure of 3,000 volts. The dielectric consists of impregnated paper which is lead sheathed, and over it is a covering of vulcanized bitumen. Outside this is a heavy yarn and armoring of double layers of galvanized steel wires, the whole being finally yarned and compounded. The cables are laid in a shallow channel in the bed of the river.—Lond. *Elec.*, May 23.

REFERENCE.

Calculation of Networks.—SOSCHINSKI.—An article, illustrated by diagrams, in which he discusses by simple graphical methods, several problems in the calculation of networks.—*Elek Zeit.*, April 24.

ELECTRO-PHYSICS AND MAGNETISM

Interference Tubes for Electric Waves.—BECKER.—An account of experiments with two forms of Quincke interference tubes used for measuring the length of electric waves. One of the forms consists of a tube with two branches, like a branched circuit, while the other has the shape of a T. In both cases the length of the wave transmitted by the tube does not depend upon the length of tube, but upon the diameter. The wave length is about 1.6 times the diameter. The waves travel along the surface of the metallic tubes and emerge into the air with a barely diminished intensity. The first form of interference tube acts as a polarizer, which only transmits vibrations which are parallel to the plane of the branches. If the stem of the T-tube is filled with insulating liquids, the wave length in the interior of the liquid may be determined, and a comparison of this with the wave length in air gives the dielectric constant of the liquid. The dielectric constant may be determined by two other methods, one of which involves the reflection of the waves by a mirror.—*Ann. d. Phys.*, No. 5; abstracted in Lond. *Elec.*, May 16.

Effect of Inductance upon Spark Discharges.—EGINITIS.—A study of the heat effects on the poles of a spark-gap as affected by a variation of the inductance of the circuit. He uses a Telsa coil without a core, and discharge points of thin wire of various metals. At first the brightness of the aureole of the spark varies inversely as the heating effect for all metals examined. At high inductances both the temperature and the brightness of the spark increase with increasing inductance, at least for iron and nickel points. He made a closer study of the effects by determining the temperatures of the discharge points with the aid of a thermo-electric couple. The metals examined included iron, nickel, aluminum, copper and silver. The heating effect is of a very complex nature. It first increases rapidly with increasing inductance, and then breaks into a succession of maxima and minima. A rough generalization arrived at is that the metals whose heating is very great are also those whose spectra are enriched by an increase of inductance, as is the case of the highly-magnetic metals. The presence of metallic vapor is not a primary factor in the heating effect, as is shown by the fact that at small inductances the brightness of the spectrum decreases with increasing

[illegible] increasing increases very rapidly.—*Comptes Rendus,* May 5; abstracted in Lond. *Elec.,* May 23.

Resistance of a Magnetic Field.—Pellat.—A paper in which he gives some further evidence in favor of his contention that there is a kind of friction across the tubes of magnetic force which makes the electric corpuscles tend to run along them rather than across them. A cylindrical tube, which shows a good stratified discharge, is placed between the cylindrical polepieces of an electromagnet so that the middle part is embedded in a strong magnetic field at right angles to the axis of the tube. As long as the field has not more than some 425 units, the anode stream is deviated in the well-known manner, forming a thread along the wall of the tube, and getting thinner and brighter with an increasing field. But if the field is increased to about 7,000 units, the anode light fills the whole tube uniformly, without stratifications, and the resistance of the tube increases some 24 times. If now a second and thinner tube is fused into the first, so as to form a branch circuit, which does not pass through the strong magnetic field, the whole discharge passes through this branch tube, just as if its resistance were enormously less than that of the main tube. When the lines of force run along the tube instead of across it, the anode stream traces out the lines of force.—*Comptes Rendus,* May 5; abstracted in Lond. *Elec.,* May 23.

Ions in the Atmosphere.—Ebert.—A description of experiments showing the ionic charge of the atmosphere. A plate of tinned iron, 2 square meters in area, was supported 4 meters above the earth's surface on insulating pillars, planted on the top of a slope 70 meters high, overlooking the river Isar. On a day when the weather was fine, the plate was first connected to earth and acquired a negative charge. It was then disconnected and left to itself for some time, so as to acquire the potential of the surrounding air. Finally it was earthed through a galvanometer, and showed a current proceeding from the plate to the earth. The exposure necessary for acquiring the potential was greatly shortened by covering the plate with sods of grass, the time then required being usually about five minutes. The charges acquired varied within wide limits with the weather, being largest in fine and smallest in foggy weather. This shows that the convection of negative ions from the atmosphere to the earth varies in accordance with their mobility in the atmosphere.—*Phys. Zeit.,* May 1; abstracted in Lond. *Elec.,* May 23.

Velocity of Ions from Hot Platinum Wires.—Child.—An account of a continuation of his researches. The principle results are as follows: The particles from a hot platinum wire have a greater retarding action on the negative ions drawn from a flame than on the positive. In hydrogen the rate of discharge is much larger than in air. The behavior of the wire in oxygen, carbon monoxide and carbon dioxide is practically the same as in air. The experiments seemed to indicate that the particles are driven off as platinum and not as some oxide of platinum. The ionization appears to occur first within the wire and there are some reasons for thinking that this part of the ionization is produced from occluded hydrogen.—*Phys. Rev.,* May, June.

Influence of Inductance upon Spectra.—De Gramont.—An article in which he shows that while in the direct spectrum analysis of minerals, the spectra are usually complicated by the presence of prominent "air lines" and lines belonging to certain metalloids, the introduction of feeble inductances in the circuit produces a great simplification of the spectra and elimination of those disturbing lines. The air lines are greatly reduced by inserting an inductance of only 0.00002 henry, and are entirely eliminated by three or four times that inductance. A slightly larger amount suffices to get rid of the rays due to sulphur. "In a mixture of selenium and sulphur the selenium may be obtained alone by eliminating the sulphur and keeping the inductance below 0.00023 henry, the value at which the most persistent of the green selenium rays disappears." Phosphorus is a substance whose spectrum disappears comparatively easily; it is slightly more persistent than sulphur.

Vacuum Tubes.—Goldstein.—An article on an optical illusion in vacuum tubes. The outer side of the glass wall of a vacuum tube which is traversed by cathode rays, is apparently luminous whenever the wall of the tube is thin in comparison with its diameter. This optical illusion produced by a thin wall is similar to the one which makes the water in a tumbler, or the mercury in a thermometer bulb, appear to penetrate the glass itself, whereas the thread of mercury in the stem apears only slightly enlarged. A film of glass of red luminescence, stuck on the inner wall of a tube, and struck by cathode rays, makes the outer wall apparently red instead of green. When the gas and not the inner wall is luminous, the rays from it do not undergo the refraction necessary to produce the optical illusion. This fact furnishes an important criterion to distinguish between canal rays, which only affect the gas, and cathode rays, which affect the wall.—*Ann. d. Phys.,* No. 5; abstracted in Lond. *Elec.,* May 16.

REFERENCES.

Wattless Currents.—Feldmann.—A lecture held before the Cologne Electrical Society in which he gave a general review of the phenomena due to wattless currents in alternating current engineering.—*Elek. Zeit.,* April 24.

Temperature Variation of Electric Resistances.—Williams.—A paper on the temperature variation of the electrical resistances of pure metals, and allied matters. Various tables are given and three formulas for the specific resistance, the temperature factor, and the specific heat, are given, which hold good for limited groups of metals. *Phil. Mag.,* May.

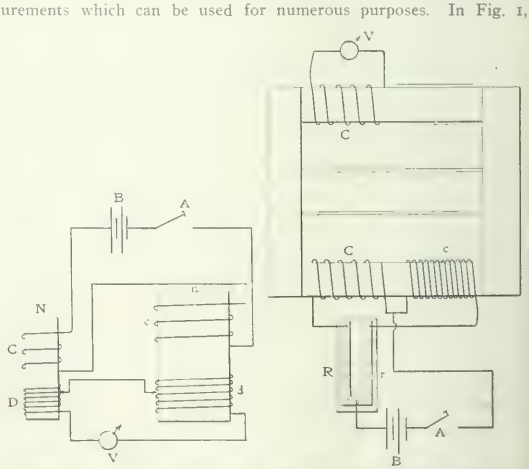
Becquerel Rays.—Tommasina.—An account of an experimental investigation of the absorption of Becquerel rays—which is of importance as it imparts to gas a conductivity due to ionization, and also increases the conductivity of liquid and solid dielectrics.—*Comptes Rendus,* April 21; abstracted in Lond. *Elec.,* May 9.

Magnetic Elements.—Beattie and Morrison.—A summary of the determinations of the magnetic elements at the Cape of Good Hope from 1605 to 1900.—*Phil. Mag.,* May.

Magnetism Induced in Iron by Rapidly Oscillating Current Fields.—Varley.—An account of a series of experiments in which he investigated the magnetization of iron in a rapidly alternating field and showed how the induced magnetization depends on the strength and frequency of the field, and on the diameters of the wire used.—*Phil. Mag.,* May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Zero Method for Magnetic Measurements.—Goldschmidt.—An illustrated description of a simple zero method for magnetic measurements which can be used for numerous purposes. In Fig. 1,



FIGS. 1 AND 2.—ZERO METHOD FOR MAGNETIC MEASUREMENTS.

herewith, the fluxes N and n of lines of magnetic induction which are produced by two coils C and c in two iron cores may be compared by connecting these coils with a battery B and a switch A and placing on the two iron cores two extra windings D and d which are connected together in series with a millivoltmeter V as shown in Fig. 1. The arrangement is so made that when the primary circuit is broken at A, the e. m. fs. induced in D and d have opposite directions. By varying the number of the turns of these auxiliary windings D and d, the e. m. fs. induced in both can be made exactly equal and opposite; the needle of the voltmeter V will then be at zero. In this case the two fluxes N and n have the same relation to each other as D to d. The method allows of very exact measurements. He describes its application for measuring the stray field of a direct current dynamo, for determining the counter-amperewindings of a direct current armature for different positions of the brushes, for determining magnetization curves, etc. Instead of changing the number of turns of D and d, one may keep them con-

stant and instead supply the windings C and c with different and adjustable currents. This is done, for instance, in the following method for determing the ratio of transformation of a transformer shown in Fig. 2. The primary and secondary coils C and c of one arm of the transformer are connected to the battery B and switch A through two variable resistances R and r respectively, for which purpose an ordinary resistance box may be used. The millivoltmeter V is connected to the primary winding of another arm of the transformer. The resistances R and r are varied until the voltmeter shows no deflection when the circuit of C and c is broken at A. The ratio of transformation is then R to r. The method is said to give very exact results. —*Elek. Zeit.,* April 10.

Fluxograph.—BLONDEL.—An abstract of a French Phys. Soc'y paper in which he described a new apparatus for registering the curves of magnetic flux in any circuit. A search coil is wound round the magnetic circuit and connected to the primary circuit of a transformer containing no iron, the secondary of which is connected to the fluxograph. The latter is a galvanometer without directing torque or damping effect. A cycle of variation of the needle deflection reproduces the cycle of variation of the flux. For developing the curve of variation of this angle as a function of the time, he uses a mirror revolving at uniform speed, as is already used with his oscillograph. An iron box enveloping the meter coil prevents any influence from an outside magnetic field of force. The coil is fixed, and acts on a moving magnet resting on pivots and enclosed in a vacuum tube. He states that many applications may be added to the one above pointed out. For registering directly the magnetizing cycle of an iron sample, he replaces the rotating mirror by an oscillating plane mirror mounted on a galvanometer with a horizontal axis.—Lond. *Elec.,* May 23.

Induction Coil.—IVES.—The first part of a long illustrated paper, giving "contributions to the study of the induction coil." He treats two cases, that of a single break and that of a simple harmonic e. m. f. in the primary. He gives the mathematical theory of these two cases and then describes the instruments and methods used in his experiments. To determine the effect of increasing the amount of iron in the core, the number of iron wires inserted in the core was varied, the current being kept constant; the potential increases very rapidly as the number of wires is increased up to a certain point, after which an increase in the number of wires only makes a small difference in the potential. He could not find that it made a difference whether the iron wires were placed in a bundle in the middle of the core or placed loosely anywhere within it. He then investigated the distribution of the flux of induction through the primary at different points of its length, the results being given in tables and diagrams. He also determined the effect of inserting localized capacity in the secondary of a small induction coil; the potential of the secondary may be increased in this way in some cases. He gives tables and curves from which can be found the value of the secondary capacity which will give the greatest difference of potential in the secondary for a given frequency.—*Phys. Rev.,* May, June.

Electric Micrometer.—SHAW.—A Brit. Phys. Soc'y paper in which he describes an instrument for measuring very small lengths by the application of electric contacts. A screw fitted with a milled head, turns in a fixed nut and its lower end presses upon the extremity of the long arm of a lever. A metal point is attached to the short arm and the distance through which it moves, on turning the milled head, can be deduced from a knowledge of the pitch of the screw and the ratio between the arms of the lever. In using the instrument this point is always brought up to a metal surface and the contact is accurately determined by a telephonic arrangement. He describes the application of the instrument for different purposes; the measurement of the thickness of plates, films, or fibres; the determination of Young's modulus; the determination of simple rigidity; measurement of thermal expansion, microscopic measurements; and measurement of the wave length of light.—Lond. *Elec.,* May 23.

Roentgen Ray Apparatus.—WALTER.—A detailed illustrated description of his set of Roentgen ray apparatus. He uses a Wehnelt break with direct current. The voltage should not be much higher than 80. He recommends using a shunt in parallel with the interrupter and the primary of the induction coil; the arrangement is illustrated in a diagram. The softer the X-ray tube to be excited, the greater must be made the self-induction of the coil in order that the breaks in the Wehnelt interrupter take place with regularity. He therefore uses a "coil with variable self-induction," the primary being wound with several separate layers of wire, the ends of which are connected to a switchboard. He uses a "multiple Wehnelt interrupter," *i. e.,* a break with several platinum pencils of different lengths. By changing the length of the pencil, the current strength of the single discharges of the induction coil is changed with very little change in the spark length. In this way it is possible to work a tube either with a large number of single discharges of small current strength (short pencil) or with a small number of discharges of large current strength (long pencil).—*Fortschr. Geb. d. Roentgenstr.,* v. 5, p. 1; Lond. *Elec. Rev.,* May 9.

Scale of Periodicity.—GUILLEMIN.—An article in which he deals with the choice of a standard interval. In acoustics the standard intervals used are the octave, 2 to 1, and the comma. The author suggests the ratio 10 to 1 as the standard intervals, and calls it the "savart." The logarithm of this ratio is unity, which means a great simplification of numerical calculations. Savarts would be measured by a logarithmic scale, and thus the "millisavart" would be the ratio whose logarithm is 0.001. This ratio would be 433 to 434 and the natural definition of standard international pitch would be 434.3 vibrations per second. The millisavart may be variously defined as the ratio of two notes giving one resultant beat per second, or as the ratio between two periodicities differing by one vibration per second, or as the number 1.002305, whose logarithm is 0.001. All these definitions are concordant.—*Comptes Rendus,* April 28; abstracted in Lond. *Elec.,* May 16.

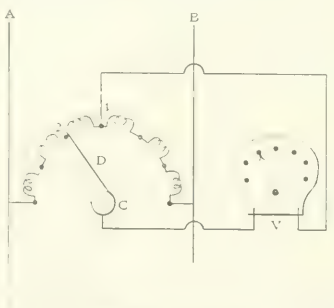
REFERENCES.

Handy Insulation Test and Some Shop Notes.—MUNROE.—A short article illustrated by diagram, giving a handy insulation test which may be made with a Weston voltmeter, and also giving some shop notes of value.—*Amer. Elec.,* June.

A Mercury Interrupter.—DEL MAR.—An illustrated article describing a simple and portable form of mercury interrupter actuated like a common vibrator, by the magnetism of the induction coil core.—*Amer. Elec.,* June.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Signal Apparatus.—HEUBACH.—A long and profusely illustrated paper read before the Berlin Electrical Society on the new signal apparatus of the Union Electric Company of Berlin, as used more especially on ships for transmitting rudder signals. The voltmeter



SIGNAL APPARATUS.

principle is used; but for this purpose a strong damping effect must be provided. The arrangement is shown in the adjoining diagram; A and B are the feeders, V is the receiving instrument, designed as a voltmeter. The transmitting device consists of a number of resistances bridged across the feeders and a handle D which can be turned around C. It is at once evident from the diagram that the voltmeter V measures the e. m. f. between the fixed point 1 and the variable point 2, to which the handle D is connected. In practice a receiver and a transmitter are placed at both ends; the commander gives a signal to the attendant who in turn sends it back so that the correct understanding of the transmitted signal is guaranteed. Two diagrams are given which show two different forms of connections for this purpose. To get a good damping effect, a short needle is used, and a large scale is obtained by a special arrangement of the pole-pieces. The instrument is practically free from errors due to insulation faults. When storage batteries or motor-generators are used for supplying the current to the signal apparatus, the errors due to variations of voltage are avoided, because motor-generators can be so designed that the dynamo delivers current at approxi-

mately constant voltage, while the voltage of the current which feeds the motor, varies considerably. In cases in which the current for the signal apparatus is taken directly from the lighting circuit they use either special iron rheostats or insert into the feeders a small series motor the counter e. m. f. of which varies and counteracts the variations of the supply of voltage. He discusses at some length telegraph apparatus to the boiler rooms and describes some special arrangements for this purpose. In the discussion which followed the paper, Querengaesser described the revolving field apparatus of the Gen. Elec. Co. of Berlin which have been noticed before in the Digest (they are operated with direct current.)—Elek. *Zeit.*, [illegible]

REFERENCE.

Block Signals.—Kinsey.—The first part of an illustrated paper, read at the Dublin section of the (Brit.) Inst. Elec. Eng., on "railway blocks and telegraphs—recent practice" on the railways in Ireland. He discusses the extension of block-signal working where double lines of rails exist, and the introduction of the train staff block instrument where there is only a single line of rails.—Lond. *Elec.*, May 23.

Miscellaneous.

REFERENCE.

Kelvin.—Crocker.—A brief account, with portrait, of the work of Lord Kelvin and its influence on electrical engineering.—*Eng. Mag.*, June.

New Books.

Engineering Education. Proceedings of the Society for the Promotion of Engineering Education. Buffalo Meeting, 1901. Vol. II. New York: Engineering News Publishing Company. 348 pages, 4 illustrations. Price, $2.50.

This volume contains a full report of the proceedings of the Buffalo convention of the Society, which enrolled 261 members from 36 States, 1 Territory, Canada, and 3 foreign countries. The Convention covered 3 week-days and included both morning and afternoon sessions, a praiseworthy programme considering the proximity of the Pan-American Exposition. Forty-six members registered, or 17.6 per cent. of the enrolled membership. The proceedings contain, in addition to routine business, a presidential address, and twenty papers.

These papers—not omitting the address—are very interesting reading to any technologist. They are all written by men of education and standing, and consequently their perusal bestows pleasure. They also differ materially in their standpoint and advocacy. It would evidently be impossible to obtain engineering educational courses that would please all the members; but the essentials in which unanimity presides are uplifting and point out the trend of engineering development. The Society is evidently bent upon doing good work, and the attainment of its aims means the development of higher civilization. The book is carefully prepared, well printed, enjoyably readable and should be on file wherever engineering is studied.

[illegible]: Contribution à l'étude des pertes diélectriques dans les diélectriques. By Paul L. Mercanton. Lausanne: Imprimerie Corbaz & Company. 63 pages, 8 plates.

The above is a reprint of a thesis presented to the faculty of Lausanne University for the degree of Ph.D. It is divided into two portions; the first, occupying 26 pages, deals with the history of the theory of loss of energy in dielectrics subjected to harmonically varying electrostatic force. The principal theories discussed are those of Maxwell, Hess, Houllevigue, Mascart and Pellat. The two former writers invented special conceptions for empirically treating the residual dielectric charge. The three latter writers introduced molecular theories of polarization. None are perfectly satisfactory. A bibliogical table is appended.

The second part, occupying 35 pages, describes an experimental research conducted in 1900 and 1901 upon the subject. To obtain a cyclically-varying e. m. f., a circular paraffine trough was filled with acidulated water and subjected to a constant e. m. f. by a pair of diametrically opposite electrodes. A small electrode dipping in the trough was made capable of revolving around the trough at speeds up to 4 revolutions per second. The dielectric under test, in the form of a single sheet condenser was connected to the movable dipping [illegible] frequencies up to 4 periods per second. By a special mechanism the charge of the condenser was examined at different successive stages of the cycle. Owing to residual charge, the charge did not follow the impressed voltage, but lagged hysteretically and the diagrams to rectangular co-ordinates of voltage and charge resemble the hysteretic, bean-pod diagrams of iron. The most marked hysteresis was with ice, and the least with paraffine.

The hysteretic loss of energy increased with the impressed e. m. f. approximately as the square, but rather in excess thereof, or at a slightly faster rate than the square.

The experimental results are interesting and the thesis is a useful addition to the literature of the subject. The descriptions, however, are involved and the paper is by no means lucid.

BOOKS RECEIVED.

Handbook for Street Railway Engineers. By H. B. Andrews. New York: John Wiley & Sons, 202 pages, 41 illustrations. Price, morocco, $1.25.

Die Gleichtstrommaschine. Theorie, Konstruktion, Berechnung, Untersuchung und Arbeitsweise Derselben. By E. Arnold. Berlin: Julius Springer. 555 pages, 421 illustrations. Price, 16 marks.

Der Elektritsche Betrieb Von Fernschnellbahnen. By Gustav W. Meyer. Halle a. s.: Wilhelm Knapp. 63 pages.

Die Elektrolyse des Wassers Ihre Durchfuhrung und Anwendung. By Viktor Engelhardt. Halle a. s.: Wilhelm Knapp. 117 pages, 90 illustrations. Price, 5 marks.

Electrical and Magnetic Calculations. By A. A. Atkinson, M.S. New York: D. Van Nostrand Company. 310 pages, 45 illustrations and wiring tables. Price, $1.50.

Standard Polyphase Apparatus and Systems. By M. A. Oudin, M.S. Third edition, revised. New York: D. Van Nostrand Company. 289 pages, 169 illustrations. Price, $3.00.

The Electric Arc. "The Electrician" Series. By Mrs. Hertha Ayrton. New York: D. Van Nostrand Company. 479 pages, 146 illustrations. Price, $5.00.

"The Electrician" Electrical Trades' Directory and Handbook for 1902. London: "The Electrician" Printing and Publishing Company, Limited. 1,422 pages. Price, 12 shillings, sixpence.

The Balancing of Engines. By W. E. Dalby, M.A., B.Sc. New York: Longmans, Green & Company. 283 pages, 173 illustrations. Price, $3.75.

Armature Windings of Direct Current Dynamos. Extension and Application of a General Winding Rule. By E. Arnold. Translated from the German by Francis B. DeGress. New York: D. Van Nostrand Company. 124 pages, 146 illustrations. Price, $2.00.

Die Funkentelegraphie. By A. Slaby. Berlin: Leonhard Simion. 119 pages, 32 illustrations.

Directory of Electrical Societies, Etc.

American Association for the Advancement of Science. Next meeting, Pittsburg, June 28 to July 3, 1902.

American Electochemical Society. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Institute of Electrical Engineers. Annual convention, Great Barrington, Mass., June 18-21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Electrical Contractor's Association of New York. Semi-Annual meeting, Hotel Ten Eyck, Albany, N. Y., July 15, 1902. Pittsburg, June 27 and 28, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Independent Telephone Association of the United States. Next meeting, Philadelphia, Pa., June 24, 25 and 26, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electrical Contractor's Association. Annual meeting. Hotel Walton, Philadelphia, July 16, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May, 1903.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION. Next meeting, Pittsburg, June 28 to July 3, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

Works and Products of the Stanley Electric Manufacturing Company—I.

BERKSHIRE County is a scenic leader. Between the Hoosac and Taghconic mountain ranges the valley of the Housatonic, lying 1,000 to 1,200 feet above tide water, presents a panorama of surpassing interest for fifty miles. Here are found the highest mountains, the deepest ravines, the greatest waterfalls and the most extensive forests of the Commonwealth. Greylock Peak, 3,500 feet above the sea; October Mountain, with its varied colors; the Stockbridge Bowl; Icy Glen; Worthington Falls, with a plunge of 76 feet; the Green River, and Sky Farm are only a few of the natural wonders that claim the attention of the fortunate traveler in this valley.

Sociologists attempt to trace connections between the natures of men and their natural surroundings. How far the rugged lines of Berkshire scenery have influenced the industrial conditions of the people there, who shall say? In its chosen lines of manufacture the county has long stood at the front as to quality of its products. Cotton prints are here produced of an excellence not attained elsewhere in the State. Everyone who passes a United States legal tender note handles paper that has enjoyed a practical monopoly for decades, because its like is not produced outside of Berkshire County. So in the field of electrical development, those who would describe the longest transmission of water that the world has seen must refer to machinery made by the Stanley Electric Manufacturing Company, of Pittsfield, by which it is being carried out.

The history of this company differs from that of most of the other large electrical manufacturers. Such companies have usually been formed to produce one or more of the main elements of a lighting or power system, as arc dynamos or power generators, and have subsequently taken up the minor parts of electrical equipments. With the Stanley company this order has been reversed. At its start this company began the manufacture of a moderate line of lighting transformers as its main product. The manufacture of transformers led to that of generators for their operation. Managers of the company early saw the great importance of long electrical transmissions at high voltages, and large station transformers were designed to give the necessary pressures. Long transmissions of energy in large units imply the ability to render any sort of electrical service at the substations. To meet these requirements frequency changers and rotary converters have been added to the products of the Stanley company. With the rapid application of alternating generators to the work of street railways, the railway motor has come to be an important adjunct to alternating systems, and the company have just added a line of such motors to their products.

The new works of the Stanley company are on a tract of about 30 acres in the suburbs of Pittsfield, on both sides of the main line of the Boston and Albany Railway. The various buildings of the manufacturing plant have a total floor area of about 180,000 square feet. Most of these buildings are of brick, but the largest is a combination of brick, wood and iron. Distribution of electric power to a large industrial works from a single steam plant finds an excellent illustration in the present case. Power for the operation of the Stanley shops is developed in a brick building, devoted exclusively to that purpose, and located about one-fourth mile from the center of the main machine shop. This steam power plant stands on the bank of a sheet of water, known as Silver Lake, from which supplies for boiler feed and condensing purposes are drawn. Water from this lake passes through a live steam purifier before entering the boilers. Four Dillon boilers of the return-tubular type, and rated at 600 hp, supply steam for the engines at 140 pounds gauge pressure. A short iron stack takes the place of a chimney with these boilers, and induced draft of any desired pressure is obtained with blowers. Three engines, one McIntosh & Seymour tanden-compound, rated at 300 hp; one Ball & Wood simple, rated at 200 hp, and one Erie-Ball tandem-compound, of 100 hp, are belt connected to a jack-shaft running along one side of the engine and generator room. Eight main dynamos with their exciters are driven from this shaft by belts, and the shaft is supplied with quilles and clutches, so that it may be split up into sections, each driven by a separate engine.

The generator equipment includes six alternators, with an aggregate capacity of 900 kw at 2,400 volts, with cycles ranging from 94 to 133 per second; also two dynamos of 320 kw, aggregate capacity for the supply of direct current at 220 volts. A ten-ton crane sweeps the entire generator room and makes changes easy. At present this generating plant is much overloaded, owing to the rapid increase in the volume of work passing through the main shops, so that the largest engine is operated much of the time at 400 to 500 hp. To do away with this condition, a new generator of 600-kw capacity, direct-connected to a cross-compound engine will shortly be installed at the power-house. Energy is conveyed from the power plant to the manufacturing plant by a number of overhead circuits that pass under the railway tracks through a tunnel.

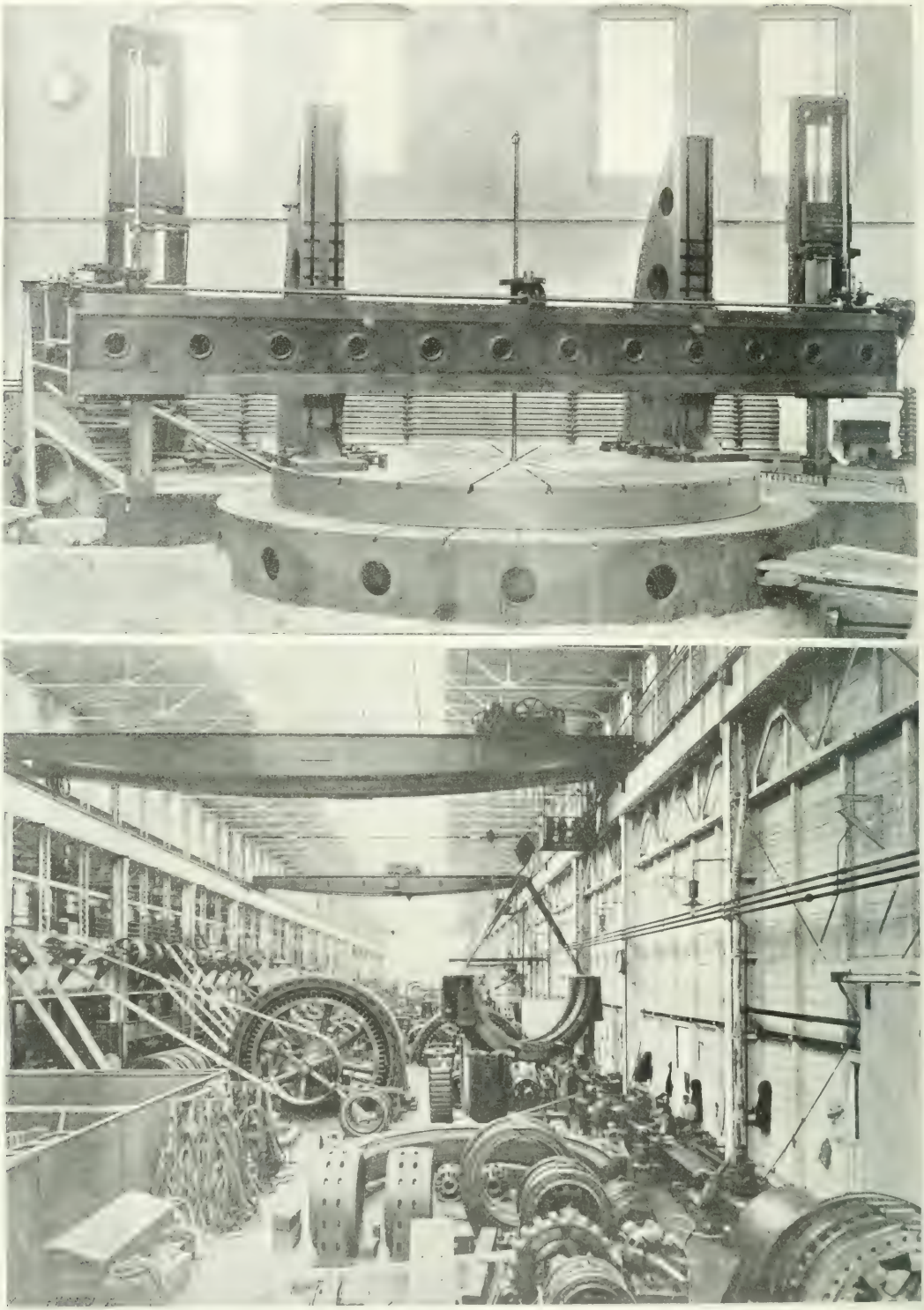
A small portion of the energy from the generators just considered is used for general lighting and testing purposes about the works, but the greater part of it passes into motors that drive the machine tools. Two general classes of motors are in use, namely, those taking direct current at 220 volts, and polyphase motors operating at 500 volts. Current at different frequencies from the alternators above-mentioned is supplied to the polyphase motors as desired for purposes of speed regulation. The majority of all motors in use are belted either to individual machine tools or to short lines of shafting, by which such tools are driven. In a few cases, however, the motors are geared or direct connected to the driven machines. Thirty direct-current motors are in use throughout the works with an aggregate rated capacity of 540 hp. Alternating motors number 48, and their combined rating amounts to 412 hp. Considering both kinds of motors, the total number throughout the works is 78, and their combined capacity 952 hp. The numbers of motors of each capacity and type are as follows:

Direct current.		*Alternating.*	
Number.	*hp.*	*Number.*	*hp.*
1		4	
4	1	2	
2	2	2	3
4	3	6	5
1	5	4	5
2	7	1	7
4	10	8	10
1	15	4	15
1	20	1	25
1	25		
2	40		
		48	

The ¼ and ½-hp alternating motors operate at 100 volts, all other alternating motors at 500 volts, as stated above.

Transformers for the operation of the alternating motors are mostly connected in banks to short distribution circuits. Besides the supply to motors, energy from the 2,400-volt alternating lines is taken transformers for lighting purposes, and by still other transformers that yield 10,000 to 50,000 volts for the purposes of testing insulation.

The largest building of the works, in which all the heavy pieces of apparatus are machined and assembled, occupies a ground area of 90 ft. x 500 ft. The part of this building which has the lesser total elevation, occupying a ground area of 30 ft. x 500 ft. contains a main



Vertical Boring Mill and View of One of the Aisles in Stanley Electric Manufacturing Company's Works.

floor and gallery of equal dimensions, where the lighter parts of the machine work is done. The higher part of this main building, with an elevation corresponding to three stories, has a perfectly clear space from floor to roof trusses, as may be seen in the illustration. This clear space is well lighted by a skylight that extends along story. A ground area 60 ft. x 500 ft., with a clear space above it the entire length of the roof, and by side windows in the third three stories in height, is thus provided for the heavy work. Two cranes driven by electric motors sweep this entire space of 60 ft. x 500 ft. One of these cranes has a capacity of 15 tons and the other of 30 tons, so that parts of the largest generators are readily transported between any points on the main floor. Branch tracks from the railway enter one end of this main shop, and a pneumatic hoist, mounted on a special car, moves on these tracks and is used for loading and unloading machinery and supplies. On the floor of this main shop are many machine tools, interesting because of their size or special features, but space here permits particular notice of only one of them, a large vertical boring mill, built by the Stanley company for its own use, and illustrated herewith. This mill is driven by an electric motor, connected through gears, and can be operated either with revolving work and stationary tools or with revolving tools and stationary work. The illustration shows the mill arranged on the latter plan, where it has a boring capacity of 32 ft. diameter. When the work is mounted on the revolving center-table the mill bores or turns to a diameter of 21 feet. On this mill the inductor spiders and circular armature frames of the largest generators are turned and bored. This mill also has a drilling attachment at each end so that the large work can be both turned and drilled at a single setting.

Along one side of the main machine shop are ranged a number of one-story buildings, opening into it, and covered with the saw-tooth type of roof. In these smaller buildings and in the gallery portion of the main section of the main shop, the smaller parts of machinery are manufactured and assembled, and the operations of winding are carried out. In the case of magnet coils for the large inductor generators, however, the head room of these smaller buildings is not sufficient to swing the spools, and these latter are therefore wound in the main shop. Two stories of a separate large brick building are devoted to pattern work, and the third story to arc lamps and instruments.

Some features of the winding work are worthy of especial mention. One point at once noted is the almost total absence of the time-honored methods of hand winding. Substantially, all of the winding for the Stanley apparatus is now done on forms or spools by machine power, and reaches its final form before it is ever applied to generators or transformers. Another important feature of both transformer and generator windings is the use of square wire and rectangular strips to the practical exclusion of round wire, except in the smallest sizes. As has long been understood, square wire makes it possible to put 25 to 30 per cent. more copper into a given space than can be done with round wire. During several years the somewhat greater difficulty of insulation with square wire operated as a great restriction to its use, but the Stanley company seems to have overcome this disadvantage and is able to enjoy the economies of manufacture incident to the use of square wire.

Other instructive features of the winding work may be noted in the methods of insulation. In many cases coils wound with heavy copper strips are left without any insulation whatever until completely formed, and thin strips of mica are then forced between the several layers of copper before tape is applied to the outside of the coils. The principal insulating materials applied to the windings of the Stanley apparatus are oiled cloth, card-board treated with insulating compounds, mica and micanite; besides, of course, paints and oils, in which the completed coils are dipped or thoroughly immersed. Coils not intended to be immersed in oil when operating are dipped into a bath of hot insulating compound when otherwise completed, and this compound is forced into the coils under pressure. Coils that are to be treated in the way just described are previously wound with dry tape, while coils intended for permanent immersion in oil are covered with strips of oilcloth.

In the Stanley apparatus, many of the stationary as well as the moving parts of generators and motors, besides the cores of transformers, are built up of thin iron stampings. The punching department of the works is, therefore, an important one, and contains a considerable number of presses. In spite of the very large dimensions of some of the generators, the tendency seems to be to cut the sheet-iron parts into sections of comparatively moderate size, and thus use dies of no great extent. Sheet-iron parts before they are [illegible] treated with a coating of insulating compound.

An 80,000-volt Transformer.

The writer recalls a paper he read before his classmates in a technical college some fifteen years ago. It was based on Sir William Thomson's prediction that some time in the future Niagara's power would be distributed over great distances by means of alternating current at 40,000 volts. There has recently been built and installed by the General Electric Company transformers to be operated at just twice that voltage which, fifteen years ago, was looked at as a possibility perhaps in the next generation, but scarcely in this.

In December last the General Electric Company was asked by the local lighting and power company in Butte, Mont., to submit a bid on a transformer to enable them to utilize 1200 hp at 80,000 volts



[illegible]

from the Madison River Power Company. While the company stated that they did not consider it the best of engineering to use so high a voltage for a transmission of only about 60 miles, it was quite willing to undertake the work and promised to deliver the transformers in fourteen weeks; an exceedingly short time considering their size (330 kw.) and a great advantage in voltage over commercial transformers previously built. The work was accomplished, however, substantially in the promised time and without an evidence of any weakness in the design as originally laid out.

In general the design closely follows the standard oil immersed

water-cooled transformer built by the General Electric Company and except for allowance for the increased voltage, is identical with that of the 500 kw. transformers built by it for the Bay Counties transmission in California, which have now been in continuous operation for over a year at 60,000 volts.

The coils of which the winding is composed are wound with flat copper strip and are remarkably strong and rigid considering the small conductors that must be used for such small high voltage units. They are covered with only sufficient waterproof insulation to exclude any moisture that might be deposited on them during transportation. The heat generated in the winding can therefore escape as easily as from the coils of a low-voltage transformer.

Oil, specially refined for this high-voltage work, is relied upon mostly for insulation. The spaces between the high voltage coil and all other parts, however, are sub-divided into separate ducts by diaphragms of solid insulation, so that any conducting particle that by accident might fall into the oil can bridge but a small percentage of the oil space. This construction, it will be seen, also subdivides the solid insulation into thin layers so that any heat that might be generated in it due to dielectric hysteresis is promptly dissipated by the free-moving oil in the ducts.

The transformer case and cover including all bushings and cables are made with air-tight joints. Previous to filling the transformer with oil it is exhausted of all air with a vacuum pump and the winding heated to expel any moisture that might be on the coil surfaces. While in this vacuous condition, oil specially treated to expel all foreign particles, air or moisture, is allowed to flow into the transformer from the oil treating tank, this method of filling being repeated when the transformers are started in commercial operation.

By the use of these novel methods, the insulating quality of commercial oil, is so improved as to require much less thickness of oil to withstand these high voltages than would otherwise be the case. Reduction in transformer costs and improvement in its constants are the natural results.

Tests showed the following performance at 60 cycles:

Efficiency	97.5 per cent.
Regulation	1 "
Reactance	4 "
Heating by resistance	30 deg. C.

When the small capacity and high voltage are considered, also the fact that the greatest reliability rather than extreme efficiency, etc., was especially aimed at, these figures prove that 80,000-volt transformers are an assured commercial success. The test included an insulation test at double voltage, *i. e.*, 160,000 volts, which failed to develop any weakness.

To determine the possible presence of losses due to dielectric hysteresis or actual leakage through the oil or other insulation at this very high voltage, transformers were excited to double their normal voltage on the low potential side. The losses were then measured with the high potential windings separated into several sections so that the maximum voltage generated was so low that no such losses could take place. The high potential windings were then connected in series and the losses again measured. They were found to be identical with those first observed, indicating the entire absence of any such losses.

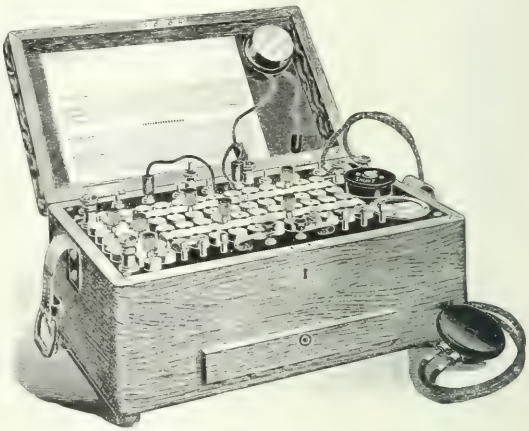
From the cut it will be seen that the terminal cables have soft rubber disks projecting from them. These were necessary in order to break up the static discharge that took place over the surface of the insulations when the transformer was under a strain of 160,000 volts between winding and ground. The insulation on these cables was ample to withstand this strain, but the static charge on the surface was so heavy as to reduce the effective length of the insulation to but a small fraction of the actual length. The test potential would cause an arc to form between the uninsulated end of a cable five or six feet in length and the transformer tank, before the soft rubber disks were added. The rubber was so molded that it could be securely cemented on the insulated cable for a distance of an inch or more. The disk, therefore, served the purpose of breaking the continuity of the static discharge and prevented the short circuiting of the test voltage. At operating voltage there was no brush discharge whatever; consequently the disks were useful only in connection with the test.

These transformers have now been in continuous operation at Butte, Mont., for several months. Unfortunately, however, the Madison River Power Company is not yet ready to deliver current at higher than 40,000 volts, so that the possibility of transmitting such voltages with the present methods of line construction has not been demonstrated " out in the open."

New Portable Testing Set.

Messrs. Queen & Company, of Philadelphia and New York, have just put on the market a new testing set, in which are embodied several features which they believe will prove of general interest and great advantage. The set is called the "Queen Decade Portable Testing Set," and is illustrated herewith. It consists of a Wheatstone bridge and rheostat, battery, galvanometer with shunt, current interrupter, telephone receiver, keys, switches, etc.

In one of the arms of the Wheatstone bridge, besides the coils of 1, 10, 100 and 1,000 ohms resistance, are included a standard condenser and a standard inductance coil. In the rheostat are four rows of coils—units, tens, hundreds and thousands—each row consisting of 10 coils, which are wound non-inductively and without capacity. To make all the common measurements it is necessary to use only six plugs, whereas in the testing sets quite generally in use at the present time 22 to 26 plugs must be employed. The possibility of variable plug contact has therefore been reduced to a minimum. Furthermore, in this plan of bridge, the value of the resistance is read off direct, instead of as in the other forms, where various coils are unplugged to cut them into circuit and where it is necessary to add up on the completion of the test in order to obtain the total resistance.



PORTABLE TESTING SET.

An extra amount of battery is provided, the set containing ten dry cells of special form, having high voltage and large current capacity. The galvanometer in the set is of the D'Arsonval pattern, of low resistance, and of such high sensibility that it can be used for insulation resistance measurements by the direct deflection method. It is provided with a shunt, having 1, 1-10 and 1-100 values, which is conveniently arranged immediately above it. There are also provided posts, enabling the use of an outside galvanometer and an outside battery if desired.

With the set is supplied a telephone receiver, which can be used in many cases in place of the galvanometer; in fact, the telephone receiver is used for the capacity, inductance and electrolytic measurements. In the lid of the testing set is mounted a small induction coil, which produces an alternating interrupted current, which is employed when inductance, capacity and electrolytic measurements are made.

As will be seen from the illustration, there is a small drawer in the front of the case, in which is placed the connecting cords, telephone receiver, together with screw-driver and a pair of pliers, etc., which are furnished with the set. The case is of polished mahogany, and the outside dimensions are approximately 12⅞ inches long by 8 inches deep by 7¼ inches wide, and the weight is about 14 pounds.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was dull, closing at 4 per cent. for 30 days to four months, and 4¼ @ 4½ per cent. for five and six months. The stock market was firm but dull, excessively narrow speculative conditions prevailing during the entire week. The inactivity seems to be the result of the uncertainty on the part of the financial public regarding the duration and effects of the coal miners' strike. There was a good deal of talk about the traction securities, based on actual and prospective increases in their earnings, but the support given to Brooklyn Rapid Transit failed to stimulate outside buying. It is understood that the floating supply of Metropolitan has decreased. The Detroit United Railway stock, which has been dormant hitherto, scored a rapid advance due to reports that the control of the property had been acquired by an Eastern syndicate. Brooklyn Rapid Transit closed at 66⅞, a net loss of ½ point, the number of sales being 54,095. Metropolitan Street Railway made a net gain of ⅜ point, closing at 148¾, the total sales being 9,385. General Electric made a net gain of 5 points, closing at 320 on sales of only 500 shares. Westinghouse, common, closed at the highest price of the week, 214, which is a net gain of 2 points over last week's quotation. A net loss of ½ point in Western Union is recorded, the closing price being 90¼; and American Telephone and Telegraph closed at 173, being a net loss of 7 points. Amalgamated copper was heavy owing to less favorable accounts of the copper trade situation. The United States Steel stocks were also heavy in sympathy with the general tendency of the market. In outside securities the sales of stock during the week were less than 25,000 shares. The heaviest trading was in San Francisco Street Railway issues, which closed at 64, being a net loss of 1⅞ points. There was some business in General Carriage and Electric Vehicle. Following are the closing quotations of June 10:

NEW YORK.

	June 2.	June 10.		June 2.	June 10
American Tel. & Cable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
American Tel. & Tel.	176	174½	Hudson River Tel.	—	103
American Dist. Tel.	37	35½	Metropolitan St. Ry.	150	149
Brooklyn Rapid Transit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Commercial Cable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric Boat	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric Boat pfd.	47	45	[illegible]	[illegible]	[illegible]
Electric Lead Reduc'n.	3¼	2¾	Western Union Tel.	90⅛	90¾
Electric Vehicle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric Vehicle pfd	14	13½	West. E. & M. Co. pfd.	210	210
General Electric	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BOSTON.

	June 2.	June 10.		June 2.	June 10.
American Tel. & Tel.	175	174	Mexican Telephone	2¼	2¼
Cumberland Telephone	—	—	New Eng. Telephone	147	149
Edison Elec. Illum.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Erie Telephone	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
General Electric pfd.	—	—	[illegible]	[illegible]	[illegible]

PHILADELPHIA.

	June 2.	June 10.		June 2.	June 10.
American Railways	45	45¼	Phila. Traction	97	97½
Elec. Storage Battery	89	88	Phila. Electric	5½	5⅛
Elec. Storage Battery pfd	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Elec. Co. of America	7⅛	7¼	Pa. Elec. Vehicle pfd.	3	3

CHICAGO.

	June 2.	June 10.		June 2.	June 10.
Central Union Tel.	—	87½	National Carbon pfd.	93	94
Chicago Edison	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Consolidated Gas Ry.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chicago Teleph. Co.	170	—	Union Traction pfd	52½	52½
National Carbon	24	24¼	[illegible]	[illegible]	[illegible]

DIVIDENDS.—The directors of Detroit United Railway have declared the regular quarterly dividend of 1 per cent., payable July 1. Twin City Rapid Transit directors have declared a quarterly dividend of 1¾ per cent. on the preferred stock, payable July 1. The directors of the Commercial Cable Company have declared the regular quarterly dividend of 1¾ per cent., payable July 1. General Electric directors have declared the regular quarterly dividend of 2 per cent. on the common stock. The directors have also declared a 66⅔ per cent. stock dividend. It is understood that details of the distribution will shortly be announced. At 320 for the present stock, General Electric new stock works out at 192. It is understood that at least 8 per cent. will be paid in dividends on the enlarged stock, and it is thought that this rate of distribution may be eventually increased to 10 per cent. The Westinghouse Electric and Manufacturing Company has declared the quarterly dividend of 1¾ per cent. upon the preferred stock, payable July 1, 1902. During this week Manhattan directors have declared the regular quarterly dividend of 1 per cent. The executive committee of Western Union has recommended the declaration of the regular quarterly dividend of 1¼ per cent. Otis Elevator directors declared the regular quarterly dividend of 1½ per cent. on the preferred stock.

LIGHTING DEAL IN BALTIMORE.—With a view to controlling the gas and electric light, heat and power of Baltimore, a movement is on foot to combine the Consolidated Gas Company and the United Electric Light and Power Company. The New York accounting and gas expert firm of Humphreys & Glasgow have been employed by a syndicate to make an examination of the Consolidated Gas Company. This syndicate is composed of Baltimore capitalists who have lately been heavy purchasers of the stock of this company. Among the purchases made were the shares held by Henry R. Wilson and Frank Tilford, the New York directors of the company, who recently retired from the board. Several Baltimore banking houses, including Townsend, Scott & Son, are interested. The syndicate is said to have bought from 15,000 to 20,000 shares of the company's stock, and to control a great deal more. The same syndicate is effecting operations in the stock of the electric light company. It is believed that the interests seeking control are connected with the Susquehanna Light and Power Company, which is constructing a big plant for utilizing the Susquehanna River.

BROOKLYN TROLLEY MERGER.—With the merging of the entire trolley systems in Queens and Nassau counties under one head, new articles of incorporation of the New York and Queens County Railroad Company have been filed with the Secretary of State. By this merger the new company takes into its control the entire plant and franchises of the New York and Queens County, the Queens Railway Company, and the New York and North Shore Railroad, which gives the combined trolley system several hundred miles of track, extending as far as Far Rockaway, in Queens, and out into Nassau County. The capital stock of the new company is set at $5,000,000. It is said the merging of the trolley roads is part of the McDonald-Belmont plan to obtain possession of the abandoned tunnel in Fourth Street, Long Island City, which has a franchise to run under the East River and connect the Long Island trolley system with the rapid transit system of Manhattan by means of this proposed tunnel.

OTIS ELEVATOR IN CANADA.—It is understood that the Otis Elevator Company has decided to form two sub-companies in Canada. The American company has been practically barred out of Canada, as far as trade is concerned, by the high duty imposed by the Canadian Government, and now proposes to equip plants in Canada for the manufacture of Canadian raw material under the Otis Elevator patents, which cover both the United States and Canada. The factory of the Leitch & Turnbull Company, Ltd., of Hamilton, Ontario, has been purchased, and the company incorporated in that city under the name of Otis Elevator Company of Hamilton. Negotiations are under way for the purchase of another plant in Montreal, and this company will be called Otis Elevator Company of Canada. The parent company will hold 51 per cent. of the stock of each company, and the majority of the remaining 49 per cent. will be held in Canada.

GENERAL ELECTRIC STOCK RESTORATION.—At a meeting of the directors of the General Electric Company last week, they not only declared the regular quarterly dividend of 2 per cent. on the stock, but also a stock dividend of 66⅔ per cent. The stock dividend, however, had been expected, as it had been announced that there would be an increase in the capital stock by a stock dividend. This will increase the capital stock of the company from $25,242,200 to $45,000,000, restoring the 40 per cent. stock surrendered in 1898. The dividend is payable July 15 to holders of record June 25. In anticipation of this stock dividend, General Electric stock has in the last year advanced materially, selling as high as 334 April 9 last.

ALLIS-CHALMERS ANNUAL REPORT.—The first annual report of the Allis-Chalmers Company, which was incorporated under New Jersey laws on May 7, 1901, has been issued. It covers the operations of the company from the beginning of business up to the close of the fiscal year, April 30. It shows: Net profits, after deducting all expenses of manufacture and selling, and after making full provision for depreciation of buildings, plant and machinery, and for possible bad debts, $1,442,260; dividends on preferred stock, $1,137,500; surplus, $304,760. The balance sheet as of April 30 shows: Assets—Real estate, good will, etc., $27,352,082; bills and accounts receivable, $2,778,721; stocks of merchandise, materials and work in progress (at cost), $3,333,665; cash, $4,514,167; total, $37,978,635. Liabilities—Capital stock, pre-

ferred, $16,250,000; common, $20,000,000; accounts payable, $1,139,500; dividend No. 4, paid May 1, 1902, $284,375; surplus profits for period, $1,442,260; less dividends on preferred stock, $1,137,500; total, $37,978,635. President Charles Allis in his report says: The manufacturing operations of the company during the past year have been marked by a demand for the products of the company greatly in excess of the capacity of the works even when operated under the most favorable conditions. The operations of the various works the past year have been greatly hampered and the output seriously restricted owing to the changes necessarily incidental to the consolidation of such large business interests, and to the prolonged strike of some of the workmen, the effects of which are still felt at several of the plants. The company has no floating debt. It has cash in bank amounting to $4,514,167, and in addition in excess of current liabilities it has net current quick assets of $4,688,511, making total cash and net cash assets of $9,202,678. The orders unfinished and in hand on April 30, 1902, amounted to $8,157,035; orders on hand and turned over to this company upon its commencement of business amounting to $5,665,882, showing a gain in the volume of business for the year of $2,491,153. The amount of work available is much in excess of present facilities, and these will be gradually and largely increased during the present year as the new works at West Allis approach completion. We believe, therefore, that the prospects of this company for the current year are most satisfactory.

THE STANLEY-WHITNEY DEAL, reports of which have been current for some time, have again been renewed, with confirmation, this week. The New York *Tribune* says: "The acquirement of a large interest in the Stanley Electric Manufacturing Company by men who control the traction companies of New York and Philadelphia and the building up of an enormous electrical business in competition with that of the General Electric Company and the Westinghouse Electric and Manufacturing Company will attract the attention of the financial world. It was ascertained by the *Tribune* yesterday that the control of the Stanley company had been taken over by William C. Whitney, Thomas F. Ryan, Thomas Dolan, William L. Elkins and P. A. B. Widener, and that the company's plant at Pittsfield, Mass., was to be increased to about six times its present size within a few months. Mr. Whitney and Mr. Ryan went to Pittsfield on May 1 and inspected the plant there, to see if it could be extended sufficiently to manufacture all the electrical supplies needed by the companies which they and their associates in Philadelphia control. They were accompanied on the tour of inspection by Harry Payne Whitney and by H. H. Vreeland and M. G. Starrett, president and chief engineer, respectively, of the Metropolitan Street Railway Company. They were received by Dr. Perrine, and conducted through the plant, and they looked over the site for the proposed extension of the plant. Arrangements for the acquirement of an interest in the Stanley company, for an extension of the Pittsfield plant and for the manufacture of the electrical supplies needed by the companies controlled by Mr. Whitney and his associates were made quietly since the inspection of the plant. Work on new buildings for the plant is already in progress. It is expected that before the end of the summer the capacity of the plant will be increased sixfold. Dr. Perrine is to be retained as the president of the company, and the Roeblings still keep an interest." The Stanley capital stock was recently increased to $3,000,000, when the Whitney pool, it is understood, took the new $1,000,000.

MONTREAL LIGHT, HEAT AND POWER.—The first annual report of the Montreal Light, Heat and Power Company was submitted at the recent annual meeting of the shareholders of the company. The gross revenue of the company amounted to $1,760,285, and the net profits to $729,721, being 5 per cent. on the capital on which the company had to pay dividends during the year. Out of the net profits there has been declared four quarterly dividends of 1 per cent. each, amounting to $587,968, leaving a balance of $141,753, which has been placed to the credit of surplus account. At a meeting of the shareholders, held on the 15th of January last, an issue of $7,500,000 of first mortgage bonds was authorized. Of this amount, $2,500,000 has been sold to take up $2,000,000 of outstanding bonds of the Montreal & St. Lawrence Power Company, and to provide for the present requirements of the company. A further amount of $1,405,000 is held in escrow to redeem the outstanding bonds of like amount of the Montreal Gas Company and the Royal Electric Company, leaving $3,595,000 of bonds in the treasury for the further requirements of the company. The old members of the board of directors were unanimously elected. The president, Mr. S. H. Holt, stated that in order to list the stock on the New York Exchange, it would be necessary to amend one of the existing by-laws of the company, which prevented anyone indebted to the company from transferring his shares. For instance, a shareholder owing a month's gas or electric light bill could not transfer shares. The listing committee of the New York Stock Exchange objected to the clause, and it was, therefore, removed with the full consent of the meeting.

NEW BELL TELEPHONE STOCK.—The American Telephone and Telegraph Company has voted an increase of capital stock, on the basis of one new share for each four shares outstanding, and as the new issue is $21,937,000, it follows that the present outstanding capital in the hands of the public is four times this amount, or $87,748,000. As this compares with an outstanding capital in the hands of the public of $28,836,300 at the close of the last fiscal year, it confirms the report that the company had sold about $5,000,000 of American Telephone stock to New York banking interests about three months ago, at $150 per share. As it is understood that the entire outstanding stock will aggregate about $136,000,000 after the settlement of the new subscription, which, of course, includes the amount held in the treasury of the old American Bell Telephone Company, and as the present stock with the new subscription will make $109,685,000, it is held to be clear that there can no longer be $32,110,200 stock in the treasury of the American Bell Telephone Company. For if this was the case the total stock would be $141,795,000. It is, therefore, clear that the sale to the New York bankers must have been from $32,110,200 of stock which was in the Bell Company's treasury.

HAVANA ELECTRIC BONDS.—Edward Sweet & Co. announce they they are authorized by the Havana Electric Railway Company to receive subscriptions until the close of business, on June 16, for $7,500,000 of the 5 per cent. consolidated mortgage fifty-year gold bonds of that company. These bonds are part of an issue of $10,000,000, the remaining $2,500,000 remaining in the treasury for future expenditures on capital account. The bonds now offered are to be used first to take up $5,000,000 of first mortgage bonds, $768,000 of second mortgage bonds, and $582,000 of coupon notes. The balance of the proceeds will be used to pay the floating debt, for extensions and acquisition of new property. Subscribers to the bonds must pay $125 on each bond upon application, $250 on allotment, and the remaining $605 on July 10. There is a simultaneous offering of the bonds in Montreal and London. The issue is redeemable either in whole or in part at 105, at the option of the company, on Feb. 1, 1907, or on Feb. 1 or August 1 thereafter, on giving six months' previous notice.

NIAGARA FALLS POWER COMPANY.—The Niagara Falls Power Company has certified to the Secretary of State, at Albany, that it has increased its capital stock from $6,500,000 to $9,500,000. The proportion of the capital actually issued is $3,331,000.

ELECTRIC COMPANY OF AMERICA.—The capital stock of Electric Company of America has been reduced from $25,000,000 to $5,000,000, and the par value from $50 to $10.

Commercial Intelligence.

THE WEEK IN TRADE.—A very satisfactory report of trade conditions is given by Bradstreet's, which states that crop prospects, taken as a whole, are really brilliant, railroad earnings are enormous despite the small grain tonnage, bank clearings are quite heavy notwithstanding the speculative dealings, and failures are fewer in number than in recently preceding years. The ending of the Boer war, it is also thought, will have a tendency to stimulate export business in manufactures. On the other hand, the industrial situation, though improved by the ending of the blast furnace strikes, is still a depressing one, owing to the prospect of the anthracite coal strike proving a long and bitter one, and the general unrest noted among workers in a number of industries. The feature in the steel trade is the conservative action of producers, who have fixed the price of steel rails for next year at $28, this being partly caused by the carrying over of large orders, delivery of which is impossible this year. A large volume of new business is also reported in this line. Business failures for the week, as reported by Brodstreet's, numbered 153 as against 163 the week previous and 163 the same week last year. The copper market was quiet but firm at the following quotations: Lake 12½@12⅝c.; electrolytic in cakes, wire bars and ingots 12½@12⅝c.; [illegible] casting stock 12⅜c.

POWER FROM FEATHER RIVER.—Articles of incorporation have been filed in California of the Feather River Power Company, with a capital stock of $5,000,000. The company has been formed by Charles Webb Howard and other capitalists for the transmission of electricity from the Big Bend tunnel, on the Feather River, to San Francisco. The tunnel was built in 1882 by the Big Bend Tunnel and Mining Company at a cost of $1,500,000. The mining company has disposed of its interests to the new power company, but the terms of the transaction are not made public. The figure is in the neighborhood of several millions. At a point twenty miles above the town of Oroville the north fork of the Feather river makes a bend fourteen miles in length, which is called

the big bend [illegible] Mining Company drove a tunnel through the mountain. The tunnel is 12,007 feet in length, the largest in the State. At the point where the tunnel emerges there is a fall of 450 feet to the river. It is this fall that will be utilized for generating electricity. The water is diverted into the tunnel by means of a great head dam, and its flow is controlled by massive gates, with stone concrete foundations. Power can be generated throughout the year, as even in the driest season there is a flow of 60,000 inches of water through the tunnel. There are no reservoirs connected with the system and no ditches that can be washed out by heavy rains. The officers of the new company are: President, Charles Webb Howard; vice-president, C. L. Fair; directors, W. J. Dingee, Charles Webb Howard, J. Downey Harvey, C. L. Fair and Frank McLaughlin. The installing of a power plant and the building of a distributing system will be begun by the company at once. At first all the power will be sold to San Francisco consumers. There is now 80,000 horse-power sold in that city and the demand is constantly increasing. The promoters of the new company believe that there is more than enough room for itself and the Bay Counties and Standard companies. They look forward to the building of a transcontinental railway line near their plant, and in that event will sell their power to the railway company. At present several trunk lines are at work surveying there.

THE MARINE ENGINE & MACHINE COMPANY, of Harrison, N. J., whose New York offices are in the Townsend Building, No. 1123 Broadway, which concern has been manufacturing electric elevators for the past two years, have made arrangements by which they have secured the sole agency for the sale of the hydraulic type of elevators built by the Portland Company, of Portland, Me. The original plunger type was first installed by the Portland people prior to the year 1850. The Marine Company has completed the erection of an extensive foundry adjacent to its elevator shops, where iron castings of every description are made. Being on tidewater castings can be made and finished of a larger size than would permit of transportation by rail. The company has also the Bournonville acetylene generators, which were formerly manufactured by the General Acetylene Company. The arrangement with the Portland Company was brought about by Mr. F. S. Hastings and Mr. Charles A. Benton, the general sales agent of the Marine Company, and Mr. R. C. Payson, treasurer of the Portland Company. Recent contracts secured by the Marine Company for electric elevators include two special self-oiling elevators for installation in the new Knox Building at Fortieth Street and Fifth Avenue. These elevators have a speed of 300 feet per minute. They are unique inasmuch that there is not a single key or pin used in the construction of the entire machines. A full automatic control elevator with a speed of 100 feet a minute has been ordered for installation in the residence of Mr. B. A. Williams, Fifth Avenue, New York.

OUR TRADE WITH JAPAN.—The "Annual Returns of the Foreign Trade of the Empire of Japan," for the year 1901 has just been received by the Treasury Bureau of Statistics. It shows that the United States which in 1881 furnished less than 6 per cent. of the imports of Japan, supplied 17 per cent. of those imports in 1901. The following table shows the increase by some of the more important articles in the importations of Japan from the United States, comparing 1901 with 1896:

Articles Imported.	1896 Yen	1901 Yen.
Electric light apparatus	272,184	375,521
Fire engines and pumps	24,434	148,292
Farmers' and mechanics' tools	83,393	128,696
Locomotive engines	416,106	783,356
Paper-making machinery	123,520	251,942
Rails, iron	[illegible]	[illegible]
Iron pipes and tubes	73,941	541,049
Iron nails	232,319	668,490
Lubricating oil	[illegible]	[illegible]
Submarine cables and underground telegraphs	none	167,536

TROLLEY COMPETITION WITH STEAM.—Reductions in suburban fares are being planned by the New York Central management of the Boston and Albany to involve the introduction of the zone system. The line between Boston and South Framingham will probably be divided into five five-cent fare zones, the total fare to be 25 cents, against the present fare of 50 cents. The primary cause is trolley competition. As far as South Framingham there are five lines directly competing with the steam road—the Boston Elevated, Boston & Newton, Newton Street Ry., Natick & Cochituate and South Middlesex. All have developed a thriving interurban business, which has been largely at the Albany's expense. The prospective competition is that of the Boston & Worcester Street Railway.

ENGINES FOR N. Y. EDISON WATERSIDE STATION.—Westinghouse, Church, Kerr & Company have received orders for two 6,500-hp Westinghouse-Corliss, compound condensing engines of the Waterside type, for the New York Edison Company. These engines will be installed in the Waterside station, making the equipment of the plant ten engines, aggregating 65,000-hp capacity, with a maximum output of 100,000 hp. The installation of the original order of eight engines is nearing completion, but the constant increase in the demand for electric power has been so great that the company has found it advisable to place this additional order and thus ensure an early installation of the additional equipment. As the new engines will be duplicates of those already installed, the work of construction at the Pittsburg shops of the Westinghouse Machine Company will be commenced immediately.

THE EAGLE-SHAWMUT MINING COMPANY, of Chinese, Calif., is installing a 200-hp air compressor plant, to be operated by an eight-foot steel disc Pelton water wheel; this wheel is to operate under a 900 ft. head, and will run at a speed of 100 r. p. m. The Pelton Company has had a great deal of experience in installing wheels for this class of work. One of unusual interest, and embracing some new and interesting features in hydraulic engineering, was recently installed at the Morning Mine, Mullan, Idaho. The wheel is 33 ft. in diameter—being the largest impulse wheel ever built—and weighs 33,000 pounds; this wheel operates under 1,400 ft. head and is direct connected to two 1,000-hp air compressors which run at a speed of 80 r. p. m.

POWER PLANT AT SEATTLE.—The Mutual Light & Heat Company, Seattle, Wash., is building a new power house, 65x75 feet, equipped with Babcock & Wilcox boilers of 600 hp., complete with chain grate stokers and superheaters, Green economizers, Sturtevant induced draft apparatus and Foster fan engine regulator. The plans comprehend four similar batteries when all is complete, with hopper storage overhead for 300 tons of coal, served through Clark's coal weighing device. The electrical equipment comprises two Alfree direct connected engines, with 60 kw. generators, and one Ideal engine belted to two 35 kw. generators. Charles E. Crane, formerly of Crane Bros. & Co., Yazoo City, Miss., is president.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Greenfield and Turner's Fall Street Railway Company for the installation of a battery of chloride accumulators. This battery consisting of 200 cells, having a capacity of 200 amperes for one hour with tanks sufficiently large to allow of a 40 per cent. increase, will be placed in the new car houses at Cheapside, a distance of ten miles from the power house. The battery floating on the line is to be used at this point to regulate the drop in voltage due to the heavy grade which occurs near this station at the terminus of the railway company's line.

NEW STATION AT NASHVILLE, TENN.—The new power plant of the Cumberland Electric Light & Power Company, Nashville, Tenn., includes two International Power Company engines; one is to drive a 1600 kw. generator and the other is to drive a 1250 kw. generator; both furnished by the General Electric Company. The plant will also include a steam equipment consisting of two double-deck vertical header boilers, each boiler to be 350 hp. The company will also purchase a 50-ton, 56-foot span, hand power traveling crane. E. C. Hathaway is the consulting engineer and H. T. Brown the electrical engineer.

BULLOCK APPARATUS FOR SHAWINIGAN.—The Shawinigan Water & Power Company, of Quebec, has closed a contract with the Bullock Electric Company, of Cincinnati, Ohio, for the machinery necessary to complete the plant for service in Montreal. The machinery contracted for includes a set of motor-generators, which will be used to generate current at 2,000 volts. Mr. R. D. Mershon, of New York, will have charge of the construction work, and it is expected that the Shawinigan Company will be ready to deliver power in Montreal by the first of December next.

BULLOCK MOTOR-GENERATORS.—The Redlands Street Railway Company recently closed a contract through the Wagner-Bullock agency in San Francisco for a 200 kw. Bullock motor generator. It will be operated on a 11,000-volt circuit. A similar motor generator was recently started up by the San Bernardino Traction Company, San Bernardino, Calif.

ELECTRICAL EQUIPMENT FOR BATTLESHIP.—The Thresher Electric Company, of Dayton, Ohio, has the contract for equipping the battleship "Virginia" with electrical apparatus. Its [illegible]

WATER POWER DEVELOPMENT.—Charters have been issued to nine new water and power companies, capital $300 each, to operate in York and Lancaster counties, to utilize the waters of the Susquehanna river for commercial purposes.

BALL ENGINES.—The Pittsburg Reduction Company, Pittsburg, Pa., has recently purchased from the Ball Engine Company, Erie, Pa., a 325-hp engine direct-connected to 200-kw generator, being a duplicate of an outfit installed a year ago.

General News.

THE TELEPHONE.

PEORIA, ILL.—The Interstate Telephone and Telegraph Company will establish a new system here.

NASHVILLE, ILL.—The Southern Union Telephone Comany will extend its lines throughout Washington County.

CHICAGO, ILL.—The United Telephone, Telegraph & Electric Company, which has operated a small exchange in Hyde Park for a number of years, has applied for a franchise to build all over the city of Chicago.

CHICAGO, ILL.—A telegram from Chicago of June 7, says: Recriminations and charges of betrayed promises flew back and forth in the City Hall to-day over the action of the City Council's Judiciary Committee yesterday in giving the Illinois Telephone and Telegraph Company all it wanted in the amendatory ordinances asked by the company. Rumors of bribery were rife, and a determination was expressed to make the vote on the motion to pass the ordinances the first test of the integrity of the new Council. By some aldermen the proposed ordinances are characterized as the biggest "thing" which has been attempted to be put through the Council since the fifty-year street railway franchise. Mayor Harrison refused to say a word about the ordinances and carefully refrained from saying whether he would veto the ordinances if they go through in their present shape. A story was current in the City Hall that preceding the Judiciary Committee's meeting President Wheeler of the Telephone Company and his Aldermanic supporters held a conference in the finance room. Here the plan of outline was arranged.

INDIANAPOLIS, IND.—The Markle Telephone Company, of Markle, capital stock $6,000, has been incorporated. Directors: E. S. Fisher, F. E. Alshouse and Abraham May.

FT. WAYNE, IND.—The issue of $50,000 additional stock has been authorized by the directors of the National Telephone Company. The money is to be used for improvements north of Ft. Wayne.

INDIANAPOLIS, IND.—The Central Union Telephone Company is installing a new substation in the northern part of the city. A substantial brick building has been completed and in a few days the substation or exchange will be in operation.

SHIRLEY, IND.—The Shirley Telephone Company has been incorporated with $3,000 capital stock, to operate in Hancock and Henry counties. C. W. Boreslog, J. C. McClain and M. E. Wood are directors. The Frost Telephone Company, also of Hancock county, has been incorporated with $120 capital stock by J. C. Moore, E. E. Brooks, J. N. Glascock and N. G. Cleft.

INDIANAPOLIS, IND.—The Albany Telephone Company, capital stock $10,000, has been incorporated. Board of Directors: Wm. H. Murphy, E. L. Lewis, E. A. Zehner, E. E. Luzadder, A. M. Pollard, E. H. Runneals and C. J. Campbell. This company will operate telephone lines and exchanges in Randolph, Blackford, Wells, Delaware, Jay and Madison Counties.

MUNCIE, IND.—As a result of an investigation and examination of the cause of the poor telephone service complained of in this city during the last few weeks, local managers of the Central Union Telephone Company discovered that nearly 5,000 feet of lead cable have been practically destroyed by being pierced with bullets. The holes were caused by shots fired from Flobert rifles in the hands of boys and young men who were shooting at birds. The loss to the company will aggregate nearly $3,000.

BANGOR, ME.—The Unity Telephone Company has been organized with a capital of stock of $10,000.

PONTIAC, MICH.—With the completion of about 10 miles of line between Linden and Holly the Oakland County Telephone Company of this place will have connection with nearly all the independent companies in the State.

DETROIT, MICH.—The Co-operative Telephone Company has placed a contract with the International Construction Company, of Chicago, for a modern switchboard of 12,000-lines capacity. It will be of the multiple central energy type and will be built under the McCormick patents.

LIBERTY, MO.—The Liberty Telephone Company has been incorporated with a capital stock of $15,000. The incorporators are: Sam. H. Woodson, Jennie M. Woodson, Pascal Parker, Sallye Parker and others.

OMAHA, NEB.—The Newport and Mariaville Telephone Company, of Newport, Neb., has been incorporated with a capital stock of $1,500.

OMAHA, NEB.—The Newport and Mariaville Telephone Company, of tion to its present building to provide larger facilities to accommodate its growing business. The new structure will cost about $100,000. The company also proposes to establish a branch exchange in the western part of the city.

AFTON, N. Y.—The Glen Telephone Company has been organized here.

ITHACA, N. Y.—The local telephone system will be extended to Moravia.

NEW YORK, N. Y.—Plans have been filed with the Building Bureau for a new six-story telephone exchange with shops, 92x100 feet, to be built for the New York Telephone Company on West Seventeenth street. It will have a facade of brick trimmed with limestone, and will cost $300,000.

BROOKLYN, N. Y.—As it would cost about $36,000 in install fire alarm boxes in all the Brooklyn schools, it is proposed to equip every school in the borough with a telephone. This plan is favored by Commissioner Jonas, of the Committee on Supplies, and by other members of the Brooklyn Board of Education as an improvement on the fire-alarm box, and much cheaper.

NEW YORK, N. Y.—The New York Telephone Company's private branch exchange service will be installed in the Manhattan Hotel, the Holland House, the Hoffman, the Imperial and the Marlborough during the summer months. Contracts have been signed covering a total of 2202 long-distance telephones to be placed in the hotels named. A total of 6374 long-distance telephones, to be placed in hotels and apartment houses in the Borough of Manhattan have been contracted for since January 1, 1902.

ZANESVILLE, OHIO.—The Zanesville Telephone & Telegraph Company has added over 100 subscribers during the past few weeks.

BUCYRUS, OHIO.—The Bucyrus Telephone Company will establish an exchange at Sulphur Springs, where a good list of subscribers has been obtained.

BARTLETT, OHIO.—The People's Telephone Company has increased its capital from $2,000 to $5,000 to provide for improvements. C. C. King is president.

VANWERT, OHIO.—The Convoy Home Telephone Company has increased its capital stock from $3,000 to $10,000, to provide for improvements. L. W. Larber is president.

JACKSON, OHIO.—The Jackson County Telephone Company has increased its capital stock from $6,000 to $12,000, to provide for improvements. W. H. Hedderjohann is president.

MANCHESTER, OHIO.—The Manchester Telephone Company has been incorporated with $1,500 capital stock by R. C. Henderson, G. J. Nicholson, J. C. Henderson, F. W. Long and Charles M. Long.

GALION, OHIO.—The Galion Telephone Company, recently purchased by local people from the Everett-Moore Syndicate, has increased its capital stock from $30,000 to $100,000. Mark Cook is president.

SMITHFIELD, OHIO.—The Farmers' Independent Telephone Company has placed its system in operation in this place. Long distance connection is secured through an arrangement with the Harrison County Telephone Company, of Cadiz

SEBRING, OHIO.—The Central Union Telephone Company is installing a local exchange, and all subscribers will be given the benefit of free service to Alliance and surrounding towns. The rates are $1 for residences and $2 for business houses per month.

WARRENSVILLE, OHIO.—The Warrensville Telephone Company has been incorporated with $5,000 capital stock by W. F. Kehres, E. C. Foote, J. N. Smith, F. A. Judson, Charles Haltz, A. L. Kehres and W. C. Teal. A system will be built in Warrensville, a suburb of Cleveland.

HASKINS, OHIO.—The Haskins Mutual Telephone Company has been organized with the following directors: F. A. Robertson, W. T. Moore, John Schutzenberg, Robert Pargellis, E. C. Thornton, J. A. Bower and Fred Dauer. The capital stock is $10,000. The company has twelve miles of line in operation, which are to be extended to Grand Rapids and Tontogany.

CLEVELAND, OHIO.—Semi-official announcement has been made by the Everett-Moore syndicate that in all probability the Federal Telephone Company will be retired from the boards. Of the 23 component organizations controlled by the Federal Company, 21 will be sold, leaving only the Cuyahoga Telephone Company, of Cleveland, and the United States Telephone Company (long distance) in the hands of the syndicate.

CANTON, OHIO.—The Stark County Telephone Company has elected directors as follows: Joseph Biechele, J. B. Hoge, Ferdinand Herbruch, Dr. T. H. Phillips, John C. Welty, R. S. Shields, H. D. Critchfield, A. Dannemiller and Henry A. Cavanah. The directors decided to push improvements at once. The company is installing a large addition to the switchboard at the local exchange. It has a large number of subscribers on the waiting list

NORWALK, OHIO.—The Norwalk Telephone Company has been organized with J. F. Laning, president; C. R. Callaghan, vice-president and general manager; Frank A. Knapp, secretary, and J. H. Beatty, treasurer. The above, with A. K. McConnell, D. Calhoun, Ford H. Lanning and W. M. Halliday, are directors. The company has absorbed exchanges at Norwalk, Milan, Monroeville, Chicago Junction, Plymouth, Greenwich, New London, Berlin Heights, New Washington, Crestline and other places. The united company has over 3,000 telephones in operation and 200 miles of toll line.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone phone Company will be extended to Eden, Weber County, Utah.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has closed the gap between Casper and Douglas, Wyo. A branch line runs from Douglas to Cheyenne.

SALT LAKE CITY, UTAH.—The County Commissioners of Salt Lake County have granted a franchise to Reed Smool, Jesse Knight, C. E. Loose, George Havercamp and S. K. Thurman to construct an electric railway and telephone lines in the county.

MONTICELLO, WIS.—The Independent Telephone Company, of Waupaca, will build a line from that city to Almond, Plainfield and Hancock.

DARLINGTON, WIS.—The Wisconsin Telephone Company will extend its lines from Darlington to Argyle and Blanchardville.

MADISON, WIS.—The Westby Telephone Company has been incorporated with a capital stock of $3,000, by A. H. Dahl, W. J. Mitchell, A. Lee and H. Slevlinger.

MENOMONEE FALLS, WIS.—The Menomonee Falls Telephone Company has been incorporated to construct and operate telephone exchanges and toll lines in the counties of Milwaukee and Waukesha.

OTTAWA, ONT.—The mayor of Ottawa, Ont., is in receipt of numerous letters from telephone manufacturers and firms in the United States inquiring for particulars in regard to the tenders invited by the city council of Ottawa for an independent telephone system for the city, mention of which has been

ELECTRIC LIGHT AND POWER.

[illegible], ALA.—[illegible] Mobile Light & Railway Company to light the city on a ten-year contract for $50 a lamp per year.

BIRMINGHAM, ALA.—The city council has granted two franchises to James L. Tanner and associates, one of which is to build an electric lighting and power plant with wires underground. Western capital is interested.

PRESCOTT, ARIZ.—The Prescott Electric Light & Power Company will use a steam turbine to operate an electric generator. Chas. C. Moore & Company of San Francisco [illegible] to carry 200 pounds of steam—and a superheater.

OXNARD, CALIF.—The Oxnard Suburban Electric Company has incorporated with a capital of $10,000. The directors are: D. T. Perkins, W. T. Wayte, M. V. Lockwood, S. Cohn, L. J. Rose, J. A. Driffil and P. S. Carr.

SAN FRANCISCO, CALIF.—The Vacaville Water & Light Company has been sold to E. D. N. Lehe, W. Z. McBride of Dixon, Calif., and F. R. Orcutt of San Francisco. The new management will distribute the current from the Bay Counties Power Company's transmission line. Dixon is lighted in the same way by Mr. Lehe and Suisun will soon have lights supplied from the Bay Counties system.

SAN FRANCISCO, CALIF.—Thos. Hill and Geo. Sparks of Redding, Calif., have filed water appropriations for 100,000 inches of water of the McCloud River in Shasta County. It is understood that these rights which had been held by a company had lapsed and that the new locators will transfer their rights to the McCloud River Electrical Power Company. H. C. Wybro will install the electric plant of this company.

SAN FRANCISCO, CALIF.—The San Antonio Water Company of Ontario, Calif., recently ordered an additional 3-phase General Electric 250-kw, 10,000-volt generator. The water company now controls the entire water supply of the San Antonio Canyon. It will do its own pumping by electricity but it is reported that nearly all of its electrical output will be sold to the San Gabriel Electric Company for distribution. A sub-station will be built at North Ontario.

SAN FRANCISCO, CALIF.—The Feather River Power Company which was recently incorporated in San Francisco with a capital stock of $5,000,000 will install an electric power plant about 20 miles above Oroville, at the Big Bend of the Feather River. A tunnel 12,007 feet in length was driven here by the Big Bend Tunnel and Mining Company and a dam constructed. The company has acquired all of that company's property and will build a power house near the outlet of the tunnel where there will be an available head of 450 feet. At least 20,000 hp will be transmitted to San Francisco. The estimated cost of the system is $2,000,000. Chas. Webb Howard is president of the company and Chas. L. Fair, vice-president.

HARTFORD, CONN.—A section of the dome of the State Capitol, in this city, is now electrically lighted. When the plans are completed there will be a total of 834 lights on the dome. Nernst lamps were used in illuminating the House of Representatives during the Constitutional Convention. When the wiring of the building is finished there will be a large chandelier under the dome with 1,500 electric lamps. The work is being carried out by the New England Engineering Company, of Waterbury, Conn.

GREENFIELD, MASS.—The Automatic Machine Company will operate its new factory with electric power.

SPRINGFIELD, MASS.—Smith & Wesson propose putting in a large electric power plant at Barrett's Junction, utilizing water power.

ZEELAND, MICH.—A proposition to issue $18,000 electric light and water works bonds has carried.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company has been organized under the laws of New Jersey to take over the properties of the Edison Electric Light Company and the Grand Rapids Electric Light & Power Company, recently purchased by Chicago and Cincinnati capitalists. The new company has $1,000,000 capital stock and $610,000 bonds.

MOBERLY, MO.—The Moberly Light, Power and Fuel Company has been incorporated with a capital stock of $2,500, one-half paid. The incorporators are J. H. Starr, W. M. Afflick, F. B. Miller, F. C. Jacoby, C. A. Thompson and others.

ST. LOUIS, MO.—The organization of the Union Electric Light & Power Company was perfected May 28 at a meeting at which Julius S. Walsh was elected president; Breckenridge Jones treasurer, and H. P. C. Coakes secretary and assistant treasurer. E. G. Bruckman was elected manager of the former Imperial plant and Chas. H. Ledlie, of the Citizens' Company, was made chief engineer of construction. The executive committee is composed of Julius S. Walsh, C. W. Wetmore, W. F. Nolker and W. F. White. New directors were elected to take the places of those elected temporarily at the last meeting of the parties interested in the consolidation, as follows: C. W. Wetmore, Geo. R. Sheldon and W. F. White, all of New York. C. W. Wetmore, vice-president of the combination, is president of the North American Company. Mr. Coakes, the secretary and assistant treasurer, has been secretary of the Imperial Company, of this city.

BINGHAMTON, N. Y. The International Time Recording Company will operate an addition to its factory with motors.

AMSTERDAM, N. Y.—The Mohawk Mills are putting in a General Electric generator direct-connected to a Hooven, Owens & Rentschler engine, with three 170-hp Franklin water-tube boilers.

GOSHEN, N. Y.—The Goshen Light and Power Company will build a new boiler house and install a 150-hp boiler. The company will enlarge its main [illegible]

[illegible], OHIO.—[illegible] are lights in the streets, current to be furnished by the Toledo, Fostoria & Findlay Electric Railway Company.

XENIA, OHIO.—H. C. Hubbell and C. C. Hubbell of this city have bought the electric light and power plant at Somerset, Ky. The plant supplies 40 arc lamps and 2000 incandescents. It is understood that new equipment [illegible]

COLUMBUS, OHIO.—Franchise ordinances of the Great Eastern Theatre & Light Company and the East Columbus Heating & Lighting Company have been recommended to the council for passage. Both concerns desire to operate lighting plants on the east side of the city.

HUDSON, OHIO.—Charles Backman of Akron has applied for a franchise to install an electric lighting plant in Hudson. He proposes to furnish arc lamps to the town at $50 per lamp per year, at least 20 to be used, and to furnish incandescent lamps at 50 cents for the first one, 45 cents for the second, 40 cents for the third, 35 cents for the fourth and down to 20 cents for six or more in one building. He also agrees to sell the plant to the town at the end of 10 years, if desired.

PORTLAND, ORE.—The Portland General Electric Company has ordered five 700-hp 3-phase generators for the power station at Oregon City, Ore. It is expected that the first machine will be in operation by Oct. 1. The water-wheels have been ordered in Dayton, Ohio. The present generating station will be extended as soon as there is low water in the river. Additional rotary converters and switchboards will be installed in a new distributing station that will be built in Portland adjoining the old one at 7th and Alder streets. It will be a fire-proof building 60x100 feet. About 40 carloads of machinery have been ordered and will be ready for use within one year. The Portland distributing system will be reconstructed and the voltage doubled on the main transmission line.

ANDERSON, S. C.—J. J. Fretwell, owner of the water power at Hatton's Ford and Tugaloo River, states that this power will be developed. There are from 6,000 to 10,000 horse power available at Hutton's Ford. It is proposed to build a large cotton mill on Tugaloo River. There is a possibility of bringing power to Anderson.

DYERSBURG, TENN., will receive bids until June 17 for the construction of water works and electric light systems. Plans and specifications may be had by addressing W. A. Fowlkes, Jr., Mayor.

SALT LAKE CITY, UTAH. A new power and development company has been organized at Grant's Pass, Ore., to utilize the power from Applegate Falls for furnishing electric power to operate all the stamp mills and mining machinery and factories in Josephine County; also to furnish power for an electric railway from Grant's Pass to the Waldo copper district. H. W. Ogible, of San Francisco, is manager of the company.

WARRENTON, VA.—The Warrenton Electric Company has placed the contract for a complete electric lighting system.

INDEPENDENCE, WIS.—The village has voted to issue bonds for an electric lighting plant.

EAGLE RIVER, WIS. The Eagle River Light and Water Company has been incorporated. The capital stock is $15,500 and the incorporators are: D. E. Riordan, J. K. Fish and F. J. Thorn.

OTTAWA, ONT.—The Soulanges Canal has been opened for the season with the new electrical apparatus for working the lock gates, sluices, bridges, etc., in full and successful operation. The canal is brilliantly lighted by electricity throughout, and is as easily navigable by night as in the daytime.

THE ELECTRIC RAILWAY.

[illegible] granted a franchise to operate a street railway in this city. The company has been incorporated at Springfield for $100,000. The incorporators are Edgar A. Potter, Mattoon; S. W. Worth and Arthur Dyanforth, Chicago; Judge T. Grosscup of the Court of Appeals, Chicago, is said to be behind the project.

INDIANAPOLIS, IND.—The Richmond Street and Interurban Railway has increased its capital stock from $500,000 to $600,000.

EVANSVILLE, IND.—An electric railway from this city to Princeton is now practically assured. Ohio capitalists have taken up the project.

MADISON, IND.—The city council has granted a franchise to representatives of an Eastern syndicate for an interurban electric railway between Madison and other river towns.

INDIANAPOLIS, IND.—The Indianapolis, Lebanon & Frankfort Traction Company has signed its acceptance of a franchise to enter this city similar to that of the Union Traction Company.

INDIANAPOLIS, IND. The Eastern Indiana Traction Company has filed notice of an amendment to its charter, to cover the construction of its road from Ridgeville, Jay County, to Gas City.

KOKOMO, IND. Officials of the Toledo, St. Louis & Kansas City Railroad announce their purpose to purchase electric locomotives to haul standard cars and will inaugurate a half-hour service between this city and Marion.

INDIANAPOLIS, IND.—The North American Railroad Construction Company of Illinois has filed incorporation papers in this State. The capital used in this State is $10,000, and J. H. McCowen is the local representa[illegible]

LOUISVILLE, KY.—Tennis Bros. & Company, electric railway contractors, are considering a proposition to build a line from Louisville to Prospect.

PADUCAH, KY.—The Paducah City Railway Company has filed articles of incorporation with $300,000 capital stock. The stockholders are W. L. Hayes, Cleveland; A. L. Rich, C. S. Maltby, Cincinnati; C. Dullam, Louisville. The company will absorb the Paducah Street Railway & Light Company. A number of improvements will be made.

TRENTON, N. J.—The Easton & Washington Traction Company, of Phillipsburg, N. J., has been incorporated; capital stock, $100,000. Incorporators:

CANTON, OHIO.—The county commissioners have granted a franchise through the county to the Massillon, Dalton & Wooster Railway Company.

Company has changed $500,000 of its common stock to preferred stock. The

CANTON, OHIO.—The Canton-Massillon and the Canton-Akron companies are to be merged on June 17. Both properties are owned by Tucker, Anthony & Company, Boston. The line through Canton will be double-tracked.

AKRON, OHIO.—The Northern Ohio Traction Company is endeavoring to secure the lighting contract in Barberton. The company is making improvements to its lighting system, and is just installing an 1,800-hp Cooper-Corliss engine with Westinghouse generator.

CINCINNATI, OHIO.—The Cincinnati & Eastern Railway Company, the Suburban Traction Company and the Rapid Railway Company have organized a union station company, and have secured a tract of land on Sycamore street, where a union passenger and freight station will be built.

CONNEAUT, OHIO.—George L. Chapman, George Cleveland, J. Thomas and George Watson of Cleveland are securing right of way for an electric railway from Girard, Pa., to Albion, Shadeland, Springboro, Conneautville and Conneaut Lake. These people are promoting several lines radiating from Conneaut.

PIQUA, OHIO.—The Miami Valley Railway between Piqua and Troy has passed into the hands of the Dayton & Troy Electric Railway Company under a 99-year lease. The road will be overhauled and improved and cars will run through from Dayton to Piqua. The power house at Piqua will be abandoned and power will be furnished from the Dayton and Troy station at Tippecanoe.

FINDLAY, OHIO.—The Findlay, Kenton, Bellefontaine & Urbana Railway Company has been organized with Senator David Joy, president; J. M. Stein, vice-president; C. H. Thorndyke, secretary; W. J. Burget, treasurer. Directors: the above and J. N. Shaffer, J. DuVald, W. P. Wiseley, C. A. Bond, L. Monheimer and M. C. Shaffer. It is claimed that a greater part of the right of way has been secured.

YOUNGSTOWN, OHIO.—A consolidation of the Mahoning Valley Railway Company, the Trumbull Electric Company and the Mineral Ridge & Niles Electric Company was effected May 1 at meetings of the directors of the companies. The new company will be known as the Mahoning Valley Electric Railway Company, and the capital stock has been increased from $1,500,000 to $2,500,000 for the purpose of covering the cost of all the properties.

CLEVELAND, OHIO.—The deal for the purchase of the Everett-Moore holdings in the Detroit United Railway by an eastern syndicate has been declared off, the option having expired. There has also been a hitch in the transaction whereby Cleveland people were to take over the holdings in the Northern Ohio Traction Company. Under an arrangement with the Toledo & Monroe Railway, the Detroit & Toledo Shore Line is again operating cars from Toledo to Detroit.

RENTON, WASH.—A franchise has been granted to the Seattle & Renton Electric Railway Company.

SPARTA, WIS.—The Sparta-Melrose Traction, Light & Power Company has been incorporated with $25,000 capital.

MILWAUKEE, WIS.—The Milwaukee Electric Railway and Light Company has increased the wages of all motormen and conductors.

SHEBOYGAN, WIS.—John I. Beggs, general manager of the Milwaukee Electric Railway and Light Company, recently went over the entire street railway line with a view of ascertaining its value and whether the system was adaptable to his corporation purpose. It is reported that an electric line is to be built from Milwaukee to this city to connect with the local line.

TORONTO, ONT.—The Consolidated Electric Company, of Toronto, has been incorporated with a capital of $100,000. The provisional directors are: A. J. Phillips, G. C. Brown, A. H. Howarth and A. R. Riches, all of Toronto.

MONTREAL, QUE.—Messrs. S. H. Ewing, Alex. MacPherson, Murdoch Mackenzie, J. P. Cleghorn and James Tasker, of Montreal, have been incorporated by the Ontario government as the Cornwall Street Railway, Light & Power Company, with a share capital of $200,000.

THE AUTOMOBILE.

THE HALSEY AUTOMOBILE COMPANY of St. Louis has been incorporated with a capital stock of $30,000, all paid. The incorporators are: Oscar L. Halsey, Augustus C. Halsey, Edward J. Snowden.

AUTOMOBILES IN THE MARITIME PROVINCES.—An automobile company has been organized in Charlottetown, P. E. I. It is proposed to have an automobile service to the various summer resorts on the north side of the island.

THE AUTOMOBILE CLUB of St. Louis has applied to the Circuit Court for a pro forma decree of incorporation. The officers are: F. H. Walker, president; E. M. Senseney, secretary, and Edward Mallinckrodt, Jr., treasurer. The club will be governed by a board of directors, consisting of the officers

John Ring, Jr., and Horace Rumsey.

NEW INDUSTRIAL COMPANIES.

THE OHIO BRASS COMPANY, of Mansfield, Ohio, has been incorporated under the laws of New Jersey with $1,000,000 capital. Incorporators: Frank B. Black, Reid Carpenter, Charles N. King, Harry F. Black, George F. Lucas, and E. T. Cook, all of Mansfield.

THE KINSMAN ELECTRIC AND RAILWAY SUPPLY COMPANY of New York, has been incorporated with a capital stock of $50,000. The directors are S. A. Wood, of New York; W. H. Van Arsdale, of Aurora, Ill., and F. E. Kinsman of Plainfield, N. J.

THE GOLD CAR HEATING AND LIGHTING COMPANY of New York City has been incorporated with a capital of $1,000,000. The directors are: Edward E. Gold, Richard Voges and John M. Scoble, of New York City; John F. Cahill, Edward J. Ronan, Christopher Moran and Lucius E. Varney of Brooklyn.

THE ELECTRICAL EQUIPMENT COMPANY is the name of the corporation recently formed in Chicago by J. Holt Gates, president; W. J. Peterson, vice-president and manager, and Arthur W. Tobin, secretary and treasurer, to carry on an engineering and contracting business for complete alternating and direct current electric light and power plants. The offices will be at 939 Monadnock Block, Chicago. The gentlemen forming this company are all too well known in the electrical trade to need introduction. They will undoubtedly obtain their share of business, since they have had long experience as

LEGAL.

TELEPHONE LITIGATION.—The American Bell Telephone Co. has recently brought suits against the Cuyahoga Telephone Co., of Cleveland (with H. A. Everett, E. W. Moore, J. B. Hoge and R. H. Judd as defendants) and against the Pittsburg & Allegheny Telephone Co. for alleged infringements of telephone patents.

PERSONAL.

MR. RUSSELL BAKER has resigned his position as superintendent of the Electric & Water Company at Little Falls, Minn.

MR. FRANK B. RAE, the well known electrical engineer, announces the marriage of his daughter, Miss Lilia Alwilda Rae to Mr. Burt Barnes.

MR. W. J. HAMMER and family are going abroad this week, and will spend some time in England and on the Continent. Mr. Hammer has several electrical matters to look after

MR. GEORGE HERBERT WINSLOW, consulting electrical engineer, Pittsburg, Pa., was married in Cleveland on June 4 to Miss Sarah Duncan, niece of the late President McKinley.

MR. GEORGE B. FRANCIS has resigned his position as chief engineer of the Providence, R. I., street railway system to accept one as civil engineer with Westinghouse, Church, Kerr & Co., of New York.

MR. BERT H. ELLIS, who has been president and manager of the Eastern Electrical Supply Company since its formation, has severed his connection with that concern, much to the regret of the company.

DR. A. W. DUFF, professor of physics of the Worcester Polytechnic Institute, gave as the annual commencement lecture before the Engineering Society a lecture on wireless telegraphy, the telegraphone and the telephone arc light.

MR. ISAAC L. RICE, president of the Consolidated Rubber Tire Company, has been elected to the recently created office of chairman of the Board of Directors, and as such will act in an advisory capacity to the officers of the company. Van H. Cartnell, who has been connected with the company for a number of years, has been elected president to succeed Mr. Rice.

MR. H. L. SHIPPY, of Roeblings, goes abroad and will be in England during the coronation. He has visited more British colonies than most Englishmen and has a wider electrical acquaintance around the globe than perhaps any other American commercial representative.

MR. W. M. PATTERSON, formerly of the ELECTRICAL WORLD AND ENGINEER, and more lately with the celebrated engraving and publishing firm of Bartlett & Co., was married on June 4 to Miss Clara Lyeth, at Nyack-on-Hudson. They will reside in Brooklyn after the honeymoon.

MR. JOHN W. MACKAY, of the Commercial Cable Company, who sailed on the Celtic last week, will go to Mrs. Mackey's London residence, Carlton Terrace, immediately after his arrival in England. Mrs. Mackay will entertain during the coronation festivities.

MR. W. J. JONES has resigned his position as engineer of the Gas & Electric Company of Bergen Co., N. J. (a description of the plant of which company Mr. Jones contributed to our issue of May 24), in order to accept charge of the Denver, Col., offices of the Stanley Electric Manufacturing Company.

MR. LEONARD WILSON, late of the Brush Elec. Eng. Co., of England, has recently arrived in this country and has now joined the engineering staff of the Stanley Elec. Mfg. Co. of Pittsfield, Mass. Mr. Wilson has had four or five years' experience in design and construction and expects to find abundant opportunity.

MR. H. W. B. BLOMQVIST, the electrician of Upper Montclair, N. J., has recently had the misfortune to lose his father, who was well known in real estate circles in New York City. Mr. Blomqvist was lately with the Metropolitan Street Railway Co., but is now intending to put up a private laboratory at his residence to develop some new ideas and inventions.

MR. CHARLES T. MALCOLMSON has received the appointment of superintendent of power and transmission exhibits at the St. Louis World's Fair. He goes direct to St. Louis from the Charleston Exposition, where he was chief of the bureau of power and lighting. At the Paris Exposition he was assistant director of machinery and electricity of the American section.

HON. CHANDOS S. STANHOPE, president of the Mexico City Electric Tramways Company, is expected to arrive in New York next week en route for England. While in New York, Mr. Stanhope, who will be accompanied by [illegible] will, it is expected, stay at the Hotel [illegible] preparatory to returning to Mexico before January 1st.

DR. W. J. M[illegible] pist reports in the "Medical Record" some extremely interesting results with regard to the successful treatment of cancer, appendicitis, etc., by [illegible] cases of melancholia. He says: "The question may be reasonably asked whether the general therapeutic effects of X-radiation are not due to a capacity for establishing favorable tissue metamorphosis rather than to a capacity for destroying or modifying bacteria or other micro-organisms."

OBITUARY.

MR. CHAS. W. PRICE, a well-known pioneer in several lines of electrical work, died at [illegible]. Mr. Price entered the service of the Western Union Company at the age of 17 and at the outbreak of the civil war went to the Pacific coast to take charge of the lines of the Pioneer Telegraph Company. About the end of the war he went to Siberia with the George Kennan party which made surveys in the interest of the Western Union Company for a trans-Siberian telegraph line. For some years he was general superintendent of the B. & O. Telegraph Company, and shortly after the formation of the Daft Railway Company Mr. Price became its general manager, and later acted as the representative in Portland, Ore., of the Northwestern Thomson-Houston Company. Subsequently he was with the Westinghouse Company in its Philadelphia offices, and at the time of his death was general manager of the Montauk Fire-Detecting Wire Co. Of genial disposition and with courteous manners, Mr. Price made hosts of friends who will deeply regret his loss.

EDUCATIONAL.

THE BLISS ELECTRICAL SCHOOL.—The 1902-1903 catalogue of the Bliss Electrical School, Washington, D. C., gives an outline of the electrical course taught at this institution. The course is of only one year, but it is comprehensive, the studies being restricted to theoretical and practical electricity and mechanical drawing. It is stated that the graduates are fitted to secure and retain good positions in the electrical industries. The tenth year of this school will begin next September.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Instruction in the summer courses of this institute is given during June and July of this year, supplementing the work of the regular school year. The summer courses are open to persons not students in the Institute of Technology. The programme includes, mathematics, applied mechanics, mechanic arts, drawing, language, history, chemistry, physics; civil, mechanical and mining engineering, architecture and biology. The entrance examinations for the regular course will [illegible] on June [illegible]

THE STEVENS INSTITUTE OF TECHNOLOGY.—At a meeting of the trustees of Stevens Institute, Hoboken, Alexander C. Humphreys was elected President to succeed the late Henry Morton. Mr. Humphreys was graduated from the institute in 1881, and is now a prominent gas engineer. He is also President of the Hibbard-Rodman-Ely Safe Company of New York and of the Buffalo (N. Y.) Gas Company. He was elected a trustee of the institute on Dec. 23, 1891, and was President of the Alumni Association in 1885-6. He was a close friend of President Morton, and is expected to carry out the policy of his predecessor in his management of the institute's affairs. A short time ago Mr. Humphreys gave the institute $10,000 for the purpose of founding a scholarship in memory of his son, who was drowned in the Nile two years ago while trying to save the life of a younger brother.

Trade Notes.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY has opened a sales office at 510 New England Building, Cleveland, in charge of Mr. H. B. Coles.

FOUNDRY SUPPLIES.—Catalogue No. 102 of the Osborn Manufacturing Company, Cleveland, Ohio, gives, in nearly a hundred pages, illustrations and brief descriptions of a complete line of foundry supplies, brushes, brooms, etc.

THE NATIONAL ELECTRIC LAMP COMPANY, Cleveland, Ohio, has executed a mortgage for $100,000 on the plant of the Brush Electric Company, which it recently acquired. The proceeds will be utilized in enlarging the factory and installing new machinery.

FT. WAYNE ELECTRIC WORKS.—Among the recent trade literature of the Fort Wayne Electric Works, Fort Wayne, Ind., are a catalogue (84 pages) of parts of "Wood" arc dynamos and an "Instruction Book" (No. 3008) for installing Fort Wayne type A oil transformers. Both publications are [illegible]

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has recently issued bulletins Nos. 3034 and 3035, devoted to alternating and direct-current exhaust fans (direct-connected) and a small alternating current motor for use with flexible shaft. Both types of machines are illustrated and their features described, together with other pertinent information.

A NEW SWITCH[illegible] Hamilton streets, Philadelphia, Pa., has just issued a pamphlet containing handsome colored half-tone illustrations of many switchboards recently built by it for various plants throughout the country. These boards in many instances show intricacies of design that can only be met by the best engineering skill.

ELEVATOR MOTORS. Bulletin No. 132 of the Holtzer-Cabot Electric Company, Boston, Mass., is devoted to the subject of this company's elevator motors. The constructional features of these machines are concisely described, and four illustrations give views of elevator motor installations in operation in Eastern cities. Tables give the dimensions of the various sizes of these elevator motors.

THE BURT MFG. CO. of Akron, O., installed two of its large Cross oil filters in the large packing establishment of Nelson Morris & Co., Chicago, Ill. Its catalogue describing these well known filters contains a long list of leading concerns in this and foreign countries who are using from one to as many as one hundred of these filters. The Burt Co. reports an unusually brisk foreign trade in its goods this season.

ELECTRIC LIGHTS ON NEW TRAINS.—The "Twentieth Century" trains that go into service on the New York Central and Lake Shore Railroads on June 15, 1902, making the run of 980 miles between New York and Chicago in twenty hours, will be equipped with the "Axle Light" system of electric lights and fans of the Consolidated Railway Electric Lighting and Equipment Company, 100 Broadway, New York.

ELECTRICAL SUPPLIES.—The latest catalogue and price-list of electrical supplies handled by the Central Electric Company, Chicago, Ill., contains 176 pages. It includes very few illustrations, almost the entire space being taken up by the price-list. From this list a faint idea may be obtained of the extent of the stock carried by this company. This price-list constitutes addenda to the company's Twentieth Century Encyclopedia of Electrical Supplies.

KELLOGG APPARATUS.—The Kellogg Switchboard & Supply Company, Chicago, Ill., has issued a very attractive pamphlet giving some excellent half-tone views of exchanges equipped with its switchboards and apparatus. The illustrations are very artistically executed, being printed in a very dark brown color, which gives a very handsome effect. At the back of the pamphlet are given two halftones of a power board, front and rear views. The pamphlet is a very fine piece of work and reflects great credit on the enterprise of the Kellogg Company.

ELECTRIC CLOCKS AND TIME STAMPS. The American Clock Company, 18 West 34th street, New York, describes and illustrates its electric clocks and electric time stamps in two separate pamphlets. The clocks are automatically wound by electricity, the current being supplied by two cells of dry battery. The time stamp is operated electrically, the time being governed by a clock which changes the time on the stamp once every minute. This device is valuable in every business.

PORTABLE CRANE AND HOISTS.—In a booklet just issued by the Franklin Portable Crane & Hoist Company, Franklin, Pa., is described the portable crane and hoist manufactured by this company. This apparatus is designed for use in shops, factories and all places where it is necessary to lift heavy pieces of machinery or to transfer them from place to place, and this with the least expenditure of time and labor, and with safety. One man, by the aid of this machine, can lift a large casting or any piece weighing up to three tons, and convey it to any part of the works and place it wherever it may be required. The hoist is illustrated, and a table gives its various dimensions.

THE AUTOMOBILE & CYCLE PARTS COMPANY, Cleveland, O., has issued three separate booklets devoted to the subjects of brass and bell-metal balls, tool steel and Bessemer balls and high-duty tool steel balls. This company pays particular attention to the production of uniform material used in the manufacture of these balls, and the hardening of the same is also given special care. The chief aim of the company is to get stock which at the outset of manufacture is certain to work well, and which when hardened and ground can be converted into what are perfect spheres. These balls are recommended for high duty and are claimed to be superior to anything now offered.

THE KEYSTONE FOUNDRY AND MACHINE COMPANY, Philadelphia, Pa., is about to add to its works a machine shop 100 ft. x 100 ft., and a foundry 130 ft. x 200 ft.; each of which can be lengthened to 400 ft. Also a cleaning house 40 ft. x 80 ft., connecting the two main buildings at one end. The buildings will be built entirely of structural steel and brick, and all power will be supplied from a central electric plant. Contracts have already been placed for all of the electric cranes, generators and motors, but not for the wiring and switchboard. Most of the shop equipment has been purchased excepting that required for the machine shop. The plant is expected to be in operation [illegible]

REPRINT OF THOMAS INSTITUTE PAPER.—The paper on "Static Strains in High Tension Circuits and the Protection of Apparatus," recently read by Mr. Percy H. Thomas before the American Institute of Electrical Engineers, has been reprinted in full by the Westinghouse Company. The author treats the subject in a comprehensive manner and, because of the non-mathematical character of the work, it will doubtless prove of interest to superintendents and station managers, as well as to electrical engineers. The reprint is copiously illustrated with diagrams and with views of the Westinghouse static interrupter. A copy can be obtained by writing to the nearest district office of the Westinghouse Electric & Mfg. Co.

FIRE DETECTING WIRE.—The Montauk Fire Detecting Wire Company, 100 Broadway, New York, has issued a list of some installations of its fire-detecting wire. The list includes many residences of wealthy New Yorkers, public buildings, stores and mills, one of the latter being in Melbourne, Australia. The utility of this wire was practically demonstrated recently in New York. A laundry stove in the residence of Mr. S. K. Lichtenstein became dangerously overheated and would have been unnoticed had not a fire-detecting wire running nearby given the alarm. The company has recently issued a pamphlet describing its new combination of high and low fusing wire. This wire is approved by the New York Board of Fire Underwriters.

"THE RIGHT OF WAY."—This is the title of a uniquely designed folder issued by the Banner Electric Company, Youngstown, Ohio. It refers to the bases for the claims made by the various lamp manufacturers for their product, with the intent of securing "The Right of Way." The foundation of the claim for "The Right of Way" by the Banner Company is the superior quality of its goods. The company has a new factory building arranged especially for its needs, which is equipped with the most modern machinery and instruments for producing the highest grade of lamps. The company lays particular stress upon its claim as to the quality and life of the filaments made by it. The Banner Company manufactures incandescent lamps of all [illegible]

Record of Electrical Patents

(Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.)

[illegible] ARCS IN ELECTRICAL APPARATUS; G. W. Partridge, London, England. App. filed March 29, 1901. A capsule of compressed air or explosive material is discharged at the instant any fuse is blown, to disrupt any arc that may form. (Issued

700,911. SIGNAL FOR COMPOSITE TELEGRAPHIC AND TELEPHONIC [illegible] Chicago, N. Y. Application filed Jan. 21 1902. Consists in imposing on a current of fixed direction, an undirectional pulsating current, thereby unbalancing the current of fixed direction in one half and reinforcing it in the other half of the circuit. (Issued May 27.)

701,280. ELECTRIC METER; H. Aron, Charlottenburg, Germany. App. filed Feb. 20, 1902. Consists in employing a planet-wheel gearing which determines the length of time of delivery of the current and a second planet-



700,809. Means for Extinguishing Arcs in Electrical Apparatus.

wheel gearing, which drives the clock mechanism and also operates the cut-out device to interrupt the circuit when the period of time for which the first-named planet-wheel gearing mechanism was set during which current will be delivered has elapsed.

[illegible],290. MAGNETIC CLUTCH; H. W. Buck, Schenectady, N. Y. App. filed Mar. 20, 1899. The clutch contains a normally excited demagnetizing coil which acts to release the clutch and prevent sticking when the energizing coil is cut out.

[illegible],295. INCANDESCENT ELECTRIC LAMP; A. A. Chaillet, Shelby, O. App. filed, Oct. 22, 1900. The filament is coiled into several convolutions in the dome of the lamp; the axes of the convolutions being so directed as to cause the lamp to throw the greatest amount of light downward.

[illegible],319. PRIMARY BATTERY; Eugene M. Fishell and William R. Clymer, Cleveland, Ohio. App. filed Oct. 14, 1901. A copper oxide caustic soda battery so constructed that it may be shipped in condition to be used. The containing case is of cylindrical form and made of tinned iron, thus serving both as a containing vessel and as a negative electrode. Within the vessel a concentric perforated tin partition is soldered to the bottom and extends to within a short distance of the top. In the annular space thus formed is placed first a layer of sand, next a layer of fine subdivided black oxide of copper, and finally a layer of pitch. Within the central cavity is suspended a zinc submerged in caustic soda. The case is hermetically sealed at the top.

[illegible],338. ELECTRIC METER; C. D. Haskins, Schenectady, N. Y. App. filed Oct. 26, 1901. In the field circuit of the motor there is included a conductor having a negative temperature coefficient, for the purpose of causing the drop of potential in the field circuit to be less than proportional to the current flowing therein.

[illegible],341. ELECTRIC MOTOR; A. B. Holson, Chicago, Ill. App. filed July 15, 1901. Certain details of construction enabling the motor to be combined with a wheel hub.

[illegible],363. PROCESS OF MAKING ELECTRIC BRUSHES; Robert D. Laughlin, Ravenna, Ohio. App. filed Dec. 30, 1901. Wire is wound spirally and longitudinally upon plates of green carbon; one or more of the plates thus wound are placed between other green carbon plates without winding; the composite plate is then so compressed as to unite the carbon of the several plates into a homogeneous mass, which is finally baked.

[illegible],369. CARBON BRUSH AND PROCESS OF MAKING SAME; William Mills, Jersey City, N. J. App. filed Nov. 5, 1901. A carbon brush composed of a layer of high conductive material and a layer of relatively low conductive material, which latter consists of a mixture of carbon and a



and Telephonic Transmission. Electric Lamp.

substance similar to ground stone, mica, coal, etc., cemented together with a suitable plastic binder.

701,374. ILLUSTRATING APPARATUS; F. S. Newman, Springfield, Mass. App. filed Jan. 17, 1899. (See Current News and Notes.)

[illegible] burg, Charlottenburg, Germany. App. filed April 30, 1900, renewed April 17, 1902. The conducting frame is provided with removable non-conducting cross pieces having performed portions projecting on each side, in connection with perforated protecting strips, the active material being interposed between the said strips; removable vertical elastic bars are held in the perforations of the cross pieces and adapted to press the protecting strips against the active material.

[illegible],396. ELECTRICAL PROTECTOR; C. A. Rolfe, Chicago, Ill. App. filed Aug. 1, 1900. Details of a fusible protector.

[illegible],423. ELECTRIC ARC LAMP; Geo. G. Tilden, Newark, N. J. App. filed Aug. 10, 1901. The device by means of which the feeding of the upper carbon is accomplished, consists of a toothed wheel against which the carbon is pressed by a suitable spring. The force of the spring pressing the carbon against the toothed wheel is sufficient to hold the former in place, except where the wheel is partially rotated through the action of gravity or a spring, or a shunt magnet.

[illegible],455. CONTROLLER; T. Von Zweigbergk, Preston, Eng. App. filed Jan. 23, 1902. These improvements relate to the moisture protectors, the contact segment and fingers, the solenoid blow-out and the cover-clamp.

[illegible],456. CONTROLLER; T. Von Zweigbergk, Preston, England. App. filed Jan. 23, 1902. Associated with the reversing switch is a peculiar lock which, when the switch is used to apply the emergency brake, prevents the switch being changed from this position by the ordinary operation of the lever.

[illegible],472. APPARATUS FOR COVERING FLEXIBLE CONDUITS WITH RUBBER IN CEMENT OR LIQUID FORM; J. T. Dickey, Hoboken, N. J. App. filed June 7, 1901. Details.

[illegible],488. GAME COUNTER; W. J. Lewers, Wilkesbarre, Pa. App. filed Oct. 15, 1901. A combined game counter and annunciator by which an alarm is sounded when the winning score is registered.

[illegible]1,572. ELECTRIC BELL; H. F. Keil, New York, N. Y. App. filed Aug. 2, 1901. The armature is mounted for adjustment in two directions.

[illegible],577. LIGHTNING CONDUCTOR; Franz E. Klein, Dresden, Germany. App. filed March 31, 1900. A horn-shaped lightning arrester in which there are provided near where the arc is to be formed, paramagnetic bodies, consisting of sheaths which partly surround the horns, but leave free their inner edges, which face each other.

[illegible],608. ELECTRIC CONTROLLER; A. Phillips, St. Louis, Mo. App. filed Sept. 23, 1901. Details.

[illegible],609. ELECTRIC SWEATING ROBE; A. Phillips, St. Louis, Mo. App. filed Sept. 23, 1901. An electric heating wire is arranged through the folds of a robe or garment for the purpose of giving a heat bath or sweat to a patient.

[illegible]1,621. CIRCUIT BREAKER; B. P. Rucker, Brooklyn, N. Y. App. filed Nov. 26, 1901. Means for releasing a movable member instantaneously under a predetermined excess of current, and for releasing said member after the duration of another predetermined excess of current.

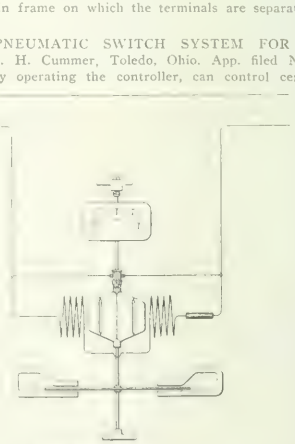
[illegible],627. SWITCH FOR ELECTROMOTORS FOR DRIVING DENTAL APPARATUS; E. Schrier and H. Dumler, Vienna, Austria-Hungary. App. filed Jan. 10, 1902. A switch for stopping, starting and reversing the motor is controlled by a switch on the handle of the tool which is driven by the motor.

[illegible],647. ELECTRICAL APPARATUS; A. Tzaut, Neufchatel, Switzerland. App. filed Feb. 18, 1902. Details of a circuit testing apparatus.

[illegible],650. MANUFACTURE OF CALCIUM CARBID; D. De Vulitch and J. D'Orlowsky, Paris, France. App. filed Dec. 13, 1900. (See page 1057.)

[illegible],680. SOCKET FOR INCANDESCENT LAMPS.; C. A. Chase, Chicago, Ill. App. filed Jan. 16, 1902. A receptacle designed to embody a small and light porcelain frame on which the terminals are separated as widely as possible.

[illegible],685. ELECTROPNEUMATIC SWITCH SYSTEM FOR ELECTRIC RAILWAYS; W. H. Cummer, Toledo, Ohio. App. filed Nov. 3, 1901. The motorman by operating the controller, can control certain electric



[illegible] Electric Meter.

curcuits to move the valves of a pneumatic switch-throwing mechanism. After the car has passed the switch, the switch-operating mechanism, is automatically restored to a neutral condition.

701,713. MANUFACTURE OF ELECTRICALLY INSULATING AND WATERPROOFING MATERIALS; Frederick Greening, Plumstead Common, Eng. App. filed Dec. 6, 1900. The process consists in mixing with fused anthracene a proportion of copal resin.

701,725. ELECTRIC SWITCH; G. Higginson, Westminster, London, Eng. App. filed Jan. 28, 1902. Details.

701,804. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed June 20, 1901. (See Current News and Notes.)

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TELEPHONE UNDERGROUND CONDUITS.

Of late years one of the most important features of telephone work in the larger towns and cities, and even in many of the smaller ones, has been the placing underground of wires and cables. Telephony depends essentially upon a multiplicity of circuits, and with the increase in the number also of exchanges requiring trunk lines, it has long been found best to underground even a moderately-sized network. Moreover, public opinion is steadfastly in favor of underground, and usually strongly opposed to overhead wires; while the improvement in conduit methods have facilitated construction and repair work. It has, therefore, appeared to us desirable in connection with the independent telephone meeting at Philadelphia next week—the programme of which we have given to our readers—to emphasize the importance of conduit work. In this issue, as a Special Supplement, appears a full, unabridged telephone conduit specification, drawn up for us by Mr. A. V. Abbott, the well-known telephone engineer. It not only constitutes a very interesting piece of technical literature, but will be found useful as a form upon which conduit contracts can be drawn up and approved by all the parties concerned in any municipality.

THE NATIONAL BUREAU OF STANDARDS.

In last week's issue appeared a description and illustration of the building which is to be constructed in the suburbs of Washington, for the National Bureau of Standards. As designed, it will have a splendid physical equipment. The plan is to have a separate power house about 100 feet distant from the main building. This is a far better arrangement than storing the hot and heavy running machinery in the basement, and then forever afterwards seeking to eliminate heat and vibration from the working rooms. For the extremely accurate work, which will doubtless form a small but relatively important part of the routine of the institution, a uniform temperature is a prime necessity, and the difficulties of maintaining constant temperature are exaggerated by the proximity of boilers and a smokestack in the same building.

The work of this very important and greatly needed National Bureau will necessarily be both national and international. From the national standpoint it will fix and determine all calibration in terms of the physical standards kept in its vaults, as Lares and Penates. From the international standpoint it will have to maintain a parity between its own standards and those of other nations generally; and, in particular, with the international standards whose depository is in Paris. Nothing perhaps more strikingly illustrates the breadth and humanity of higher civilization engendered by science, nurtured by technology and schooled by engineering than the fact that as the physical standards of a nation become more accurate and defined, they likewise become less purely national and more purely wide-world. In a certain sense the test and criterion of material civilization lies in the extent of universality of its measures. The old Mohammedan creed of unity of Diety and Prophetship finds a prototype in our time in the unity of science and her metrology. This is why the spread of the metric system means so much more than a mere change of units or even of a gain in simplicity. It is a necessity of the higher civilization that can only exist by co-operation of deeds and unity of thought.

It is interesting to see that pending the construction of its permanent home, a matter of many months, the Bureau is, and has for some time been, prepared to undertake the calibration and verification of much electric apparatus. This facility should be availed of by every manufacturer and every large user of electric apparatus.

The Primary Battery.

For some reason not easy to fathom, that old standby, the primary battery, has not received of late years anything like the attention that is its due. To be sure, the day of huge battery plants for telegraph and telephone systems is now gone by, but with the enormously increased use of miscellaneous electric appliances of all kinds there is a bigger field for a really good battery than there has ever been before. For the light intermittent current required for many uses we have, of course, the so-called dry cells of the Leclanche type, which are extraordinarily useful, but in spite of the immense number of batteries which have been brought out we have not yet anything which is similarly useful for work of a somewhat more serious description. Of fairly good batteries there are many, but the resources of modern chemistry and chemical industry ought to produce something far better than we yet have. There are many purposes for which a steady output of a few amperes would be exceedingly convenient if it could be obtained from a compact and convenient battery at moderate cost. To meet commercial requirements such a battery must derive its energy from moderately cheap materials so far as those which cannot readily be recovered are concerned. It must have an e. m. f. not less than a Leclanche cell, and must be able to hold it quite steadily until exhausted. These simple demands are easily met, but there are others more difficult. A successful battery must be neither smelly like a grove cell, nor slimy and troublesome like a gravity cell. It must be capable of pretty thorough sealing if provided with liquid electrolytes, and must neither run down on open circuit nor have a high internal resistance. If a Leclanche cell could be made to stand up for continuous service it would come nearer to filling the bill than any other yet devised, but in spite of many inventions it just misses a very large field of usefulness. The storage battery meets the requirements within its particular sphere, but wherever it can be conveniently charged current is also easily obtainable for general purposes, so that it cannot replace the primary battery to the best advantage. We believe it would be a good thing, at the next exhibition of things electrical, to make a special feature of the primary battery, with a thorough series of competing tests of those batteries now available. The results would at least be immensely instructive as to the present state of the art, and might serve to stimulate invention in a very useful direction. A thoroughly first-class battery may not be an epoch-making invention, but there is money in it to an amount often denied to inventions far more sensational.

Hughes and the Microphone.

From time to time the claim crops up, usually by implication, that Hughes, and not Berliner or Edison, was the prior discoverer of the microphonic principle. There is some reason for the persistence of this error, for Hughes' publication of his independent discovery was at the time heralded throughout the world, and public attention was caught by the statement that Hughes' microphone enabled the footfall of a fly to be magnified to the tramp of a horse. Moreover, Hughes generously offered his discovery to the world free of price, while the prior discoverers embodied the principle in patents, which in this country were withheld from issue for such long periods as to form a plausible basis for outspoken charges of fraud; and though these charges were not sustained in court, the situation naturally contributed to sentiment in favor of the claim for Hughes. Without in any manner wishing to detract from the credit due to Hughes as an independent discoverer of the microphonic principle, we consider that in the interest of scientific chronology it should be pointed out that priority must be assigned to both Berliner and Edison.

There is some reason to believe that Hughes began his investigation leading up to the discovery in December, 1877, and he privately exhibited some devices showing the microphonic principle in operation as early as January, 1878. The first public announcement, however, consisted in a communication made to the Royal Society by Prof. Huxley, in May, 1878. Preece, on May 23, 1878, in a lecture before the Society of Telegraph Engineers, described the investigations of Hughes; and on June 8, 1878, Hughes himself read a paper before the Physical Society on the subject. These several publications attracted much attention at the time, while on the other hand general knowledge of the discoveries of Berliner and Edison was lacking, by reason of the delay in issue of their U. S. patents. It should be said, however, that if the world had been so minded, it could readily have discerned Edison's work at least, in his British patent of 1877. Berliner made the discovery of the principle of microphonic action while practising with a Morse telegraph key, and a few days later, on April 14, 1877, filed in the United States Patent Office a caveat, in which he described the application of the principle to a telephonic apparatus, thus antedating Hughes more than a year in publication, and almost a year in discovery. The underlying patent describing the principle first enunciated in the Berliner caveat, and describing likewise an apparatus embodying the same, was not issued until 14 years later, and has been the subject of a *cause celebre* in patent litigation, which is yet in the courts.

The discovery of both Berliner and Hughes was of the broad microphonic principle not limited by the choice of any material. Edison, however, in an application filed July 20, 1877, described the carbon microphone, thus also antedating Hughes by some months in publication; and it has been claimed in certain patent litigation that Edison discovered the principle of the carbon microphone much earlier than the date of the above application. The Edison patent was not issued until fifteen years later—in 1892—and was then found to be invalid by reason of the fact that the British Edison patent on the same invention had previously expired. While Edison explained the theory of his microphone on the principle of "mass compression," and thus did not recognize in set phrase the microphonic principle, the fact remains that he did invent, prior to the Hughes publication, an instrument which embodied the same principle as that of the Hughes microphone. The priority of Berliner over Hughes does not appear, however, to be open to any qualification whatever. Prof. Hughes did so much pioneer work that even after this deduction is made from what has erroneously been attributed to him, his fame as a great electrical inventor stands permanently secure; and none may contest his credit as an independent discoverer of the microphone.

A Voltameter for Feeble Long-sustained Electric Currents.

In the April number of the Proceedings of the Physical Society (London), there is a description of a single and seemingly useful form of voltameter that has important applications for special research. A glass tube, of about millimetre bore, is filled with mercury, except for a drop of decinormal aqueous solution of mercurous nitrate near the middle. The sealed ends of the tube have platinum electrodes included. The tube is set with the top electrode the anode. The current to be measured must not have a density of more than 1 centiampere per sq. cm. of tube section. With this density, the drop of solution will climb up the tube at the rate of about 1 mm. per diem. A tube 30 cms. long would, therefore, serve to register ampere-hours, or coulombs, at this density for nearly a year before it was time to upset the tube. Consequently, where a very feeble current has to be kept flowing, either steadily or intermittently, through a circuit for a long period of time, this simple apparatus would appear to be just the measuring instrument to employ. It seems unlikely that the instrument can be closely relied upon when shunted, not only on account of temperature-variation of resistance, but mainly because of c.e.m.f.

THE DEGREE OF CYCLIC MAGNETIZATION OF IRON WIRES AT HIGH FREQUENCIES.

An excellent paper on this subject appears in the May number of the "Philosophical Magazine." The question is one of considerable practical importance. Telephony, wireless telegraphy, and electro-therapy employ relatively high frequencies of alternating currents, and it may become a matter of consequence for special purposes to ensure and maintain the magnetic efficiency of iron cores at these frequencies. Dr. W. M. Varley has attacked the matter experimentally with the aid of the Braun tube, an instrument that has already done good service to technologists, and seems destined to do yet much more.

The Braun tube is a specially designed, and relatively long, Crookes tube excited in the regular manner to give a long thin beam of cathode rays, which impinge upon a relatively large fluorescent screen at the opposite end of the tube. In the normal quiescent condition of service, the cathode-ray beam produces a small, steady spot of light in the center of the screen; but by placing an electromagnet with its pole close to the tube near the origin of the cathode ray, every magnetic impulses in the electromagnet will be accompanied by a deflection of the cathode-ray beam and a movement of the luminous spot on the fluorescent screen. The lag in the cathode-ray deflection behind the magnetic is so extremely small as to be insignificant for all practical purposes. Consequently the Braun tube makes a particular kind of galvanometer devoid of lag or inertia.

Dr. Varley studied the deflection of this Braun tube galvanometer under the influence of the magnetism excited in cores formed of bundles of iron wire, under high-frequency oscillating currents The frequency was computed from the capacity and inductance of the discharging circuit, and the deflections due to the cyclic magnetization of the cores were compared with the deflections due to the same exciting solenoids with the cores removed. The cores tested were four in number, all 9 cms. long, and composed of carefully insulated separate iron wires. The total cross-section of each core was 0.15 sq. cm., made up of different numbers of different sizes of wire. In the coarsest wire core the wire had a diameter of 1 mm., while in the finest wire core the diameter was 0.22 mm., the other two cores having wire diameters of 0.71 and 0.525 mms. respectively. The frequencies were carried up to 128,000 cycles per second. The results show that with the core of finest wire, the cyclic magnetic intensity fell off about 20 per cent at 40,000 cycles, and about 25 per cent at 80,000 cycles. In the cores of larger sized wire, the falling off was much greater.

These results, assumed to be reliable, are in general accordance with the theory of the subject, and show the importance of using quarter-millimetre iron wire, at largest, in iron cores subjected to a frequency of many thousands of cycles per second. If the wire has a diameter much in excess of a quarter millimetre, a large fraction of the mass of the iron core is, for magnetic purposes, no better but rather worse, than so much paper. Just as electric waves of alternating current dip into a wire out of the enveloping ether, and can only penetrate to a certain depth of skin, if the frequency of alternation is high, so the magnetic waves of alternating current dip into an iron wire core out of the enveloping ether, and can only penetrate to a certain depth of skin, if the frequency of alternation is high. The higher the frequency, and the thicker the wire, in either case, the thinner will be the skin which will respond to the waves.

SYNCHRONIZING.

An article by Mr. J. M. Roman, printed last week, puts the methods and devices for synchronizing in most convenient form, both for instruction and for reference. In spite of many examples to the contrary, the operation of alternators in parallel has made comparatively slow headway in this country, and we fancy that a census of alternating plants in general would still show a surprisingly large number of instances in which machines are regularly operated on separate circuits, and load is snapped from one to the other when it is found convenient to run a less number of machines. The introduction of big polyphase generators has done much to break down the earlier prejudice, but it is not too much to say that synchronizing practice is still rather backward, and that the art of station operation by alternating currents still needs more attention than it receives. In spite of some exceedingly ingenious synchronizing apparatus, the ordinary phase lamp is the main reliance, and, perhaps, all in all, it is the most convenient and straightforward of all the methods yet proposed. Just why most American engineers persist in synchronizing with the lamps dark we have never been quite able to understand, since the European plan is somewhat safer and more sensitive. But this is a mere matter of detail compared with the improvements that can be made in the matter of accurate adjustment of voltage.

It is not enough that two alternators should be thrown together when at the same voltage and speed and accurately in phase. The final end to be attained is that the machines should go together without variations of voltage in the external voltage, and right at this point the trouble often comes. If the machines concerned have very good inherent regulation, they can be thrown in parallel, by the exercise of sufficient care, with such precision that the lights will scarcely blink; but in the average station it is quite too easy to tell when a new machine is being thrown on. Ordinarily in small stations one generator is pretty well loaded before another is thrown on, and when the load is redistributed there is a very perceptible change of voltage. A skillful operator can so adjust the voltages of the light and loaded machines prior to synchronization as to reduce this trouble to a minimum, but the European practice now and then adopted of loading the light machine on an artificial load prior to synchronizing is almost unknown in this country.

Ten years ago alternating-current practice was a stronghold of rough-and-ready methods. Any sort of regulation, or lack of it, would do. The lamps were specially planned to stand up under all kinds of abuse, and efficiency was utterly disregarded. It is small wonder that alternating methods, which were mostly bad, were held in disrepute, and that central station engineers looked upon the whole business with the most profound contempt. The times have changed since then, but the average alternating station has still much to learn. Gradually that most distinguished abomination, the house-to-house transformation system, has been obliterated; secondary mains have come into extensive use, machines are freely run in parallel, and lamps of better efficiency can be used.

But we are still very far from working the alternating distribution for all it is worth. In central station working, in particular, its present use is largely a makeshift, and there are very few places in which it is really getting a trial on its merits. The old controversy of alternating vs. continuous currents still rages like the ancient one between predestination and free-will. The continuous-current central station has worked out apparatus and methods for exact regulation to a point that is little short of marvellous, but in alternating current practice there still linger relics of old blunders that are rarely shaken off. The best alternating practice is to-day found in some of the large polyphase transmission plants, but they are too often handicapped by a market already provided with a well-developed, continuous-current system. The result is a series of compromises and makeshifts that give a fairly good but far from an ideal result. It is a great pity that nearly every large city is so conditioned that electricity cannot play its rightful part, but a mighty incubus of vested rights and capitalized blunders has the average municipality well in hand. As the question now stands, one has to seek not necessarily the most perfect methods, but those which can be grafted upon a huge existing investment with the least amount of change. A system built *de novo* in the light of present knowledge would yield economic results of a most startling character.

Programme of the Independent Telephone Convention.

Mr. Chas E. Wilson, general manager of the Keystone Telephone Company, of Philadelphia, sends us the following, which embodies further data as to the annual convention of the Independent telephonists to be held next week in Philadelphia:

The meeting of the Independent Telephone Association will be held at the Hotel Walton, Philadelphia, on June 24th, 25th and 26th.

The local committee has secured the large banquet room on the top floor of the hotel for their meetings. The officers' quarters have been secured on the floor below. Delegates will be charged the regular rates for accommodations while in the city, and for those who cannot get suitable quarters at the Walton accommodations can be had at the Continental Hotel, 9th and Chestnut streets, or the Colonnade Hotel, 15th and Chestnut streets. Owing to the fact that two of the largest hotels in the city are being torn down for the purpose of rebuilding at this time, it will be impossible for all to be accommodated at the Walton. The committee has made no arrangements for the representatives of the manufacturing and supply houses. Those who wish to make exhibits can get space on the ground floor of the Keystone Telephone Building at Second and Sansom streets, at a very nominal figure.

On the 24th of June, it is intended by the committee that after the business meeting the afternoon be given up to visit points of interest in and about the city, and also to visit the main exchange of the Keystone Telephone Company.

After the meeting on the 25th, at 2 o'clock, the committee has arranged for a tally-ho ride through the famous Wissahickon drive to Indian Rock and return.

On the 26th the committee has arranged for an excursion to Atlantic City, after the business meetings have been concluded, and they will leave about three o'clock on special cars. The drive in the Park and the excursion to Atlantic City will be at the expense of the local committee. The committee may be able to arrange for a theatre party on the night of the 24th, but are not positive about that as yet. So far as making exhibits is concerned, they have decided that it is best to let each representative make his own arrangements.

The Mayor will deliver an address of welcome immediately after the convention convenes on the 24th.

Meetings of Electrical Contractors.

We learn from Mr. W. H. Morton, secretary of the National Electrical Contractors' Association of the United States, that the annual meeting is to be held in July, at the Hotel Walton, Philadelphia, Pa. The board of directors will meet at the hall of the Franklin Institute, at 9 A. M., July 16. The first delegates' meeting will be called to order in the same hall, at 1:30 P. M., on that date. In the afternoon, a special boat will take the delegates and invited guests along the river front to Cramp's Shipyard, and to League Island. This boat will leave the Arch Street Wharf at 4:30, returning, will land at the Washington Park, at 6:30 P. M. A dinner for the delegates will be given at 7 P. M. On July 17th the delegates' meeting will be called to order at 2 P. M., on the Steel Pier, Atlantic City, New Jersey. A special train will leave Philadelphia for Atlantic City at 9 A. M., of July 17th. The entertainment committee will provide transportation to and from Atlantic City for the delegates, and the tickets will be arranged to allow the holders to return any time within six days, so that the delegates can remain in Atlantic City if they desire to do so. The convention will adjourn on the afternoon of July 17.

In connection with the above, we should note the programme of the semi-annual meeting of the Electrical Contractors' Association of New York. This meeting will be held at Albany on July 15th, under the auspices of the Eastern New York Electrical Contractors' Association. The headquarters of the association will be at the Hotel Ten Eyck. The directors' meeting will be held at 9 o'clock A. M., July 15th, and will be immediately followed by the meeting of the delegates. At 12 o'clock a trolley ride will be taken to Schenectady, and the works of the General Electric Company will be inspected. A lunch will be served at that place. It is proposed to return by the way of Troy and Watervliet, if the trolley road now in the course of construction is completed, otherwise to return direct to Albany. At 8 P. M. the delegates will leave by the steamboat "Adirondack" for the trip to New York.

Arrangements have been made to serve a banquet on the boat after leaving Albany. Speeches will be made by the members of the different associations, and Mr. Charles L. Eidlitz, president of the National Association, will act as toastmaster.

It is also expected that the directors of the National Association will be among the guests at the State meeting.

Important Underground Work for Brooklyn, N. Y.

Commissioner Dougherty, of the New York Department of Water Supply, Gas and Electricity, has sent a report to Mayor Low as to the placing of electric light wires and all electrical conductors underground in the Borough of Brooklyn.

In his report the Commissioner said: The department proposes that the heavy trolley feeder wires which line the sides of numerous streets or run under the elevated structures be removed, and be placed underground. If an area with a radius of two miles from the bridge be adopted, subways could be built within it before July 1, 1903, and the work already done is sufficient to indicate that if the plan be steadily pursued, the streets within a radius of two miles from the Brooklyn Bridge can be relieved of this overhead danger within the course of a year.

The following are the recommendations of the Commissioner:

That the following classes of overhead wires be removed within an area of two miles from the Brooklyn Bridge.

The trolley feeder wires of the Brooklyn Rapid Transit Railroad Company and of the Coney Island and Brooklyn Railroad Company. The Coney Island and Brooklyn Railroad Company has not yet constructed any subways. The Brooklyn Rapid Transit Company, with the next year, might easily complete construction of subways to such an extent as to relieve this portion of the borough from overhead trolley feed wires without incurring a financial burden of too serious a nature.

The Edison Electric Illuminating Company should remove its overhead wires from the same area, because it is doubtful whether it has the right to maintain them there at all, and because the wires carry a dangerously high electric current, and are one of the most serious menaces to life and property in the borough.

The New York and New Jersey Telephone Company should remove its overhead conductors from the same area. The work which it is proposing to do will enable it to achieve this much desired result within the same time. The telegraph and signal companies should also remove their wires.

With regard to the general subway question, Controller Grout said, last week, that he would make a protest against the contractors for the rapid transit tunnel being allowed the use of 70 additional ducts for electric wires. The claim of Controller Grout is that the subway contractors in the original contract received authority to place 70 ducts for the purpose of carrying electric wires and power wires for propelling cars, lighting, and heating. The Rapid Transit Commissioners gave the contractors the right to put in 70 additional ducts. Controller Grout argues that the contractors will never need the additional electric conduits, and that it is their purpose to sell electricity for light, heat and power.

Telephone Rates in Washington, D. C.

The U. S. Supreme Court, at Washington, has just passed in a rather indeterminate manner on telephone rates for the national capital. On June 30, 1898, Congress passed an act fixing the rates of telephone service in the District of Columbia, running from $25 to $50 a year, according to the number of telephones connected on one wire—the maximum sum was for a single telephone on a wire. The Chesapeake and Potomac Telephone Company defended suits brought to enforce the law on the ground that the rates were confiscatory, and the Supreme Court of the district held that they were. The Court of Appeals reversed the judgment, and the company appealed to the Supreme Court. Justice Brewer, in the opinion of the court, reviewed the history of the legislation fixing the rate of charges, and came to the conclusion that Congress had acted unadvisedly. The decrees of the lower courts were reversed, and the case was remanded to the District Supreme Court to further inquire as to the reasonableness of the rates in the light of the construction given the statute by the Supreme Court. The decision was supported by only four justices—Messrs. White, Harlan and McKenna dissenting, and Messrs. Gray and Brown taking no part.

Development of Independent Telephony in Philadelphia.

CONSIDERABLE space was given in ELECTRICAL WORLD AND ENGINEER of April 5, last, to an illustrated description of the development of independent telephony in Philadelphia at the hands of the Keystone Telephone Company. At that time attention was paid more particularly in our article to the "Main" exchange, and we are now able to present some data with regard to the "Race" exchange of the same corporation. This has now gone into operation, and will, therefore, be ready for inspection by those who attend the independent telephone convention at Philadelphia next week.

The First, or "Race," District Exchange has been equipped by the Kellogg Switchboard and Supply Company, of Chicago, and is a common battery multiple exchange. In general, the apparatus which is installed consists of 15 sections of multiple switchboard (each section consisting of six panels and being arranged for three operators' positions), one main distributing frame, one intermediate distributing frame, one relay rack which is used for mounting the relays in the line circuits, one relay rack for mounting the relays in the incoming trunk circuits, one chief operator's desk, one wire chief's desk, one manager's desk, and one information desk, and one complete power plant.



FIG. 1.—RACE EXCHANGE, KEYSTONE TELEPHONE COMPANY, PHILADELPHIA.

The multiple switchboard at present consists of four trunk and eleven subscribers' sections. Each section is arranged with apparatus for three operators, and has a capacity of 7,200 subscribers' multiple jacks, 240 outgoing trunk jacks with designation strips, and 300 answering jacks and answering lamps. A cable turning section is placed at the right end of the switchboard. From this cable turning section the switchboard sections grow in a direction from right to left. The four sections nearest to this cable turning section are incoming trunk sections. At the first position the trunk lines from the chief operator's desk and the wire chief's desk are located. The remaining eleven positions in these sections are each arranged for an incoming trunk operator, with 30 plug terminated incoming trunk lines. The first five of these eleven positions have not been furnished with equipment with this installation. The remaining six positions are each completely equipped. Arrangement has been made for switching all incoming calls required at any one of these positions to any desired position. By this arrangement, one operator can handle all the incoming business of the exchange during the night or the slack times of the day.

The fifth to the fifteenth sections are each arranged for an equipment for three subscribers' operators, with 15 pairs of connecting cords and 10 order wire circuits. Each position, excepting the three positions in the fifteenth section, has been completely equipped. Each cord equipment consists of two supervisory lamps, a listening key and a two-party line indicating ringing key.

Each of the fifteen sections is provided with an equipment of 3,200 subscribers' multiple jacks, 240 outgoing trunk jacks, 320 answering jacks and lamp jacks. The multiple lines are multiplied once in every section, and the outgoing trunk lines are multipled once in every two sections. The first and last subscriber's operator in each section is furnished with 100 answering jacks and 100 lamp jacks. The middle operator's position at each section has an equipment of 120 answering jacks and lamp jacks. One pilot lamp is located at each incoming trunk operator's position and two at each subscriber's operator's position. The lamp at a trunk operator's position lights whenever an incoming order wire call is received at that position when the operator's telephone plug is not inserted in the telephone jack; one pilot lamp at each subscriber's operator's position light whenever any line lamp at that position is lighted, and the other pilot lamp at the subscriber's operator's position lights at the end of conversation when the clearing out lamp, which is associated with the answering cord, is lighted.

The chief operator's desk is provided with circuits for calling and conversing with the superintendent or manager; for conversation between the chief operator and any subscriber, and with any other desk operator, and with circuits which notify the chief operator of the rapidity and accuracy of the work of all of the exchange operators. The information desk and the manager's desk are each provided with three regular exchange lines and one line to each one of the other desks in the exchange.

The wire chief's desk is provided with apparatus for testing any line in the exchange, and for determinng the nature and location of any trouble which may arise on these lines. It is also provided with [illegible]

exchange operator, with any subscriber and with the chief operator, information operator or manager.

The terminal room is located directly below the switchboard room. The terminal frame, main and intermediate distributing frames and relay rack are parallel to each other and are located as near to the switchboard as possible. The terminal frame is of a size large enough to accommodate forty 100 pair cable heads, but arrangement has been made so that additional iron work can be added later and the size increased so as to accommodate cable heads for



FIG. 2.—REAR OF SWITCHBOARD.

the ultimate number of lines. The present installation consists of the complete equipment of 40 cable heads.

The main distributing frame provides for an equipment of 4,160 lines, with provision for growth. The present equipment consists of terminals on both the line and switchboard uprights for 3,200 subscribers' multiple lines, 360 outgoing trunk lines, 360 incoming trunk lines and 120 miscellaneous lines.

The framework for the relay rack, which is provided, consists of iron work for 18 bays, each having a capacity for 200 pairs of lines, and cut-off relays and four strips of retardation coils, which are used in connection with the outgoing trunk lines. Arrangement

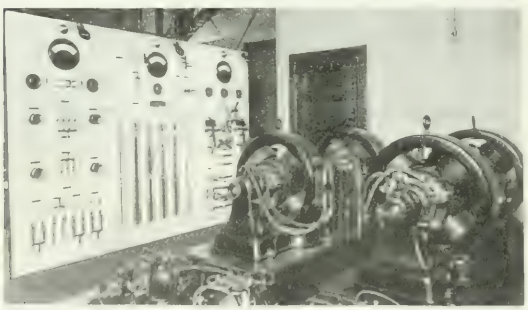


FIG. 3.—REAR OF SWITCHBOARD, SHOWING MACHINES AND POWER BOARD.

has been made so that the size of this rack can be increased when desired.

The intermediate distributing frame provides for a capacity for 3,520 lines. The present outfit consists of the complete equipment of terminals for 3,200 subscribers' multiple lines and 160 miscellaneous lines.

The trunk relay rack has a capacity for the relays required in the incoming trunk circuits for eight incoming trunk operators.

The entire power plant, with the exception of the storage batteries, is located in a room adjoining the terminal room; while the batteries are located on the floor below the terminal room. Two Holtzer-Cabot specially-wound telephone generators have been provided for charging the storage batteries; each is run from the primary source of power, which is 220 volts direct current. Three ringing dynamotors with "busy back" and "don't answer" attachments have been furnished. Two are wound to run on the 220-volt mains, and the third is wound to run by current from the storage batteries. The ringing and charging machines are located on a machine pier made of white enameled brick. The power switchboard and fuseboard are mounted in one iron frame and are made of polished marble. The power board is provided with copper switches, which enable



FIG. 4.—POWER MACHINES AND REAR OF SWITCHBOARD.

all desired changes in the power circuits to be made. Weston voltmeters and ammeters, which are capable of measuring all voltages and currents in the power circuits, rheostats, starting boxes and overload and underload circuit breakers. All fusing of power and switchboard circuits is done on the fuseboard. Under switchboard circuits are included, and cord circuits.

The storage battery plant consists of two sets of batteries of 11

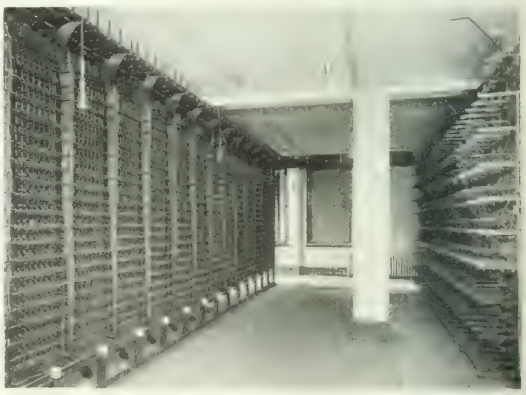


FIG. 5.—RACKS AND INTERMEDIATE DISTRIBUTING FRAME.

cells each. The battery tanks are lead lined and are provided with battery plates which are capable of supplying current for the present number of equipped lines, but are large enough to accommodate plates for the ultimate capacity of the exchange.

All power leads from the power board to the machines and batteries have been run in conduits located in the floor and the power leads from the power boards to the switchboard are run on an iron rack which is supported from the ceiling.

In addition to the above, we may repeat that the Keystone Telephone Company is building an exchange at Filbert and Preston Streets, West Philadelphia. Switchboard and instruments have been ordered,

as well as the conduits and all other material excepting cables, and orders for these will be placed shortly. It expects to construct during the year one exchange at Tenth street and Susquehanna avenue, one in Germantown and on in Kensington, making a total of six exchanges in Philadelphia County. The West Philadelphia exchange will have an ultimate capacity of 2,880 lines and 960 lines installed. The Germantown and Kensington exchanges will be duplicates of the West Philadelphia plant. The North exchange at Susquehanna Avenue will be a duplicate of the "Main" exchange. This year's work will require the laying of about 5,000,000 feet of conduit.

The rates of the company for service are: Unlimited business telephones per annun, $84; unlimited physicians' telephones per annum, $64; two-party line business telephones, $52; direct wire residence telephones, $48; two-party line residence telephones, $36; extension desk sets, $10. The officers of the company are well known men, whose names in some instances have been prominent in recent traction developments in Philadelphia. They are: President, Robt. H. Foerderer; vice-president, Jacob E. Ridgway; secretary and treasurer, W. H. Clark; general manager, C. E. Wilson; directors, R. H. Foerderer, Norman Grey, John M. Mack, Michael Murphy and J. E. Ridgway.

The company has a traffic agreement with the Keystone State Telephone and Telegraph Company, which gives it connection with the surrounding territory. That company is building in all suburban points around Philadelphia, and is building lines to connect with the principal exchanges in other cities. A submarine cable across the Delaware River will be completed in about two weeks, giving connection with Camden and all points in Camden and Gloucester counties New Jersey, and the line is being surveyed to Atlantic City and Trenton to give connection wth the Interstate Telephone Company, of New Jersey, which controls practically all of the independent telephone plants in the State of New Jersey. The connection with the lines of the Maryland Telephone and Telegraph Company affords relations with all of the independent companies in Maryland and Delaware.

The Alternating Current Arc.

BY ERNST ADLER.

THOUGH illumination by alternating current arc lamps has already reached a high degree of perfection, the knowledge of the alternating current arc itself is rather incomplete. There are some features known to every engineer for which a satisfying explanation has not yet been offered, as, for instance, the fact that the alternating current arc requires a somewhat lower pressure than the direct current arc.

There are also other phenomena in which the physicist is more interested than the engineer. To this class belongs the peculiar property of the alternating arc with respect to different electrodes, iron and carbon, for example. Dr. Sahneka, of Vienna, discovered in 1894 that in such an arc direct currents also flow. This fact was discovered by the constant deflection of a magnetic needle situated in the vicinity of the arc. Later, the experiment was repeated by having in circuit a copper voltameter of the ordinary type. The deposition of copper on the cathode showed clearly that during the flow of alternating current a direct current also passes through the circuit. Messrs. Eichberg and Kallir have given an explanation for this phenomenon based on a number of experiments, including the taking of instantaneous photographs of the arc, the result showing that the arc has only one direction, acting as a kind of "electric valve," like the well-known rectifier devised by Pollak.

The present writer wishes to offer an explanation of both of these phenomena—an explanation which has not yet been given so far as he is aware. The idea occurred to the writer when reading the excellent paper on "Oscillations in High Potential Transmissions," read by Mr. C. P. Steinmetz at the Buffalo convention of the A. I. E. E., in August, 1901.

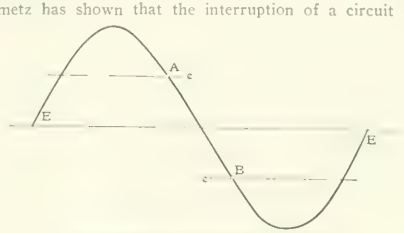
Mr. Steinmetz proved that when a circuit containing a self-inductance and capacity is interrupted, an oscillating current is produced. I believe that this principle may also find an application to the theory of the alternating current arc.

Referring to the accompanying sketch, Fig. 1, E is the alternating e.m.f. impressed on the circuit and e the counter e.m.f. of the arc. According to the opinion of a great number of scientists, this e. m. f. is due to some kind of electrochemical polarization. An alternating current arc is a circuit containing resistance, inductance and electrochemical polarization. Electrochemical polarization is a word without distinct meaning. There have been many efforts made to define strictly the real nature of electrochemical polarization in a satisfactory manner.[1] But without understanding the exact nature of electrochemical polarization we know all that it plays in alternating currents the part of a capacity. We do not know how many microfarads are equivalent to the electrochemical polarization of a given cell, but we often apply "water or liquid condensers" (first proposed by Mr. Swinburne), especially in starting single-phase induction motors.

It is very difficult to measure the resistance of the alternating-current arc, but we know that it is very great, compared with the inductance and with the condensance (equivalent to the amount of electrochemical polarization). Therefore the impedance of such an arc consists of two components, the ohmic resistance component, which preponderates, and the combined inductance and capacity component, which is far less. I say "capacity" instead of "capacity equivalent to the unknown amount of electrochemical polarization."

A slight consideration teaches us that the alternating-current arc must be a self-interrupting phenomenon, a view which is by no means new, but is held to by many authorities. We know that such an arc needs a certain voltage. If the impressed e.m.f. E (Fig. 1) is less than that necessary to overcome the counter electromotive force e, as in A and B, it follows that the arc is extinguished. This interruption occurs twice in the time of a complete cycle. We do not see the effect of this interruption, because the standard frequency in illumination circuits is too high; but with somewhat lower frequencies upon looking through a stroboscopic disk it is quite perceptible. With the standard frequency the air between the carbons has not time enough to cool, and the glowing gases retain their high temperature.

Steinmetz has shown that the interruption of a circuit containing self-induction and capacity produces an oscillating current. In the present case, we may say that an oscillating current is produced by the interruption of a circuit containing self-induction and electrochemical polarization. This interruption occurs twice per period, and each time an oscillating current is produced. The apparent resistance or impedance is no longer the resistance opposing to an alternating e.m.f., but is the resistance against a combination or superposition of an alternating e.m.f. with an oscillating one. As Mr. Steinmetz has pointed out in his classical treatise, "Theory and Calculation of Alternating Current Phenomena," that the impedance of a circuit containing self-induction and capacity is not the same for an alternating and for an oscillating current. The reactance pressures through self-induction and capacity are not quite wattless, as in the common case, but have "negative energy components," which tend to diminish the ohmic resistance. This fact may be easily shown by calculating $I.\frac{dI}{dt}$ for an oscillating current of the general type $i = I_0(\epsilon^{-\alpha t} - \epsilon^{-\beta t})$. In a similar manner the energy component of capacity reactance is computed.



IMPRESSED AND COUNTER E. M. FS.

This principle granted, it is obvious that the resulting ohmic resistance of the arc is diminished. As stated above, the ohmic component is preponderant, and therefore the impedance becomes considerably less. Therefore the voltage necessary to work an alternating-current arc is smaller than that necessary to work a direct-current arc.

This method of considering the alternating-current arc as a source of oscillating currents offers also an explanation for the second phenomenon referred to above, i. e., the flowing of direct currents in the alternating-current arc between different electrodes.

We may suppose that the electrochemical polarization in such an arc has a value which fulfills (by chance or by necessity) the con-

[illegible]

dition under which the resulting current ceases to be a periodic one, but flows in the same direction, decreasing very rapidly.

This explanation for both of these properties is founded on a mere hypothesis. But a hypothesis holds good so long as it is possible to explain different phenomena in a concordant manner. To verify this supposition there should be made a thorough investigation in an experimental and in a theoretical direction. Both of these investigations are very difficult—the first owing to the complex nature of the phenomenon taking place during a very short time; and the second through the impossibility of calculating or measuring exactly the ohmic resistance, and by the present incompleteness of our knowledge of electrochemical polarization and its connection with capacity.

Storage Batteries.

At the recent Cincinnati Electric Light Convention, storage batteries were the subject of two queries in the "Question Box"—namely:

"How may storage batteries be protected, operating in connection with induction or synchronous apparatus, when interruptions occur on the transmission line? and what is the cost of maintenance and depreciation of storage batteries?"

Responding to the first-mentioned query, Mr. Lamar Lyndon, of New York, stated that storage batteries may be protected, when operated in connection with induction or synchronous apparatus, and prevented from discharging back through the same when interruptions occur on the transmission line, in several ways, depending on whether the machines are used for charging only, or whether they are to be used reversibly; that is, on useful discharge the energy from the battery converted back into alternating currents and fed into alternating systems.

In the first instance the ordinary underload circuit breaker, interposed between the charging machine and the battery, will protect the latter. A polarized relay circuit breaker or an underload circuit breaker of an ordinary type, will also meet the requirements. The polarized relay may be constructed with a permanent magnet, or the poles may be produced by an exciting coil connected to the battery terminals, as these give electromotive force in one direction only, whatever may be the direction of current flow.

The above-mentioned breakers cannot be used where the battery is to discharge back into the alternating line, passing through an inverted rotary converter or synchronous motor generator, since reversal of current direction in the direct-current side would cause the circuit to open.

The method most suitable for this case—which is a somewhat rare one in practice—is to make a spring-controlled circuit breaker to open the battery circuit, the latch being held in by the tongue of a small motor which receives current from the alternating transmission line, and which is similar to a well-known alternating voltage regulator. Those familiar with this device understand that the armature does not rotate continuously, but simply exerts a torque. The regulator mentioned is a reactive device, the torque being merely incidental and not in any wise useful; but a very small apparatus, made on the same lines and excited from a transformer such as is used in connection with station voltmeters could be made to operate the current breaker latch; nor would the complete combination be expensive, nor as complicated as the foregoing would indicate.

It may be added that the batteries in any case would not greatly need protection, as they would drive the converter or motor generator, as a motor and the counter electromotive force would prevent abnormal current flow; in fact, the current discharged by the battery would be only that necessary to drive the machine operating at no load, and the consequent energy loss would simply be that due to the friction and internal losses of the translating machine.

Mr. R. H. Pierce, of Chicago, said that if the object is to protect the battery, then it can best be protected by fuses or by some kind of circuit breaker having a time limit. It will not do to have the storage battery thrown out of service by an instant overload, even if this overload amounts to many times the capacity of the battery. On the other hand, we cannot afford to overload the battery for any length of time with such a heavy short circuit that it would warp the plates. In the latest installation of this kind made by Mr. Pierce, the battery was protected with copper fuses rated at about twice the one-hour discharge rate of the battery. This saved the battery, which had about 200-kilowatt capacity, which otherwise would have had to carry about 1000 kilowatts.

The one asking the question may have had in mind more particularly the protection of the apparatus than the protection of the battery. A serious trouble that has occurred, where a storage battery has been used with rotary transformers, has been that the rotary transformer when running with a light field has acted as an inverted rotary and has run away. When there is almost unlimited power in a battery, this may mean the destruction of the rotary unless it can be cut out of circuit. There are two ways of avoiding this: The first way is to have the rotary excited by the exciter, which is belted to the rotary or direct-coupled to it, so that as the speed increases the field of the rotary will strengthen and prevent running away. The other method is to have some kind of centrifugal speed-limiting device attached to the shaft of the rotary so that at a certain speed an electrical contact is made which automatically opens the switch controlling the rotary and puts it out of circuit.

In reply to the second question—as to the cost of maintenance and depreciation of storage batteries—Mr. Pierce said that in general, and assuming average conditions, if there be such, the positive plates should last three or four years. Should they last four years, the annual cost of maintaining the plates would amount to ten per cent. of the original cost of the plates. To this would have to be added the cost of making the changes of plates, which would depend upon circumstances. If the plates lasted three years, this would make the depreciation equivalent to fifteen per cent. These figures ought to cover all depreciation. Of course, the cost will be different where a battery is used for railway work and where it is used to its capacity for doing heavy lighting work, from the cost where it is used simply to float on the line in connection with lighting work. The above statement is based on what the central station manager would have to be prepared to face under average conditions.

As regards the maintenance, this depends upon the location of the battery—whether or not it can be inspected by a man that is also doing other work; and maintenance in the sense of putting the battery in good condition is covered by the item of depreciation. The figures given would probably not be accepted by the battery men. One battery in New York is guaranteed at six per cent. maintenance for three years, but Mr. Lyndon does not consider that a three years' maintenance guarantee amounts to anything. The best way to find out what the maintenance of a storage battery costs, is to see what the makers will guarantee on a ten-year contract under the actual working conditions. Mr. Lyndon said he installed a battery under these conditions where the maker agreed to maintain the battery for about five per cent. of the cost of the plates and tanks, but this is probably too low for anything like the average condition.

Mr. Lyndon considered the cost of maintenance and depreciation of storage batteries as a question that cannot possibly be answered without complete data as to the size of the battery, the work that it is doing, the quantity and density of the electrolyte, the character of the plates, and the minimum voltage at which they are allowed to discharge. If the battery is used for regulation, alternately charging and discharging at intervals not widely apart, the plates should have a comparatively thin layer of active material and, for a given quantity of active material, should have a considerable area exposed to the action of the electrolyte. If the batteries are to be used for storage purposes, being charged full during the hours of light load and discharged on the peaks, these same conditions should hold, provided the rate of discharge is rapid. On the other hand if the discharge is comparatively slow, a thick layer of active material will be more suitable.

Generally speaking, if a battery conform to the following specifications and limits of operation, the maintenance and depreciation should come within nine or ten per cent.: 1. Rate of charge or discharge never to exceed twelve amperes per square foot of active surface; the active surface to be considered as the length multiplied by the breadth by two, of each of the positive plates. The factor two is introduced to cover both sides of the plates. Of course, this is only an average value, applicable to most of the usual types. There are, however, batteries for which the rate given may be exceeded with safety.

2. The temperature at which they are operated never to exceed 100 degrees F.

3. The density of the electrolyte not to exceed 1.24 when battery is fully charged

4. The quantity of electrolyte to be not less than ten pounds per 100 ampere hours of battery capacity.

5. The electrolyte to be pure and to contain no metals or lead dissolving acids.

6. The density and quantity of the electrolyte always to be maintained at the original values.

7. The battery never to be permitted to discharge below 1.85 volts per cell, the reading being taken when the normal current rate is passing, or 1.80 when the discharge is at the maximum permissible rate.

It will be seen that there are a number of conditions, but they are no more onerous than those required in the successful operation of any dynamo electric machine. It may be noted that the difficulties that have attended battery operation in this country have arisen largely from an attempt to perform work with too small a battery. Increased battery capacity not only reduces the depreciation and cost of maintenance, but increases the efficiency to a marked extent. The question, also, of proper quantity of electrolyte does not seem to have received the attention in this country that so important a factor deserves.

In addition to the requirements mentioned, others with reference to prevention of excessive overcharge, not allowing the cells to stand uncharged in the electrolyte, cleaning out the sediment in the bottom of cells, etc., are to be understood.

Wattmeters.

A large number of replies were received to queries in the "Question Box" of the National Electric Light Association relating to wattmeters. Mr. E. J. Bechtel, of Toledo, Ohio, considered that induction type meters are preferable to the commutator type under most conditions, and especially so in residences or where light loads are frequently used for long hour burning, and heavy loads are demanded at times. The induction type of meter requires less attention and inspection, and a good form is more reliable on constant potential or other low power factor loads. Mr. J. E. Barker, of El Paso, Tex., said that the induction meter has the same advantage over the commutator meter that the induction motor has over the commutator motor, in that there are no brushes to spark on the commutator, or get out of place. Moreover, the meters are easier to clean and repair, and repair parts are cheaper.

Mr. E. H. Jenkins, of San Antonio, Tex., favored the induction meter for the reasons that there are fewer chances of the meter stopping; it can be made just as accurate as the other type, and the moving parts are lighter. Mr. Geo. R. Greene, of Philadelphia, considered that the commutator type meter when properly compensated registers with commercial accuracy equally well on both direct and alternating-circuits of the usual frequency, and also on inductive and non-inductive loads. Recent improvements have tended greatly to reduce disadvantages due to commutator and brush troubles and to the trouble with jewels incident to the relatively heavy rotating parts. The disadvantages of the induction meter are that it is applicable to alternating currents only and must be adjusted to any large difference in frequency. Its general advantages over the commutator meter are: absence of commutator and brush troubles; reduced jewel troubles, due to lightness of moving parts; saving in shunt losses, these losses being one-third or less than in the case of the commutator meters; they can usually be repaired more easily and quickly, require less repairs and the cost of repair parts are less; they are more sensitive on light loads and remain calibrated longer. Mr. Greene stated that his company uses the commutator type meter on all direct-current circuits, and is now installing an induction type of meter on all alternating-current circuits.

Mr. F. P. Cox, of the General Electric Company, considers that in those stations where meters can receive but little attention and where inspection and adjustment cannot be made, it is probable that the greater revenue will result from the use of induction meters. The disadvantages of induction meters are that their curve does not approximate a straight line law as closely as that of a meter of the commutating type; they are particularly susceptible to changes in wave form; they are at a disadvantage with the commutating meter because they cannot also be used with direct currents; they are unquestionably subject to aging, which ultimately affects the light load accuracy; the induction meter must be looked upon as a device not yet thoroughly established, while this is not true of commutating meters; finally, induction meters as a class may be designated as "low torque" meters, and as such are liable to greater changes in accuracy. Mr. Cox believes that a discussion of the relative merits of induction and commutator currents will of necessity center on a discussion of torque.

Mr. O. J. Bushnell, of the Chicago Edison Company, stated that the advantages of the induction type meter are that they are more accurate on light and inductive loads, they have lighter moving parts and consequently less wear of jewels, and with no increasing friction due to brush contacts. Commutator meters have the advantage of stronger torque. Mr. J. H. Perkins, of Youngstown, Ohio, enumerated the advantages of commutator type meters, as consisting in greater independence of frequency and their applicability to both direct and alternating-current circuits. The advantages of the induction type meter are that they are dust-proof and are more accurate on light loads, both when new and after use; there is no commutator friction; they will not creep, and in one type manufactured there is no jewel bearing to give rise to inaccuracy. Upon the whole, Mr. Perkins considers, after one year's use of induction meters, that they show far better results than the commutator meter on every point except those noted in connection with the latter, and these are of small importance when compared with the general advantages of the induction meter.

On the subject of locating a meter on the consumer's premises, Mr. W. T. Oviatt said that a clean, dry place should be chosen, unexposed to vibration or sudden jars, and not more than 8 feet nor less than 4 feet from the floor. The meter should be protected by fuses, and there should be a service switch between the meter and the lights, so that the shunt coil will have current at all times there is current on the line. Mr. Geo. Greene, of Philadelphia, said that the meter should, if possible, be located on the lower floors of the buildings and in a position accessible at all reasonable times for reading and testing. Small closets, bathrooms, kitchens and damp, dusty places should be avoided. The meter should never be installed where it will be liable to unusual vibration. It should be placed about 6 feet above the floor and sufficient room left above and below it for removing the cover and jewel. Mr. O. J. Bushnell, of the Chicago Edison Company, gave advice similar to the above.

Messrs. F. L. Sargeant and W. T. Oviatt favored direct-reading dials, the former because of the lessened clerical work, and the latter because there is less liability to mistake in reading and the consumer can read his own meter, thus obviating a great many disputes as to bills. Mr. Geo. R. Greene considered that the direct-reading meters thus far placed on the market are subject to the disadvantage that the cylinders are apt to stick; otherwise they are preferable to the index dial type. Mr. O. J. Bushnell, of the Chicago Edison Company, said that the direct-current dial is very hard to read, and his company for this reason prefers the index dial. An anonymous communication criticized direct-reading dials, the statement being that they cause more trouble than index meter dials; moreover, direct-reading dials have been given a fair trial by both gas and water companies, and have been abandoned.

In answer to a query as to whether it is desirable to do away with all constants on meters, even if the meters cost more, there was a unanimity of opinion on the part of the five central station men who discussed the question, the consensus of opinion being that constants on meters cause more trouble than almost any other feature in the collection department of central stations, and that they should be eliminated. In eliminating constants, however, the value of the dials on larger sized meters need not be changed, as this is almost sure to result in confusion and consequent loss to the company in some instances.

Electric Lighting in Morocco.

There is but one electric lighting plant in Morocco, namely, at Tangiers. It is owned by the "Campania Transatlantic," the local agent being Mr. A. Ortenbach. Owing to the increased cost of coal and increased working expenses, the rates for current have recently been advanced. The present rates are: 1.20 pesetas per kw-hour by meter, or 9.60 pesetas per month for a 16-cp lamp, and 6.60 pesetas per month for a 10-cp lamp. The par value of the peseta is 20 cents. Street incandescent lamps, including renewals, cost 7 pesetas per month. The plant stops at 10 P. M. As to other luminants, in 1900 there were imported through the city of Tangiers candles to the value of $38,400, and petroleum to the value of $6,000.

New Electric Lighting at the University of Illinois.

BY MORGAN BROOKS.

THE recent revision of the National Electrical Code of the Fire Underwriters, increasing the limit of low voltage systems from 300 to 500 volts, has favored the introduction of a somewhat unusual method of distribution in lighting the five new buildings of the University of Illinois.

The plant is 440 volts alternating, and heretofore transformers, with a ratio of 4 to 1 have been used with 110-volt lamps. The new wiring has been done on the three-wire system, as shown by the accompanying diagram, the neutral connection being obtained by means of auto-transformers, of about one-fifth the size of regular

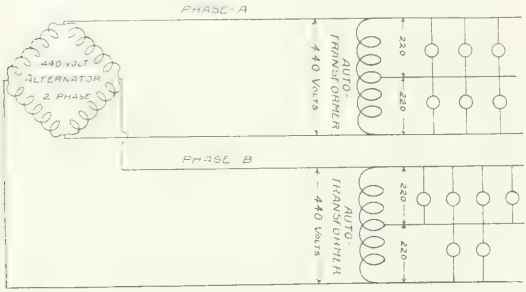


FIG. 1.—DIAGRAM OF CIRCUITS.

transformers serving the same number of lamps. The advantages of this method are evident, as there is not only a saving of four-fifths in the first cost of transformers and a corresponding saving in core losses, but an entire absence of the usual transformer drop at heavy loads. The regulation of the voltage between the two sides of the three-wire system by the auto-transformers has proved entirely satisfactory. At balanced loads, whether light or heavy, the transformer plays no part; with the most unequal distribution of load between the two sides of the system there was no noticeable difference in brilliancy of lamps, although about 4 per cent. measured difference in voltage. This difference is due to resistance drop only, as the transformers were wound with the two coils equally distributed over both branches of the magnetic circuit, eliminating all difficulty from magnetic leakage. For the 400 lamps (16-candle basis) installed in the new Gymnasium, there are in use two auto-transformers of 2 kilowatts capacity each, one in each phase as shown, and they have proved of ample capacity for the purpose.



FIG. 2.—[illegible] GYMNASIUM, UNIVERSITY OF ILLINOIS.

To protect the transformers from a possible overload it will readily be seen that a fuse cannot be used, but a special circuit-breaker operated by the current in the neutral, opens the main leads.

The use of the less-efficient 220-volt lamps in place of the 110-volt is of comparatively little importance owing to the relatively small number of hours of actual lighting, and also to the fact that during the heaviest lighting season the exhaust steam from the lighting plant is used for heating without supplying the demand for steam.

The new Gymnasium was first thrown open to public inspection on the evening of May 17th, when the swimming pool with incandescent lamps beneath the surface, the running track, and the spacious floor were much admired. The pleasure of the visitors was enhanced by the splendid lighting of twelve Nernst lamps, furnishing ample shadowless illumination for basket-ball or other indoor sports without the trying qualities of arc lamps.

While the conditions of college lighting—heavy possible demand with low load-factor—are particularly suited to the auto-transformer distribution system, nevertheless the plan tried at the University of Illinois has proved so successful that it would seem applicable to some small cities. The use of a 440-volt primary thus connected to a three-wire system, instead of the usual 1100-volt primary would secure the benefits claimed for direct-current distribution without sacrificing the advantages of alternating current for long distance lines and for power applications.

The Economic Design and Management of Telephone Exchanges—XII.

BY ARTHUR V. ABBOTT, C. E.

To determine the specific trunking capacity Q it is necessary to consider in some detail how trunk lines are handled, in order that the limitations surrounding them may be given full weight. When a subscriber calls the central office in which his line ends, the act of signaling displays an indicator (usually a drop or small incandescent lamp) placed in sight of an operator (termed a subscriber's or *A* operator) before whom the line of the particular subscriber terminates. On perceiving the signal the *A* operator inserts a plug into the answering jack of the subscriber calling, and switching her telephone set into communication with the cord attached to the plug placed in the jack gives the familiar request, "Number, please?" the subscriber replies stating the number of the party desired, together with the name or designation of the office in which the called party is to be found; for in all multi-office exchanges each office has its own special appellation. Learning that the called subscriber is in a foreign office the *A* operator must obtain a trunk line leading to the office desired and gain the attention of the operator (usually called a *B*, or incoming trunk operator) before whom this trunk line appears, in order that this second operator may call the wished-for party, and connect his line to the trunk line. When this is done the *A* operator in the originating office can establish communication by inserting into the trunk line jack the companion plug to the one already placed in the jack of the calling subscriber. There are two methods in common use whereby the *A* operator may gain the attention of the *B* operator. The first and oldest method requires the use of a signal for each trunk line placed in sight of the *B* operator, capable of being actuated by the *A* operator. Under this arrangement each *A* operator must either have a separate and independent set of trunks to each *B* operator, which necessitates an enormous trunk line plant, or if the same trunk lines appear or are multiplied in front of a number of *A* operators some means must be provided to inform the several operators which lines are in use, for if this is not done two operators may plug different parties on the same trunk line, and the consequent *double connection* results in "confusion worse confounded" to the exasperation of the subscribers and the humiliation of the operators. It is easy to devise an automatic signal associated with each trunk line placed before the *A* operators that shall inform them whenever a line is engaged. But such signals take up considerable space in the face of the switchboard, which cannot be spared in these days of five thousand line switchboards, wherein every sixteenth of an inch must be gained to make room for the multiple jacks. So it is usual to arrange that trunk lines in use may give the familiar *"busy test"* or emit a sharp click in the *A* operator's receiver when the jack rings with which they are associated are touched with the tip of the connecting plug. In the case of large and busy offices many trunk lines are needed, and during the rush hours of the day an operator may have to test a dozen or twenty lines before finding one that is disengaged. This takes considerable time at a period when it can be ill afforded; also the operator is quite liable to error, and in spite of the busy test may take engaged lines, all of which is exceedingly injurious to the service. But omitting errors from consideration the course of business is as follows: On receiving the subscriber's order the *A* operator tests the trunks leading to the desired office; selects one disengaged; inserts the connecting plug, signals on the trunk line, by ringing or otherwise. On perceiving the trunk line signal the *B*

operator restores the signal to its normal position, inserts an answering plug into the trunk line jack in the second office, switches her telephone set onto the cord, and asks the *A* operator for "Number." Then the *A* operator gives the *B* operator the order, on receiving which the *B* operator places the connecting plug into the jack of the called subscriber and rings.

To avoid the loss of time, errors and other imperfections of the *Signal Trunk System* the *Reverse Call Circuit Method* has been devised, and has practically supplanted the old plan in all but small offices. In this method one or more special pairs of wires are provided to each *B* operator's telephone to which the various *A* operators can connect their transmitter by the simple function of pressing a button, or *call circuit key*. The trunks extend from jacks in front of the *A* operators and end in cords and plugs before the *B* operators. The course of business is as follows: When an *A* operator receives an order from a foreign office she touches the proper call circuit button, and speaks the desired number directly into the ear of the proper *B* operator. The *B* operator picks up a plug attached to a disengaged trunk, inserts it into the jack of the desired party and rings, simultaneously pronouncing *back* over the call circuit to the *A* operator the number of the *trunk line selected*, and the *A* operator inserts the connecting plug into the jack of the trunk line thus designated. The simplicity, speed and accuracy of this plan leaves little to be desired for the transaction of trunk line business.

If the average length of time that a trunk line is in use during the transmission of messages be known, its practical specific trunking capacity can at once be calculated. The average time of occupancy must not only include the interval of time that parties are actually engaged in conversation, but must allow for the time taken by the *A* operator to obtain the trunk; for the *B* operator to find the jack of the called subscriber, and signal; for the called subscriber to answer

TABLE NO. 4.

ANALYSIS OF TIME OCCUPIED BY TRUNK LINE MESSAGES.

A SIGNAL TRUNKS.

1	2	3	4
		Probable Time.	
	Minimum.	*Average.*	*Maximum.*
A operator answers	2.0 sec.	5.0 sec.	7.0 sec.
B operator rings	5.0 sec.	12.0 sec.	20.0 sec.
Subscriber answers	10.0 sec.	15.0 sec.	30.0 sec.
Conversation	10.0 sec.	120.0 sec.	300.0 sec.
Disconnect	3.0 sec.	6.0 sec.	10.0 sec.
Total	30.0 sec.	158.0 sec.	367.0 sec.

B REVERSE CALL CIRCUIT TRUNKS.

A operator answers	2.0 sec.	3.0 sec.	5.0 sec.
B operator rings	3.0 sec.	5.0 sec.	10.0 sec.
Subscriber answers	10.0 sec.	15.0 sec.	30.0 sec
Conversation	10.0 sec.	120.0 sec.	300.0 sec.
Disconnect	2.0 sec.	3.0 sec.	6.0 sec.
Total	27.0 sec.	146.0 sec.	351.0 sec.

the ring of his telephone bell; and finally, after conversation is completed, a sufficient interval to enable both operators to restore the trunk line to its normal condition, ready for the next message. Of all these various intervals, the time occupied by the subscriber in answering the telephone bell is the most uncertain factor. In the business hours of large cities answering is usually speedy and reliable, for business men are trained to prompt, quick action; and further, usually have a pretty fair idea of the inconvenience to which others are subjected by delay in replying, and the unjustness of such a course. Again, one or more employes are usually assigned the duty of responding to telephone messages, and general office discipline ensures immediate attention. Small city stores, and country town business houses come next on the list, with greatly extended and very variable times of answering, while residences, particularly those in small towns and villages, are telephonic terrors to their exchanges, in the utter irresponsibility displayed to telephone calls. In a case in mind (an actual fact) a worthy housewife finished a loaf of bread she was kneading, when the telephone bell rang, and a considerable fraction of an hour later when she answered, soundly berated the unfortunate operator because the calling party had not been compelled to await the completion of the breadmaking. The length of time occupied in conversation necessarily varies, between extremely wide limits, owing to the varying nature of business to be transacted, and while instances are on record of lines being held for an hour and a half, such are the exceptions that only emphasize statistics showing that scarcely five per cent of all messages last over five minutes, and some seventy per cent are completed in less than a minute and a half. City messages are shorter than country calls, and business communications much more terse and abrupt than those from residences. The times needed by the operators to find the trunk line, signal the called subscriber, and disconnect when conversation is completed are fairly regular and easily determinable by observation. In the foregoing table No. 4 the consumption of time for the various avocations indicated is given.

Columns 2, 3 and 4 of this table exhibit the probable consumption of time in the performance of the functions specified in column 1. The second column is the minimum time achieved with the very best service, column 3 the average time ordinarily to be counted on, while column 4 the maximum allowable time compatible with service even remotely satisfactory. From these statistics it would appear that on an average a trunk line is actually engaged a little less than three minutes per message, and that with an allowance of thirty seconds for lost time a specific trunking capacity of twenty messages per line per hour might be expected. Occasionally, under exceptionally good management, this amount of work is realized, or even slightly exceeded, but on the average fifteen calls per line per hour is all that can be calculated on, and even this quantity can only be handled in large and busy exchanges, under the most vigilant superintendence. The reason for so small a specific trunking capacity is not far to seek. In no business is the load factor so low as in telephony. Take, for example, the average subscriber's line, and assuming the average message to consume two minutes the line has a possible daily load factor of 720 messages. But even in the busiest offices of the largest city it is rare to find an average call rate of over thirty messages per station per day, or a load factor of only 4.15 per cent. For fourteen hours of the twenty-four most lines are absolutely idle, for few but residence telephones call outside of business hours. For trunk lines the load factor is somewhat better. From the preceding table it is seen that a trunk line would have a possible daily capacity of, say, 540 messages for signal trunks and 580 messages for call circuit systems. In well managed busy offices trunk lines will carry 150 messages per day, but taking large and small offices together, and allowing for inefficiency in management it is doubtful if the trunk line plants of all exchanges average a hundred messages per line per day. Thus the load factor might, under favorable circumstances, reach 26 to 27 per cent, but would only average from 15 to 18 per cent.

A telephone plant also differs markedly from most other electrical installations in its absolute inability to respond to any forcing. A dynamo will answer to a fifty per cent overload for a considerable period without injury, but a trunk line can by no possibility carry out *one message at once*. It is either working at *no* load or a *full* load; no other condition is, at present, conceivable. It is equally futile to press the operators, for the present rates of work are so taxing that almost the slightest excess so increases the nervous strain that the operators lose presence of mind, become confused and break down. There is also no momentum, no inertia to the parts of a telephone plant, and no possibility of any storage device that will enable even momentarily a rush of business to be carried over. When a subscriber calls he demands immediate attention and complains bitterly at the delay of a second in the response of the operator. To be told that a party in a foreign exchange could not be obtained because all the trunk lines were busy would invite an unquenchable storm of criticism from the modern telephone subscriber. So it is necessary to supply a trunk line plant so large as to be able to carry almost any conceivable overload. Not only must there be ample facilities to carry the peaks and rushes of the busy hours in the daily load, but the exigencies of holiday traffic, coupled with the extra pressure of bad weather, must be reckoned with, and provided for.

As the trunk line plant usually consists of cables buried in the ground it is not possible to put it in and out of service at pleasure, but it must be designed and installed a long time in advance of the necessity of its use, and once in place must remain till its term of service is over. There is one aspect, however, in which the trunk plant shows some elasticity. In cases where there are three or more offices in an exchange, it is always possible to connect any office indirectly with any other office by looping together in a roundabout fashion the lines through two or more offices, when the direct trunks between the pair of offices are exhausted or incapacitated. So, for the pre-

ceding reasons it is unsafe to assume a trunk line load, Q, of more than 150 messages per day from large and carefully managed offices, 100 messages per day from medium-sized offices, and 80 messages per day from small offices.

In a preceding paragraph it was shown that the office trunkage symbolized by T was given by the formula $\frac{R S T}{Q}$. Substituting in this expression the values of R and Q just deduced, and denoting with small numerals the limiting values of the literal factors, as is common with the sign for integration, the actual number of pairs of wires needed to carry the out-trunk traffic from any office to the rest of the exchange is obtained as follows:

$$\text{Number of Pairs} = \frac{q^{.85}_{.65}}{Q^{150}_{80}} \left[S T - S_{.5} T + S' T' \pm \frac{P S T}{100} \right];$$

or approximately

$$\text{Number of Pairs} = \frac{q^{.85}_{.65}}{Q^{150}_{80}} \left(S - S_{.5} + S' T' \right)$$

This is the actual number of lines needed to carry the out-trunk traffic, but experience has demonstrated the wisdom of installing a slight excess in trunk line plant over and above the calculated number needed, that may act as a factor of safety, to care for unexpected fluctuations in traffic, and provide for possible growth.

If n represent the excess pairs advisable to thus install for each office and N the number of offices in the exchange, then $n\ (N\text{-}1)$ is the total excess trunkage. The indications of practice are that in small offices where the load fluctuations are likely to be severe, and there is a probability of rapid growth n should have a value of from 3 to 5, while in large offices with many lines, steadier loading, and slower growth, it may be as low as .5. When signal trunks are employed the true trunkage T will be the sum of the actual pairs needed plus the excess pairs, or,

$$T = \frac{q^{.85}_{.65}}{Q^{150}_{80}} \left[S T - S_{.5} T + S' T' \pm \frac{P S T}{100} \right] + N_{.5}\ (N - 1)$$

or approximately,

$$T = \frac{q^{.85}_{.65}}{Q^{150}_{80}} \left(S - S_{.5} + S' T' \right) + N_{.5}\ (N - 1).$$

In these expressions there is no allowance for the necessary pairs of wires to serve for call circuits to the B operators when the reverse call circuit system is employed. Evidently there must be at least one call circuit from the given office to each of the others, so there will be at least $N - 1$ call circuits, from the office aspect, and possibly more if the volume of out trunk traffic demands. With the call circuit system good practice shows that a B operator can handle reasonably 3000 message per day. Therefore the out-trunk traffic divided by 3000 indicates the number of order wires needed from purely a *traffic* standpoint. Using the expression previously deduced for the out-trunk traffic, and dividing the same by 3000 the number of pairs needed for call circuit traffic is developed as follows:

$$\text{Call circuit pairs} = \frac{q^{.85}_{.65}}{3{,}000} \left(S T - S_{.5} T + S' T' \pm \frac{P S T}{300{,}000} \right);$$

or approximately,

$$\text{Call circuit pairs} = \frac{q^{.85}_{.65}}{3{,}000} \left(S - S_{.5} + S' T' \right)$$

Now if the above result is *less* than $N - 1$ then $N - 1$ pairs must be employed, or if it be greater, then the value of the formula must be taken; algebraically this is stated as follows:

$$\text{Call circuit pairs} = N - 1 + \frac{q^{.85}_{.65}}{3{,}000} \left(S T - S_{.5} T + S' T' \pm \frac{P S T}{300{,}000} \right) - (N - 1)$$

or approximately,

$$\text{Call circuit pairs} = N - 1 + \frac{q^{.85}_{.65}}{3{,}000} \left(S - S_{.5} + S' T' \right) - (N - 1)$$

the quantity in the brackets being taken only in its arithmetical sense as a positive quantity. The complete expression for the trunkage from any office to the whole of the rest of the exchange thus becomes for reverse call circuit system:

$$T = \frac{q^{.85}_{.65}}{Q^{150}_{80}} \left[S T - S_{.5} T + S' T' \pm \frac{P S T}{100} \right] + N_{.5}\ (N - 1)$$

$$+ N - 1 + \frac{q^{.85}_{.65}}{3{,}000} \left(\frac{S T - S' T}{S T} + S' T' \pm \frac{P S T}{300{,}000} \right) - (N - 1)$$

or approximately,

$$T = \frac{q^{.85}_{.65}}{Q^{150}_{80}} \left(S - S_{.5} + S' T' + N_{.5}\ (N - 1) \right) + \left[N - 1 + \frac{q^{.85}_{.65}}{3{,}000} \left(S - S_{.5} + S' T' \right) - (N - 1) \right]$$

To ascertain the complete trunkage for the entire territory, the preceding expression must be applied to each office in the exchange successively, thus obtaining the trunkage for each one, and finally the summation of all these separate results will give the desired total trunkage.

In order to complete the design for an interlacing trunk system it is necessary to know the number of trunks and call circuits from each office to every other office, the offices thus being taken in pairs. The preceding formula can be used for this purpose, only in this case S is the sum of the sub-stations in the two offices under consideration, while S' is the stations in the office *from* which the trunk lines are to extend, T is the average originating traffic in both offices, and T' is the originating traffic in the office S'.

It is often urged that a complete system of this kind requires the expenditure of more wire plant than the business will justify, and that a saving could be made by resorting to indirect trunking, or the transmission of messages from one office through a second office to a third office. When the daily business is very small and the distance between offices great the employment of signal trunks instead of the call circuit system will make a justifiable saving in wire plant. But experience has shown that the resort to indirect trunking is never an economy. The time consumed in sending trunk messages through three operators, and the concomitant blunders, injures the service far more than can be counterbalanced by the annual saving in cost of a direct trunk line in all ordinary cases. Signal trunks can, on a pinch, be designed to serve as both outgoing and incoming trunks in both offices, and it must be a very small office, in a very small exchange, that will not transact a hundred messages a day, an office of twenty-five lines should do more than this, and it is rare that so small an establishment would pay under any circumstances.

New York Electrical Society's Annual Meeting.

There was a large attendance at the dinner of the New York Electrical Society, at the Café Boulevard, on June 12. Over a hundred were present. After dinner was held the annual meeting for the election of officers, which resulted as follows: President, Dr. Samuel Sheldon; vice-presidents, H. A. Lardner (re-elected), Geo. Herbert Condict (re-elected), H. V. A. Parsell (re-elected), W. I. Donshea, Hobart D. Betts and W. S. Barstow; secretary, G. H. Guy (re-elected); treasurer, H. A. Sinclair (re-elected).

The secretary's report showed that the year started with 611 members; 184 members have been elected during the year; 17 have resigned, and 265 have been struck off the rolls for non-payment of dues. This leaves an existing solid membership of 513, the best the society has had in years. The secretary referred to the pamphlet which has just been issued by the society, containing a list of meetings held since 1886, the new by-laws and constitution, and full list of members. The report of the treasurer showed that there was a balance in the treasury of $206.77.

After the business of the meeting was concluded the musical programme provided for the evening was entered upon. An excellent selection of pieces was played by the Hungarian band. The treat of the evening, however, was the singing of Mr. Harry T. Burleigh, of the St. George's choir. This rising baritone created unbounded enthusiam by his artistic rendering of several songs, in all of which—and notably in "Shades of the Palm," from "Florodora"—the rich and sympathic quality of his rare voice was admirably displayed. The evening was pronounced to be one of the most delightful occasions the society has ever enjoyed.

Convention of the Canadian Electrical Association.

The Canadian Electrical Association met for the twelfth time in convention at the City of Quebec, on Wednesday, Thursday and Friday, June 11th, 12th and 13th, and proved to be one of the most important in the history of the Association, the attendance of members and guests being the largest on record. Everything which could possibly be done for the comfort and entertainment of the Association was taken care of by the local committee, consisting of Messrs. Edward Slade, G. U. G. Holman, Louis Burran, A. R. Henry, Ed. A. Evans, Edw. Blair, J. S. Bosse and A. Dodge.

The social features arranged by the committee consisted of the annual banquet; a visit to the famous Shrine of Ste. Anne de Beaupre; Montmorency Falls and Kent House, and to the power house of the Quebec R. L. & P. Co. at Montmorency; a band concert by the Royal Canadian Artillery Band; a visit to the sub-stations of the Quebec-Jacqués Cartier Electric Company, and the Quebec Railway Light and Power Company; and, at the invitation of Mr. Frederic Nicholls, second vice-president and general manager of the Canadian General Electric Company, Ltd., a trip by steamer was given around the Island of Orleans, visiting the docks, harbor and site of the new Quebec bridge.

The first session of the convention was opened in the Chateau Frontenac on Wednesday morning with the President, Mr. P. G. Gossler, of Montreal, in the chair. Mr. George Tanguay, pro-mayor in the absence of Hon. S. N. Parent, addressed the Association in the name of the citizens of Quebec, and welcomed them to the ancient capital. He hoped that their stay in the city would be pleasant as well as a beneficial one, and that they would carry away with them a favorable recollection of their trip to Quebec. Mr. A. A. Dion, of Ottawa, on behalf of the Association, replied to the address of welcome and thanked Mr. Tanguay for the pleasant reception tendered them, and felt assured that their stay in Quebec, whose hospitality was proverbial, would be most enjoyable to all of them.

President Gossler delivered an interesting annual address in which he dealt with the question of the early development of electric power transmission in Canada; the aims and objects of the Association; legislation; inspection of electrical installations; the expansion of the business of electrical companies, and other items of minor importance.

He spoke of the particular appropriateness of meeting in the city of Quebec which was so closely connected not alone with the early settlement of the continent but also with the extremely early history of electric power transmission power development in the country. It was only necessary to look around them to find evidences of the abundant courage, foresight and energy which had brought to such successful completion such undertakings as the transmission of electric power from Montmorency Falls, at a time when high tension apparatus and lines used for the supply of commercial light and power were looked upon with some doubt, and considered by many as being an experiment. He felt safe in saying the installation of the Montmorency plant was the first high-tension system put into commercial use in this country.

He said one of the objects of this organization, as set forth by the constitution, is to promote the interests of those engaged in any electrical enterprise; to sucessfully secure this object its influence must be far reaching, and all companies, firms and persons interested in electrical enterprises should be related to each other through the medium of the Association; and the steady increase in membership in the last few years and the very marked widening of interest justified the Association in expecting that within a comparatively short time all these interests would be represented on the membership roll.

He was pleased to say that during the past year no legislation detrimental to electrical interests had been passed, which was largely due to the Asociation and its committees; yet the fact must not be overlooked that there was what he termed an undercurrent pointing to legislation by which many companies now existing and much invested capital would be deprived of rights and protection which were theirs legitimately. He deemed it his duty to bring to the attention of the Association the fact that evidence had, during the past year, been given in arbitrations required by the Conmee Act, which could not do other than have a tendency towards depreciation of the value of plants below the point which this Association would approve of. The promotion of the interests of its members was clearly the obligation and duty of the Association and such publicly-expressed opinions as might have a tendency to put other than a fair value on the properties of electrical companies should be discountenanced and discredited.

Special attention was called to the report of the Committee to Confer with the Board of Fire Underwriters, from which it was noted that there is an effort by the Board of Fire Underwriters to force upon one of the largest cities in the country the expense and responsibility of establishing a system of inspection for electrical installations.

The President thought the Association would agree than an efficient and thorough periodic inspection of all electrical installations was necessary and desirable, but the cost of this inspection must not be made a burden to the customers of electrical companies; otherwise the rapid development of electricity for commercial and domestic uses would be hindered. He felt strongly that electrical inspection bureaus should be established by and maintained at the expense of the Fire Underwriters, and thereby the interests of all parties would be best served.

A natural reduction in prices for lighting and power would be the result of developing business along the lines being successfully advocated in some of the cities—the limitation of the use of electric current for manufacturing purposes to the hours when there is practically no demand upon the supply station for meeting the lighting requirements, in other words, to the daylight hours. The disadvantages of the peak load characteristic of practically all supply plants, some years ago, and still of the majority of lighting and power plants, were known only too well to all of those present.

The idea that it is profitable for many, if not all, manufacturers to work only during the daylight hours is gaining ground rapidly; the best evidence of which is the fact that contracts are continually being entered into which do not require the supply of all or part of the power during the hours when the need of illumination makes the greatest demand upon an electrical plant. Under these conditions power could be supplied at a cost very much less than they could ever expect to secure it otherwise; and at the same time an additional demand for power could be created from sources heretofore incapable of being reached.

The report of the Secretary-Treasurer showed a standing membership of 306 with a gain since last year of 39, and a good balance to the credit of the Association.

The report of the Committee to Confer with the Board of Fire Underwriters recommended the advisability of having an Inspector for electric wiring, but a division into two classes should be made, that relating to outside wiring on and over the roofs of public buildings, and that done inside of buildings.

While a visit was being paid to the car-sheds of the Quebec Railway L. & P. Company, Mr. A. B. Lambe, of Toronto, presented a paper on "The Electrical Equipment of an Ordinary Street Car," in which he went very fully into all the details of the equipment. While this paper was somewhat elementary in its character, yet it proved to be very interesting, especially to those who were not familiar with electric street car equipment. By courtesy of the railway, Mr. Lambe had on the platform the necessary working apparatus to illustrate his remarks.

On Friday the election of officers took place and the following were elected: President, B. F. Reesor, Lindsay; first vice-president, Edw. Slade, Quebec; second vice-president, K. B. Thornton, Montreal; secretary-treasurer (re-elected), C. H. Mortimer, Toronto; executive committee: Messrs. J. J. Wright, A. A. Dion, John Yule, O. Higman, A. Sangster, P. G. Gossler, E. A. Evans, A. B. Smith, A. A. Wright and G. Henderson. The convention adjourned; will meet in the city of Toronto in 1903.

Two papers were presented on arc lighting. One of these is entitled "Relative Merits of Open and Closed Arc Lights for Street Illumination," and is the same paper that during the past year or more has been presented by the author, Mr. W. D'A. Ryan, before several electric light meetings. The paper by Mr. Green, entitled "Arc Lighting," is mainly an argument in favor of the enclosed arc lamp. The conclusions of the writer are that the enclosed arc is better and cheaper to operate than the open arc; that the direct, constant-current, enclosed arc system is best and most economical for plants devoted exclusively to arc lighting; and that the alternating, contant-current, enclosed arc system is best and most economical for plants which use large alternators of from 40 to 125 cycles, the arc lighting alone being but a small part of the total output of the system. It is admitted, however, that direct and alternating-current arc lamps are very extensively used on constant-potential systems of distribution for inside lighting, and somewhat

for street lighting, but only when there are special reasons for so doing. Mr. Green considers that the open-coil arc generator of the Brush type is superior to arc generators with closed coil armature for the reason that the voltage at the terminals of the generators on breaking the circuit will not rise over 20 per cent. above the maximum voltage which the machine will supply at normal current, which is not the case with machines of the closed-coil type, in which the rise of voltage is much greater. Another advantage is the great reduction in the number of commutator segments in comparison with generators of the closed-coil type. The advantages of the Brush multi-circuit machines are also set forth. In the opening paragraph of the paper, Mr. Green states that the arc light was discovered by Davy, in 1802, and that it practically remained in the laboratory until the time when Brush began his work. While Davy was first to produce the arc on a large scale, owing to his laboratory coming into possession of, perhaps, the largest primary battery ever made, the electric arc on a smaller scale had previously been obtained and described. The statement as to the electrical arc remaining in the laboratory until Brush invented his type of dynamo ignores the lighthouse plants established during the 60s, using the "Alliance machine," as well as the lighting, by Jablochkoff, in Paris.

In answer to a question by Mr. Lambe, as to what the power factor of the arc was in an ordinary 60-cycle alternating arc, Mr. Green said that one of the writers had given the power-factor of the arc operating from as ranging from one down to six-tenths; he said it depended very largely upon the grade of carbons which were used; very hard carbons lowered the power-factor, conducted the heat away and made the resistance vary greatly, while soft carbons conducted the heat away less rapidly and did not make the resistance change so rapidly. In reply as to whether when the power-factor is less than unity there is a reactance, Mr. Green replied that there is a variable resistance which will give a different power factor from unity; that is, the resistances vary with your current. In answer to a question by Mr. Martin, of Hamilton, as to the candle power of the alternating arc as compared with the direct current arc, Mr. Green said the candle power from the alternating arc was slightly less than from the direct current arc. There is about five per cent difference in candle power between a 450-watt alternating and a direct-current arc.

Mr. F. H. Leonard, Jr., said, that while he did not wish to lead up to an endless discussion, yet he did not like to have the convention left with the impression that there is too much altogether in favor of the direct-current arc system. He was personally very much in favor of the simplest and most uniform system that could possibly be arranged for central station purposes, and for that reason he had, as far as possible in installations with which he had been connected, adopted the alternating current. The advantages of having a single machine which operated all classes of service, it seemed to him, outweighed so much any little advantages that could be obtained by a variety of different kinds of machines and were sufficient to warrant the use of, and he believed that the results obtained with alternating current arcs, certainly for street illumination, could not be excelled by the direct-current arc. In reference to a question asked by Mr. Martin as to the difference between a 60 and 125-cycle arc, and to straighten the matter out, he would like to say with the 60-cycle arc the power factor is very much higher than with the 125-cycle arc, and there is very little difference in the illumination. So far as he had been informed, with the 125-cycle arcs a power-factor of about .67 or .68 and sometimes as high as .70 only could be obtained, whereas from .88 to .90 could be obtained with the 60-cycle arcs.

Mr. Percy Thomas read a paper entitled "Lightning Protection and the Static Interrupter," which covers much of the ground covered by a paper read by Mr. Thomas some months ago before the American Institute of Electrical Engineers. The paper describes the Westinghouse static interrupter, and gives instruction as to the location of the same in plants. The static interrupter consists of a condenser in connection with a comparatively small choke coil, the condenser being connected between the line and ground. The line connection is made between the apparatus to be protected and the choke coil. With this arrangement a comparatively small coil may be used, for the condenser by absorbing a large part of the charge which passes the coil, multiplies the choking effect. It is stated to be possible, by increasing the size of the condenser, to get almost any degree of protection. The use of the static interrupter is stated to render harmless the abrupt waves resulting from lightning and similar causes.

Mr. Lambe asked whether in passing over an unusually high hill it is desirable to have some protector, to which Mr. Thomas replied that that would depend upon how severe the conditions are; if the apparatus placed at the end would not protect, possibly it would be better to have something over the hill. Mr. Lambe also inquired what protection is necessary in taking a secondary system around a town, where a 2000-volt primary ends here, there and all over; Mr. Thomas said that this was a case where actual experience with the plant, if it be an old plant, would have a good deal to do. He thought arresters ought to be placed from three or four to the mile, to one or two to the mile near the greatest number of transformers, and if there were any on the line they should be placed on the end of the line; there would be a reflecting point, and the increased potential would be found there and it was a good thing to have an arrester at that point; the idea being that wherever a wave might be started that it should reach the arrester before it passed to any transformer.

Mr. Gossler and Mr. Martin spoke of the excellent protection from lightning afforded by barbed wire, and Mr. Reynolds, of Philadelphia, mentioned the great value of the storage battery in this connection, the lightning discharge being received by the immense surfaces of the lead plates in the battery, which, while it might destroy one cell, did not cut any figure where there was possibly a collection of 300 cells.

Mr. A. A. Dion read a paper on "The Use of Storage Batteries in Electric Distribution Systems," in which he recapitulates the arguments for the use of storage batteries in central station and electric railway service. The several different methods are taken up in turn, namely, direct-current generation and distribution for lighting and power service; direct-current generation and distribution for railway service; alternating-current generation and transmission, and direct-current distribution for railway service; alternating-current generation and transmission, and direct-current distribution for light and power service; and alternating-current generation and distribution for light and power service. In the three latter cases the rotary converter is used to charge the storage battery and to send alternating current into the line when the battery is discharging.

Mr. Dion referred to his very satisfactory experience with a storage battery in the Ottawa station, where it is run in multiple with direct-current generators operating at 250 and 500 volts on a three-wire system. The battery was placed at the center of distribution, about 1½ miles from the station. Owing to bad speed regulation of water-wheels, and of varying load of direct-current motors, including many elevator motors, it had previously been found impossible to obtain satisfactory regulation. Although the battery is operated without a booster or regulating device of any kind, the improvement made in regulation has been such as to silence all complaints and to elicit complimentary remarks from customers.

In the discussion of Mr. Dion's paper, Mr. Martin and others advocated the use of the storage battery for supplying the line with power at any time when the generating plant is out of order; Mr. Martin instanced a case where this had happened in connection with the Hamilton Street Railway; Mr. Reynolds also spoke of its advantages in this connection.

Mr. Ed. A. Evans, of Quebec, read a paper on "Electric Suburban Railways," in which he dealt with the practical operation of electric cars upon and over the same tracks as were used by the steam railway, the electric cars running between the usual steam railway service. This innovation had been successfully made, and the results, he said, had more than justified the expenditure, in connection with what was formerly the Quebec, Montmorency and Charlevoix Railway, a steam line 30 miles long, running between the city of Quebec and Ste. Anne De Beaupre and Ste. Joachim, now under the control of the Quebec Light and Power Company.

Trolley Refuse Carts.

A new scheme for disposing of the refuse of Brooklyn is being looked into. The plan, which has been devised by H. Milton Kennedy, of the Brooklyn Rapid Transit Company, is to make use of trolley cars in carrying off the refuse, the Brooklyn Rapid Transit Company to take the contract for the work. Mr. Kennedy's idea is to have receiving stations in central parts of the borough. The city's trucks and carts, instead of taking the refuse to the dumps, are to carry it to the stations. The company is to take the refuse on specially constructed flat cars to Flatlands and Gravesend, where it is to be used for filling in land. The belief is that expense can be saved by the plan.

Nineteenth Annual Convention of the American Institute of Electrical Engineers.

THE nineteenth annual convention of the American Institute of Electrical Engineers was held this week at the Berkshire Inn, Great Barrington, Mass., with great eclat and success. As the business sessions last from Wednesday to Saturday, the meeting is still in progress when the current issue of ELECTRICAL WORLD AND ENGINEER goes to press. The attendance was excellent, about 150 being registered by Wednesday noon, with hourly arrivals from different parts of the country until Thursday, totalling over 200.

The convention began with a reception to the Institute in the assembly hall of the Berkshire Inn, at 8:30 on Tuesday evening, when hundreds of the residents of Great Barrington and vicinity turned out to greet the Institute. The hotel and the hall were gaily decorated, and as two or three hundred ladies were present in full evening dress, the affair was a decidedly brilliant one. About 9 P. M., Mr. William Stanley, as chairman of the local committee, made a brief but most eloquent address of welcome on behalf of the community. He referred to the famous natural beauties of the region, as well as to its immortal associations with American history and literature; and described the population as quiet and pastoral in its nature. None the less, they were proud of their intimate connection with some of the best-known achievements and men in electrical work; and he instanced, in particular, the part borne by Cyrus Field in laying successfully the first submarine cables; and he quoted also the name of the late Franklin Leonard Pope, formerly president of the Institute. He made incidental reference also to the upgrowth of electrical industries in the region, and the interest that members would naturally take in the beginnings of electrical work and manufacture in the region. In giving an outline of the programme, Mr. Stanley extended a hearty and cordial welcome to the Institute, and expressed the sense of the honor done to Great Barrington by the holding of the annual Institute meeting there.

Past-President Martin acknowledged, on behalf of the Institute, the address of welcome, and said that already the members, to whom so many friends from the Berkshires were known, had been made to feel at home by the generous cordiality of their reception.

The regular meetings began on Wednesday morning at 9:30, when President Steinmetz called the members to order in the reception hall. The following papers were then read in the order given, discussion being reserved until the close:

"Method of Compounding Alternating-Current Generators and Motors, Direct-Current Generators, Synchronous Motor Generators and Synchronous Converters," by Mr. F. G. Baum, of Stanford University, Calif.

"Formula for Calculating the E. M. F. at Any Given Point on an Alternating-Current Transmission Line," by Mr. Maurice Le Blanc, of Paris, France.

"The New Generating Plants of the Niagara Falls Power Company," by Mr. Harold W. Buck, of Niagara Falls, N. Y.

"Notes on the Theory of Synchronous Motors, with Special Reference to Surging," by Pres. Charles P. Steinmetz, of Schenectady, N. Y.

"The Predetermination of Alternator Characteristics," by Prof. L. A. Herdt, of Montreal.

Discussion was opened by Dr. Perrine, who read an additional and explanatory letter from Prof. Baum, and then passed on to the paper by Mr. Buck, on the Niagara plant, describing the three new 10,000-hp, 12,000-volt, three-phase generators being put in the Canadian power-house. He noted that no efficiencies were given, and also agreed in general with the limitation of the modern tendency to adopt bench-board control of switchboards. It was not the best thing in very large plants. He also expressed a strong opinion in favor of centralizing recording apparatus in the superintendent's office and leaving the switchboard attendant with as few indicating instruments to watch as possible.

As to change from external to internal field, that was certainly radical, but large machines were running already with internal fields, and the change in this case seemed a distinct mechanical improvement.

Mr. Buck described the arrangements for balancing the shaft hydraulically, in the familiar fashion, also the plan of oiling the shaft bearings. The new turbines adopted with ring gate governed from above were of a type not perhaps known in America, but already used in Italy and other parts of Europe. The discussion was participated in by Messrs. Perrine, Buck, Pattison, Garratt and others.

On being urged by Pres. Steinmetz, Mr. Buck gave a few details in regard to the proposed transmission line from Niagara to Toronto, using the current from the 12,000-volt, 10,000-hp machines. He drew a diagrammatic sketch of the transformer, showing how with the five equal windings steps from 11-12,000 up to 40,000 and 60,000 volts would be obtained, getting the full copper efficiency in all the voltages. He also sketched the horizontal porcelain insulator to be used, with five ears and four recesses, and said they were experimenting with sizes from 14 inches down to 8. This insulator has the wire at the center and at a place of minimum liability to puncture of the porcelain, on account of the length of the path.

After this a desultory discussion followed, by Messrs. Kennelly, Adams, Esty, Perrine, Guttman and Steinmetz, on points connected with the Le Blanc, Baum and Steinmetz contributions. The meeting adjourned at 1 P. M.

Abstracts of Papers.

NEW METHOD OF COMPOUNDING GENERATORS AND MOTORS.

Prof. F. G. Baum read a paper giving a method of compounding alternating-current generators and motors, direct-current generators, synchronous motor generators and synchronous converters. The compensating system is shown in Fig. 1. *G* is the generator shown as a two-pole machine. From its shaft is driven the armature, *aa'* having field-poles *AA'*. The armature winding is shown as a single turn of wire, one end of which goes to a solid ring and the other end to a ring broken as shown, the two parts of the latter, however, being metallically connected. It will be noticed that there is no commutation, the same armature wire being always conneted to the same brush. The brush on the broken ring is at the center of one pole, the metallic segments of this ring covering about 90 electrical degrees.

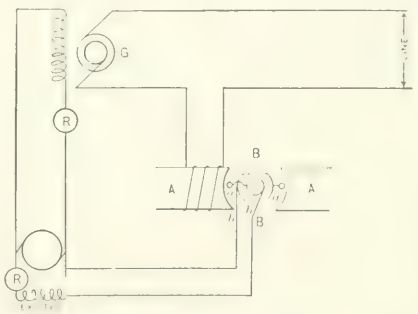


FIG. 1.—COMPENSATING SYSTEM.

If the field *AA'* were excited by direct current, parts of an alternating wave would be obtained at the brush, a part of each wave being cut out owing to the fact that the ring is divided. If *AA'* is excited by a sinusoidal alternating current in synchronism with the rotation of the armature, *aa'*, waves of the e.m.f. are obtained at the brush of different forms depending on the position of the armature coil when the current passes through its maximum value. For example, if the armature coil passes the position shown when the current in the field coil is a maximum, it will be evident that there is a rectified potential at the brushes *bb*. The top of the waves is really cut off, and a potential given at *bb* which may be measured by an ordinary direct-current voltmeter. If the current in the field passes through zero when the armature coil passes the position shown, there is no rectified potential.

The arrangement recommended for practice is shown diagrammatically in Fig. 2, and its application in Fig. 3. The rectified potential is used to excite a small direct-current generator of 100 to 500 watts capacity, and the armature of this machine is connected in series with the series winding on the exciter. The direct current is large, so that only a few turns are needed on the exciter. These may be easily threaded on by hand, if there is not already a series winding on the exciter, so that no new exciter is needed. The percentage compounding may be changed simply by turning the rheostat handle in the armature circuit of the compensator. The compensator has four poles and is

driven in synchronism by a gearing on the generator shaft. The compensator set being small, it is a simple matter to add the compensator to any generator.

This method may be applied to compounding alternators operating in parallel, whether the generators have separate exciters or are all excited from the same exciter. When there is a separate exciter for each machine, the compensator may be applied to each generator, or a

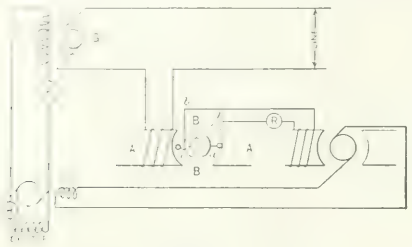


FIG. 2.—COMPENSATOR CONNECTIONS.

single compensator may be put on one generator and the current from the direct-current side carried around each exciter field. The station would then, of course, be compounded only when the generator to which the compensator was connected were running. The entire station may be compounded by a single compensator set where all generators are excited from the same exciter. In this case, the current for the field of compensator would be taken from the bus-bars. Since only a fraction of the exciting energy of the exciter is supplied the compensator set of 500 watts capacity is large enough to compound a 10,000-kw station.

Some of the advantages of this method of compounding are that the generators have but a single winding; no collector bus-bars, switches, etc., are necessary; no adjustment of low resistance shunts

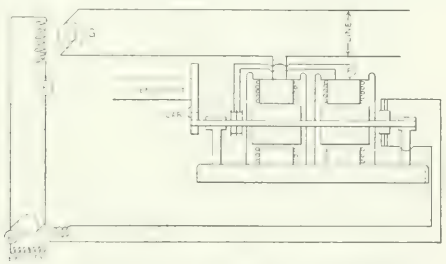


FIG. 3.—GENERAL ARRANGEMENT OF COMPENSATOR.

are necessary to make machines take their proper share of load; when the generators are over-compounded there is no drop in voltage when the brush machine is added. The amount of compounding may be changed instantly by turning a rheostat handle; the cost of compounding a large station will be less than compounding the same number of direct-current generators; owing to the absence of equalizer switches the operation of the station is simpler.

The application of the method is given to compounding synchronous motors, direct-current generators, synchronous motor-generators and rotary converters. Its application is also given to the most general case of the transmission system with a long trunk line having several branch lines. In this case the generators are to be compounded for the center of distribution, and the synchronous motors on each branch line also compounded with respect to the center of distribution.

CALCULATION OF E.M.F. OF TRANSMISSION LINE.

Mr. Maurice LeBlanc communicated a paper giving a formula for calculating the e.m.f. at any point of an alternating-current transmission line. The paper, which is highly mathematical, shows the application of the formula deduced when the line is operated at no load and when the line is rather long. The maximum value which the voltage will attain on a line will occur when the length of the line is equal to ¼ of the length of the transmitted wave. This condition will not generally occur with currents of average frequency but it may occur on long lines with low harmonics and give rise to dangerous surgings in the voltage of the line. Consequently the production of harmonics by the generating and receiving apparatus should be avoided with the utmost care, and in long-distance transmissions the frequency should be as low as possible in order that the length of the line may be always very short in comparison with the length of the waves transmitted.

THE NEW NIAGARA PLANTS.

Perhaps the paper of most general interest on the programme was that of Mr. H. W. Buck, entitled "The New Generating Plants of the Niagara Falls Power Company." A reprint in full of this paper will appear in these columns.

The paper first considers the additions to the present Niagara plant, consisting of eleven 5,000-hp machines of two types. The new turbines, while of the same general type as those in the older power-house, differ in that they are of the internal discharge type and are provided with draft tubes, which add 10 per cent. to the effective head. The remaining capacity of the Niagara tunnel being 50,000, the increase due to this better utilization of the water power permits of the use of eleven instead of ten units. Six of the generators are of the external revolving field type, used in the older power-house, but are designed for a much closer regulation—10 per cent. instead of 30 per cent.—the collector rings, moreover, are placed at the bottom instead of at the top of the dynamo shaft, and centrifugal ventilation is employed.

The five other generators are of the internal revolving field type, being thus similar to the standard type of alternator. All generators will have a speed of 250 r. p. m., and generate current at 2,300 volts and 25 cycles. The efficiency of the external field generators was found by test to be 98.15 per cent.

The exciter plant is located at the bottom instead of the head of the pit, being installed in a recess and driven by a vertical turbine. Many changes have been made in the switching arrangements, there being only one board instead of two, as in the older power-house. Electrically-operated oil-break switches are employed, and switching is done by means of relay switches placed in such a relation to imitation bus-bars that the connections are clearly indicated—the real switches being on the power-house floor. Mr. Buck criticizes unfavorably the system of bench-board switch control.

Instead of the ordinary time-limit relay, a device is used, consisting of a dash-pot attachment to the tripping plunger of the dash-pot. This retards the movement of the plunger for ordinary temporary overloads, but if a real short circuit occurs, the pull on the plunger is so strong that the dash-pot has no effect.

It is the intention to operate the 21 generators normally in four independent groups, but the arrangement of circuits is such that they may all be operated in parallel, or any one generator thrown on any group.

The paper also describes briefly the main features of the great plant to be erected on the Canadian side of the Falls, with an ultimate capacity of several hundred thousand horse-power. The units will be similar to the new Niagara design, above-referred to, and of 10,000-hp each. They will be wound for 12,000 volts, three-phase and 25 cycles, at 250 r. p. m. The weight of the revolving part will be 141,000 lbs. and the diameter over-all only 19 feet—the machines taking little more space than one of the older 5,000-hp units. For long-distance transmission the voltage will be stepped-up to 22,000, 40,000 and 60,000 volts, respectively—the latter to be the Toronto transmission voltage. The hydraulic features of the plant will be similar to the American plants.

THEORY OF THE SYNCHRONOUS MOTOR.

With the title, "Notes on the Theory of the Synchronous Motor," President Steinmetz presented the first section of a contribution to the mathematical theory of this type of motor. It is pointed out that synchronous motors—including the rotary converter—unlike induction motors, can at the same power output have the voltage, current, power-factor, etc., varied over a wide range by varying the field excitation—that is, the counter or "nominal" induced e. m. f. As a consequence, this type of motor can be utilized to a considerable extent to control the phase relation, and thereby the voltage, while at the same time producing mechanical power.

The paper proceeds to develop the mathematical theory of the motor, both graphically and analytically, numerical examples being solved to illustrate the application of the results arrived at. It is shown that a given impressed voltage and current output, the power output of the synchronous motor, can vary over a wide range, and also that for each value of power output there corresponds a lagging

and a leading current. As excitation is increased the lag of current is decreased until it becomes in phase with the e. m. f.; and if further increased the current leads the e. m. f.

The second portion of the paper deals with the case of a motor not having constant speed, as when it is accelerated or retarded from any cause. This phenomenon of surging is denominated electro-mechanical resonance, and is made the subject of mathematical analysis. The result shows that the frequency of oscillation does not vary much with the load and with the excitation, and that it slightly decreases with increase of load, and increases with increase of excitation.

The third section of the paper treats of the theory of damping devices, and the final section considers means for avoiding surging. An external cause of surging may be the field of a self-exciting, direct-current generator, driven by the synchronous motor, and if the generator is also the exciter of the motor, the effect may be intensified. The governor of the prime mover may also act to cause surging. Internal cause may be found in the lag of the synchronous motor field behind the m. m. f.. Appliances, such as short circuits around the field poles, while increasing the steadiness of a steady motor, will increase the unsteadiness of an unsteady motor.

The final conclusions are that the avoidance of surging requires consideration; first, of the design of the motor and the system on which it is to operate: second, the use of anti-surging devices, such as an induction motor winding in the field poles or short circuits between or around the poles; third a flexible connection, such as to a flywheel or by a belt to the load.

DETERMINATION OF ALTERNATOR CHARACTERISTICS.

With this title, Prof. L. A. Herdt read a long paper on indirect methods for the determination of the characteristics of alternating current apparatus. The subject is treated under the following heads: Armature reaction and armature reactance, tests of an inductor alternator, alternator regulation and indirect methods for determination, application to inductor machine, application to other types.

Complete numerical and graphical data are given from a test of 15.4-kw, 110-volt inductor alternator, at a speed of 720 r. p. m. For determining alternator regulation three methods are described, namely, the short-circuit characteristic method, the "composing m. m. f." method and the "two reactance" method, all of which were applied in testing several machines. In the case of the inductor alternator above mentioned, the short-circuit method gave a better result than the "composing e. m. f." method, but the "two reactance" method gave the best result, and in other tests the latter method gave the most correct results.

SINGLE-PHASE ALTERNATORS IN POLYPHASE CIRCUITS.

Mr. C. O. Mailloux presented a paper giving an account of an interesting experiment with single-phase alternators connected to a polyphase circuit. The paper was prefaced with an account of the plant of the Phœnix (Arizona) Light and Fuel Company, where the experiment was tried. The plant will have two water-power stations located about 15 miles apart, generating three-phase currents at 22,500 volts and 60 cycles. The receiving station will be situated 9 miles and 24 miles respectively from the generating stations, which latter will have an aggregate capacity of 600 kw. At present one of the water-power stations is in operation, and also a single-phase monocyclic steam station in Phœnix, which will later be discarded and the site used for a receiving station.

In order to tide over until the second generating station is completed, it was desired to run the single-phase steam plant in connection with the polyphase water-power plant, and to this end the following experiment was made:

Arrangements were made for coupling the single-phase alternators, each with one phase of the two-phase bus-bars in the sub-station. The necessary connections having been made, and a Lincoln synchronizer having been procured and connected, the experiment of coupling first one, then another of the alternators in multiple with either of the two phases was tried, the alternator being brought to the synchronous speed by regulating the engine throttle-valve. The next step was to connect one of the alternators with each phase. This was done easily. There was no difficulty in making the alternators keep in step and in making them carry a proportion of the total load. It was also found, as was to be expected, that the alternators would be utilized in balancing the two phases, in case they were unequal in potential difference, owing to unequal loads.

The next step was to determine if two single-phase alternators could be maintained in two-phase relation by means of a rotary converter, when they were the sole source of the energy conveyed to the entire system. After careful consideration of all the reactions involved, the experiment was decided upon. The results completely justified the confidence with which the experiment was tried.

The generators having been connected with the transformers and excited so as to give the full line voltage on the transmission line, the rotary converter was then started in the regular way. This having been done, two of the single-phase alternators were then coupled in succession to the feeder bus-bars, one to each phase. In coupling each alternator, a Lincoln synchronizer, suitably connected was used as a phase indicating device. After the two alternators had been coupled, each to one phase, the connections of the Lincoln synchronizer were then changed so as to show the phase relation between the two phases of the lighting feeder bus bars. The instrument showed that a perfect quarter-phase relation was being maintained between the two phases, as was expected. The load on each machine could be adjusted, both by regulating the steam supplied to the engine at the throttle-valve, and by changing the excitation of the magnetic field.

After all adjustments had been completed, the line switches were then quickly pulled open, thereby disconnecting the transmission line, and shutting off all electric energy supplied from the water-power station. At the instant of disconnecting the speed of the rotary converter fell off slightly, as was evident not only by the frequency pitch or tone, but also by the readings of the direct and alternating voltmeters. This falling off was ascribed to the fact that the engine throttle valves were not fully open. On opening the throttle, the speed rose gradually, until the frequency again became about the same as it was before disconnecting the transmission line. The index of the Lincoln synchronizer remained all the time at a point 90° from the position of synchronism, showing that the two single-phase alternators were being kept perfectly in the same two-phase relation as when the rotary converter was run with current supplied from the transmission line. The external load was then varied by opening and closing the feeder-line switches at the lighting switchboard. The maximum load put on was equivalent to more than three-quarters of the full current capacity of each alternator; the load being composed almost entirely of incandescent lights, the power factor was, of course, somewhat high.

After continuing the experiment for about ten minutes the alternating current-switches of the rotary converter were opened and the single-phase alternators immediately disconnected, the synchronizer having shown that the quarter-phase relation was lost at the same instant that the rotary converter was disconnected. The experiment was repeated with slight variations two or three times, and each time with perfect success. It was found that by opening the engine throttles somewhat more than was done in the first experiment, and increasing the steam pressure available at the engine cylinder before disconnecting the transmission line, there was less falling off of the frequency at the instant of disconnecting. It was observed that the alternating current in the rotary converter increased slightly, as was to be expected at the time of disconnecting the transmission line. This was of course, due to the new inter-reactions taking place between the single-phase alternators and the rotary converter in consequence of the new function imposed upon the converter, that of acting as an electromagnetic coupling and flywheel for the two single-phase alternators. It was found that the amount of this current could be varied, to some extent, as was to be expected, by varying the field strength of the rotary converter. There were no facilities for imposing a direct-current load on the rotary converter in addition to the load resulting from its operation as a phasing device for the two alternators. There is no reason to doubt, however, that a direct-current load could have been placed upon the rotary converter up to the full generating capacity of the two single-phase alternators serving as the source of current supply in the experiment. The experiment may, therefore, be taken to be a sufficient demonstration of the possibility of using single-phase alternators to produce two-phase current, three-phase current and direct current, with an arrangement and under conditions such as shown in the diagram.

The paper proceeds to discuss at length the reactions that take place in operation under the above conditions. It is concluded that the synchronizing force comes from the phase connected with the leading alternator, to the phase connected with the lagging one, the converter being an elastic coupling medium

ELECTRIC TRACTION FOR THE NEW YORK CENTRAL RAILROAD.

Without doubt the most important practicial paper read was that of Mr. B. J. Arnold, entitled "Method of Ascertaining by Means of a Dynamometer Car the Power Required to Operate the Trains of the New York Central and Hudson River Railroad Between Mott Haven Junction and Grand Central Station, and the Relative Cost of Operation by Steam and Electricity." The paper, in fact, is an abstract of the report made by Mr. Arnold to the New York Central authorities, in which a plan is proposed for handling the urban part of the system by electric power.

Details of the tests made are given, accompanied by tabulations and many curves. Calculations showed that the electrical energy required to haul a ton one mile over the division of the road over which the tests were made would be 63 watt-hours per ton-mile.

As a result of the investigation, Mr. Arnold recommended the direct-current system in combination with the third rail for the main line, and overhead construction for the yards. All of these elements have demonstrated fully their ability to meet the conditions imposed by railway operation so far as motive power is concerned, although there has not yet been an electric installation on any existing terminal that is as complex, or into which anywhere near the number of heavy trains enter as on this section of road.

Had the length of road under consideration been considerably greater, and had it been thought possible to secure sufficient time to conduct experiments or invite demonstrations by manufacturers of alternating-current motor equipment, this class of apparatus would have been more seriously considered.

In the preparation of estimates, 12 distinct plans of generation and distribution were considered. All the estimates were computed upon the same basis so far as cost of fuel, labor and losses in transmission were concerned. The plan, which a careful study showed to be preferable, involves a combined direct and alternating-current power station at Harlem, run near one end of line, with a rotary converter substation near the other end of the line, the transmission being at 11,000 volts, and the distribution at 600 volts, direct. One storage plant is provided in or near the powerhouse, and another at the substation, each of such capacity it may, together with only a portion of the main station and substation machinery, take care of the entire load of the line for a short period in case of emergency.

The following figures are given as to the comparative cost of the steam and electric systems:

	Steam.	*Electricity.*
Operating expenses per locomotive mile exclusive of fixed charges but including water, labor, cost of cleaning and repairing tunnel, and all other expenses of locomotive operation	23.05	15.80
Fixed charges per locomotive mile, assuming that it now requires 40 locomotives to perform the present service, and that 33 electric locomotives could perform the same service	1.13	7.83
Total in cents	24.18	23.63

From these figures it appears that while there would be a slight annual saving in operating expenses in favor of electricity, it is not sufficient to warrant its adoption on the grounds of economy in operation alone, although its adoption can be justified on other grounds.

These figures could be made more favorable to electricity were an optimistic view of many of its advantages taken, and the probability is that practical operation will show a somewhat greater gain than here indicated, but Mr. Arnold deemed best a conservative view throughout the entire investigation. It is, however, safe to conclude that the saving in operation expenses by the electric system would be sufficient to offset the increased fixed charge due to the additional investment made necessary by its choice.

COMPARATIVE ACCELERATION TESTS WITH STEAM LOCOMOTIVE AND ELECTRIC CARS.

A joint paper, by B. J. Arnold and W. B. Potter, with the above title gave an account of experiments carried on by means of a dynamometer car ,to determine data for a comparison of steam and electric traction on short-haul suburban passenger service. The tests were made with a steam locomotive, designed specially for the rapid acceleration work required in suburban service, and with two 35-ton electric motor cars, adaptable to similar service. A train of six cars, including five New York Central passenger coaches, and the dynamometer car, was started and run over a mile of track, acceleration being made as rapidly as possible; on some of the runs the train was hauled by the locomotive, and on others by the motor cars. Full data of the tests are tabulated, including weights, speeds, watt-hours per ton-mile, etc., and acceleration, speed, torque and other curves plotted from the data.

The data bring out clearly the fact that the electric motors during acceleration can utilize the weight on the drivers more effectively than the locomotives. Owing to motors being able to maintain their maximum accelerating rate longer than the locomotives, they were able to cover the same distance in the same time with less energy expended and at less maximum speed. With a shorter run, the motor cars were able to make higher average speeds than the locomotive over its longer distance, and these higher speeds were also obtained with a lesser maximum speed.

On the basis of the energy per seat mile, the weight of the steam locomotive capable of performing the same service is considerably greater. For example, with six cars to a train, the watt-hours per passenger would be 43.9 with steam, and 29.7 with electricity, which figures become 187.8 and 45.2, respectively, for one car.

The paper gives the efficiency of an electrical system between boiler and track as 51.33 per cent., based upon the following component efficiencies: Engine, 90 per cent.; alternator, 92 per cent.; high potential transmission, 98 per cent.; transformers, 97 per cent.; converters, 92 per cent.; third rail, 95 per cent.; motors, including control, 75 per cent..

In the case of the locomotive, the coal per effective hp per hour is calculated to be 15.6 pounds. Assuming a consumption of 2½ lbs. per hp-hour at an electrical plant, and 50 per cent. efficiency for the motor, the corresponding figure for electric traction is 5 lbs. of coal. Assuming that the cost of coal for electrical power is one-third of the total cost, including maintenance and interest on investment, it is probable that the actual gross cost of electrical power would closely approximate the coal consumption of a steam locomotive in this class of service, the maintenance of the electrical equipment and attendance required being, however, considerably in favor of electrical power.

THE FUNCTION OF SHUNT AND SERIES RESISTANCES IN LIGHTNING ARRESTERS.

In a paper with this title, Mr. Percy H. Thomas describes a new method of enabling a lightning arrester to suppress an arc which may follow a lightning discharge, which otherwise will maintain a circuit from the station generator. The device involves the use of series and shunt resistances in connection with a multi-gap arrester.

The paper refers to previous work in the use of shunts with lightning arresters, and gives at length the principles involved. A circuit illustrating the shunt principle is shown in Fig. 1. It consists of a number of small air gaps connected between line and ground, a portion of the gaps being shunted by a resistance, as indi-

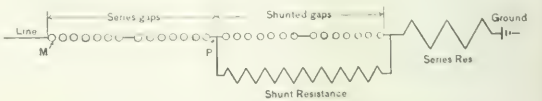


FIG. 1.—ILLUSTRATING SHUNT PRINCIPLE.

cated, and a series resistance placed in earth connection. The shunt resistance is usually placed next to the series resistance, as shown, and half the total number of gaps are shunted.

When the arrester is not in action, the point P at the junction of the shunted and series gaps is at ground potential, and consequently the arrester will discharge whenever the voltage of the point M of the line reaches a potential above the ground sufficient to cause the series gaps to break down; that is, the voltage on the line necessary to cause the arrester to discharge, is that required to break down the series gaps alone, regardless of the presence of the shunted gaps. During actual discharge the series gaps break down, and the resistance between the points M and P is momentarily reduced to practically zero, and the full amount of the potential of the line is then thrown on the shunt and series resistances. If this potential, which is thus abruptly applied to the resistances, is high, the shunted gaps

will be broken down. This makes, for the instant, a direct path for the static discharge from line to series resistance. If conditions are right, current from the generator will then follow the static discharge through the gaps, establishing an arc. The current will flow through the shunt and series resistances and usually through the shunted gaps, but if the various parts are properly proportioned, the shunt resistance will take enough current from the shunted gaps so that the arc cannot hold in the latter and will drop out. Once the arc drops out in the shunted gaps, it must pass through both resistances, which will reduce the current strength, and enable the series gaps to suppress it altogether.

The series resistance, though from one standpoint objectionable, is found necessary for the successful operation of the arrester, in order to prevent the enormous rush of current, which, on circuits of large generating capacity, would otherwise follow discharges and cause lights to dip and synchronous apparatus to fall out of step, as well as overheating the arresters themselves.

The paper then proceeds to an explanation of the principles of the multi-gap and alloy cylinders in lightning arresters, which subject is considered under the heads of generator voltage, short-circuit current, inductance, frequency and phase of e. m. f. at time of discharge. The considerations governing the choice of shunt resistances are then given, and the paper concluded with sections on the design of an arrester, and a method of experimenting with the same.

THE ELECTROSTATIC WATTMETER IN COMMERCIAL MEASUREMENETS.

Mr. Miles Walker read a paper with the above title, giving the application of the Kelvin quadrant electrometer to electric power measurements. Used as a wattmeter, this instrument reads the power correctly whatever the shape of the wave form, for at any instant the turning moment is proportional to the instantaneous value of the power and the needle takes up a position that corresponds with the average of the instantaneous turning moments. The accuracy of the instrument with low power factors, its wide range and freedom from burning out, make it suitable for general testing purposes, whenever low power factors are likely to be met with. When the power of a three-phase motor is measured in the ordinary way, with two successive readings on a wattmeter, one of these readings will be negative, or of very low power factor, when the motor is lightly loaded. It may be necessary to take the difference between two readings, both of which are inaccurate on account of the effect of the low power factor upon an ordinary wattmeter, and the final results will be very far indeed from accurate. On the other hand, an electrostatic wattmeter can be made to read power supplied at pressures as low as 100 volts.

The paper deduces the equations applying to this use of the quadrant electrometer, and gives instructions for connecting up in different cases.

Notes of the Institute Convention.

THE SPECIAL TRAIN from New York left at 2 P. M., on Tuesday, and reached Great Barrington at 5:30, with nearly 75 members and friends on board. The trip was made in delightful weather, and the Berkshires never appeared more cool and beautiful than to the senses of city folk who had just undergone the worst weather of the season, in heat and humidity.

MR. STEPHEN D. FIELD came over from Stockbridge, and was heartily greeted by a host of friends who had not seen him since his return from Geneva, Switzerland, where he has been busily engaged during the past four years constructing street railway systems.

THE TOWN HALL was the scene, on Thursday evening, of a notable assembly and ball, where all the youth and beauty of Berkshire was focussed to do honor to the visitors. Outside hung a fine sign with the badge of the Institute executed in colored incandescent lamps. Inside the lighting was equally profuse, and was supplemented by floral work. In fact, some 2,000 lamps, all told, are said to have been used for the lighting, while everywhere the eye rested on green foliage and bright flowers. Dancing was kept up to a record hour for Great Barrington, and some of the members, still in evening dress, were ready to help President Steinmetz open the regular proceedings at 9 A. M., on Friday.

THE STANLEY COMPANY was naturally very much in evidence durthe week, and the recent deals connected with its control and management formed a frequent theme of conversation. It was generally understood that a further step likely is the acquisition of the Ganz rights and details for this country.

FRIDAY AFTERNOON was reserved for a visit to the factories of the Stanley Electric Manufacturing Company, for trips by trolley around Pittsfield and Dalton, and for a garden party at the residence of Dr. F. A. C. Perrine, where Mrs. Perrine was to be assisted in receiving by representatives of the Institute. Our report had closed, however, before these events came off.

THE PROGRAMME of papers given in these pages was duly carried out, all the papers on electric railway work being presented on Thursday, as listed. The discussion was opened in his usual brilliant and incisive manner by Mr. Sprague, who received quite an ovation. Mr. F. S. Pearson, as a leading operator of electric railway systems, was also very heartily greeted by the members. One of the most striking features of the whole session was Mr. B. J. Arnold's brief presentation of his plan for calling in the aid of compressed air for heavy electric traction. Briefly stated, the plan consists in a combination of electrical power and compressed air. The energy that is always wasted in overcoming resistances in stopping or starting motor cars he employs in compressing air, and thus storing away power for use when needed. This air power is utilized either as an auxiliary to the motor in procuring high bursts of speed or as a brake, or as a substitute for the electric power should the motor be deprived of current at any time. Mr. Arnold has built and operated, for his own experiments, a 20-mile track, on which he has tested all his devices. In his address, after expressing his belief in the efficiency of alternating currents as opposed to direct, the engineer thus sums up the results which he believes he has attaned: First—the entire elimination of the present standard system of rotary converter substation plant, together with the maintenance thereon and the cost of the necessary attendants. Second—A large reduction in the first cost of electrically equipping long-distance railroads, thereby making it feasible, from an engineering and business standpoint, to equip many roads on which it cannot now be shown to be advisable.

AN ORGAN RECITAL in honor of the Institute was given on Thursday afternoon, at Barrington House, the palatial residence of Mr. Edward F. Searles, said to possess the finest private music chamber in America. It contains a large pipe organ, designed and built by Mr. Searles himself, and the distinguished organist, Mr. Henry Rowe Shelley, arrived from New York to give a programme that illustrated its remarkable range of power, tone color and sensitiveness of control. The visitors were received by Mr. Harry Douglas, curator, and Mr. Searles himself, and after the organ recital, the art treasures of the place were thrown open for inspection. In the evening Mr. Searles entertained a few of the prominent members of the Institute, and gave them a further musical treat. He also showed them what is one of the very earliest private lighting installations in the United States, as well as a few more of the artistic curios he has gathered the world over. After a couple of memorable hours, the party toasted their host as a "kindred spirit" and thanked him in the Institute's name for the exquisite courtesy shown upon the occasion of its visit to Great Barrington.

LECTURE EVENING.—The evening of Wednesday was devoted to the exhibition of a large number of lantern slides on subjects of an electrical nature, and treated popularly for the benefit of the public of Great Barrington. The meeting was held in the Town Hall, which was crowded with an audience of 700 or 800 people, many of whom had driven in from the surrounding farms and country homes. The speakers were introduced by Secretary Pope, and the proceedings were interspersed with music. The first item on the programme was a series of slides presented by Mr. T. C. Martin, illustrative of the decorative use of the electric light, and based very largely upon the work done by Mr. Luther Stieringer at successive expositions, including Chicago, Omaha, Atlanta, Buffalo Pan-American, Paris, in 1889 and 1900, was also illustrated as exemplifying foreign work. Mr. Martin showed how electric lighting, and particularly the incandescent lamp, had lent itself to this work, and pointed out how large a part electricity could play in adding to our æsthetic and intellectual pleasures, as well as in subserving utilitarian needs. Some 50 beautiful slides were exhibited, supplemented by request with some from the collection of Chairman Calvin W. Rice, and including portraits of Kelvin, Steinmetz, Edison, Elihu Thomson and W. Stanley, whose first transformer and first alternating-current pole line erected in Great Barrington, were also shown. Mr. W. B. Spellmire, of the Bullock Company, in behalf of Mr. R. T. Lozier, then presented a series of slides de-

Sprague road, at Richmond, and closing with the Baker torpedo automobile, which had made a speed of 90 miles an hour before destroying itself. The series included, also, views of machinery driven by motors and of the factory at Niagara, where crackers are baked by electricity, and where, in the restaurant, little electric cars bring to each guest the items ordered from the menu. Next came Dr. F. A. C. Perrine, president of the Stanley Electric Manufacturing Company, who showed a wonderfully fine series of slides, illustrative of some of the engineering feats done in California, especially those required in installing the 220-mile line and the plant for sending power from the Sierra Nevadas to San Francisco. The last item on the programme was presented by Mr. W. J. Jenks, of the legal and standardizing bureau, who submitted and described a unique series of slides of lightning flashes and forms of all classes. This closed a solid three hours of varied entertainment, traversing the whole art of electricity in pictorial fashion, and which if applause be any criterion, was hugely enjoyed.

A MOST ARTISTIC BOOKLET was that which had been prepared by the Local Committee, and which had been printed by the Griffith Press, of Holyoke. It was in oblong form, 12 inches by 6, enclosed in a gray paper wrapper, stamped with the badge of the Institute in gold. The cover of the programme was in deep shades of blue, green and gold, with title, seal of the Institute, etc., in green and gold, and inside were 20 pages devoted to giving information, with the names of the local committees, the programme, views of the surrounding country, and snatches of verse, by such local but national poets as William Cullen Bryant—the Berkshire Inn, by the way, standing where stood the Bryant house, now moved back a little from the road. The demand for these handsome souvenirs was so keen that a large edition was early exhausted, and more are being printed.

THE STANLEY LAWN PARTY, at near Mr. Wm. Stanley's new home, "Brookside," on Wednesday afternoon, was one of the most delightful affairs and decided successes of the whole week. It was attended by several hundred people, who gathered around the tea tables or spread over the lawns and witnessed the evolutions of the May Party of young girls, in yellow and white, or listened to the arcadian comedy in the little theatre under the trees. The lakes, the grass, the trees and mountains were at the height of their charm, and the lovely scene was one from which it was impossible to withdraw the gaze.

MR. WM. STANLEY, who from his dash and vim, has sometimes been called the Prince Rupert of electricity, never gave stronger evidence of his capacity and enthusiasm than during the whole week, when, aided by Mrs. Stanley, he spared no effort to live up to his responsibilities as chairman of the local committee. While extending a boundless hospitality himself, he had also to direct the manifold courtesies of the whole community, and his work was well done.

"No. 8," where the local committee held forth, soon became an electric club, and members hied thither at all hours of the day and night to enjoy the hospitality of the committee there provided under the care of a butler and the indefatigable members of the committee itself. More good stories with a technical twist were told in "No. 8" than any member of the Institute could ever recall as characteristic of any previous convention. The idea to provide these rooms was a very happy one, and was much appreciated by all.

MR. E. H. MULLIN, who directed transportation and hotel accomodation, had no easy job, for the roster grew bigger and bigger, swamping all available space, and it was conceded on all hands—even by those who could not get a "room with bath," that no one else could possibly have done better. But Mr. Mullin was very glad when Saturday came and he knew that no more unexpected batches of ten or twelve could drop in and besiege him for the best rooms in either hotel—for he ran not only the Berkshire Inn, but the Barrington and the Miller, with sundry cottages thrown in. His General Electric training on large affairs and big diplomacy stood him in good stead.

THE LOCAL COMMITTEE, to whom the credit of the success at Great Barrington must be attributed, were William Stanley, chairman; John H. C. Church, treasurer; Harry Douglas, secretary; Parley A. Russell, Great Barrington; Frank H. Wright, Great Barrington; Frederick N. Deland, Great Barrington; Charles N. Gilbert, Great Barrington; John B. Beebe, Great Barrington; William H. Browne, Great Barrington; F. A. C. Perrine, Pittsfield, Mass.; W. W. Gamwell, Pittsfield, Mass.; John F. Kelly, Pittsfield, Mass.; C. [illegible], Pittsfield, Mass.; Daniel England, mayor, Pittsfield, Mass.; Stephen D. Field, Stockbridge; W. C. Dalzell, South Egremont. The committee of the Thursday Morning Club was Mrs. O. W. Lane, Mrs. William Stanley, Mrs. H. C. Joyner, Mrs. Alice Whiting, Mrs. A. C. Collins.

DR. A. E. KENNELLY addressed the Ladies' Thursday Morning Club on Thursday, at Kellogg Hall, on the subject of "Wireless Telegraphy," which he handled in a popular manner with accustomed clearness and grace of diction. He was heard with great delight by a large audience.

Attendants.

Following is a list of those registered at the convention up to Thursday:

W. C. Andrews, Harry Alexander, C. A. Adams, Mr. and Mrs. A. H. Armstrong, W. S. Andrews, B. J. Arnold, Mr. and Mrs. A. E. Averrett, E. H. Anderson.

A. C. Bell, Mr. J. J. and Miss Bellman, Douglass Burnett, R. H. Bell, W. H. Browne, E. G. Bernard, H. W. Buck, Morgan Brooks, G. H. Bragg, C. E. Bibber, H. D. Bayne, H. A. Burson, W. S. Bennett, E. J. Berg, H. W. Bowen, P. A. Bates, C. S. Bradley, A B. Bradley, R. D. Brown.

Chas. L. Clarke, H. M. Cogan, W. R. C. Corson, Wm. Curry, E. E. F. Creighton, C. E. Canfield, Mr. and Mrs. C. C. Chesney, F. B. Crocker, Mr. and Mrs. F. E. Case, J. H. Craig.

Louis Duncan, Edward Durant, Thos. Dempster, Mr. and Mrs. S. T. Dodd.

Miss Ernst, Henry S. Eddy, Horace T. Eddy, J. B. Entz, Mr. and Mrs. W. G. Ely, Jr.

S. D. Field, W. L. Fairchild, C. E. Farrington.

A. A. Gray, Mr. and Mrs. A. V. Garratt, L. Guttman, A. G. Grier, J. M. Gilmore, Mr. and Mrs. W. W. Gamwell, W. E. Goldsborough, E. W. T. Gray.

W. H. Hale, E. W. Hammer, Carl Hering, H. F. Hoxie, C. W. Holtzer, Mr. and Mrs. C. H. Hines, W. E. Haskins, H. E. Heath, E. Heitmann, B. K. Hough, C. F. Hopewell, M. G. Haight, Mr. and Mrs. G. A. Hamilton, Miss Hamilton, Mss Edith Hamilton, A. B. Hendricks, Jr.

Hanford Judson, W. J. Jones, A. P. Jenks, W. McA. Johnson, Mr. and Mrs. W. J. Jenks.

A. E. Kennelly, Mr. and Mrs. J. F. Kelly, August Kruesi, J. D. Keiley.

Miss Ella Levy, Miss Lieb, Mr. and Mrs. C. A. Lieb, Mr. and Mrs. J. W. Lieb, Jr., R. D. Lillibridge, Miss Lillibridge, W. J. Lloyd, F. V. T. Lee, Mr. and Mrs. H. Ward Leonard, Mr. and Mrs. A. B. Lisle, Lamar Lyndon, Mr. and Mrs. Herbert Lloyd, R. W. Lohmann, D. R. Lovejoy.

E. H. and Mrs. Mullin, Miss Michaelis, Mr. and Mrs. T. C. Martin, L. B. Marks, Mr. and Mrs. Wm. Maver, Jr., Mr. and Mrs. T. E. Murray, Mr. and Mrs. C. O. Mailloux, W. L. Mulligan, John Murphy, C. P. Matthews, E. G. Merrick, Miss McIlvaine, G. E. Miller, J. R. McKee.

R. B. Owens.

R. W. Pope, Mr. and Mrs. F. A. Pattison, Mr. and Mrs. J. S. Peck, L. K. Perot, Mr. and Mrs. C. W. Price, Miss Leonice Price, Miss Gray Price, Amy S. Pope, H. C. Parker, Mr. and Mrs. F. A. C. Perrine, G. W. Patterson, Jr., Henry W. Pope, Mr. and Mrs. F. S. Pearson, F. S. W. Pope, C. H. Porter, W. B. Potter, A. L. Pierce.

W. I. Reich, H. D. Reed, Calvin W. Rice, Norman Ross, Miss Clara Russel, E. B. Rosa, H. G. Reist, D. B. Rushmore, W. L. Rugg.

Luther Stieringer, Mr. and Mrs. A. B. See, J. E. Schmidtt, Langdon Smith, Geo. F. Sever, W. B. Spellmire, C. P. Steinmetz, Joseph Sachs, Wm. and Mrs. Stanley, C. E. Skinner, Walter I. Slichter, Jas. H. Styles, W. N. Smith, F. J. Sprague, Oberlin Smith, Samuel Sheldon, G. O. Squier.

Calvert Townley, Mr. and Mrs. P. H. Thomas, A. E. Truesdell, E. J. Thompson, Elihu Thomson, Mr. and Mrs. David P. Todd, H. W. Tobey, Albert Taylor, Miss Dora Truesdell.

F. K. Vreeland, Richard Varley.

J. Wilkinson, Mr. and Mrs. Jos. Wetzler, W. H. Wiley, F. F. Wood, Mr. and Mrs. J. M. Wakeman, C. B. Wismer, Arthur Williams, H. R. Wellman, R. N. Williams, G. W. Whittimore, P. B. Woodworth, Mr. and Mrs. E. J. Willis, W. D. Weaver, J. D. Wright, Miss Isabel M. West, Miss Ara M. West.

Recent Progress in Electrochemistry.

BY CLINTON PAUL TOWNSEND.

THE EDISON BATTERY.

In accordance with the practice of the U. S. Patent Office in rigidly excluding from a single application more than one specific form of an invention, the Edison battery, which is not a unitary device, is being protected by a considerable number of patents, substantially identical in their disclosure, but limited in their claims to one or another form of the oxidizable or the depolarizing element. The most recent of these patents deals with a depolarizer of a "specific magnetic metal other than iron"—*i. e.*, nickel or cobalt, in the form of a hydrate, mixed with flake graphite, and compressed in the perforated pockets of the plate. These plates are substantially those heretofore described, comprising frames of nickel or carefully nickel-plated iron, and retaining shells of hard-rolled sheet nickel, .005 inch in thickness, and closely perforated with holes of .015 inch diameter.

The nickel compound is the hydrated lower oxide, prepared by first precipitating either the monoxide or the black hydrated dioxide, filtering and washing and drying the precipitate. The resulting compound is finely powdered, mixed with something over 40 per cent. of its weight of flake graphite, moistened with strong potassium hydroxide, packed into the pockets and electrolytically oxidized to that higher stage believed by Mr. Edison to be represented by the formula $Ni_2 O_3$. The oxidation is practically limited to the surface of contact with the conducting material, and the function of the graphite is to greatly extend this surface.

This depolarizing agent is employed with any one of several oxidizable elements as iron, cadmium or copper. Iron is produced by the electrolytic oxidation and subsequent reduction of the monosulphide, no reference being made to the recently described method of production from scale-oxide. Cadmium is best obtained by electro-deposition from the sulphate solution with high cathode current densities, the metal being precipitated under these conditions in a finely divided state. Copper in suitable form is obtained by reducing the carbonate by hydrogen at the minimum temperature, and subsequently oxidizing it also at low temperature to the black oxide *Cu O*, followed by electrolytic reduction to metal. Upon discharge, the iron is oxidized to its ferrous state, the cadmium to its oxide, and the copper to its red oxide $Cu_2 O$. Iron and copper should be admixed with flake graphite, but in the case of cadmium this may be omitted by reason of its superior conductivity. Mr. Edison's claims for his battery are stated as follows:

"My improved battery can be overcharged, fully discharged, or even reversed and charged in the opposite direction without any injury. Overgassing does not disturb the initial state of the materials in the pockets. All the ingredients are insoluble, the supporting plates are unattacked by electrolytic oxidation, and the whole operation is independent of the strength of the solution, so that the battery is of great permanence, while at the same time more energy will be stored per unit of weight than with any other permanent practical combination heretofore suggested."

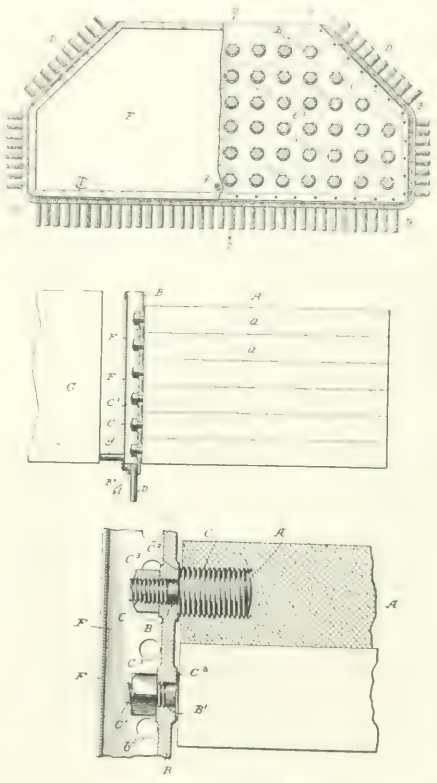
ELECTRIC FURNACE TERMINAL.

Mr. Acheson concludes a description of his new terminal for resistance furnaces with the following words: "For instance, when these graphitized-carbon electrodes (72 in number) are individually 16 inches in cross-section, so that the total cross-section of the terminal is 1,152 square inches, a current of 37,500 amperes can be carried on the terminal with safety and efficiency." This well expresses the magnitude of the problem of conducting the current to a modern electric furnace.

As shown in the accompanying figures, a series of blocks *a* of graphitized carbon, placed in close relation to form a single terminal, *A*, are secured to a copper plate, *B*; this plate constitutes the inner wall of a water-tank, *F*, the sides and bottom of which are formed by the peripheral flange B^2, and the back by the sheet-metal plate F^1. A pipe, *g*, affords communication with a larger tank, *G*, in which a constant level may be maintained. The essential feature is the connection between the graphite blocks and the plate *B*, which is effected through copper plugs, *C*, screwed into cavities, A^1, in each of the component graphite blocks. These plugs are provided with external bearing surfaces, C^2, and reduced extensions C^1, whereby the copper plate may be closely clamped by bolts C^3 without exerting any undue strain upon the graphite itself. Connection between plate *B* and the external circuit is made through a series of copper connectors, equal in number to the graphite blocks, and sweated into openings b^2 in the flange B^2.

GLASS MAKING IN THE ELECTRIC FURNACE.

Reference has frequently been made to the several promising applications of the Nernst principle to the manufacture of glass. A patent issued to August Voelker, of Ehrenfeld, Germany, would appear to involve a backward, rather than a forward, step, inasmuch as he proposes to mix with the ground raw materials a sufficient quantity of graphite or metal powder to render the same a conductor. Owing to the high coloring powers of the metals, they



TERMINAL FOR ELECTRIC FURNACE.

can be used only for the production of special grades of glass; and if graphite be used, there must be added a corresponding amount of an energetic oxidizing agent. It would seem also that the high ash content of most graphites would enter as a disturbing factor.

TREATMENT OF ANTIMONY ORES.

Jarig Van der Ploeg, of The Hague, patents anew the method described in 1889 by Schreiber and Knutsen, for the separation of antimony from simple or complex ores. The leaching agent employed is a solution of calcium sulphide, to which a proportion of hydrate is added to reconvert any polysulphides formed into the lower sulphides, which are more soluble and better electrolytes.

Rubber Covered Wire for Service Connections.

One of the questions asked at the Cincinnati Electric Light Convention was whether the service-wire insulation recommended by the National Underwriters' Code is desirable. An answer submitted by "L. A. M." is that rubber covered wire is unfit for insulating purposes if exposed to the weather unless covered with weather-proofing.

New Telephone Patents.

Owing to lack of space, notice of several of the telephone patents issued June 3 did not appear last week, and is now given below:

Three inventors, Messrs. Wilton A. Williams, Oscar L. Ingram and John B. Wilson, all of Walla Walla, Washington, have collaborated to produce a party-line call of the step-by-step variety, which is not without its ingenious features, but is about as complicated and costly as the usual device of this class. The action is to make a contact-maker rise to a certain position by means of a series of impulses and then descend slowly, the descent being checked by a dash pot; at the right station the contact arm will meet in its descent a contact plate and so establish the bell circuit. The bell circuit will not be made at the other stations; at those corresponding to fewer impulses than the number sent the arm will not reach the contact plate, and at those corresponding to a greater number

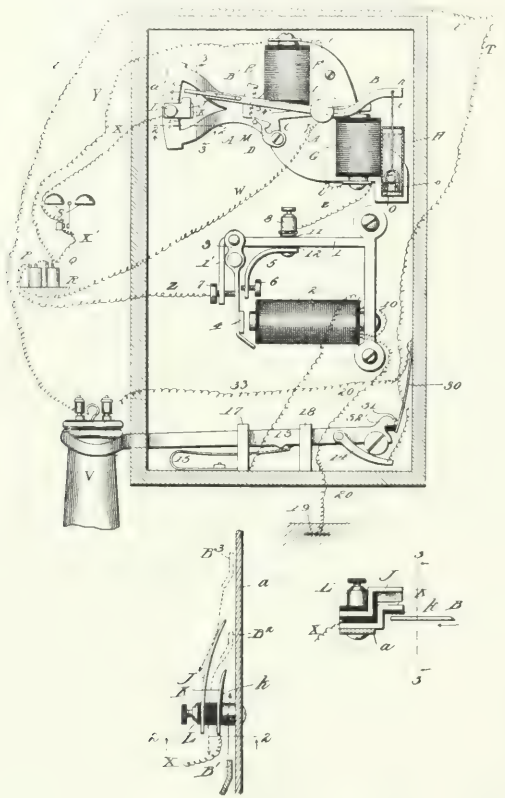


FIG. 1.—TELEPHONE CALL FOR PARTY LINES.

the arm fails to make contact, as in going up it passes underneath the plate, which is insulated on its lower surface, and in coming down it is fended off and prevented from making contact by a guard projection beyond the contact plate. In the drawings (Fig. 1) the complete apparatus is shown, and details of the contact plate and guard. The lever B is raised by the armature C, pawl D and ratchet E fixed to B; C is controlled by the magnets F and G, which are in a local circuit with battery R, governed by the relay 2 connected to line. The arm B carries contact spring B^1, and its descent is checked by the dash-pot H, so that after having been raised by the action of the magnets B^1 shall fall slowly over the arc a. At a different point on the arc a at each station is fixed the post L, carrying the contact-plate K, having insulated lower surface, K, and the insulated guard strip J. As shown in one drawing the arm B^1 in going up passes underneath K and is insulated from it by K; in coming down it will either pass over K, establishing the required contact, or will be fended off by J, according to the height to which it has been raised. If the series of impulses have carried B^1 to the position shown at B^3, and B^1 is then allowed to fall it will make contact with K; if the impulses have carried B^2 to the position shown at B^3 it will in falling be deflected by J, and, riding over J, fail to make contact with K. Therefore, by setting K and J at different points on the arc at each station it is clear that a given series of impulses will bring B^1 and K into contact at only one station, and will fail to bring them into contact at any other.

A patent on a telephone system, employing a single line wire not grounded at either end, granted to Charles G. Burke, of Brooklyn, is due to an interesting phenomenon observed by the inventor which is that by connecting a second induction coil in circuit on a telephone line with the secondary connected to line and the primary to a local circuit containing a battery and a telephone receiver wound to a low resistance the action of the telephone is very greatly improved and it gives a much louder and clearer effect. Mr. Burke further has discovered that with the use of such local circuits containing both the battery and receiver he is enabled to transmit speech practically over a single ungrounded line wire, including at each end the long fine-wire coils of the induction coils, the short coarse-wire coils of which are included in the local circuits. In the drawings, the upper portion of Fig. 2 shows the arrangement just described. Mr. Burke says it is important that the corresponding ends of the secondaries, S S', be connected to line. If two receivers be used at each end of the line, one connected with the line and the other with the local circuit, greatly improved results will be obtained. Such an arrangement is shown in the lower figure. In this arrangement there are added the coils F C, F' C', the secondaries of which are

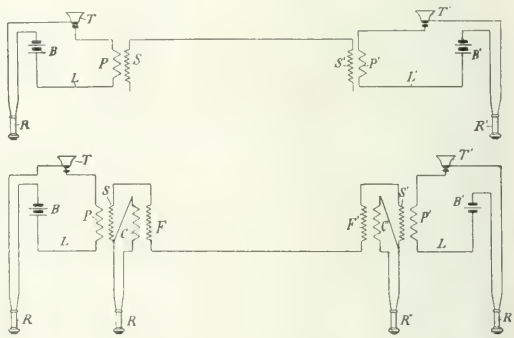


FIG. 2.—BURKE'S TELEPHONE SYSTEM.

connected to line and the primaries to receivers R' R'', the free ends of the secondaries S S' of the original coils being also connected to the corresponding ends of C C'. In this case also, says Mr. Burke, a certain order of connection must be observed; if the outside end of S is connected to line, the corresponding end of S' must also be connected to line, and F F' must be connected so as to bring their outer ends in connection with the outer ends of S S'. The inner ends of C C' must be connected to the inner ends of S S', respectively, to secure the best results. Mr. Burke says that he has found the above-described arrangements of circuits and apparatus to yield much better results than are obtainable with the same class of instrument when used in the ordinary way. It would be interesting to know over what length of actual line and under what conditions Mr. Burke has tried his novel circuit.

Telephony contributes but one patent to the issue of June 10, the inventor being Mr. James M. Overshiner, of Elwood, Indiana, and the invention a combined drop and jack with self-restoring mechanism, actuated by the movements of the plug. In the accompanying illustrations the upper figures show a front view and section of the drop and jack, and the remaining figures illustrate the conditions at various positions of the plug. The front plate, 2, is slotted at 7, the slot having a lower curved face, 9, and an upper curved face, 8; 9 serving as a cam-surface in guiding the movement of the restoring slide, 10. The slide 10 has a bent rear arm, 11, which depends through an elongated slot in the jack-tube, 1, and terminates in the path of the plug. The front of slide 10 is hook-shaped, having shoulder 12 to ride on cam-surface 9 and tip 13 to engage the drop-

shutter 3. The slide 10 is held normally outward by spring 14, and normally upward by a small lever, 15. This lever is pivoted to tube 1 by a pin, 16, passing through a slot, 17, in the lever, whose lower arm normally projects a sort distance into the tube.

When the drop falls, the shutter is caught by end 13 of slide 10, as shown in the upper of the plugged views. When the plug is inserted it will first raise the lever 15 and pass it, not causing it to be thrown forward because spring 14 blocks a forward movement of 15. The slot 17 permits 15 to be raised to the position shown in Fig. 2, the end of 15 riding on the plug. When the end of the plug has passed

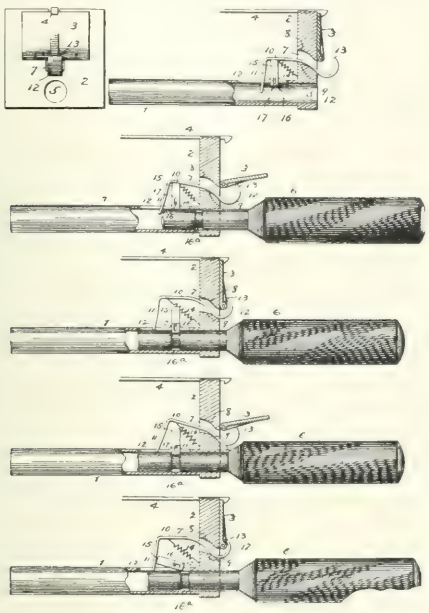


FIG. 3.—OVERSHINER'S COMBINED JACK AND DROP.

15 it will meet arm 11 of slide 10, pushing it upward and inward, and shoulder 12, riding on the cam-face, 9, the hook 13 will rise and close the drop-shutter. When this shall have been accomplished, the lower end of 15 will have entered groove 16a in the plug, and be thus retained in an upright position, as shown in the following figure. When the parts have reached the position shown in the figure below, spring 14 will act to withdraw the slide to its outward position. When the drop again falls, the signal is for clearing out, and the withdrawal of the plug again restores the drop by the action of lever 15, which by groove 16a is swung on its fulcrum as the plug is retired and causes the slide 10 to be again forced back. When the plug is entirely withdrawn the spring 14 returns 10 and 15 to their normal positions.

CURRENT NEWS AND NOTES.

ELECTROCUTION IN INDIANA.—A bill to substitute electrocution for hanging as capital punishment in Indiana will be introduced in the next Legislature.

THE COMMERCIAL PACIFIC CABLE.—Advices from London are to the effect that a thousand-mile section of the Commercial Pacific Cable Company's cable, to be laid between San Francisco and Honolulu, has been completed.

MARCONI'S NEW WORK.—A cable dispatch from London, of June 13, says: In the course of a lecture to-night before the Royal Institution of Great Britain, William Marconi announced that he had invented a highly sensitive magnetic detector of electric waves, by which it was possible to read about 30 words per minute in wireless telegraphy.

WIRELESS TELEGRAPH SYSTEM FOR HAVANA.—The steamship "Morro Castle," of the Ward Line, which sailed from New York last Saturday, carried the De Forest-Smythe wireless telegraph system, which is to be installed in Havana. For several hours after sailing, the "Morro Castle" remained in communication with the De Forest-Smythe stations, at Staten Island and Coney Island. Details of his work, by Mr. De Forest, have already been given in our pages.

AUTOMOBILISTS SET FREE.—No indictment was found by the Richmond County grand jury, last week, against W. C. Baker and D. E. Denzer, who were under bonds to answer a charge of homicide in having caused the death of Andrew Featherstone and John G. Bogart by the running wild of their electric automobile at the automobile speed trial held on Staten Island, on May 31. The grand jury handed down a recommendation setting forth that it is advisable that no further public automobile races or steam tests of automobiles or other automobile vehicles be held on any public highway in the County of Richmond.

THE PARIS UNDERGROUND.—A cable dispatch from Paris, of June 14, says: Another long section of the Metropolitan Underground Railway, from the Chaussée de Clignancourt to the Boulevard Magenta, has just been completed. The cost of construction of each kilometre thus far has been 4,500,000 francs ($900,000), or $1,440,000 per mile. Each kilometre also cost the life of one workman. It will be seven years yet before the whole system is completed. Visiting New Yorkers are astonished to see how little disturbance is being made by the contractors. The entire work is carried on underground, with only an occasional small shaft opened from the surface.

U. S.-GERMAN CABLE BUSINESS.—The annual report of the German Atlantic Cable Company, which has just been made public, and which covers the first full year of the company's operations, shows that the number of words transmitted by the company between the United States and Germany and *vice versa*, in 1901, was greater than the number of messages it was estimated would be sent between the two countries by all lines in 1898. The year of 1901 was the record year in transatlantic cable business. The new cable between Germany and the United States, which has been contracted for by the German Atlantic Cable Company, is to cost 21,000,000 marks ($5,250,000), and will be manufactured in Germany. The company's recent experiments in cabling direct from Emden to New York, without rehandling in the Azores, have been quite successful.

BROOKLYN SUBWAY.—It was intimated last week that the Belmont-McDonald syndicate, who are contractors for the Manhattan Subway, might offer to construct the Brooklyn tunnel at their own expense. The Rapid-Transit Board, at its meeting, decided that the work must be begun within 60 days of the letting of the contract, and that it should be finished within three years, but that the board under exceptional circumstances might extend the time for another year. It was agreed that a premium of 1 per cent. should be given for every month the contractor gains in pushing the work, and a fine of 1 per cent. levied for every month of delay. The period of the franchise was reduced from 50 to 35 years, with the privilege of renewal for a further 25 years, upon readjusted compensation. The clause against disfiguring advertisements remains.

ARTIFICIAL GRAPHITE.—The United States Geological Survey reports that the manufacture of artificial graphite has increased greatly, the production during 1901 amounting to 2,500,000 pounds, valued at $119,000, as compared with 860,750 pounds, valued at $69,860, in 1900, and with 162,382 pounds, valued at $10,149, in 1897, the first year of commercial production. The sole producer is the International Acheson Graphite Company, at Niagara Falls, N. Y. More than one-half of the output for 1901 was in the form of graphitized electrodes for use in the manufacture of alkali and bleach by electrolytic processes, the remainder being consumed in the manufacture of paints, lubricants, pencils, motor brushes, crucibles and dry batteries. The total consumption of graphite of all forms in this country is nearly 150,000 tons, almost 90 per cent. of which quantity is imported.

TIME SIGNALS WITH ELECTRIC LIGHTS.—The Harvard Observatory recently put into use a system of giving time signals with electric lights, which is intended to serve the same purpose as the daily noon ball, but with greater efficiency. This is the first signal of the kind established. They ought to be called Revere signals.

INVESTIGATING WIRELESS TELEGRAPHY.—A cable dispatch from Berlin, of June 9, says: Commander Francis M. Barber, U. S. N., (retired), ex-Naval Attache to the United States Embassy here, and Lieut. John M. Hudgins, U. S. N., who was ordered to Europe to receive instruction in the operation of foreign wireless telegraphic instruments arrived here to-day and began experiments with the Slaby-Arco system of wireless telegraphy. Experiments with the Braun system will be made later. Lieut. Hudgins will remain here for one month.

WESTERN UNION CHANGES.—The recent promotion of R. C. Clowry, general superintendent of the Western Division of the Western Union Telegraph Company, with headquarters at Chicago, to the presidency of the company, says the San Francisco *Chronicle,* is responsible for a number of changes among officials of the company throughout the country, not the least important of which is the promotion of Frank Jaynes to the position of general superintendent of the Pacific Coast Division. The Western Union has planned to have four grand divisions instead of three, as heretofore. The Western Division, which now embraces all of the company's lines west of Pittsburg, is to be divided into two jurisdictions, Mr. Clowry's successor, with headquarters in Chicago, taking charge of the Eastern end of the division, which will be known as the Western Division, and Jaynes taking charge of the Pacific Coast Division, with the title of general superintendent of the coast division. His headquarters will continue to be located in San Francisco.

CHESS BY WIRELESS TELEGRAPH.—The Cunard Line steamship "Campania," which arrived Saturday last from Liverpool, enjoyed a unique experience on the passage. On Tuesday, June 10, the wireless telegraph operator, Mr. Gannon, got in communication with the American Line steamship "Philadelphia," bound to New York from Southampton. When first heard, the "Philadelphia" was about 70 miles ahead of the "Campania." After passing the usual courtesies, the "Campania" suggested a game of chess, which was agreed to by the "Philadelphia." Notice was posted in the music room of the "Campania," and a passenger was found to play. The "Philadelphia" announcing readiness the game commenced at 2 o'clock in the afternoon, and lasted till 6:45 in the evening. At this time the "Campania" came in touch with her sister ship, the "Lucania," bound from New York for Liverpool, and being obliged to attend to business communications, the chess game was suspended, and was not resumed. At the time of the suspension of the game, the "Campania" had the best of it.

ILLUSTRATING APPARATUS.—A patent was granted June 3 to Frederick S. Newman, of Springfield, Mass., on an apparatus for use in halls, theaters, etc., whereby the incidents of a baseball or other game may be recorded in the order of occurrence. The apparatus shown in the engravings is adapted specially for reporting the details of baseball games. On a curtain is a diagramatic view of a baseball field with the positions of the various players. There are also various blank tables in which to record the various events of the game. In connection with the screen is a keyboard which may be located at any point convenient for receiving telegraphic messages. By manipulating the keyboard a reflector lamp is lighted to represent the event which it is desired to record. Transient events are also recorded, such, for example, as the course of a ball from start to finish, a lamp lighting when a ball is struck and going out as soon as the ball is thrown. In this manner a fly ball, for example, striking the right field is indicated; foul balls are visually denoted, etc. If a player on the side that is in the field puts out a player trying to make any of the bases, or to score, the operator will cause the lamp at the station of the player who did it, to be lighted, and also the lamp, at the base where the player was put out, in order to show the audience who put the player out and where it was done. The instrument appears to provide for recording visually every event of a [illegible]

LETTER TO THE EDITORS.

The Effect of Electric Waves on the Human Brain.

To the Editors of Electrical World and Engineer:

Sirs.—I have read the article in your issue of May 31, in which Messrs. D. McIntosh and J. Graham-Willmore criticize the methods described in my article in your issue of Feb. 22, which were employed in some experiments showing that brain matter is sensitive to impinging electric waves, and in turn, I beg to offer some criticisms on the methods employed by these gentlemen.

Referring to their use of a spark-gap ranging from 2 to 5 cm., it is common knowledge that the spark-gap of any oscillator system, though fed by a secondary current having a difference of potential of 100,000 volts, should be cut down to at least 0.5 cm. Not that this wide divergence from practice would cause the oscillator to fail in its emission of electric waves, but with a spark-gap 5 cm. in length a coil having a maximum spark length of 40 cm. would be required to effect the proper balance. Likewise the resonators, we are informed, were brass rods 7 feet long. With this gigantic transmitter, capable of propagating electric waves 500 miles—if properly adjusted—Messrs. McIntosh and Willmore tested the coherer at 4, 10 and 25 feet from the coil. At this distance a coil giving a maximum spark of 2 cm. will act upon a properly constructed coherer *without any disrupted discharge* through the field of force set up by the surging of the low-frequency, high-potential currents alone.

With Messrs. McIntosh and Willmore's apparatus, the room must have been filled with the invisible electric waves, and its effect on matter subject to cohesion similar to that produced on the organ of superior discriminating power by a 50,000-cp arc lamp suspended in the center of a 12 x 14 room, with walls formed of French-plate mirrors. Under these conditions the tests were made.

Messrs. McIntosh and Willmore mention the coherer they used as a standard, but refrain from describing it. If it was proportionately as large as the rest of their apparatus, it would be an interesting addition to the literature on coherers to have an unabridged description of it.

These gentlemen also state that they placed an accumulator in series with the coherer and millivoltmeter. An accumulator is most excellent for operating an automobile, but for delicate tests of electric waves, a single dry cell is more than sufficient. Considering the enormous plant used by Messrs. McIntosh and Willmore, if any deflection of the needle had been observed under these circumstances, I should have attributed it to electrostatic stresses in the intervening dielectric and not to electric waves, for unless every precaution is taken, especially with very large coils, it is almost impossible to eliminate such untoward disturbances. In delicate experiments with electric waves there is another factor, which, overlooked as it was by Messrs. McIntosh and Willmore, precludes the probability of any testing instrument working properly, if at all; this is the rapidly-alternating magnetic field created. For these reasons I prefer a 2-cm. spark coil, as it is then easy to screen such effects from the receiver.

Leaving the physical for the psychological side of the case for a moment, a curious phase of Messrs. McIntosh and Willmore's position is their willingness to accept hypnotic suggestion as the cause of death of a weakened, nervous, disease-stricken patient, who, as they declare on the authority of a pre-anæsthetic surgeon, "died when the finger-nail was drawn over the perineum marking the line of incision." Had Messrs. McIntosh and Willmore said the patient died *after* the surgeon had performed a successful operation, the facts in the case would have been much more clear. It is remarkable that men trained in experimental physics should be so ready to accept hypnotic suggestion—which is itself synonymous with action at a distance without physical contact—as an easy explanation for every obscure psychological and physiological phenomenon. Apropos, it would be interesting if Messrs. McIntosh and Willmore would make known their explanation as to why "birds are affected by the approach of a storm." In this they admit that there is a connection between the storm and the birds. If this connection is not electrostatic or due to electromagnetic influence, what is it? If the gentlemen belong to the Boscovitch eighteenth century school of action-at-a-distance through absolute vacuum, I wish to be counted out of the argument.

In another part of their article they would have the reader accept

as a fact that which remains yet unproven, namely, that the brain conducts by electrolytic action. The idea that brain matter is analogous with alkaline solutions may be quickly dissipated by heating a solution of chloride of sodium until the water is expelled, when salt will remain; then heat a small cross-section of the "moist brain material" in the same manner and it will carbonize. Dry salt is a non-conductor of electricity, carbon a conductor. When the electric waves act on the brain cells it carbonizes particles of it between the conductor plugs, however small the carbonization may be. The description of the terminal conductor plugs employed in Messrs. McIntosh and Willmore's tests is so meagre that comment is not possible, yet these are vitally important factors in making successful tests.

Messrs. McIntosh and Willmore are presumptuous in supposing I would object to the brain of a bird for impromptu test purposes; I rather admire it, especially since Lodge has mentioned that the *trilobita* had a cavity sensitive to electric waves; but what I do strenuously object to is having my experiments tried with apparatus different from that with which I succeeded; however defective my method seemed to others, it was effectual. It also seems to me that since the experiments I made were qualitative and not quantitative; and that inasmuch as the telephone receiver is a hundred times more sensitive than a Weston millivoltmeter, it is not such a crude instrument, or the method I employed so defective as my Canadian critics believe. And while condemning the telephone method as defective, in an unobtrusive little footnote they tell how easy it is to measure the resistance of the brain by means of an alternating current and a telephone. They evidently are not aware that Mr. Marconi used a telephone receiver in his great transatlantic cableless experiment to detect the cohesion of the metal filings produced by the impinging electric waves, and I have no doubt that Mr. Marconi would have employed a millivoltmeter if that instrument stood in the same class with the telephone receiver for sensitiveness.

If Messrs. McIntosh and Willmore were to try to repeat Mr. Marconi's long-distance cableless test using their millivoltmeter, would they expect to obtain results? The moral of this controversy is, that if you don't succeed with apparatus of your own devising, try again and follow the specifications of those who did succeed.

[illegible] A. [illegible] Collins

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Commutators of Direct-Current Dynamos.—ROTHERT.—An article, illustrated by diagrams, on the question of how many commutator segments a direct-current dynamo should have. He starts from Parshall and Hobart's method for calculating the coefficient of self-induction of a short-circuited armature coil and develops formulas for determining the number of commutator segments. Other conditions being equal, the number of segments for the same type of machine should be proportional to the voltage at the terminals. A small breadth of the iron is favorable, *i. e.*, it is to be recommended to build narrow armatures with large diameters. A strong field is also favorable.—*Elek. Zeit.*, April 10.—A correction in one of his discussed at some length in a communication by Dick, who compares formulas is given by him in *Elek. Zeit.*, May 8.—The article is also Rothert's formulas with those of others, and points out that in order to determine the required number of commutator segments, under the assumption of a certain reactance voltage, the influence of the field cannot be neglected—*Elek. Zeit.*, May 1.

REFERENCES.

Stray Flux of Dynamos.—CORSEPIUS.—An abstract of a paper read before the Dresden Elec. Society. In direct-current as well as in alternating-current dynamos the stray fluxes of lines of induction depend upon the armature current. If it is no direct current, the stray flux changes during each alternation; not only does the amount in per cent. change, but also the total amount of the unutilized magnetism. This is explained by analogies and by direct demonstration.—*Elek. Zeit.*, May 1.

Shunt Regulators.—KRAUSE.—An article, illustrated by diagrams, in which he describes a method for determining the steps of the regulating resistance of shunt generators with self-excitation.—*Elek. Zeit.*, May 1.

Formers.—DAVIES.—A third article on formers and former-windings. This part deals with formers for ring armature cores.—Lond. *Elek. Eng.*, May 23.

Polyphase Induction Motor.—A brief critical remark, by Lindstroem, of Ziehl's recent description of an induction motor; and a reply by Ziehl.—*Elek. Zeit.*, April 10.

LIGHTS AND LIGHTING.

Lighting of the St. Paul's Cathedral.—An illustrated description of the electric lighting installation of St. Paul's Cathedral, in London. The wires have been run in iron barrel, and the lateral distribution is mostly hidden beneath the floor of the crypt, where inspection boxes are placed at frequent angles and intervals. The vertical cables have, when possible, been carried in the hollow centers of the main piers. The distributing board system of wiring has been used on the two-wire system, and current is taken from the mains of two different companies, duplicate circuits having been laid throughout the building, so that alternate groups of lamps are fed by the two companies. The pressure adopted is 200 volts, and very large cables have been used to compensate for the long runs, the current density allowed for being 250 amperes per square inch. The iron barrel is not insulated in any way, the rubber covering of the wires and an additional layer of tape being relied upon. All the fittings in the chancel, dome and nave are provided with an especial form of molded glass globe, which is said to be the result of many experiments and which has been found to act as an excellent dispersant of light. Some original tests with plain lamps and the globes showed that the use of the latter enabled a reduction of about 200 cp in the nave to be made for the same illumination. The lamps range from 32 cp to 5 cp.—Lond. *Elec.*, May 30.

POWER.

Electricity on a Shipyard.—O'HARA.—A very long and profusely illustrated description of the electric installation in the plant of the New York Shipbuilding Company, in Camden. Direct current is used for the enclosed arc lamps and the crane motors, while alternating current is used for driving the machine tools; the powerhouse contains two 500-kw double-current generators. A very elaborate system of cranes is in use. For the machine tools induction motors are used throughout. Shafting was almost completely eliminated throughout the works.—*Cassier's Mag.*, June.

TRACTION.

Train Resistance.—DAVIS.—An article in which he replies to the criticisms of Lundie, Bell, Dodd and Wille upon the author's original paper, recently noticed in the Digest, in which he presented his formulæ, based on the results of the Buffalo and Lockport test. The author calls attention to the fact that these experiments were made under conditions similar to those of former experiments with steam locomotives, the only difference being that in the Buffalo and Lockport tests an electric locomotive was used. He compares some of the best known formulas and calls attention to the fact that with the exception of the Wellington test, the number of cars forming a train, or the cross-sectional area of the car, were not taken into consideration. Attention is also called to the fact that in the Buffalo and Lockport tests none of the coaches were of the vestibuled type, and the outline of the electric locomotive was such that it and the car following presented practically a flat surface to the wind. The other type of interurban electric car is vestibuled at both ends, and consequently presents a partially rounded or wedge-shaped end to the direction of motion. This, of course, will modify somewhat the

data obtained from the tests with cars presenting flat surfaces to the wind.—*St. R'y Jour., Int. Ed.,* June.

Special Tests vs. Commercial Practice.—JAMES.—A communication reviewing the discussion about Mr. Davis' formulas, and suggests that it might be well to apply the results that have been obtained in commercial practice. The writer contends that enough high speed runs have been made by electric cars in the neighborhood of 60 miles an hour to prevent any alarm being felt on account of the danger of reaching a prohibitive figure, due to the train resistance. The writer calls attention to the tests on the Lake Electric Railway, which are published in this issue, as supporting his position. He favors the explanation that there is possibly some error in the conclusion which would probably be developed by a careful checking of the readings of the ammeter and voltmeter just before current was cut off, where the coasting method is employed.—*St. R'y Jour., Int. Ed.,* June.

Tests for Air Resistance on the Berlin-Zossen Experimental High-Speed Line.—An article briefly describing the principal features of the conditions under which the high-speed tests were made, and gives the plotted results of the wind resistance tests. Two cars were used, one furnished by the Gen. Elec. Co., of Berlin, and the other by Siemens & Halske. The fact is brought out in one curve that the wind resistance varied as the square of the velocity. Figures on the total train resistance are not yet available, but are promised in an early issue. The experiments have been stopped for a while, as the track proved to be too weak for the service. As soon as it is strengthened, runs at higher speeds will be made.—*St. R'y Jour., Int. Ed.,* June.

Berlin-Zossen Tests.—A review of a consular report containing an abstract of Lochner's paper on this high-speed line, the text of which, however, has been withheld from publication. Comment is particularly made upon the lightness of the track construction. For high speeds it is pointed out that the rails should weigh 90 lbs. to 100 lbs. per yard, and should be specially designed to meet the exacting conditions of this class of work. Moreover, a solid roadbed under the rails is absolutely necessary to secure the best results. The writer expresses the views of most American engineers when he says that much more favorable opportunities would be offered for developing high speeds by making similar tests on the New York Central and Pennsylvania roads. Much doubt is expressed, however, on the probability of American engineers securing any place in the development of this class of work.—*St. R'y Jour.,* May 17; *Int. Ed.,* June.

High-Speed Electric Trains Between Cleveland and Toledo.—A description of the tests that have been made by the Lake Electric Railway Company with a view to determining the possibilities of fast through cars from Cleveland to Toledo, a distance of 118 miles. The company is putting the road in shape to operate limited cars between these cities in four hours, which would mean a sustained speed of 29½ miles per hour, allowing for all stops, and the 44-minute schedule for 7 miles in Cleveland, and 26 minutes for 2¾ miles in Toledo. The car used in the tests mentioned is built very much like a steam railroad coach. Some tables are given, showing the actual time between the stations on the road in regular passenger service and on a special run. In the latter case, the loaded car weighed 36 tons, but the conditions were such that it is difficult to anticipate just what results will be obtained when the road is thoroughly equipped for this service.—*St. R'y Jour.,* May 17.

Electric Freight Locomotive.—An illustrated description of a new electric locomotive, built for heavy freight service on the Hudson Valley Railway between Albany and Warrensburg, N. Y. This locomotive is intended for hauling regular steam road freight cars between the points mentioned, the line passing through a country that is filled with mills and factories. The dimensions of the locomotive, mounted on trucks, are as follows: Height from rail to top of body, 12 ft. 11½ ins.; extreme height over trolley span, 13 ft. 6 ins.; length over end sills, 25 ft.; length over buffers, 27 ft.; extreme width, 8ft. 3ins. The heaviest possible construction has been adopted. There are four 100-hp motors; air brakes and automatic couplers are provided. A track sanding device, operated by compressed air, has also been adopted. Including the trucks, the weight of the locomotive is about 30,000 lbs., and with the motors and air brake equipment it will be increased to 50,000 lbs.—*St. R'y Jour.,* May 10.

Regulating the Voltage for Car Lighting.—SCHUH.—An illustrated description of a simple method for keeping the voltage of the lighting current in electric railway cars constant within given limits; it is in satisfactory operation on a road in Switzerland. As relay, a revolving system of the Deprez-d'Arsonval type is used. An armature is provided with three different contact arms. When the current increases, the armature is turned and the three contact arms close circuits which contain electromagnets; the latter attract armatures which again close circuits containing the resistances, by means of which the voltage is kept constant.—*Elek. Zeit.,* April 3.

Restrictions on the Controller Handle.—CRAVATH.—An article in which he reviews the many plans that have been proposed for restricting or automatically regulating the rate at which current is turned on in starting an electric car or train. The injurious effects of the rapid turning on of current have been evident even from the earliest days, and particularly on a light equipment. Even with the heavier motors and better construction of to-day, the sudden inrush of heavy current often repeated will seriously impair the motors and finally result in break-downs. The writer points out that there is a great waste of energy at the present time in the ordinary operation of cars. The practice which results in these serious losses is also objectionable, because of the inconvenience to which the passengers are subjected in the jerking motion of the car in starting and stopping. What is needed in city service is smooth and rapid acceleration from the first to the last point of the controller. Experience seems to have demonstrated that it is impossible to secure this service without the use of an automatic device.—*St. R'y Jour.,* May 24, and *Int. Ed.,* June.

Broken Trolley Wires.—An article in which superintendents are urged to give special attention to the points on the line that are subject to the greatest wear. A little care originally in the construction of these lines will go far toward minimizing chances for accidents. It is now recognized that No. 4 wire is not large enough to last for any length of time, and that a rigid suspension for the hanger is inferior to one that is more flexible; also that long ears which taper off until they become thin and similar construction in overhead switches and frogs, are better on straight tracks than short ears or frogs with ends of no flexibility. It is suggested that attention be given to the question of sag and overhead alignment, as these two features comprise the entire problem of the mechanical erection of the trolley wire. The writer believes that if the overhead line is kept taut by being pulled up and let out at expansion ears about four times a year, to allow for expansion and contraction, the pressure of a pole with a light trolley wheel could be reduced greatly, which would, of course, lessen the wear on the overhead line. The writer also expresses doubt as to whether the circular section for the wire is in all respects preferable, as European experience indicates that ribbon-shaped wire, with rounded edges, is very serviceable.—*St. R'y Jour.,* May 17, and *Int. Ed.,* June.

Street Railway Management in Texas.—STUART.—An abstract of a recent paper read before the Southwestern Gas, Electric and Railway Association, at San Antonio. He emphasizes the necessity for establishing a schedule and observing it very closely. The paper is intended for the information and guidance of managers of the smaller class of properties, and has particular reference to the development of new business. For companies, however, that have a large clientele, the policy of establishing and encouraging places of public amusement along the route is advocated. Some hints to managers upon the treatment of men employed in various capacities are given.—*St. R'y Jour.,* May 10.

REFERENCES.

Mountain Railway.—BIGNAMI.—An illustrated description of the Vevey-Mont Pelerin road, which is a cable operated mountain railway in Switzerland, the cable being driven by an electric motor. There are two 30-hp gas engines, driving direct-current dynamos. There is also a battery intended to aid the generating station at the moments of heavy load when it discharges in parallel with the generators; at times of small load it is charged; by this arrangement the generators work constantly at full load.—*Eng. Mag.,* June.

Great Variations in Trolley Wheel Wear.—An editorial note suggesting a comparison of trolley wheel wear on high-speed interurban roads operating heavy cars, as inquiry among managers of such properties shows a much greater variation of the life in miles than can reasonably be accounted for. The average life of trolley wheels on the heaviest and highest speed cars varies on different roads from 500 to 5,000 miles, which, of course, is altogether too wide a margin.—*St. R'y Jour.,* May 24.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Electric Lighting in Spain.—A note stating that electric lighting makes rapid progress in Spain. There are 588 central stations, of which 35 are in the county of Madrid and 14 in the city of Madrid. The progress is due to the high price of coal and to the abundance of water power. The 96 meter high falls of the Manzanares are being utilized, and the work has progressed so far that for Madrid 500 hp are already available.—*Elek. Zeit.,* April 10.

Feeder Regulators.—GESING.—An article on the practical and rapid calculation of feeder regulators for lighting circuits, *i. e.,* of the adjustable resistance which when inserted in a line, enable one to adjust the voltage at the consumer's terminals within a small permissible limit of variation of voltage. He has calculated a set of numerical tables, which are reprinted, by means of which the calculation of these resistances is rendered easy.—*Elek. Zeit.,* April 3.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Economical Cross-Section of Conductors.—CAHEN.—A communication in which he discusses at length Teichmueller's article on the calculation of the economical cross-section of conductors (Digest, May 3). He agrees that the matter is of great importance, but doubts whether Teichmueller's method of calculation could be used to advantage in practice.—*Elek. Zeit.,* April 3.—A long reply by Teichmueller to this criticism in *Elek. Zeit.,* May 22.

ELECTRO-PHYSICS AND MAGNETISM

Cathode Rays.—STARK.—An account of an experimental investigation of the reflection of the cathode rays. When a pencil of cathode rays impinges upon a surface, some of the electrons penetrate into the surface and are absorbed; others may be transmitted; the rest are reflected. Those reflected may either have been turned back at the first encounter with the surface, or the particles may have penetrated some distance into the surface, having been deflected by central forces, and threaded their way out again. He has studied the manner in which both these reflections depend upon the angle of incidence. The relation varies from metal to metal, "as might have been expected, since some metals, like aluminum, absorb the electrons more easily on account of their large atomic volume."—*Phys. Zeit.,* May 15; abstracted in Lond. *Elec.,* May 30.

Conductivity of Insulating Liquids.—DI CIOMMO.—A study of the effect which mixing two liquids of high resistivity has upon their electric conductivity. Benzol, toluol, hexane, ettane, carbon bisulphide and chloroform were experimented with. The resulting conductivity cannot be directly calculated from the conductivities of the constituents and the proportion in which they are mixed. "The results show that ionizations cannot be simply added as they can in extremely dilute solutions of electrolytes, and that the mixture of two dielectric liquids interferes with the normal behavior of the ions of each separate liquid."—*Phys. Zeit.,* May 15; abstracted in Lond. *Elec.,* May 30.

REFERENCE.

Electromagnets.—VARLEY.—An illustrated article on machines for winding electromagnet coils.—*Elec. Age,* June.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Production of Copper.—EGLI.—A paper in which he first discusses the processes at a cuprous sulphide anode. In a sulphuric acid solution, copper dissolves as copper ions, while the sulphur precipitated gives rise to passage resistances. In a hydrochloric acid solution, copper will partly dissolve as copper ion, though there may be an excess of chlorine separated. The dependence of the ratio of cuprous and cupric ions on the density of current and acid, has not yet been determined, but he finds that under certain definite conditions cuprous chloride is formed. Sulphur will be oxidized to sulphuric acid by nascent chlorine. When cuprous sulphide is used as an anode in an alkaline solution, Bernfeld has found that the metal is converted into its hydroxide, the sulphur passing through all degrees of oxidation to sulphuric acid. When cuprous sulphide is used as cathode in an acid solution, Bernfeld has found that sulphuretted hydrogen will be produced at the cathode, the metal remaining at the electrode (in a manner analagous to Salom's electrolytic lead reduction), while in an alkaline solution sulphur dissolves as ion, the metal forming a muddy mass. The author confirmed these results. He then investigates the precipitation of copper from cupric chloride solutions. As rapid circulation of the electrolyte greatly diminishes the amount obtained, it should be only just sufficient to maintain uniformity in the electrolyte. The presence of hydrochloric acid, while assuring a greater purity of copper, will considerably diminish the efficiency of the process. The addition of *Na Cl* is favorable to purity, as it tends to prevent the formation of cuprous chloride, with only a slightly decreased efficiency. A large percentage of cupric chloride is unfavorable either to efficiency or purity, as it increases the formation of cuprous chloride; but the percentage should not be less than about 0.05 (gram?) molecule per liter, as the metal would then separate in a spongy state. Raising the temperature enables the current density to be increased, giving higher efficiency, the solubility of copper in the electrolyte not being sensibly affected thereby, as long as Faraday's law is satisfied. From an electrolyte containing 0.1 (gram?) molecule cupric chloride, 0.1 molecule hydrochloric acid and 0.4 molecule sodium chloride, a precipitate containing 99.90 to 99.98 per cent. of copper has been obtained. —*Zeit. Anorg. Chemie,* v. 30, No. 1. p. 18; abstracted in *Science Abstracts,* May.

Precipitation of Colloids by Electrolysis.—WHITNEY AND OBER.—Starting from the work of Linder and Picton on the precipitation of colloidal solutions of arsenious sulphide by solutions of barium chloride, they find that the precipitated sulphide of arsenic contains a definite percentage of barium in the case of dilute solutions of precipitant and sulphide solution; this percentage is independent of the amount of barium chloride used as precipitant or its concentration. When solutions of calcium chloride, strontium chloride or potassium chloride are used in place of the barium chloride, similar results are obtained. Moreover, the amounts of calcium, strontium or potassium in the precipitated sulphide are chemically equivalent. —*Zeit. Phys. Chem.,* Jan. 31; abstracted in *Science Abstracts,* May.

REFERENCES.

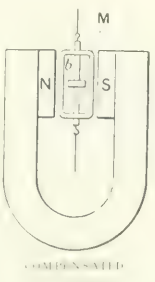
Electrolytic Process of Making Copper Tubes.—An illustrated description of the plant of the English Electrometallurgical Company, in which the well-known Elmore process for making copper tubes is in use.—Lond. *Eng'ing,* May 16.

Storage Battery Boxes.—A description of the methods of manufacture of vulcanite boxes for storage batteries.—*Centralbl. f. Accum.,* March 15; Lond. *Elec.,* May 23.

The Ions of Electrolysis.—BROWN.—A lecture given before the Brit. Royal Institution. He sketches the work of Hittorf and Kohlrausch and the development of the electrolytic dissociation theory.—*Science,* June 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Compensation for the Weakening of Permanent Magnets.—An illustrated description of a new type of instrument, devised by Weiss, and made by a French firm, with a view to eliminating the error due to the weakening, in time, of the permanent magnet in measuring instruments of the Deprez-d'Arsonval type. The instrument, as diagrammatically shown in the adjoining figure, consists essentially of a moving coil, *b,* deflected by the field of a permanent magnet, *N S.* The elastic force of the suspension wires is made as low as possible. The controlling force is mainly obtained by means of a small piece of soft iron suspended in the axis of the moving coil. The greater part of the controlling force results from the field of the magnet *N S,* acting on the induced magnetism of the iron *M.* A weakening of the magnet *N S* will thus decrease the controlling force at the same time as the deflection force. The weakening of the magnet will, therefore, have no effect if a proper relation exists between the dimensions and magnetic density of the magnet *N S,* the iron piece M, and the elasticity of the suspension wires. The time variation in these latter will have no influence either, since their action has now been made practically negligible. It is stated that as much as 20 per cent. variation in magnet strength does not result in any change in the calibration curve. An aluminum spool carries the coil, and this dampens the oscillation of the coil. Moreover ,the light weight, when pivoted on jewels, allows the apparatus to be placed in any position without any sticking or perceptible friction. Thermic variations are avoided by the use of manganine wire.—Lond. *Elec.,* May 30.



COMPENSATED INSTRUMENT.

Measurement of Power in Alternating Current Circuits.—GOERNER.—An article, illustrated by diagrams, in which he first discusses the various difficulties in measuring the power in alternating-current circuits. The power is always the product of effective current, effective e. m. f., and power factor; but the value of the power factor depends upon the wave form; only for pure sine waves is the power factor equal to the cosine of the phase difference between the e. m. f. and current waves. In practice the wave form of the e. m. f. is often different from that of the current, and neither is a sine wave. He points out the consequences of these facts in various methods of measuring. For instance, the method of the three voltmeters will give wrong results in most cases. While the hot wire voltmeters and ammeters are entirely independent of the wave form, the hot wire wattmeters are not independent, and, in general, any method will give wrong results, in which the geometric sum of currents or e. m. fs enters into the calculation of the power. He says that the only safe method of measuring power is one in which the mean value of the products of the instantaneous values of current and e. m. f. is measured directly, and for this purpose there exists at present only one exact instrument, namely, the dynamometric wattmeter; all other instruments which are based upon the principle of induction have certain disadvantages, such as dependency upon frequency or upon wave form, etc. He then discusses in detail all requirements which must be fulfilled in order to make a dynamometric wattmeter give exact results. For instance, it is necessary to avoid all superfluous metallic parts and to make the main current coil of laminated copper so that the formation of eddy currents is avoided; furthermore, the self-induction of the shunt coil must be very small compared with the ohmic resistance. He describes a wattmeter of Hartmann & Braun, in which these requirements are said to be very exactly fulfilled. The article is concluded by some remarks on the measurements of power in three-phase circuits. He suggests giving up the term phase e. m. f. (phasenspannung) which is often used in Germany, and to use instead the clear terms delta e. m. f. or star e. m. f.—*Elek. Zeit.*, April 17, 24.

Dettmar.—A communication referring to the last point of Goerner, concerning the terminology for three-phase e. m. fs. A committee of the German Society of Elec. Eng. proposes to eliminate the term phase e. m. f. and to define star e. m. f. as the voltage between the neutral point and one of the three main circuits.—*Elek. Zeit.*, May 1.

Polarization Capacity and Dissipation of Energy of Voltameters Carrying Alternating Currents.—FRANCHETTI.—An account of measurements, made by the three ammeter method for voltameters with electrodes of lead or iron with sodium carbonate solution as electrolyte; and also for voltameters with electrodes of nickel in a solution of sodium carbonate; or nickel sulphate or potassium or sodium hydroxide. The voltameter with lead electrodes in saturated sodium carbonate solution exhibits at temperatures of 10° to 15° C., a minimum of capacity for a certain value of the effective potential difference applied to the poles, this varying, according to the formation of the voltameter, from 0.89 to 1.07 volts. The capacity per sq. cm. of electrode varies from 530 to 290 microfarads, and the angle of lead of the current before the voltage from 48 to 58 degrees, whilst the increase of resistance (*i. e.*, the energy dissipated divided by the square of the current) over the resistance of the electrolyte, has finally a value three times that of the latter. With iron electrodes, however, the resistance of the voltameter is but slightly greater than that of the electrolyte, and is almost independent of the current. Voltameters with nickel electrodes and electrodes of alkaline carbonate or hydroxides show similar behavior. For nickel electrodes in potassium hydroxide the impedance increases only to a very slight extent with the frequency, and the mean capacity during a period is inversely proportional to the frequency. The increase of resistance of a voltameter over that of the electrolyte has been attributed by Wien to spontaneous depolarization, but, in the light of the present results, the author considers the greater dissipation of energy as due partly to an increase of resistance and partly to polarization loss.—*N. Ciemento*, 1901, Nov., Dec.; abstracted in *Science Abstracts*, May.

Earth Currents.—GUARINI.—An illustrated article on earth currents and the electro-tellurograph. An account is given of experiments made by Perez del Pulgar in a Spanish observatory. The earth plates of two lightning conductors were connected to a galvanometer, in series with a very great resistance. He found that the oscillations of the galvanometer are more frequent and more intense when thick clouds pass along at a considerable speed; the variation in intensity of the sun's light seems to cause variations in the intensity of the earth currents; on damp and foggy days the needle generally points to zero; the wind very appreciably influences the intensity of earth currents, this intensity increasing in inverse proportion to the rate at which the wind travels. Notwithstanding these observations he concluded that the nature and the origin of earth currents cannot yet be explained satisfactorily. For a systematic study the automatic electro-tellurograph of Lancetta is recommended; it consists of a very sensitive galvanometer, the coils of which are connected with two different earth connections more or less distant from one another. The relay has two contacts, and, according to the direction of the earth current, works one or the other of two electromagnets which act upon a dial recording mechanism.—Lond. *Elec. Rev.*, May 16.

Vacuum Tube Apparatus.—VON CZUDNOCHOWSKY.—A description of a universal apparatus suitable for demonstrating numerous vacuum tube phenomena. The main body is a vacuum bulb with four tubes attached, the whole forming a cross. One of the tubes contains the anode, and the opposite one is the tube to be connected to the mercury pump. The two remaining tubes have wide mouths, and are intended for the reception of different cathodes and anticathodes, including plane and concave plates, hollow cathodes, after Goldstein, and wire cathodes.—*Ann. d. Phys.*, May 15; abstracted in Lond. *Elec.*, May 30.

REFERENCES.

Measurement of the Angle of Lag.—FINZI.—A communication in which he first briefly discusses the method of Hanchett of measuring the angle of lag and the power factor with a voltmeter (ELECTRICAL WORLD AND ENGINEER, Nov. 2, 1901); it is Ayrton's method of the three voltmeters; measurement of the three voltages to be determined is made with one voltmeter and a switch. Concerning Breslauer's method of measuring large phase differences, recently described in the Digest, he remarks that it can be applied to the so-called three-ampere method.—*Elek. Zeit.*, April 10.

Hot Wire Ammeter.—KOLLERT.—An article on the theory of the hot wire ammeter, with references to measurements of Hankel and Friese.—*Elek. Zeit.*, May 1.

TELEGRAPHY. TELEPHONY AND SIGNALS.

REFERENCES.

Electric Waves and Wireless Telegraphy.—SEIBT.—A very long mathematical article on electric waves on wires, with special references to Marconi's wireless telegraphy. It appears to be a simple and good introduction into the mathematical theory of Hertzian waves. Steinmetz's symbolic method is made use of with great success. The intimate connection is shown between problems of wave transmission over cables and problems of wireless telegraphy. The capacity, which is considered to be a disturbing factor in cable telegraphy, becomes a very important factor in wireless telegraphy, for without it transmission to a distance would not be possible. He first gives the general analytical theory and applies the results to the explanation of several arrangements used in practice for wireless telegraphy. The paper is concluded by the description of a series of experiments which appear to be good lecture-room illustrations, and in which he reproduced Tesla's light effects in a different way. The experiments refer to the resonance of coils, the damping of waves in coils and the demonstration of the waves in coils by photographic methods.—*Elek. Zeit.*, April 10, 17, 24, May 1, 8.

Underground Telephone Wires.—ZAPPE.—A long and profusely illustrated paper, read before the Berlin Electrical Society. Since 1888 the German Post-office Department (which has a monopoly of telephone installations in Germany) has begun to put the wires underground and is continuing this every year. The methods of construction are described in detail.—*Elek. Zeit.*, April 10.

MISCELLANEOUS.

Dusseldorf Exposition.—SLYTERIH.—A long illustrated description of the electrical exhibits at the present industrial and commercial exposition for Rhineland and Westphalia, in Dusseldorf, Germany. The generating station for lifting and power contains 20 dynamos, or, together, 7,900 kw; six are three-phase generators of 4,450 kw, and one is a single-phase alternator of 300 kw. Electric power is used for various exhibits; the exhibits of the equipments of mines are said to be especially interesting.—*Elek. Zeit.*, May 8, 15.

Directory of Electrical Societies, Etc.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Next meeting, Pittsburg, June 28 to July 3, 1902.

AMERICAN ELECTOCHEMICAL SOCIETY. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

ELECTRICAL CONTRACTOR'S ASSOCIATION OF NEW YORK. Semi-Annual meeting, Hotel Ten Eyck, Albany, N. Y., July 15, 1902. Pittsburg, June 27 and 28, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES. Next meeting, Philadelphia, Pa., June 24, 25 and 26, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION. Next meeting. Pittsburg, June 28 to July 3, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting. Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4. 1902.

Works and Products of the Stanley Electric Manufacturing Company—II.

TRANSFORMER building for general lighting purposes was the initial purpose of the Stanley Company and has remained one of their most important lines of manufacture. Transformers of this type are now built in sizes of 0.5 to 30-kw capacity. The standard voltages of these transformers correspond to general practice

Primary Voltage.

Each lighting transformer has four primary terminals on a porcelain board, and these terminals are readily connected by two clips for either of the primary voltages for which the transformer is adapted. These transformers are filled with oil when ready for operation. Iron used in transformer cases is made to a patented formula owned by the Stanley Company, and is said to present a nearly constant hysteresis loss irrespective of age. A special feature of transformer windings



FIG. 1.—ALTERNATORS IN ELECTRA POWER HOUSE.



FIG. 2.—TRANSFORMER COIL WINDING DEPARTMENT.

size and the assembly of these coils. The smaller transformers contain three primary and three secondary, and the larger transformers five primary and five secondary coils. In each transformer, all of the coils are assembled into two equal groups after being completely taped.

Each group consists of three or five coils. A group of three coils contains one secondary in the center with a primary coil on either side. A group of five coils contains three primary and two secondary coils, the primary coming at the outside, center and inside of the group. By this construction a secondary is always interposed between two primary coils so that a high degree of insulation is maintained between the several primary coils, and the voltage at the terminals of any one of these coils is only a fraction of that on the line. Each lighting transformer case is insulated from its case and a test with 10,000 volts is made between core and case; coils and case, coils and core, and between primary and secondary coils.

Besides the lightning transformers just described, the Stanley Company makes a line of subway transformers, and three distinct types for use in stations. The subway transformers are intended for use in manholes with underground construction and each is provided with a cast-iron case, oil and water-tight. These subway transformers

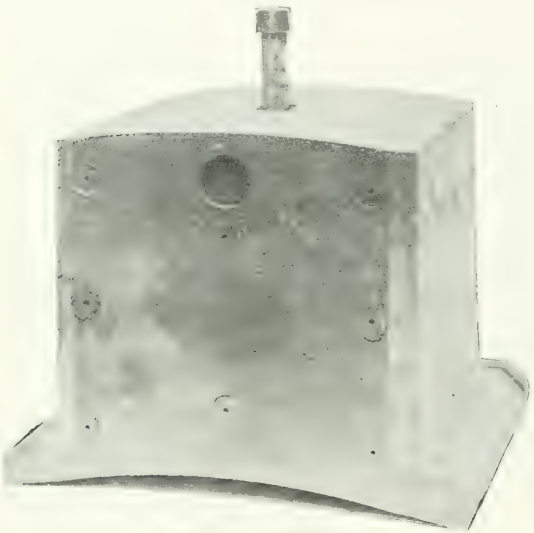


FIG. 3.—A MAGNET CORE.

are all filled and are made in sizes from 5 to 40 kw. Metal tubes make water-tight joints with the transformer case at points where primary and secondary cables enter, so that the lead coverings of these cables may be joined to the tubes by wiped joints. This type of transformer is built for any periodicity and for any pressure up to 2400 volts.

A line of indoor transformers with dry insulation and air cooled by either natural or mechanical draft is built in sizes from 10 to 75-kw and for use on any potential up to 10,000 volts at any frequency. In these transformers there are openings at the tops and bottoms of the cases, so that the cooling air passes directly over the coils and cores.

Another line of indoor transformers, oil insulated, is built in sizes from 10 to 50 kw at any pressures up to 15,000 volts.

For long-distance transmission or other service where large units, continuous service and high potentials are necessary, the Stanley Company has worked out its line of oil insulated water-cooled transformers. This series includes sizes from 35 to 500-kw for any frequency, and for any voltage up to 40,000. In the oil surrounding the core and coils of each of these transformers, is placed a coil of brass pipe intended to carry circulating water when the transformer is in operation. This circulation of water in the brass pipe may be maintained from any source of moderate pressure. Water enters the brass piping cold or at its normal outside temperature and is discharged at a higher temperature after having absorbed a quantity of heat from the oil in the transformer. The transformer temperature can be varied, as more or less water is forced through the brass coil, but enough water to lower the temperature of a transformer below that of the surrounding air should not be forced through the pipe, as this will cause the transformer to sweat. It is stated that a 150 kw transformer of this type will not rise in temperature more than 35° C. above that of the surrounding air under constant operation at full load if 0.5 gallon of water at 15°C. is forced through the brass piping.

The oil-insulated indoor transformers have a maximum rise in temperature of 40°C. above that of the surrounding air, under continuous operation at full load. Both types of oil-insulated station transformers are subject to similar insulation tests. These transformers when designed for operation at less than 5000 volts are tested with 10,000 volts between primary and secondary coils during one minute; 10,000 volts between primary coils and iron for one minute, and 10,000 volts between recording coils and iron frame for one minute. Transformers designed to work at more than 5000 volts in either set of coils are tested with double the primary voltage between primary coils and secondary coils, and between primary coils and iron, during a period of one minute. Also with the full primary voltage between secondary coils and iron during one minute.

In all of the station transformers, the primary and secondary windings are made up of a number of separate coils, each varying from four to sixteen according to capacity and voltage. As may be noted in the illustration showing piles of these coils in the winding room, each coil is very narrow compared with its diameter. This construction is produced by a comparatively large number of layers and very few turns per layer. The voltage between layers is thus kept relatively low. Primary and secondary coils are assembled on the transformer cores in alternate order so that a secondary is between two primary coils. This not only permits ample insulation, but also ensures proper interlinking of the magnetic flux with all of the coils. Coils are supported on the transformer cores by wooden blocks and wedges, and sheets of insulating material are placed between primary and secondary coils. After all the coils are in position on a transformer core, they are connected into their respective groups.

At this point it is interesting to note some of the structural details of the 700 kw transformers installed at the Colgate power-house and operated for the transmission to San Francisco, the longest in the world—220 miles.

Each of these transformers is of the oil-insulated, water-cooled type with capacity of 700 kw at 60 periods per second. These transformers step up from 2300 volts on the generator side to 34,675 volts on the line side, but have taps brought out for 23,175 and 28,925 volts.

As at first used, these transformers were connected in groups of three, delta fashion on the generator side and star fashion on the line side so as to give 40,000 volts on the line, but the permanent connection will give 60,000 volts on the line. In each of these transformers, the primary winding is divided into 16 coils and the secondary winding into 8 coils. The pressure per coil of the primary winding is thus 2167 volts. Each primary coil is composed of 73.5 turns of copper strip, one turn per layer. Each secondary or low pressure coil contains 19.5 turns of copper strip wound one turn per layer, and each layer with three strips in parallel. Two of these primary coils are mounted with a sheet of micanite betweeen them on the core, and such groups of two primary coils alternate with the secondary coils, as may be seen by inspection of the figure. These transformers were put to an insulation test of 75,000 volts between high-tension winding and core for one minute, 75,000 volts between high-tension and low-tension winding for one minute, and 37,000 volts between low tension-winding and core for one minute.

All the iron parts of these transformers are connected to earth. The efficiency and regulation given by the Stanley Company for these transformers are as follows:

EFFICIENCY.

98.6	per cent	at	125	per cent	load
98.5	" "	"	100	" "	"
98.4	" "	"	75	" "	"
97.8	" "	"	50	" "	"
96.—	" "	"	25	" "	"

FULL LOAD REGULATION.

—	per cent	power	factor,	regulation	0.7	per	cent
99	" "	"	"	"	1.9	"	"
98	" "	"	"	"	2.4	"	"
97	" "	"	"	"	2.6	"	"

After 24 hours' run at full load the temperature of oil in these transformers was 35° C. above that of the surrounding air.

While not confined to any one type of generator, the Stanley Company has pushed the construction of inductor alternators to a high degree of perfection. These alternators are regularly made by the company from the smallest sizes up to machines of more than 2000 kw capacity. The standard construction for these alternators includes a cast steel element of flywheel type with a circular group of

laminated poles or inductors mounted at each side of the rim. This element, composed entirely of iron and steel, revolves, and is the only moving part of the machine. Outside of the revolving inductor, comes the armature, a cast steel ring with two circles of armature punchings built up on its interior surface. Armature coils are mounted in these two circles of iron stampings, and come directly over the laminated inductors or poles on the revolving element. There are thus two independent rows of armature coils, and between these rows the single magnet coil of the inductor alternator is mounted. This coil is supported by the armature casting, and so requires no moving connections. Armature coils are usually wound two per slot and are of the concentrated type, as there are only two slots opposite each of the revolving inductors. By suitable spacing of the armature coils in these slots, currents of either two or three phase are obtained.

The single magnet coils previously mentioned are of peculiar and interesting construction. Each coil is wound, usually with copper strip, in a heavy brass spool or ring. Radial depth of the winding is small compared with the diameter of the spool, and the winding is divided into two equal parts by a radial space that is left all round the spool, for the purpose of ventilation. These magnet spools and coils change but little as the capacities of generators increase, but their diameters go up rapidly. The magnet spool for the smallest inductor alternator built by the company has a diameter of 14 inches inside, 22½ inches outside, and is 4¼ inches wide. For an alternator of 1500 kw capacity at 120 r.p.m. the diameter of a magnet spool is 17 feet 11¾ inches outside and 15 feet ¼ inch inside with a face of 4¼ inches. Two of these spools are used in the 7500 kw machine.

Several sizes of these inductor alternators are employed in the long distance transmission previously mentioned and the following data relates to the largest of the lot. This generator has a capacity of 2000 kw at 2200 volts and 60 cycles, when driven at 240 r.p.m. At this speed the periphery of the inductor travels about 10,000 feet per minute. The total weight of this inductor is nearly 52,000 pounds.

Power.	Regulation.
100 per cent	3 per cent
90 " "	5 " "
85 " "	6 " "
70 " "	11 " "

The regulation of this alternator at different power is given above.



FIG. 4.—50,000-VOLT OIL TRANSFORMER, WATER-COOLED.

The efficiencies at different loads are:

Load.	Efficiency.
125 per cent	95.00 per cent
100 " "	94.75 " "
75 " "	94.5 " "
50 " "	93.5 " "
25 " "	89.5 " "

A no-load curve of e.m.f. for this generator very closely approaches the true sine form. For continuous operation the temperature rise above the air was 35° C., and the generator carries an overload of 50 per cent for four hours without dangerous heating.

The type of induction generators just described is especially suited for frequency changers, because there are two entirely independent groups of armature coils. These frequency changers are made by the company for any even ratio, but the standard apparatus is suited only for the ratio of two to one. As in the inductor alternator, so in the frequency changer; there is only a single magnet coil. In the latter machine, one set of armature coils acts as a motor and the other set acts as a generator. The ratio of voltage transformation in the frequency changers may be as great as ten to one, and the phase relation of the delivered currents may differ from that of the received currents. An independent voltage regulation of 10 per cent in each phase is also provided for at the frequency changer. These machines may be used to render the low frequency currents of long transmissions and of street railways available for any purpose where high frequency is required. Besides the inductor type, the Stanley Company also build a line of revolving-field alternators. The magnets of these machines are built up of stamped iron sheets between end plates and are mounted on a center portion of cast steel. The magnet stampings are bound together by rods of soft steel, as shown, the cut also illustrating the method of bolting into one of these rods to attach the magnet to the circular frame of a rotary converter. These rotary converters are made in a variety of sizes to meet the usual requirements. One of the converters recently constructed was of 600 kw capacity and 600 volts on the direct-current side, at 375 r.p.m. This converter was 8-pole, 25-cycle and had an efficiency of 96 per cent at full load.

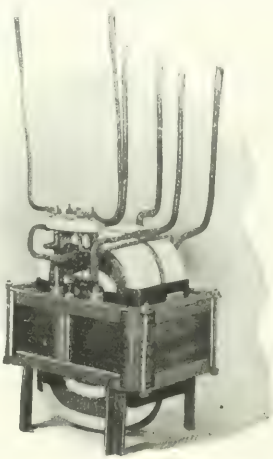


FIG. 5.—TRANSFORMER.

The company is now at work on a line of street railway motors ranging from 35 to 150 hp capacity. These have cast-iron frames, but the poles and magnet cores are laminated throughout.

To avoid the troubles that frequently occur with ordinary rheostats, due to overheating on long and heavy loads, a rheostat in which the resistance is built up with grids of cast iron, has recently been developed. Owing to the high melting point of cast iron, it is believed that this rheostat cannot be injured by any loads that will be applied to it.

In this hasty sketch of the main products of the Stanley Company, many kinds of auxiliary apparatus of much interest have necessarily been neglected. Prominent among these latter may be mentioned full lines of ampere, volt and watt meters, arc lamps for both direct and alternating-currents, lightning arresters, ground detectors, circuit breakers, fuses, phase indicators, and condensers.

Time Element Circuit Breaker Attachment.

By B. Parks Rucker.

The apparatus shown in the accompanying illustrations is a time element and instantaneous trip attachment for automatic circuit breakers, on which the writer has just been allowed patents. The two photographic views show this apparatus attached to a "G. E." and to a "G. I." circuit breaker, respectively, and in the drawing the same attachment applied to a "Type A" Westinghouse breaker.

Primarily, the device consists of an auxiliary weight or other resistance added to the tripping solenoid core or armature magnet, and a device for removing said weight or resistance after a predetermined overload or short-circuit. In the apparatus shown, this is accomplished by means of an independent operating circuit, which is closed by a small switch controlled by a slight movement of the tripping parts on the advent of an overload. The movement of the switch is much greater than that of the part controlling it, this being accomplished by pivoting the switch-carrying arm at a point

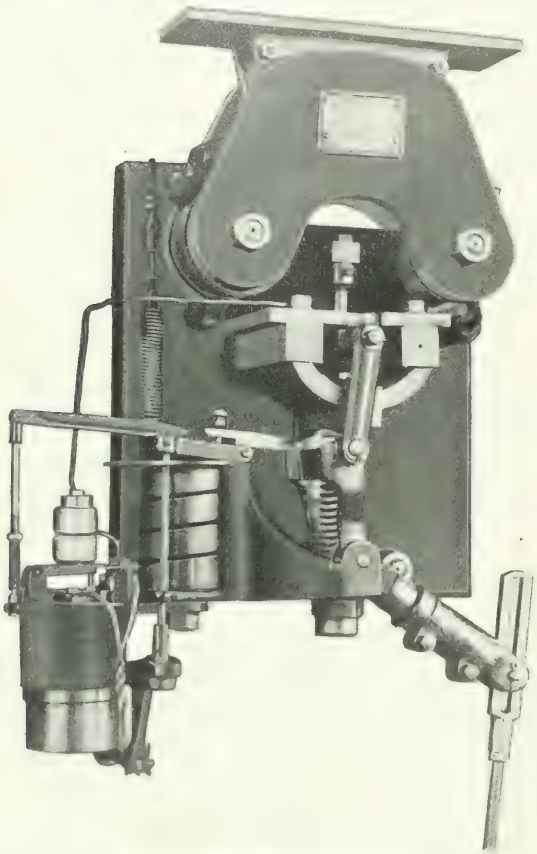


FIG. 1.—CIRCUIT BREAKER ATTACHMENT.

close to the place where the force is applied. These switches, or switch-carrying arms, also serve as a means of adding the auxiliary weights to the spring, weights, or other calibration of the breaker; and by being withdrawn from mesh with the other mechanism allow the breaker to trip at a lower rating than it otherwise would.

The operation of the apparatus is as follows: The circuit breaker used is calibrated in the usual way, and is set at the point at which it is desired to have it open the circuit with a time limit, of, say, five seconds; then the auxiliary weight is added until the point is reached at which an instantaneous break is necessary. It is seen that adding these auxiliary weights has exactly the same effect as if they were added directly to the solenoid core or magnet armature. Then if an overload, greater than the time, but less than the instantaneous calibration, comes on, the tripping device closes the circuit through the operating solenoid, and the core rises slowly, being retarded by the oil-dash pot. If the overload stays on long enough, the pin in the solenoid core raises the auxiliary weight and draws the switch-carrying arm free of the other mechanism, and the breaker is then free to open the circuit in the usual way.

Should the overload cease before the five seconds is up, the tripping

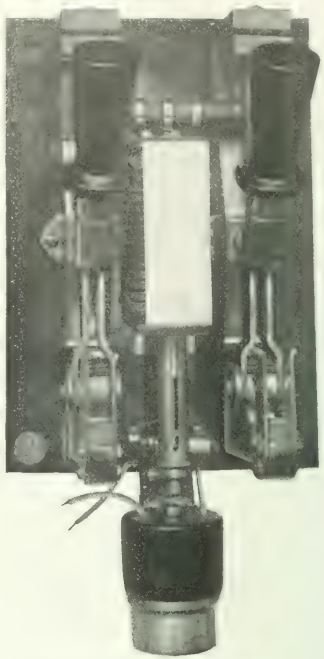


FIG. 2.—CIRCUIT BREAKER ATTACHMENT.

core falls back and the parts resume their normal positions. On the other hand, should a short-circuit or abnormal overload come on, the pull on the solenoid core or magnet armature is great enough

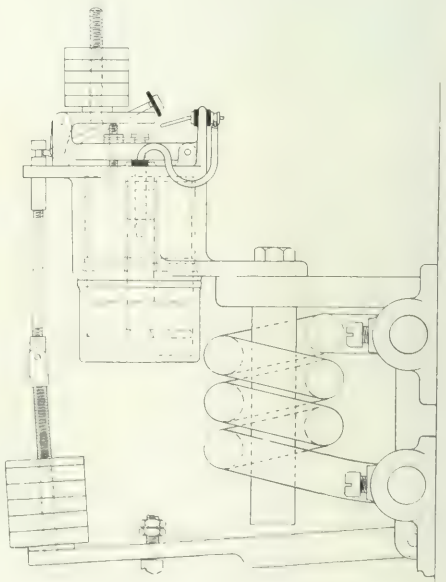


FIG. 3.—TIME ELEMENT AND INSTANTANEOUS TRIP.

to raise both weights and break the circuit instantaneously. The timeing device is calibrated by regulating the distance through which

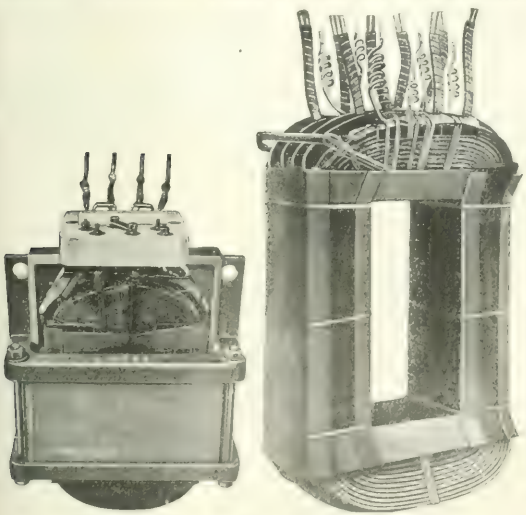
the operating solenoid core has to travel before releasing the weights, and by regulating the amount of current in the solenoid. A very light oil is used in the dash-pot to prevent any possibility of sticking, and the piston fits loosely in the cylinder, thus allowing the oil to flow around the edges instead of through valves.

The "G. E." apparatus shown has been in operation for over two months on a 550-volt railway panel, and has been put through a very severe test. The breaker formerly had a habit of opening about twice in three days, and was set at 1,200 amperes. After installing the time limiting device the instantaneous break was raised to about 1,500 amperes, and the time limit set to break the circuit in four seconds with the current above the 1,000-ampere limit. In the first six weeks the breaker opened three times—twice instantaneously on short circuits, and once on time; the conditions were exactly the same in both cases. A tell-tale, placed in series with the operating solenoid, showed that the breaker starts to open as often as before, but the periods of overload are so short that the apparatus does not have time to work.

A scheme of this kind should be valuable wherever the current flow is subject to fluctuation, as for instance, at railway panels, on street car breakers, elevators, cranes, printing presses, motors, and, in fact, wherever an automatic overload circuit breaker is used. The same apparatus, with slight modification, can be used on alternating current breakers, oil switches, etc.

New Westinghouse Transformer.

As the Westinghouse Company was the first to introduce the practice of winding for two primary and two secondary voltages, it is not surprising that this company has taken another step forward in the same direction by bringing out a transformer provided with additional voltages. The new transformer, known as "Type N," is not intended to replace the company's well-known "O. D." transformer, but rather to fill the demand for one which, provided with additional ratios of transformation has a greatly extended range of voltage. The shell type of canstruction is used. The primary winding is divided into equal parts, which may be connected in series or in multiple. The secondary winding is divided [illegible]



which may be connected in series, series-multiple, or multiple. The primaries of all transformers are wound nominally for 1000 and 2000 volts. Transformers from ½ to 25 kw inclusive are wound for nominal secondary voltages of 50, 100 and 200, and those from 2 to 50 kw, inclusive, for voltages of 100, 200 and 400. The secondary voltages in each class of transformers can be varied to suit either the varying line voltages of an extensive transmission system, or to give special voltages from standard circuits. All transformers are arranged for three-wire secondary distribution, and the secondary coils cross-connected to give equal voltages on both circuits, even with large unbalanced loads.

Telpherage Plant in Cuba.

In these modern exporting days, no American device or invention ought to be considered to enjoy full recognition until it has been tried abroad as well as at home. Thus the telpherage system, which after so many earlier years of tribulation and failure, has at last been worked out to a successful issue in the United States, and is now exemplified in so many useful plants for handling material, may be regarded as having received the final seal of ap-



[illegible]

be the first foreign telpherage plant is that here illustrated, having been built and put in operation by the United Telpherage Company, of New York City, for a concern in Cuba.

It was necessary to handle limestone in a region where tropical rains frequently caused the rivers to rise to such an extent that bridges were swept away, and where it would not pay to maintain a construction equal to every flood, if indeed it were possible to do so. In such a situation it was easy to prove the advantages of telpherage, and in Figs. 1 and 2 we show the style of construction adopted for the line. The telpherage circuits are held by the [illegible]



[illegible]

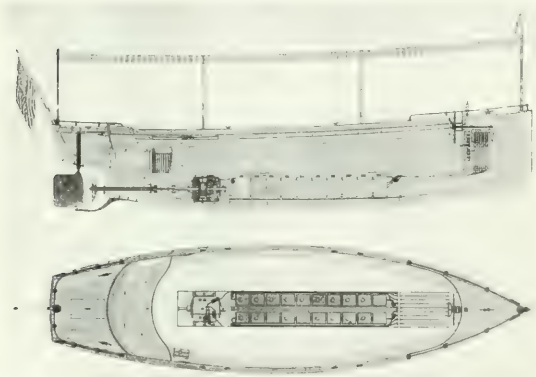
200 feet span between the supports in some places, as at the ford, although they are in general spaced 100 feet along the line. There is, as will be noted, a double track, with solid steel curves, and the little telphers make a speed of 15 miles an hour, each with its load of limestone. Four trains are in use, and with the telphers it is easy to add a train of trailers. In this case a load of 1,200 pounds is transported usually per train. There are eight curves, and a grade of 5 per cent. is attained. Fig. 3 illustrates the form of loop terminal adopted at each end of the line, so that an endless procession of the skips can be kept up, and the loading and unloading proceeded with at a high rate of speed. In fact, the capacity of telpher

lines to get away with material runs up into extraordinarily large figures, for while the load of any individual telpher may be relatively



FIG. 3.—TERMINAL STATION FOR LOOP.

small, the succession is at the shortest intervals and can be made virtually incessant. This condition suits tropical work admirably



SECTIONS AND PLAN OF ELECTRIC LAUNCH.

in many ways, and we shall not be surprised to learn that telpherage has found many of its best customers in tropical countries.

Electric Launch "Koola."

The Electric Launch Company, of Bayonne, N. J., has recently supplied an electric launch of special design, for use on Tuxedo Lake. The hull is built of mahogany throughout, with a long cockpit on level floor for accommodating easy wicker chairs, as shown in the accompanying illustration. There is room in the cockpit to accommodate five chairs and a table comfortably, which, with the divan seat, enables the owner to carry six or seven guests.

The length over all is 21 feet; beam, 5 feet 6 inches; draught, 24 inches. It is fitted with a 2½-hp electric motor, with storage battery capacity enabling the launch to cover a distance of 40 miles on one charge. The highest speed of the launch is seven miles an hour. The motive apparatus, including batteries and motor, is placed below the flooring of the boat, thereby increasing the stability of the craft.

Power for refilling the batteries, when exhausted, is obtained from the electric lighting plant at Tuxedo. One man, usually the gardener about the place, is all that is necessary to charge and care for the launch. The launch is usually operated by the owner, Mr. Richard Delafield, and is named "Koola." Mr. Delafield expects to use this launch for fishing and pleasure purposes, and has a special attachment whereby both control of power and steering of boat is obtained at two distinct points, at the fore and aft ends of the cockpit of the boat, respectively. For fishing, the lowest speed, 2½ miles, is used, which makes an excellent trolling speed, and with less noise than in the case of a row-boat with muffled oars.

As the water at Tuxedo Lake is used for drinking purposes by the residents of the Park, the community has been strongly opposed to all power launches on the lake; row-boats and sail-boats have only been in use for a number of years. Upon carefully investigating the power of an electric launch, Mr. Delafield came to the decision that there was absolutely nothing pertaining to the power apparatus of the launch that could in any way contaminate the water of the lake. He, therefore, placed an order early in the winter for a boat to be specially built to meet his requirements. The outboard shaft bearing is lubricated by the water which surrounds it, and, therefore, no oil or grease is used on any part of the apparatus. A recent improvement enables electric motors to be operated at 1,00 r. p. m. without the use of any oil on the bearings, and this type of motor is installed in the launch at Tuxedo.

Direct-Current Ceiling Fans.

The ceiling fan, illustrated herewith, is manufactured by the Sterling Electric Motor Company, Dayton, Ohio. The fan is stated to have minimum mechanical, electrical and magnetic resistance, which insures a cool-running machine. The armature is built up with laminated disks. The fan may be operated on 500-volt circuits. The bearings, commutator, switch, brushes, etc., have been designed for efficient service over the most lengthy period. The speed regulating rheostat, which is made of fire-proof material, is separate from the fan mechanism, by reason of which the heat of the rheostat is kept away from the windings, insulation and bearings of the motor. This, it is claimed, is a distinct advantage in the operation of the fan.



CEILING FAN.

The Sterling Company makes only this one type of ceiling fan for the standard voltages, and in the various fittings and finishes.

Conduit Rods for Underground Work.

A number of essential details are connected with the use and operation of underground conduits, and among the most important in the line of conduits come the rods for pushing through the ducts. We illustrate herewith the Villard automatic-wheeled conduit rods, which have been found very effective for their purpose. They have been evolved by a practical conduit workman, from an experience of several years, during which he rodded several millions of feet. These rods possess the good qualities of the solid joint, and have, in addition thereto, the advantages of being quickly connected and disconnected, and of being easily pushed or drawn through the ducts.

Attempts have been made in the past to replace the threaded or pipe-coupling rods with others which could be more easily and quickly connected, but defects were usually found, which prevented their coming into practical use. In using rods with joints that were easily detached heretofore, a loose joint would cause the rods to buckle when they were pushed through the ducts, and, under the strain, a zigzag line was formed, which destroyed the alignment, and, in consequence, the ends of the rods were pressed against the sides of the conduit. This caused considerable friction, making it necessary sometimes to employ the combined strength of several men to manipulate the rods. These disadvantages have, it is said, been eliminated in the Villard automatic-wheeled rod. The rods are very light running, owing to their being provided with wheels. In

their construction, special provision is made for their becoming rigid when they are pushed through the conduits, and flexible when they are pulled, thus allowing a considerable variance when crossing a man-hole, and making it easy to take another duct out of line with the first; the rods becoming again rigid when pushed into the new conduit on the opposite side. It is a physical impossibility for the rods to become uncoupled while in the conduits, owing to the fact that a 3-ft. rod has to be raised 20 inches, or to an angle of about 45 degrees before it can be separated.

The Villard automatic-wheeled conduit rods are made of very hard bronze couplings, the wheels being of chilled cast-iron, and the rods of first-class seasoned hickory soaked in oil. The soaking prevents their absorption of moisture, and thereby prolongs the life of the wood. The rods are fastened securely in the ferrules, with a wedge at the inner end, which enables them to stand more tension than they would if they were fastened by the ordinary riveting.

The wheels on the conduit rods save friction and wear on the rods themselves, enabling one man to push with ease a set of 200 rods or 600 feet. The ordinary section length averages, approximately, 400 feet, thus making rodding light work. They also serve as duct cleaners; each pair of wheels bringing out a quantity of dry dirt or mud as they are removed from the conduit or passed through a man-hole, leaving the duct comparatively clean. In removing obstructions, a very hard blow can be struck with telling effect with these rods without the slightest injury to the rods. The wheels also act as a guide to the rods, causing them to take a bend or curve as great as 2½ feet in 12. The wheels insure a 2½-in. duct opening through the entire section length, thus allowing a cable of that dimension to be installed without any danger from obstructions.



CONDUIT ROD.

The average day's work of four men with the old style of screw rods is 3,000 to 4,000 feet, while with these Villard automatic-wheeled rods the average day's rodding of two men is said to be from 8,000 to 10,000 feet. On one occasion two men did 20,915 feet of rodding in eight hours.

These rods are made in hickory, 3 ft. to 4½ ft. long, and of ⅞-in. and 1-in. diameter, and of iron pipe when desired, instead of hickory. James S. Barron & Co., 200 to 206 West Broadway, New York, who are sole agents, and who are selling these rods strictly on their merits, will send a full set of 200 (600 feet) on ten days' trial, upon application of any company contemplating purchasing rods.

Regulating Incandescent Lamp.

A new incandescent regulating lamp has recently been patented by Miller & Burrows, of Chesaning, Mich. The lamp fits standard sockets without the intervention of special attachments, and is claimed to be so simple in construction as to insure the minimum of cost in manufacture and the maximum of durability, while equal to others in economy of consumption. The lamp has two filaments. To reduce the candle-power the filaments are connected in series by means of a simple switch attached to the bulb, and so placed as to be easy of access.

A Selective Party-Line Telephone System.

At the present cost of line construction the only possible way of giving a very cheap telephone service to the "occasional user" is by means of the so-called "party-line," where several instruments are connected on the same circuit; but the annoyance occasioned by the frequent ringing of the bells, the difficulty of recognizing the proper signal and the lack of privacy often render this class of service unsatisfactory. It has always been recognized that a selective-signalling system for party lines, which should lock out subscribers not wanted and warn such subscribers that the line was in use, was greatly to be desired. The requirements are that such a system should not need instruments complicated in construction, or liable to get out of order. It should be adapted to any style of telephone and should not require more line wires than the usual metallic circuit. It should be applicable to the usual switchboard, and not require special skill on the part of the operator, nor extra labor on the part of the subscribers.

The Maybury-Holmes Selective System, now being put on the market, aims to fulfil all the above requirements, and to meet objections now existing in the party-line telephone, giving practically as good service as if such instruments had an exclusive line to the exchange.

The subscriber by removing his receiver signals "central," and at the same time locks out all instruments on his line, displaying a "busy" signal at locked-out stations. When central signals the subscriber, she rings only the bell at the station required, and also locks out all other stations on that line. When two subscribers are in communication, there is no possibility of their conversation being interrupted or overheard by other subscribers connected to the line. It is arranged with complete double supervision, so that as each receiver is hung up at the close of conversation, the clearing-out signals are displayed in the central office. The operator on receiving clearing-out signal restores the instruments on both lines to zero, and removes plugs. If she neglects to properly restore the lines, the line signal will be immediately displayed upon removal of the plugs, and can be only replaced by restoring the instruments to their normal conditions. Intercommunication is possible to parties on the same line, but only through the co-operation of the central office.

An automatic key is provided, the switchboard consisting of a series of push-butons, numbered to correspond to the number of instruments on any one circuit, and all that is necessary for the operator to do in signalling the desired subscriber is to push in the button corresponding to the subscriber wanted, and to press her ringing-key in the usual manner. This selects the subscriber wanted automatically, and rings the bell at that station only. Only one automatic key is required for each operator's position, no matter how many party-lines may be assigned to her.

This system has been given a thorough trial, and is now in successful operation in regular exchange service. To Mr. F. E. Maybury, West Medford, Mass., who is interested in the development of this system, we are indebted for the above data.

Lineman's Torch.

We illustrate on this page a lineman's torch, made by the Clayton & Lambert Manufacturing Company, of Detroit, Mich. It is a pint size. The tank is drawn out of heavy brass, free from seams, and all the fittings are heavy. Reinforcements are used to make the tank extra strong. A brass air pump of the latest design forms part of the handle. The burner produces a strong, blue flame, consuming very little gasoline. Improved double-shouldered needles are used, making very durable burners. By referring to the cut, it will be seen that the burner is mounted on a swivel joint, so that the flame can be thrown in any direction. It is thoroughly well made, and, though strong, is still light, well balanced, easy to handle and always ready for use. Clayton & Lambert Manufacturing Company will be glad to send fuller description and price to any reader of the ELECTRICAL WORLD AND ENGINEER upon receipt of their request.





Popular Telephone Outfits.

A new departure is being made in the line of popular telephone apparatus by the Atwater-Kent Manufacturing Works, of 116 North Seventh Street, Philadelphia, who are placing on the market a complete telephone outfit, packed in a box, ready for installation. The chief feature in this set is their new "monoplex" telephone, which has received a hearty welcome as a low-priced piece of apparatus. Ordinarily a man putting up a private telephone line has to think of, and buy separately, every piece of necessary auxiliary apparatus, and to haunt an electrical or a hardware store. Out of this state of affairs has arisen the plan of the concern named, to put up all the parts of a system in a box. The outfit consists of the monoplex telephone, two dry batteries, one pound of No. 18 annunciator wire, one box of double-pointed tacks or staples, 8 backboard screws, and all put up with directions for installing. The motto is "Every man his own telephonist," for there are innumerable places where a telephone line can be installed to advantage without any idea of exchange service. An illustration of the "Monoplex" telephone was shown in a recent issue of ELECTRICAL WORLD AND ENGINEER.

St. Louis World's Fair Subway.

An interesting piece of work is being pushed vigorously to its completion, and is monopolizing the attention of a large force of workmen on the World's Fair site, St. Louis. This is the subway which is to contain all the electric wires of the distribution system.

The contract for constructing this subway was let some two months ago, at which time some intimation was given of the extent of the work. Visitors to the site find that in passing from one part of the grounds to another their way leads many times over deep excavations, spanned by broad planks.

Along the entire length of this tunnel workmen are employed boxing in the sides and bottom, and installing a series of shelves on either side. This work is rapidly reaching its completion, will be over one mile long when complete, extending from a point near the government building, along the entire length of one of the transverse avenues of the exposition, following the direction of the



River des Peres channelway and terminating at the Electricity Building, where the Westinghouse Company will install a complete electrical plant, furnishing a large percentage of the power for running the exposition. After the "trunk lines" of the wires have been conducted along the shelves of the subway, it will be covered with earth, as all the other series of underground ways are being treated, and subsidiary wires connecting with the main wires will be conducted to every part of the grounds.

The system will be one of the most intricate pieces of work in connection with the exposition. This electrcal subway is 7 feet wide by 7 feet deep. It will be 1 foot beneath the surface of the earth when the final grading has been done and the whole surface of the exposition valley has assumed the level of a floor.

form of hills and dales, the cut which has been made is in places fully 40 feet deep.

Westinghouse Equipment for Mersey Tunnel

The last of the main Westinghouse generators and engines intended to be installed in the power plant of the Mersey Tunnel Railway are about to be shipped from the Westinghouse works, at East Pittsburg. These generators are of railway type, 1,200-kw, 650-volts, 90 r. p. m. They will be direct connected to vertical cross-compound engines of 1,500 hp each. The power-house lighting and the electric light of all stations, sidings, etc., will be supplied from a separate generating plant. Two compound-wound generators, each having a capacity of 200 kw at 650 volts, direct connected to Westinghouse compound engines, are to be installed for this purpose. The speed will be 250 r. p. m. The Westinghouse electro-pneumatic system of train control is to be used. The Mersey Tunnel Railway, which joins Liverpool and Birkenhead, was formely a steam road. It is about 4½ miles in length, and is principally laid in a double-track, brick-work tunnel, the total track length being 12 miles. The change to electric motive power, made by the British Westinghouse Electric and Manufacturing Company, Limited, is attracting considerable attention in railway and electrical engineering circles in Great Britain.

The rolling stock will consist of 60 cars. The trains will be formed of five cars each. No locomotives will be used; the first and last cars of a train will be motor cars, each equipped with four 100-hp motors. The contract with the British Westinghouse Company stipulates that they shall guarantee the interest on the existing four and half per cent., redeemable, first debenture stock, amounting to £249,276, and that they shall provide for the repayment of the stock at par not later than June 30, 1904. The price to be paid to the Westinghouse company is £635,303, payable as to £620,000 in new four per cent. first perpetual debenture stock, and £15,303 in cash. Thus, allowing for the retirement of the existing four and a half per cent. first debenture stock, the Westinghouse company will receive a net sum of about £386,000. The railway, operated under steam, has shown an average deficit for the last five years of over £33.000. The enormous traffic between Birkenhead and Liverpool—last year about 9,000,000 passengers by steam road, and nearly 23,000,000 by ferry boat—will, it is expected, result in the new electric line being placed among the most important in the world. The £20 stock of the Mersey Railway Company, which last year was quoted not higher than £1, and as low as 5 shillings, was listed last week at no less than £14. The contract with the Westinghouse Company calls for completion of the system by January 15, 1903.

Electric Lighting in Sydney, Australia.

The Municipal Council of Sydney, New South Wales, Australia, has decided to install an electric lighting system in Sydney, and through its consulting engineers, Messrs. Preece & Cardew, of London, England, has asked for tenders on furnishing the complete station and substation machinery.

The plan as laid out by Messrs. Preece & Cardew, and accepted by the council, is as follows:

Main Station.—The central station is to be located in the center of the city on Darling Harbor, a short distance from the new power-house now being built by the General Electric Company, for the city tramway system. The location affords excellent water-front facilities, and is convenient to the Government railway, thus enabling a siding to be run from the railway to the power-house for carrying coal and ashes. The intention is to run the siding up an incline, so that the coal can be dumped directly into the coal bin, thus doing away with coal handling machinery. Similarly the ashes will be loaded directly into the cars.

The boiler room will contain five water-tube boilers, each one capable of evaporating 10,000 lbs. of water per hour, the temperature of the feed water being 200° F. These boilers are to be provided with mechanical stokers and all of the most modern appliances. A separate superheater, capable of superheating the steam 100° F., is to be provided and located between two of the boilers. Three Green economizers, each consisting of 576 tubes, and provided with scrapers, etc., are to be used, as well as two feed pumps of the vertical type.

The engine room is to contain two 600-kw units and one 300-kw unit, each consisting of steam engines and electric generators. The generators are to be wound to deliver three-phase alternating current at a voltage of 5,200, and at a frequency which has not been

absolutely decided upon [illegible] and 60 cycles. The engines are to be provided with surface condensers, and the air and circulating pumps are to be electrically driven by means of three-phase induction motors, operating at 415 volts.

Each unit is to be provided with a 125-volt exciter, whose armature is placed directly on an extension of the main engine shaft, and thus forms a part of each unit.

In addition to these exciters, an auxiliary storage battery of a capacity of 1,500 ampere-hours, is to be provided, to be used for lighting the station and as a reserve in case of trouble with the exciters. This battery will be charged by a motor generator set, consisting of a 415-volt three-phase induction motor, direct connected on one end of its shaft to a 125-volt direct-current generator, and on the other end to a booster.

The necessary switchboards are to be provided, and the station is laid out with a view to ultimately enlarging it to 25,000 hp.

Substations.—Six substations are already planned, two to be located in the central part of the city, and arranged for direct-current distribution on the three-wire system at 240 volts between neutral and each outside wire. These stations are to be provided with motor generating sets, each set consisting of a 150-kw three-phase induction motor, wound for 5,000 volts and direct connected to two 75-kw, 240-volt direct-current generators, one connected to each end of its shaft.

The other four substations will be situated in the suburbs and be provided with static transformers for distributing on the four-wire, three-phase system. The three transformers will be Y-connected, and will be wound to transform a voltage of 5,000 down to 240. All of the transformers are to be oil-cooled, and are to be built in sizes from 10 kw up to 50 kw. The necessary high-tension and low-tension switchboards, for controlling the substation apparatus, is to be provided for each substation.

A system of mains and feeders will be laid out, and we believe the American "pulling-in" system will be used and not the "solid-laid," as common in English cities. A sufficient number of ducts will be laid in the streets to provide for future use; 220-volt arc lamps will be used for street illumination, and the Council intends to do private lighting where such business can be obtained, all of this lighting being done at a voltage of 220.

The city is now mainly lighted by gas, although there are one or two small private electric lighting companies, whose business is mainly the lighting of stores and theatres in the business section of Sydney. These the Council will have to compete with, but as they do not wish to make money, but simply to pay running expenses they should have no trouble. Within 18 months, if all goes well, Sydney will have the finest electric lighting plant in Australia, and should be as well and as cheaply lighted as any city in the world.

Telephone Cable Fittings.

The New Haven Novelty Machine Company, New Haven, Conn., is placing on the market a line of telephone cable fittings designed to supersede the wiped joint. Since the advent of the telephone many hundreds of patents have been taken out for electrical devices pertaining to the art, but to the equally essential side, the mechanical, it is claimed that minor attention has been given, and particularly with respect to jointing. The present method of connecting lead covered electric cables is by means of plumbers' wiped joint, probably because constructing engineers as a class know of no other. Aside from the initial cost of a wiped joint there are other factors that should be considered; for example, having plumbers always at hand when wanted; when the joint is wiped that it will never leak; the cost of a leaky joint, not only in finding its location, but when found, the cost of repair. This latter cost is apt to be more than the original cost of wiping the joint. No two constructing engineers agree on what the cost of a wiped joint is, how much time it takes, or how much solder used. Moreover, no consideration is usually taken of the difference in the cost between wiping a joint in the shop, in the manhole or on a cable suspended from a telephone pole; yet these are important factors.

The New Haven Machine Company claims to have produced a successful substitute for a wiped joint, which is moisture proof, simple of construction, and does not require skilled labor, which can not only be applied quickly, but gives liberty of inspection without extra cost, as often as desired, thereby adding a flexibility which the wiped joint does not possess; moreover, it is also economical and purely mechanical. It is claimed that this substitute not only fills these requirements, but has been thoroughly and successfully in practical use.

We illustrate herewith the "Novelty" slidable sleeve for telephonic cable connection. The essential features are as follows: The slidable sleeve allows inspection at any time and as often as required to disconnect and reconnect requiring but a wrench and a few minutes' labor. The sleeve is attached to the cables by means of a joint which allows the solder to flow down by its own gravity, and gives a longer

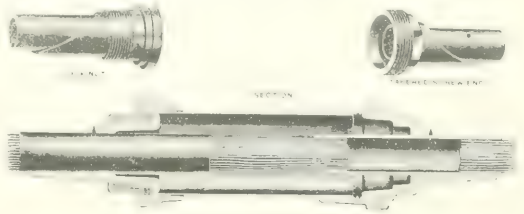


FIG. 1.—SLIDABLE SLEEVE.

supporting surface to the cable than the wiped joint, making it stronger and requiring no skilled labor. To make the sleeve moisture proof, a lock nut on one end is compressed against a soft metal ring, and on the other end a tapered thread screw is employed the same as used by the pipe fitters.

Fig. 1 shows a Novelty slidable sleeve, consisting of a brass shell with hubs attached to each end, the latter tinned and ready for soldering; the lock nut is also shown. To apply this joint the taper screwed end is passed over the cable, then the rest of the sleeve is slipped on the opposite end of the cable. The wires are next spliced as usual,

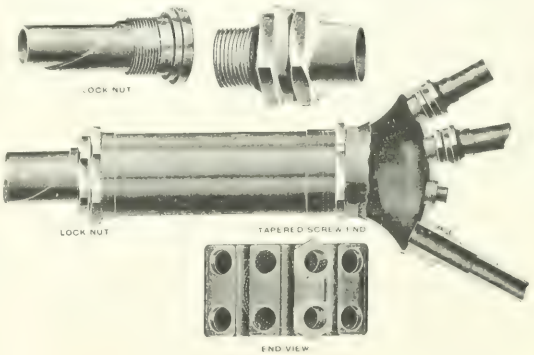


FIG. 2.—TERMINAL HEAD.

after which the tapered sleeves are placed centrally on the cable and the outside sleeve joints soldered to the lead covering of the cables.

Fig. 2 shows a terminal head and fittings, with eight branches. To apply the head the sleeve is slipped on the cable and the tinned outside end is soldered as above. The sleeve is then screwed into the head, red lead being used on the thread. After the cables are placed in place, the sleeve is slipped back and the splice made. The Y branch is practically covered by the above description, but its cheapness over the old method will particularly appeal to all users of lead covered electric cables. The pot-head consists merely of two pieces, the brass shell, and the nut with solder encased; to join the same with the cable requires only a hot iron to cause the solder to flow, and dispenses with the necessity of binding the cable to wipe the joint as at present.

Plant for Tremont Temple, Boston.

A new engine and dynamo will be installed in Tremont Temple Building, Boston, as an indirect result of a difference between the consolidated electric light companies and the Temple management. The addition will also provide for the heating of the building and the operation of elevators as at present. The new installation will [illegible] being rated at about 50 kw; that number of lamps being virtually the requirement of regular Sunday evening services in the large hall. The [illegible]

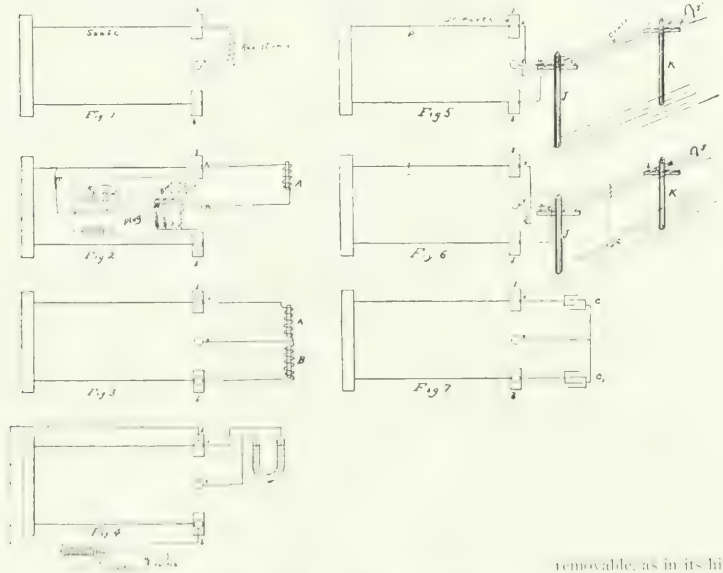
into use only in case of a break-down, or when the entire building has to be lighted. Under the previous arrangement, the Temple ran about half its lights with its two engines and bought from the outside companies the extra current required for evenings when all its halls and meeting rooms were in use. The cost of the extra light was about $40 per month. The Temple management decided to install another unit rather than take all its current from outside at a cost of $200 per month, and an outlay for new elevator machinery of about $7,000.

The new unit will be composed of an 86-hp Ames engine, direct connected to a 50-kw Westinghouse generator. The engine is of the usual type found in isolated plants, being single cylinder, 12 in. x 12 in., non-condensing, automatic cut-off, operating at 90 lbs. steam pressure per square inch. The generator is designed to give 110 volts direct current at 275 r. p. m. Both engine and generator, together with others in the plant, are located 30 feet below the Tremont Street sidewalk. All the generators in the plant are connected on the inverted three-wire system, the wires from the positive brushes of the machines going to positive bus-bars forming the outers, and the negative brushes being connected together on the middle bus used as a common return of larger cross-section.

The Sage Ohmmeter.

It is probably not generally appreciated that the well-known Sage ohmmeter type of instrument can be used for making many tests which are not within the range of an ordinary Wheatstone bridge. They are so nearly absolutely non-inductive that it is feasible to use alternating current instead of battery power without introducing any appreciable error, and this, of course, enables such work as measurement of inductance and capacity and the resistance of electrolytes to be accomplished.

The accompanying figures show various methods of connection. Fig. 1 shows how an ordinary resistance is connected to the ohmmeter when it is desired to measure its value in ohms. Fig. 2 shows the complete scheme of connections of the ohmmeter. Fig. 3 shows how inductances are compared, *A* being the unknown inductance, and *B* a coil whose inductance is known. Fig. 4 how the resistance of an electrolyte is measured. It will be noted that this is connected



FIGS. 1 TO 7.—DIAGRAMS OF METHODS OF CONNECTING OHMMETER.

in the same way that an ordinary resistance is attached, but that the alternating current obtained from the secondary of an induction coil is used instead of the direct current ordinarily furnished by the batteries contained in the instrument. Fig. 5 shows how crosses on lines may be determined by the ordinary loop test, and Fig. 6 the location [illegible] in a similar way. In Fig. 7 are shown the connections for measuring capacity, *C'* being a standard condensor, and *C* the unknown capacity. In this case, as in Fig. 4, an alternating current is employed in place of the direct current.

The length of the scale of the ohmmeter on which the resistances are read off is 30 inches. As the scale of an ordinary portable volt



FIG. 8.—OHMMETER.

or ammeter is but 5 inches long, some idea can be had of the fineness of readings obtainable. The instrument itself is illustrated in Fig. 8.

Messrs. Machado & Roller, of 203 Broadway, New York, the general selling agents for the Whitney Electrical Instrument Company, have arranged for the exclusive manufacturing and selling rights for these interesting devices.

A New Telephone Receiver.

The demand for a somewhat cheaper receiver than has usually been furnished by the big exchanges, has led the Kellogg Switchboard & Supply Company, of Chicago, to produce a new instrument, illustrated herewith. It is made in composition shells. The tailpiece is not made



TELEPHONE RECEIVER.

removable, as in its highest grade receivers, but a cord can be readily repaired by taking the working parts out of the receiver after removing four small screws. The company states that it has always been opposed to the substitution of any imitation of hard rubber for use in receiver shells, and heretofore has refused to furnish receivers with this kind of shell. It has, however, claimed to have secured a good composition which it is willing to guarantee in all respects. The material has the external appearance of hard rubber in its glossy blackness, and is said to retain this appearance almost indefinitely.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money hardened somewhat during the week, the closing rates for 60 days to six months' time being 4½@5 per cent., according to collateral. In the stock market, dullness at the close of the week followed increasing activity, with advances in standard railroad stocks. On the whole there was a general improvement in prices, although it was evident that the speculative public had little to do with the market. The coal strike did not cause any particular irregularity in any of the stocks directly or indirectly affected thereby. The United States Steel shares declined on account of injunction suits against the proposed bond issue and retirement of a part of the preferred stock; the industrials were generally neglected, and Amalgamated Copper was dull. The tractions and electrics were generally firm with upward tendencies. Of the former class, Brooklyn Rapid Transit made a net gain of ¼ point, closing at 67⅞, the sales for the week aggregating 11,675 shares. Met. St. Ry. closed at 150¾, being a net gain of 2 points, the total sales being 3,395 shares. General Electric closed at 313 asked, being a net loss of 6¾ points, the highest point of the week being 320 and the lowest 311. Westinghouse common suffered a net loss of 4 points while the 1st pfd. made a net gain of 6 points, the closing figures being 210 and 214¼, ex. div., respectively. Western Union closed at 91¾, a net gain of 1½ points; Am. Tel. & Tel. 174⅛, a net gain of 1⅛, and Amer. Dist. Tel. 36, a net loss of 2 points. Following are the closing prices of June 17:

NEW YORK.

	June 10.	June 17.		June 10.	June 17.
American Tel. & Cable..	87	—	Gen. Carriage (n. st'k).	4⅝	4¾
American Tel. & Tel....	174½	177¼	Hudson River Tel.....	103	104
American Dist. Tel.....	[illegible]	[illegible]	Metropolitan St. Ry	149	151⅜
Brooklyn Rapid Transit	[illegible]	[illegible]	N. E. Elec. Veh. Trans.	—	—
Commercial Cable	186	[illegible]	N. Y. L. & T. Co....	13	13
Electric Boat	30	28	N. Y. & N. J. Tel.....	166	166
Electric Boat pfd.....	45	40	Tel. & Tel Co. of Am..	—	—
Electric Lead Reduc'n..	[illegible]	[illegible]	Western Union Tel....	90¼	92
Electric Vehicle	[illegible]	[illegible]	West. E. & M. Co.	[illegible]	—
Electric Vehicle pfd	[illegible]	[illegible]	West. E. & M. Co. pfd.	200	217
General Electric	317½	305			

BOSTON.

	June 10.	Holiday.		June 10.	Holiday.
American Tel. & Tel....	174	—	Mexican Telephone	2¼	—
Cumberland Telephone..	—	—	New Eng. Telephone ...	149	—
Edison Elec. Illum.....	—	—	Westinghouse Elec	—	—
Erie Telephone	[illegible]	—	Westinghouse Elec. pfd.	—	—
General Electric pfd....	—	—			

PHILADELPHIA.

	June 10.	June 17.		June 10.	June 17.
American Railways	45¼	45½	Phila. Traction	97¼	98
Elec. Storage Battery ..	88	90	Phil. Electric	5⅛	5⅛
Elec. Storage Bat'y pfd.	88	90	Pa. Elec. Vehicle	1¼	1¼
Elec. Co. of America....	7¼	7¼	Pa. Elec. Vehicle pfd...	3	3

CHICAGO.

	June 10.	June 17.		June 10.	June 17.
Central Union Tel.....	87½	90	National Carbon pfd....	94	95
Chicago Edison	—	179	Northwest Elev. com...	37¼	36⅝
Chicago City Ry	[illegible]	[illegible]	Union Traction	18½	18½
Chicago Teleph. Co.....	—	170	Union Traction pfd	52½	52½
National Carbon	24½	24½			

TOLEDO RAILWAYS AND LIGHT.—The Toledo Railways and Light Company, with a capital stock of $12,000,000, has passed into the control of interests represented by Kean, Van Cortlandt & Co., New York. With the transfer of the control of this company the famous Everett-Moore syndicate, which controlled the principal street railway systems in Northern Ohio and Southern Michigan, and has been in liquidation for several months, loses control of one of the most important systems in its combination. The Toledo Railways and Light Company controls the street railway system and the electric lighting plant of the city of Toledo. It was organized in July, 1901, and soon thereafter purchased all of the property, rights, and franchises of the Toledo Traction Company and the Toledo Consolidated Electric Company, which consisted of all the street railways and public electric lighting business in the city of Toledo, Ohio. The railway lines of the company consist of 102 miles of standard gauge track, averaging over 75 pounds per yard, and extending through all the principal streets in Toledo. The Toledo Railways and Light Company has a bonded indebtedness of $12,000,000, of which $4,000,000 is outstanding, $6,000,000 is reserved for underlying bonds, and $2,000,000 is reserved for betterments and improvements. The net earnings for the year ended Dec. 31 last, after deduction of taxes, were $674,677. The surplus, after interest payments, was $220,677, or about 2 per cent. on the capital stock. The gross earnings for the four months ended April 30 showed an increase of $46,823, and net earnings an increase of $15,288 over the previous year.

UTICA, N. Y., LIGHTING MORTGAGE.—A first mortgage of $1,000,000 has been executed and filed by the Equitable Gas and Electric Company, of Utica, N. Y., in favor of the Central Trust Company, of New York, as trustee, upon all its property rights and franchises, to secure the payment of 5 per cent., 40-year gold bonds of the said corporation, to the amount of $1,000,000. The gas company covenants and agrees that out of the total issue of bonds, $1,000,000, there shall be retained in the hands of the trustee $150,000 par value thereof, which shall be held by the trustee for the purpose of retiring an issue of 6 per cent., 20-year gold bonds secured by a mortgage given by the Utica Electric and Gas Company to the Central Trust Company, of New York, as trustee, for $150,000. The gas company further agrees that $100,000 par value of said issue shall not be authenticated until the company has deposited with the trustee the sum of $97,500 in cash, which shall be retained in the hands of the trustee to be paid to the company or upon its order only upon the completion of the electric light plant now in process of construction by the gas company.

U. S. TELEPHONE CO.—The bankers' committee in charge of the affairs of the Everett-Moore syndicate has given an option to a party of independent telephone capitalists on the United States Telephone Company, with the result that the latter, it is said, will soon be reorganized and fully financed. The United States is the independent long-distance company operated in connection with the Federal Telephone Company. Its lines now connect with nearly all the cities and towns in Ohio, and are being rapidly extended into adjoining States. Ultimately these lines, it is understood, will be connected with the independent long-distance companies in the East. Connection with Chicago and other Western cities, it is said, will also be made, and a through service between the East and West established. It is announced that a large portion of the stock in the reorganized company has already been underwritten. The United States Telephone Company is capitalized at $2,000,000. Under the reorganization plan, it is proposed to retire the floating indebtedness of the company at once.

N. Y. DISTRICT TELEGRAPH.—An examination of the books of the American District Telegraph Company by expert accountants shows, it is reported, a shortage of between $15,000 and $20,000, according to a statement made by a director of the company. An examination of books, usually undertaken after the resignation of a treasurer, was commenced some time ago. Soon afterward some differences from the usual methods of bookkeeping were discovered which, when followed up, disclosed a discrepancy, which may be only a technical one, or which may be an actual shortage. Mr. Chas. S. Shivler, for twenty-two years past secretary and treasurer, etc., of the company has been arrested and has confessed that his peculations have been going on since 1895. He had a salary of $3,000 a year.

GENERAL ELECTRIC NEW STOCK.—Stockholders of the General Electric Co. are in receipt of a circular notice regarding the recent declaration of 66⅔ per cent. stock dividend, which is made payable July 15 to stock of record June 25. Scrip will be issued in place of certificates for fractional shares, no dividends to be paid on the scrip or fractional shares until the scrip has been exchanged and certificates for whole shares issued in lieu thereof. The Farmers' Loan and Trust Co., of New York, and the American Loan and Trust Co., Boston, on and after July 15, will deliver the certificates and scrip specified. The above transfer agents will buy or sell fractional shares at the market price of the stock at the time when any order may be received.

CHICAGO ELEVATED.—Directors of the Metropolitan Elevated have sold to the First National Bank $1,500,000 4 per cent. extension bonds. The issue is being put out to meet the cost of construction of new electric branches. The price realized is not disclosed, but is understood to be about 93½ with interest.

GREENSBORO, N. C.—According to Greensboro, N. C., dispatches a deal involving the consolidation of all gas, electric light, street railway, and power interests of that city has been consummated, by which control has passed from Baltimore interests into the hands of New York parties.

WESTERN UNION EARNINGS.—The statement of the Western Union Telegraph Company for the quarter ended June 30, partly estimated, was made public last week. It compares with the actual figures for the corresponding quarter of last year as follows, 1902 being estimated for the quarter.

	1902	1901	Increase
Net revenue	$1,850,000	$1,762,436	$87,564
Interest on bonds	254,770	239,040	15,730
[illegible]	$1,595,230	$1,523,396	$71,834
Dividend	1,217,010	1,217,005	5
Surplus	$378,220	306,391	$71,829
Previous surplus	10,330,306	9,012,895	1,317,411
Total surplus	$10,708,526	$9,319,286	$1,389,240

* Estimated.

The fiscal year's figures (partly estimated this year and actual in the year previous) are as follows:

	1902	1901	Increase
Net revenue	$7,249,852	$6,685,248	$564,604
Interest and bonds	992,580	956,160	36,420
Balance	$6,257,272	$5,729,088	$528,184
Dividends	4,868,033	4,868,007	26
Surplus	$1,389,239	$861,081	$528,158
Previous surplus	9,319,286	8,458,205	861,081
Total surplus	$10,708,525	$9,319,286	$1,389,239

METROPOLITAN BONDS.—Messrs. Kuhn, Loeb & Co., who financiered the Metropolitan Securities Company, underwriting $30,000,000 of that company's stock when it undertook to supply the Metropolitan Street Railway Company with $23,000,000 in cash as part of the consideration of the lease, have just purchased from the Metropolitan Securities Company $12,400,000 of the Metropolitan Street Railway Company's bonds. As in the underwriting of the $30,000,000 of the Securities Company's stock, Messrs. Kuhn, Loeb & Co. formed a small syndicate among their friends to underwrite the bonds, it is not known whether the bonds will be offered to the public; or if so, at what price. It is expected they will be exceedingly popular. There were only $65,000,000 of them altogether, and they will ultimately become the first and only mortgage on the property of the Metropolitan Street Railway Company. They are 4 per cent. bonds and they run for one hundred years.

AUTOMATIC TRAIN-CONTROLLER COMPANY.—The Automatic Train-Controller Company is a recent incorporation under the laws of New Jersey to exploit a patented invention to prevent railroad accidents. The company's prospectus calls attention to the fact that 85 per cent. of the country's railroad mileage is absolutely without any system of signal protection, and that the subject of controlling trains automatically is now receiving attention in government and legislative quarters. The company is capitalized at $1,000,000, all common stock, par $10, the first allotment of which is being offered at $5 per share. The officers are: J. L. McLean, of J. L. McLean & Co., bankers and brokers, president; C. A. Shea, treasurer, and H. A. Herr, secretary. A complete working model of the invention may be seen at the company's office, 25 Broad Street, New York.

AMERICAN BICYCLE.—The American Bicycle Co. is now absolutely controlled by Col. A. A. Pope and John D. Rockefeller. Mr. Pope recently had some serious differences with the old management, sold his holdings and resigned from the presidency. Since then, however, he has repurchased his stock, and he and John D. Rockefeller now own a majority of the outstanding stock. A majority of the common stock was purchased in the stock market between $6 and $9 per share. John D. Rockefeller has become interested in the company during the past five months. In the near future the management will undergo a change, and Col. A. A. Pope will again be placed in charge of the company's affairs. Automobile business will be a notable feature.

GOLD CAR HEATING & LIGHTING.—The Gold Car Heating and Lighting Company, which has just been incorporated under the laws of the State of New York with a capital of $1,000,000, has purchased outright the entire business of the Gold Car Heating Company of New York, Chicago, and London, and also the entire business of the Gold Street Car Heating Company. Edward E. Gold, of New York City, has been elected President of the new company and made Chairman of the Executive Committee. The business has been one of the most successful of its kind and has enjoyed a large measure of prosperity.

DIVIDENDS.—The directors of the Hall Signal Co. have declared a quarterly dividend of 1½ per cent. This is an increase of ½ per cent. over the previous regular rate. A dividend of $1 a share has been declared on the Hestonville, Mantua & Fairmount Ry. common stock and $1.50 on the preferred stock. New York Metropolitan directors have declared the regular quarterly dividend of 1¾ per cent., payable July 15. The Commercial Cable Company has declared a quarterly dividend of 1¾ per cent., payable July 1.

BOSTON EDISON.—The Massachusetts Gas Commissioners have authorized the Edison Electric Illuminating Co., of Boston, to issue 16,500 new shares at $200 per share.

ROCHESTER, N. Y.—Word comes by way of Philadelphia that Stone & Webster, of Boston, have been making inquiries in Rochester, with the view of acquiring the Rochester Gas & Electric Company, which has absorbed all the heating and lighting companies of that city, and also the Rochester Railway, with the view of combining the properties, as is being done in New Orleans.

LOUISVILLE TROLLEYS.—The Louisville Railway will receive $300,000 of new 44-foot electric cars by July 1, and will put them into service at once. The company is gradually introducing modern equipment, and will spend $400,000 in improvements this year. The business of the company was never so good, earnings gaining an average of $10,000 a month and likely to go to $1,750,000 for the year, against $1,620,000 last year.

Commercial Intelligence.

THE WEEK IN TRADE.—The effect of the anthracite coal strike has widened, and distributive trade of a larger area has been touched by its influence. Good crop prospects, on the other hand, give much hope for future business. Generally, the outlook is favorable, and confidence in fall trade is evidently growing. "Export business, notably manufactured goods, is certainly improving," says *Bradstreet's*, "and cotton goods and copper, mineral oils and lumber are all moving freely." The demand for the cruder forms of iron continues undiminished, while finished products are quite active notwithstanding the quieting influences of the season. Building activity is impaired except where labor troubles interfere. Pig iron, steel rails, structural material and, in fact, all of the heavier kinds are as active as ever. In all 650,000 tons of rails are reported sold ahead for next year's delivery. Railway gross earnings for the month of May aggregate $54,143,739, a gain of 9.3 per cent over the same month last year. The granger roads report the heaviest ratio of increase, 15 per cent., while the Pacific coast roads are second on a gain of 14.5 per cent., and the southern lines third with an increase of 11.6 per cent. From the latter percentage gains range down to 3.3 per cent., reported by the southwestern railroads. The business failures during the week, as reported by Bradstreet's, aggregated 165, as against 153 the week previous and 188 the same week last year. Copper was easier during the week at an average price of 12¹⁵⁄₁₆c.

BUENOS AYRES HORSE ROAD TO BE CONVERTED.—The Buenos Ayres Grand National Tramways Company, Limited, a British capitalized concern, which operates about 50 miles of horse tramways, employing nearly 300 cars, in the City of Buenos Ayres, Argentine Republic, is about to be electrically converted, according to private advices just received from South America. Mr. J. Hamden Wall, the general manager of the company, is now on his way to London for the purpose of conferring with his directors on the subject. The consulting engineers of the company are Sir George Bruce and White, London. The company's head offices are at 6 Eastcheap, London, E. C.

WESTINGHOUSE ENGINES AND GENERATORS.—The Woonsocket Machine & Electric Company, of Woonsocket, R. I., has placed a contract with Westinghouse, Church, Kerr & Company, calling for the shipment of two 20x40x48 horizontal cross compound condensing Westinghouse-Corliss engines and the same number of direct current Westinghouse street railway generators of 750 kw. capacity each. This contract was secured by the Boston office of the Westinghouse interests.

PLANT FOR PITTSBURG BUILDING.—The Westinghouse Electric & Mfg. Company has received a contract for the electric lighting plant to be installed in the 24-story Farmers' Deposit Bank Building on the corner of Fifth Avenue and Wood Street, Pittsburg. The Phoenix Iron Works, Meadville, Pa., have received the contract for a 400-hp engine for this plant.

NATIONAL TUBE PLANT.—A 400-hp direct-connected outfit, consisting of engine, built by the Ball Engine Company, Erie, Pa., direct connected to Westinghouse alternator, will be installed at the National Tube Company's works, Middletown, Pa.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the eports of electrical materials and machinery from the port of New York for the week ended June 7: Antwerp—17 pkgs. material, $1,193. British East Indies—27 pkgs. material, $1,009; 2 pkgs. machinery, $50. Berlin—2 pkgs. material, $40. Brazil—59 pkgs. material, $2,830. Bremen—4 pkgs. material, $222. British Poss. in Africa—246 pkgs. material, $6,943. Brussels—16 pkgs. machinery, $750. Barcelona—3 pkgs. material, $100. Bilboa—2 pkgs. material, $85. British West Indies—33 pkgs. material, $805. Bournemouth—4 pkgs. material, $228. Central America—5 pkgs. material, $41. Copenhagen—4 pkgs. machinery, $391. Chili—9 pkgs. material, $175. Christiana—5 pkgs. machinery, $1,023. Frankfort—1 pkg. machinery, $50. Glasgow—52 pkgs. machinery, $2,800; 1 pkg. material, $32. Genoa—2 pkgs. material, $20. Gibraltar—1 pkg. machinery, $39. Hong Kong—1 pkg. material, $70. Hamburg—11 pkgs. machinery, $5,159; 14 pkgs. material, $807. Havre—31 pkgs. material, $648; 1 pkg. machinery, $60. Japan—3 pkgs. material, $1,250. Liverpool—399 pkgs. machinery, $19,744; 17 pkgs. material, $529. London—223 pkgs. machinery, $18,668; 75 pkgs. material, $4,025. Mexico—20 pkgs. material, $321; 14 pkgs. machinery, $2,003. Manchester—11 pkgs. machinery, $1,040; 114 pkgs. material, $9,277. Peru—3 pkgs. material, $294. Portsmouth—4 pkgs. material, $298. Reval—17 pkgs. machinery, $420. Southampton—4 pkgs. material, $211. Trieste—4 pkgs. machinery, $90; 4 pkgs. machinery, $700. U. S. Colombia—128 pkgs. material, $2,043. Vienna—2 pkgs. machinery, $75. The following are the exports of electrical materials and machinery for the week ended June 14: Antwerp—20 pkgs. material, $933; 1 pkg. machinery, $200. Argentine Republic—4 pkgs. machinery, $1,620; 54 pkgs. material, $665. Amsterdam—1 pkg. material, $65. Azores—3 pkgs. material, $250. Athens—6 pkgs. material, $250. Barcelona—17 pkgs. machinery, $413. Berlin—2 pkgs. material, $45. Bremen—2 pkgs. material, $50. British East Indies—12 pkgs. machinery, $2,137; 49 pkgs. material, $1,094. British Guiana—49 pkgs. material, $741. Brazil—76 pkgs. material, $5,868; 12 pkgs. machinery, $951. Bergen—4 pkgs. machinery, $645. British Australia—83 pkgs. machinery, $6,575; 83 pkgs. material, $2,387. Cuba—2 pkgs. machinery, $468; 49 pkgs. material, $2,504. Central America—25 pkgs. machinery, $557. Copenhagen—8 pkgs. machinery, $521. Chili—15 pkgs. material, $410. Danish East Indies—1 pkg. machinery, $25. Danish West Indies—2 pkgs. machinery, $11. Dutch West Indies—7 pkgs. material, $64. Egypt—42 pkgs. material, $650. Gibraltar—1 pkg. material, $27. Genoa—5 pkgs. material, $253. Glasgow—12 pkgs. material, $795; 3 pkgs. machinery, $335. Gijon—4 pkgs. material, $135. Hamburg—31 pkgs. material, $1,291. Hong Kong—8 pkgs. material, $308. Havre—3 pkgs. machinery, $140; 30 pkgs. material, $580. Japan—3 pkgs. material, $115. Lisbon—77 pkgs. material, $2,733; 2 pkgs. machinery, $342. London—24 pkgs. machinery, $12,718; 245 pkgs. goods, $13,662. Leicester—2 pkgs. material, $186. Liverpool—477 pkgs. machinery, $37,975; 247 pkgs. material, $5,112. Malmo—1 pkg. machinery, $269. Mexico—327 pkgs. material, $6,009; 12 pkgs. machinery, $1,005. Milan—1 pkg. material, $50. Marseilles—25 pkgs. material, $115. Naples—11 pkgs. machinery, $750. New Zealand—71 pkgs. machinery, $3,500; 171 pkgs. material, $1,031. Oporto—32 pkgs. machinery, $5,065. Peru—13 pkgs. material, $1,107. Portsmouth—4 pkgs. material, $304. Philippines—81 pkgs. material, $3,112. Riga—13 pkgs. material, $500. San Domingo—30 pkgs. material, $350. Southampton—6 pkgs. material, $141; 86 pkgs. machinery, $7,680. Stockholm—1 pkg. machinery, $103; 1 pkg. material, $135. Siam—24 pkgs. material, $2,677. U. S. Colombia—2 pkgs. material, $43. Venezuela—91 pkgs. material, $1,592. Warrington—10 pkgs. material, $252.

SALES OF ALLIS-CHALMERS ENGINES.—We give below a partial list of Allis-Chalmers engine sales for May, 1902. Wolf River Paper Co., Shawano, Wis., one 18 in.x36 in., one 22 in.x48 in. Southern Cotton Oil Co., New York City., one 14 in.x36 in., four 18 in.x42 in. Surrey Lumber Co., Baltimore, Md., 26 in.x48 in. S. P. Brown & Co., Albany, Ga., 16 in.x42 in. Devoe & Raynolds Co., Chicago, Ill., 22 in.x42 in. Carnegie Steel Co., Pittsburg, Pa., five pair vertical cross compound blowing engines, steam cylinders 46 in. and 86 in.x60 in., air cylinders, 84 in. and 84 in.x60 in. Rapid Transit Subway Construction Co., New York City, two combined vertical and horizontal Reynolds Corliss engines, cylinders, 42 in. and 86 in.x60 in. Union Steel Co., Pittsburg, Pa., three 26 in.x52 in.x48 in. horizontal cross compound direct coupled Reynolds Corliss engines. Willis Coal & Mining Co., Murphysboro, Ill., 18 in.x42 in. Gunther Foundry Machine & Supply Co., San Antonio, Tex., 16 in.x36 in. Buffalo Union Furnace Co., Buffalo, N. Y., vertical long crosshead blowing engine, steam cylinder 42 in.x60 in. air cylinder 84 in.x60 in. Studebaker Bros. Mfg. Co., South Bend, Ind., 22 in.x42 in. cross compound direct coupled Reynolds Corliss engine. Colorado Milling & Elevator Co., for Monte Vista Mill, Colo., 14 in.x36 in. Great Western Gold Co., Calif., one 14 in.x36 in. Park City Sampling Mills, Utah, one 16 in.x36 in.

THE OTIS ELEVATOR COMPANY announces the recent closing of contracts for more than fifty electric passenger elevators in New York and vicinity, forty-five of which will be installed in New York City proper. Further recent contracts cover installations for elevators to be installed in Yokohama, Japan, Melbourne, Australia, and Buenos Ayres, South America. Within the past week three large contracts have been closed for Otis standard hydraulic elevator plants in large office buildings, covering a total of 24 installations, as follows: The twenty-four story office building being erected for the Farmers' Deposit National Bank, of Pittsburg, Messrs. Alden & Harlow, architects, and the George A. Fuller Company, contractors, will be equipped with ten high speed hydraulic passenger elevators and several small elevators for freight and special service. The twenty-story office building being erected for the Corn Exchange National Bank at 15-19 William Street, New York City, Messrs. Robertson & Potter, architects, and John Downey, contractor, will be equipped with nine high speed hydraulic passenger elevators. The twenty story office building being erected for Messrs. Kuhn, Loeb & Company, at 54 William Street, New York City, Mr. James B. Baker, architect, and the Thompson-Starrett Company, contractors, will be equipped with five high speed hydraulic passenger elevators.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY of Chicago has recently closed a contract with the Northern Construction Company for a central energy multiple switchboard for Hamilton, O., consisting of three 6-panel, 3-position sections, having a total present equipment of 960 local common battery lines and 20 toll lines. Each section will contain multiple jacks for 960 lines, making the board fully multiple. The ultimate capacity of the board is 3,000 multiple lines. Included in this contract is the main and intermediate distributing frames, power plant, 900 standard common battery wall telephones, and 100 desk sets complete.

THE BOSWORTH-HOLDING COMPANY, of Cleveland, has recently been formed by W. H. Bosworth and H. H. Holding, both well known in the machinery trade in that section, with headquarters at 26 Merwin Street. It will handle new and second-hand machine tools, dynamos, motors, engines, boilers and electrical appliances and will act as Cleveland agents for the C. & C. Electric Company, the Helios-Upton Company, the Griffith & Wedge Company, the Mansfield Engineering Company, the Gem City Boiler Company, and Thomas Carlin's Sons Company.

THE D. S. & M. MANUFACTURING CO. has been organized at Cleveland, O., to manufacture telephone hardware specialties. The active members of the firm are George S. DuPont, Z. F. Sneyd and A. C. Morse, all of whom have been identified with the Federal Telephone Company in its construction work throughout Ohio. They are fully alive to the necessities of telephone line work and their chief productions will be cable hangers and messenger hangers of new and durable design.

STEAM TURBINES FOR ROSLYN, L. I.—Westinghouse, Church, Kerr & Company have been allotted a contract for two 400 hp Westinghouse steam turbines for installation in the plant of the Roslyn Electric Light Company, of Roslyn, L. I. The order was placed by C. O. Mailloux, the electrical engineer of 76 William Street, New York, who is acting as consulting expert for the Roslyn plant.

WEST POINT, N. Y.—The plans prepared for the expenditure of between $5,000,000 and $6,000,000 on improvements to the United States Military Academy, at West Point, N. Y., include a central power station, $1,146,000; new pumping station and stand tower, $10,000; modern fuel gas plant, $60,000, and steam heating plant, $25,000.

THE JENNEY ELECTRIC MFG. CO., of Indianapolis, Ind., has recently installed its special geared linotype motors in the following well-known newspaper offices: Kansas City Journal, Pittsburg Dispatch, Portland Oregonian, Minneapolis Journal, Cincinnati Times-Star, Baltimore American, Kansas City World, St. Paul Dispatch.

WESTINGHOUSE COMPANY BUYS MEXICAN COPPER MINES.—The Westinghouse Electric & Manufacturing Company is again reported to have purchased some copper properties, this time in the State of Sonora, Mexico. The purchase price is said to have been $125,000 gold.

RAILROAD SHOP PLANT.—The Atcheson, Topeka, and Santa Fe Railroad shops at Topeka, Kan., are installing a 1200-hp. electric power plant, consisting of four Ball tandem compound self-oiling engines direct connected to General Electric generators.

General News.

THE TELEPHONE.

LOS ANGELES, CALIF.—The Sunset Telephone Company will reduce its rates in Los Angeles in the effort to meet the prospective cut of the new Home Telephone Company.

LOS ANGELES, CALIF.—The Kellogg Switchboard & Supply Company has secured the contract for the switchboard and 6000 telephones from the Home Telephone Company, Los Angeles, Calif. Included in this contract is a two-position chief operators' desk, two-position wire chiefs' desk, two-position information desk, and a one-position monitors' desk, provided with the necessary connections in and to the local board, completely wired for the present equipment. The system is to be the very latest common battery multiple relay type.

DOVER, DEL.—The National Telephone Company, of New York City, has been incorporated here with a capital of $3,000,000. The incorporators are John H. Lewis, Wm. E. Milne, of New York City, and James G. Gregg, of Morristown, N. J.

WILMINGTON, DEL.—The Delaware Long-Distance Telephone and Telegraph Company was incorporated at Dover, Del., last week, with a capital stock of $250,000. The incorporators of the concern are Jesse Slinghuerr and Carroll T. Bond of Baltimore and John G. Gray of Wilmington, Del. The purpose of the company is to construct a long-distance telegraph and telephone line in Delaware, Maryland and Pennsylvania.

ATLANTA, GA.—A receiver has been appointed for the Standard Telephone Company, of Atlanta.

COLUMBUS, GA.—By a new deal the Bell Long Distance Telephone Company will connect with the system of C. W. Moore, of Paschal, Ga., who operates long-distance lines in several counties. The Bell company will also build from Columbus to Talbotton, also to Buena Vista, thence to Plains and other points, and finally to Lumpkin, Ga.

BLISS, IDAHO.—The local telephone which connects Hagerman with Bliss, and owned by W. L. Colthorp, will be extended to Salmon Falls and Shoshone.

WAUKEGAN, ILL.—The Chicago Telephone Company will soon erect a fine new building in Waukegan.

GALESBURG, ILL.—The Galesburg Union Telephone Company has increased its capital from $100,000 to $150,000.

TROWBRIDGE, ILL.—The Trowbridge Mutual Telephone Company has been incorporated by H. C. McClory, J. C. Quinn and Bernard Wilson. Capital $1500.

QUINCY, ILL.—The Adams County Telephone Exchange at Camp Point was struck by lightning and the building and contents were destroyed by the resulting fire.

ALTON, ILL.—The Central Union Telephone Company has established an exchange at the Liberty Prairie post-office, and farmers in the vicinity are installing telephones in their residences. Rural telephone lines are becoming quite numerous in the county.

ALTON, ILL.—Manager W. W. McKee, of the Alton Exchange of the Central Union Telephone Company has completed a deal whereby all the lines of the Calhoun County Telephone Company are leased to the Central Union for a term of years. The Bell instruments will be used on the system, which connects every town and village in Calhoun County with Grafton and the outside world.

VENDOME, IND.—The Vendome Telephone Company has been incorporated with a capital stock of $2000.

EVANSVILLE, IND.—Officials of the long-distance telephone company have offered to build two lines to Evansville from Louisville, Ky., to aid the movement for a local municipal plant.

MARKLE, IND.—Citizens of this place have organized an independent telephone company with $6,000 capital stock. An exchange will be installed and connection will be made with Pleasant Grove, Center, Zanesville and Ft. Wayne.

INDIANAPOLIS, IND.—The following companies have been recently incorporated: The Uniondale Rural Telephone Company, of Uniondale; capital stock, $1,300. John Smith heads the board of directors. The Needmore Telephone Company, of Needmore; capital stock, $2,000. J. B. Fleener heads the board of directors. The Beech Valley Rural Telephone Company, of Beech Valley, Ind.; capital, $130. Martin Pearson heads the board of directors. The Steuben County Farmers' Telephone Company; capital stock, $25,000. Directors Charles Griffith, C. W. De Lancy and T. W. Teagarden.

EVANSVLLE, IND.—The project to construct, maintain and operate a municipal telephone plant in this city is a question of much contention, and the stock is not being subscribed for as readily as first supposed. At a recent meeting of the Council, to further the project, to which the citizens were invited, the business men were not very numerous nor much in evidence in the discussion. It was stated that the greater number of telephones operated, the greater would be the expense, and that time will prove that a large plant cannot be maintained and operated at a low ordinance rate. A sliding scale of charges, to be increased with the increase of connections, was declared to be a future necessity. This argument was calculated to dampen the ardor of the municipal ownership people who had been led to believe the sliding scale would be to lessen rather than increase the cost of service.

[illegible] the Adams Telephone Company is building a new line from Grant to Elliott.

MITCHELLVILLE, IA.—Local people are taking steps toward the organiza-[illegible]

EMPORIA, KAN.—Frank L. Brown has bought a controlling interest in the Emporia Telephone Company. Mr. Brown has an interest in most of the independent telephone companies in the southern part of the state.

AUGUSTA, ME.—The People's Telephone and Telegraph Company has been organized for the purpose of establishing a telegraph and telephone system in Worcester, Mass., and in the territory of Oklahoma and the island of Porto Rico, with $500,000 capital stock. President, Hamilton Braman, of Boston, Mass.; treasurer, Frank E. Baldwin, of Boston, Mass.

ST. LOUIS, MO.—The St. Louis County Court has assessed the telephone and telegraph companies as follows: Pacific Mutual Telegraph Company, 27.25 miles of poles, $60 per mile; 190.75 miles of wire, $10 per mile. Western Union, 921.41 miles of poles, $60 per mile; 6,450 miles of wire, $10 per mile. Bell Telephone, 14.79 miles of poles in Kirkwood, Florissant, Ferguson and Pacific, $60 per mile; 178.91 miles of wire, $10 per mile; outside of incorporate towns, 90.28 miles of poles, $60 per mile; 395.75 miles of wire, $10 per mile. American Telephone Company, 42.63 miles of poles, $60 per mile; 230.13 miles of wire, $10 per mile. Kinloch Telephone Company, 15 miles of poles, $60 per mile; 150 miles of wire, $10 per mile.

LEWISTON, MONT.—An independent telephone company will be organized at Lewiston. Those interested are: D. G. Higler, George Butch, G. M. Stone and D. M. Crowley.

PAULDING, OHIO.—The Paulding Home Telephone Company is building a line to Latty.

COLUMBUS, OHIO.—The Spencerville (Ohio) Telephone Company has increased its capital from $20,000 to $40,000.

SOUTH CHARLESTON, OHIO.—The Madison-Clark Telephone Company is preparing to build an exchange at South Solon.

PROSPECT, OHIO.—The Citizens Telephone Company is completing its new exchange at Prospect. Lines to Waldo and Richwood will be built in the near future.

STEUBENVILLE, OHIO.—For the second time within two weeks the exchange of the Phœnix Telephone Company was damaged by fire from crossed wires. About 100 telephones were burned out.

VERMILLION, OHIO.—The Vermillion Telephone Company has been incorporated, with $25,000 capital stock, by E. L. Coen, C. C. Baumhart, R. F. Quigley, Charles McGraw and W. H. Fledderjohorm.

WARRENSVILLE, OHIO.—The recently organized Warrensville Telephone Company will have its exchange in operation within 30 days. Connection with the United States long-distance lines will be made at Randall.

SALEM, OHIO.—Negotiations are pending for the sale of the Everett-Moore interests in the Columbiana County Telephone Company to the minority stockholders. The system is one of the largest controlled by the Federal Company and it is understood the Cleveland interests are offered at $300,000.

BLACKBURN, OKLA.—The Blackburn Improvement Company, Blackburn, Okla., will install a telephone system and erect an electric light plant. The officers are: M. M. Rhodes, president; W. E. Brady, first vice-president; John Landes, second vice-president; G. H. Schultz, secretary, and Frank Landes, treasurer.

TROJT RUN, PA.—The Rohe Valley Telephone Company, Trout Run, Lycoming County, capital, $600, has been incorporated.

SHICKSINNY, PA.—The Lower Luzerne Telephone & Supply Co., of this place, has been incorporated with a capital of $7500.

BUTTONWOOD, PA.—The Jackson Telephone Company, of Buttonwood, Lycoming County, has been incorporated; capital, $12,000.

CHESTER, PA.—The Bell Telephone Company has completed its new exchange in Media. The new equipment cost about $36,000.

PHILADELPHIA, PA.—The Keystone Telephone Company hasreceivedan order from the Union Traction Company for the installation of a private system of 250 telephones.

PHILADELPHIA, PA.—The Keystone Telephone Company has over 4000 telephones in operation, and new subscribers are, it is stated, being added at the rate of 80 to 100 daily.

PARIS, TEXAS.—The Citizens Telephone Company of Paris has been incorporated with $120,000 capital stock with A. H. O'Neill, R. W. Wortham, James Bastable, Frank Bain, B. Seymour, Joseph Timmons, H. J. Runkle, J. W. Fulton, George E. Crane, D. O. Fruth, B. S. Young and C. S. Ames. All except the first two are residents of Kenton and Fostoria, Ohio. McCrady & Mitchell of Austin will build the line.

FREDERICKSBURG, VA.—The Northern Neck Telephone Company will build a branch line to Lewisetta on the Potomac River in Northumberland County. The Madison Telephone Company is building a branch line from Madison Court House to Criglersville and one to Wolfstown.

ELKINS, W. VA.—The West Virginia Eastern Telephone Company has completed a line between Elkins and Phillipi. The company is building a substantial system in connection with the Bell system.

MILTON, WIS.—The Milton Telephone Company has been sold by its owners, Richardson & Hadden, to Mrs. Oviatt & Son.

EAU CLAIRE, WIS.—The Wisconsin Telephone Company will erect a telephone building at Grand avenue and Farewell street.

KENOSHA, WIS.—The Bristol Rural Telephone Company has applied to the town of Somers for a franchise to build its line through the town, in order to connect the village with the large system now under control of the company. Many Racine County farmers living near the line are asking that the system be extended to their district.

PLYMOUTH, WIS.—At the late meeting of the Wausaukee Telephone Company the following officers were elected: President, E. F. Fox; vice-president and general manager, A. W. Larson; secretary and treasurer, C. Nutt. The capital stock of the company is $10,000. It will establish an exchange at Wausaukee and build toll lines in Marinette and Oconto Counties.

ELECTRIC LIGHT AND POWER.

REDDING, CALIF.—The large iron ore reduction plant to be built thirty miles northeast of Redding, on the Pitt River, will use electric power furnished by the McCloud River Electrical Power Co., which is now building a plant on the McCloud River.

SAN FRANCISCO, CALIF.—The Tuolumne County Electric Company was recently forced to shut down its electric power plant, which supplies power for the mines on the mother lode in Tuolumne County. A heavy storm caused a washout, which carried away sixteen sections of the flume and damaged the ditch.

LOS ANGELES, CALIF.—Orders have been placed for the Pacific Light & Power Company's plant. The boiler order to the Stirling Company called for 1000-hp. McIntosh & Seymour obtained the engine contract. The Westinghouse Electric & Manufacturing Company received a contract for a 750-kw. generator.

SAN FRANCISCO, CALIF.—The Riverside Power Company, of Riverside, Calif., which was recently formed to supply electric light and power in Riverside and Covina, will build a canal costing $85,000. The entire electric power plant, with a capacity of 700 hp, will cost about $200,000. The company will use the water of the Santa Ana River.

SAN FRANCISCO, CALIF.—The Northern Counties Power Company, of California, has been incorporated by I. J. Truman, Joseph Martin, of San Francisco; William Ellery, John R. Phelps, L. B. Edwards, Curtis Hillyer and William F. Buttle. The capital stock is $250,000. An electric plant will be installed in the northern part of the State.

SAN FRANCISCO, CALIF.—The report that the water rights acquired by the Copper Belt Railway and Power Company had lapsed and had been re-located by Thos. Hill, of Redding, Calif., has been denied by the Copper Belt promoters. An electric power plant will be installed on the McCloud River. An electric railway from Bully Hill to Kennett, Shasta County, is also projected.

SAN FRANCISCO, CALIF.—The Mariposa Commercial and Mining Company's California electric power plant is now in successful operation. Current is transmitted at 15,000 volts and is stepped down to 440 volts. The machinery at the mill is operated from one motor, and an additional air compressor at the mine is operated by another. The mine hoist will be driven by compressed air.

CANYON CITY, COLO.—The Colorado Electric Power Company, of Canyon City, has been granted a franchise to light the town of Cripple Creek.

DENVER, COLO.—The Otero County Interurban Light and Power Company, of Denver, has been incorporated. Capital, $1,000,000. The promoters are: Senator Swink, W. B. Cobin, H. P. Dye, J. W. Beaty, F. M. Wieland and C. F. Lacombe. The purpose of the company is to build an electric railway and to furnish power to a number of towns along the route.

DALTON, GA.—Electric light bonds to the amount of $10,000 have been sold and bids will be advertised for at once for the erection of a plant.

CADWELL, IDAHO, has a new electric light plant. A Warren 3,200-volt alternator is in service. Water power will be substituted later on.

POCATELLO, IDAHO.—The Idaho Canal and Improvement Water Power Company, Limited, has been incorporated at Pocatello, with a capital of $500,000, by J. H. Brady, A. B. Melville, W. S. Chaney, A. T. Marshal and F. S. Stobbs. The company will purchase water rights and build a large power plant.

FORT WAYNE, IND.—The Jenney Electric Light & Power Company of this city has been sold to the Fort Wayne Electric Works.

LOUISVILLE, KY.—The Citizens' Lighting Company has received a permit to erect a three-story brick building, practically doubling the capacity of the present plant. A 1,600-kw lighting generator and a power generator of 1,200 hp will be placed in the new addition.

CROWLEY, LA.—The city of Crowley proposes putting in an electric light plant. Information will be given by Mr. Armas Durio.

SPRINGFIELD, MASS.—The municipal electric light plant will receive extensive improvements, at an expense of $10,000. A new engine and dynamo will form part of the new equipment.

WILLIAMSBURG, MASS.—Considerable new equipment will be installed by the recently organized Mill River Electric Light Company of Williamsburg, Mass., which will put in a power plant, using sawdust, shavings and slabs as fuel. Henry W. Hill is treasurer.

NORTH WILBRAHAM, MASS.—The plant of the Whiting Paper Company at this place will be enlarged to double its present size and will be operated by electric power. The new plant will be so designed that source of the power may be steam or water or a combination of both.

MINNEAPOLIS, MINN.—The Cottagewood Water & Light Company, of Minneapolis, has been incorporated with a capital stock of $2,000. Among the incorporators are Fred. Tayran and F. J. Hopkins of Minneapolis.

ST. LOUIS, MO.—The Union Electric Light, Heat and Power Company of St. Louis has been chartered, with a capital stock of $10,000,000. It is the consolidation of the Imperial Electric Light, Heat and Power Company and Citizens' Electric Lighting and Power Company. The directors are E. C. Bruckman, H. P. C. Coats, S. B. Way, J. H. Drabelle, George Milbart, Adolphus Busch, Sam M. Kennard, William J. Lemp, Julius S. Walsh and William L. Nalker.

NASHUA, N. H.—The city's new contract with the Nashua Light, Heat & Power Company makes the price for arc lights $100 per year, and for incandescents $30 each.

OSWEGO, N. Y.—The Oswego Electric Light Company has been organized with a capital of $50,000. The directors are James G. Holleran, John D. McRae and John P. Miller, of Oswego.

LITTLE FALLS, N. Y.—The Consumers' Electric Light Company of this place has been incorporated with a capital of [illegible]. The directors are [illegible] heim, P. W. Castler and George D. Ferguson.

NEW YORK, N. Y.—Commissioner Dougherty, of the Department of Water Supply, Gas and Electricity has notified all corporations and companies having overhead electric wires in Brooklyn within two miles of the Bridge that they must prepare immediately to put the wires under the ground.

DURHAM, N. C.—It is reported that J. B. Duke, president of the American Tobacco Company, has placed orders for machinery for a million-dollar cotton mill, to be built at Great Falls, on Catawba River, in Chester county, S. C. The Dukes own enough water power in the South to run a million spindles.

KENTON, OHIO.—The Kenton Cracker Company, Kenton, Ohio, will build a power house and its machinery will be operated by electricity.

SANDUSKY, OHIO.—The American Crayon Company is putting in a new power house with boilers of 475 hp, and a 400-hp engine and a 500-hp generator, accompanied by a Buffalo Forge fan and heater system.

BAKER CITY, ORE.—The City Council has granted a franchise to A. Prescott, J. A. Veness and L. T. Turber for electric light and power privileges.

YORK, PA.—The York Haven Electric Transmission Company has been incorporated with a capital of $30,000. The directors are W. F. B. Stewart, H. L. Carter and James H. Norris.

M'KEESPORT, PA.—The common council has passed the ordinance appropriating $60,000 for the erection of a municipal electric light plant. The measure has yet to pass through the Select Branch, where it will probably meet with some opposition.

TURNER, WASH.—The new malt plant to be erected here will use electric power. The new company will spend about $300,000 in the erection of the plant.

MT. VERNON, WASH.—The Mt. Vernon Water, Electric and Power Company has been incorporated, with a capital of $50,000. W. R. Morgan, R. F. Guerin and H. R. Lamb are interested.

AMERY, WIS.—The Amery Electric Company has been incorporated, with $7,500 capital, by G. G. Griffin, L. Q. Olcott and G. Heald.

THE ELECTRIC RAILWAY.

LOS ANGELES, CALIF.—A positive denial of the report that he had purchased the Los Angeles Traction Company is made by H. E. Huntington, president of the Pacific Electric Railway Company and the Los Angeles Railway Company. The option which Senator W. A. Clark, of Montana, holds on the Los Angeles Traction Company will not expire until July.

RICHMOND, IND.—The Richmond & Northwestern Traction Company, capital stock $50,000, has been organized by G. M. Hodges of Dayton.

PORTLAND, IND.—The Eastern Indiana Traction Company has amended its charter to permit it to build a line from here to Richmond and from Ridgeville to Gas City.

KANSAS CITY, KAN.—The Kansas City Outer Belt & Electric Railway Company has been incorporated with a capital of $1,500,000.

BOSTON, MASS.—The Boston Elevated people state they have agreed to accept a lease of a two-track subway for 25 years at 4½ per cent. at the urgent request of Governor Crane.

UNION CITY, MICH.—The Southern Michigan Traction Company has revived the project for an electric railway from Coldwater to Battle Creek and is securing private right of way.

ALBANY, N. Y.—The Salamanca & Little Valley Railroad Company has been incorporated; capital, $400,000. Directors: J. S. Rockwell and C. W. Hammond of Buffalo; E. B. Vreeland, Hudson Ausley, J. J. Spencer of Salamanca; A. E. Danlow and E. E. Kelly of Little Valley, and D. J. Bissell of Leroy.

NEW YORK CITY.—Work will begin at once on the Eighth street crosstown line, which is to be converted for operation by the electric conduit. This is one of the most important of the crosstown lines, as it taps the heavy passenger business of the Christopher Street Ferry. Later a change will be made on other crosstown lines belonging to the company.

GREENSBORO, N. C.—A deal has been consummated involving the consolidation of all electric light and street railway, gas and power interests of the town. The Greensboro Electric Company is the promoter. Dr. F. A. C. Perrine was elected president at the reorganization meeting.

YOUNGSTOWN, OHIO.—A. W. Jones, John H. Ruhlman and W. S. Anderson, of Youngstown, are promoting an electric railway, to extend from Youngstown to Columbiana.

NEW PHILADELPHIA, OHIO.—The Council has granted a franchise to representatives of Tucker, Anthony & Company for the proposed extension from Massillon to New Philadelphia.

DELPHOS, OHIO.—The promoters of the Lima, Delphos, Van Wert & Ft. Wayne Traction Company announce that construction work will start at once. The power house will be located at Delphos.

BUCYRUS, OHIO.—J. H. Merrill, of Cleveland, has been appointed general manager of the Ohio Central Traction Company and the Mansfield, Crestline & Galion Railway, succeeding W. E. Haycox.

AKRON, OHIO.—The Northern Traction Company has increased the wages of its first year men from 17 cents to 18 cents an hour. Wages of the older men were recently increased from 19 cents to 20 cents an hour.

DAYTON, OHIO.—It is reported that the Dayton, Springfield & Urbana Railway will build its main car shops and repair shops at Dayton instead of at Springfield. The contemplated improvements will cost about $150,000.

TOLEDO, OHIO.—The Toledo & Indiana Railway Company has obtained additional financial backing and is placing contracts for material to build the road. President C. P. Griffin has established offices at 826 Spitzer Building, Toledo.

BRYAN, OHIO.—George Yesbera and J. W. Williams, of this place, are interested in the organizing of the Southern Michigan Electric Railway, which proposes to build from Hillsdale, Mich., to Bryan. A number of franchises have been secured.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Electric Railway Company has decided to commence work within 30 days on the extension of the road from Fostoria to Toledo. All right of way has been secured, and contract has been placed with the Dover Construction Company.

YOUNGSTOWN, OHIO.—The directors of the Mahoning Valley Electric Railway Company have elected the following officers: Murray Verner, Pittsburg, president; C. F. Clapp, Warren, first vice-president; B. F. Miles, Cleveland, second vice-president; John E. McVey, Youngstown, secretary; A. A. Anderson, Youngstown, treasurer and general manager.

OTTAWA, ONT.—A deal has been ratified by which the Electric Tram Company, of Halifax, Nova Scotia, has purchased the property and franchise of the People's Heat & Light Company, thus centralizing in one corporation the electric light and gas interests of that city.

JACKSON, TENN.—The Thompson syndicate of Pennsylvania capitalists has taken charge of the Jackson Street and Suburban Electric Railway. It is understood that the line will be extended.

SALT LAKE CITY, UTAH—De Soto has secured a blanket franchise to construct and operate an electric railway throughout Snowhomish County, Wash.

NEWPORT NEWS, VA.—W. B. Livezey has applied for a franchise for the Newport News and Elizabeth City Railway and Electric Company.

RICHMOND, VA.—The Passenger and Power Company has been awarded a five-year contract for furnishing 600 arc lights of 1,200-candle power at 15 cents per light per night, one cent below the price named in the present contract.

KENOSHA, WIS.—A franchise has been granted the Kenosha Electric Railway Company to lay its tracks through the city, thus completing the connection between Chicago and Milwaukee.

OBITUARY.

MR. A. B. STROWGER, patentee of the Strowger automatic telephone, died at St. Petersburg, Fla., a few days ago.

MR. C. F. WOOD.—A telegram from Boston of June 14 states that Mr. C. F. Wood, superintendent of the Western Union Telegraph Company, died at Newton late that afternoon. Mr. Wood had been connected with the company for forty years, beginning his active superintendency in 1862, and continuing in that office until 1883, when the American Union Telegraph Company came into full control of the Western Union. The fifteen years following Mr. Wood was connected with a commercial house, four years ago returning to the Western Union Company, where he occupied a clerical position until his death. He was eighty-five years of age.

PERSONAL.

MR. E. T. SCHOONMAKER, of Fordham, N. Y., has been awarded a silver medal at the Charleston Exposition for his beautiful magnetic spectra.

MR. E. C. HEALEY, of the French Westinghouse Electric Company, has been recently on a visit home to Pittsburg from the Havre factory, which has so much business it is likely to be doubled.

MR. H. S. PATTEN, formerly with the New York Heat, Light and Power Company, and more recently with the American Electrical and Maintenance Company, is now associated with Graham Bros. Co., New York City.

MR. C. O. BAKER, JR., the well-known platinum merchant, has just returned from a trip to Europe of some weeks' duration and in good health after the change, his only regret for absence having been to miss the recent electric light convention.

MR. T. W. GOODRIDGE has recently resigned from the secretaryship of the Electric Vehicle Company, with which and its predecessors he had been connected for six years. He has now been appointed manager of the new automobile department of the Studebaker Bros. Manufacturing Company, of South Bend, Ind., who bid fair to become prominent in the new branch, as they are already in the older lines of carriage building.

MR. DOW S. SMITH, superintendent of the St. Paul system of the Twin City Rapid Transit Company, has been offered and has accepted the position of general manager of the Brooklyn Rapid Transit Company. Mr. Smith is to take the place of J. C. Brackenridge, who has been appointed Engineer of Construction. Mr. Brackenridge has been acting as general manager for the company ever since the Brooklyn Heights, the Nassau and the other systems which now compose the Brooklyn Rapid Transit Company were combined.

MR. J. C. STEWART, the American contractor, whose record bricklaying performance in connection with the erection of the British Westinghouse Electric & Manufacturing Company's works at Manchester, England, recently caused so much discussion, has been engaged by the Midland Railway Company to supervise and expedite the work at the mammoth Midland Railway Hotel at Manchester. The contract is in the hands of Messrs. William Brown & Son, of Salford, England, and it is said that they are to receive $100,000 in bonuses if the work is finished within a year, and $10,000 a month for each month shorter than that time. The total price is $5,000,000.

COL. ALLAN C. BAKEWELL, second vice-president and general manager of the Sprague Electric Company, has been nominated for the office of Department Commander of the New York G. A. R. Col. Bakewell will not make a personal canvass, but his comrades of the Lafayette Post, of which he is past commander, assume all responsibility and feel assured of his election at the encampment at Saratoga Springs this month, because of his unselfish and untiring devotion to the high principles of the order. Col. Bakewell has been largely instrumental in perpetuating respect for our country's flag by virtue of the work he has accomplished as chief aid on the staff of the Commander-in-Chief in charge of the military instruction and patriotic education in the public schools. His election to the office of Department Commander would reflect great credit upon the [illegible]

Trade Notes.

FEE & STEWART CO., Melbourne, Fla., wish to receive electrical supply catalogues.

CHANGE OF NAME.—The Abbott Electric and Manufacturing Company of Warren, Ohio, has changed its name to United States Brass and Manufacturing Company.

MESSRS. WILLIAM H. WESTON & CO., Philadelphia, have just completed and installed in the Masonic Temple of that city an eight-panel blue Vermont marble switchboard.

EMERSON FANS.—The Emerson Electric Manufacturing Company is sending out a mailing card of unique design, relating to an entirely new type of ceiling fan for low-frequency current.

[illegible] HARDWARE CO., of New York Broadway, New York, has bought out the entire business of the Yankee Company, including all contracts, patents, machinery, etc., relative to the Yankee nail-puller.

ELECTRIC CUTTERS.—The Nopper Electrical Cutting Machine Company, Baltimore, to manufacture and deal in electrical cutting machines, capital, $150,000, has been incorporated under the laws of Delaware.

McCULLAGH & CO.—The partnership between A. McCullagh, Jr., L. A. Clark and Prof. E. J. Houston, under the firm name of McCullagh & Co., with offices at New York and Philadelphia, has been dissolved by mutual consent.

PANEL BOARD CABINETS.—A description of cabinets for use with Zimdars & Hunt's standard panel boards is given in Bulletin 35 recently issued by that firm. A price-list of boxes, trims, doors, etc., is also given, together with code words.

CENTRAL MANUFACTURING CO., of Chattanooga, Tenn., in spite of its recent fire, is filling orders for pole line material more promptly than ever. The fire simply gave it a chance to show what it could do in the way of "humping itself" to meet demands for its specialties.

THE WOTTON ELECTRIC & MFG. CO., Atlanta Ga., has not only been doing a large business from its home office, but the Thomas G. Grier Co., 128 West Jackson Boulevard, Chicago, managers of the Western sales department, have also found business very good in their territory.

THE CAPITAL ELECTRIC COMPANY, of Denver, Colo., has purchased two lots on California Street in that city on which it will build a factory for the manufacture of incandescent lamps. The company was organized four years ago and has twice before been compelled to double its capacity.

SECOND-HAND ELECTRICAL APPARATUS.—The Chas. E. Dustin Company, No. 11 Broadway, New York, has just issued a list of second-hand electrical apparatus, boilers and engines, which it has on hand for immediate delivery. The company states that its apparatus is in first-class condition and guaranteed.

OIL FILTERS.—A few weeks ago The Burt Mfg. Co., of Akron, Ohio, received an order for a large Cross oil filter from the Anheuser-Busch Brewing Association of St. Louis, which was shipped and gave such excellent satisfaction that the Burt Company has just received a duplicate order from it.

"WOOD" ALTERNATING ARC LIGHTING.—The "Wood" multiple system of alternating current enclosed arc lighting for street service is the subject of Bulletin No. 1,023 of the Fort Wayne Electric Works, Fort Wayne, Ind. The system is very completely described and illustrated. Some interesting candle-power curves are also shown.

MR. GEORGE PAROSCHOL, of Athens, Greece, who was graduated in June from the Massachusetts Institute of Technology, has enrolled in the American School of Correspondence of Boston. Mr. Paroschol expects to complete the school's course in the fall, when he will return to Greece to accept an engineering position under the government.

ELECTRIC AUTOMOBILES.—The Electric Storage Battery Company has reprinted as one of its standard bulletins, the article of Mr. W. H. Palmer, Jr., printed in the ELECTRICAL WORLD AND ENGINEER of April 12, 1902. This article, which is illustrated, constitutes a valuable addition to the available literature on this important subject.

COAL HANDLING.—The C. W. Hunt Company, in Circular No. 028, illustrates and describes a number of examples of economic coal handling, in which Hunt machinery is used. A large coal handling plant recently installed for the Baltimore City Consolidated Railway Company is illustrated and described in detail in the opening pages.

FERRANTI METERS.—Ferranti, Limited, Hollinwood, Lancastershire, England, has issued a catalogue devoted to the Ferranti type of direct-current meters. The Ferranti meters are of the interesting mercury motor type. That is to say, the current to be measured sets in motion a mass of mercury, which drags with it a vane, the steam of which actuates the recording mechanism.

"PROFITABLE ADVERTISING," a bright and up-to-date monthly periodical issued in Boston, has devoted its June issue very largely to a general treatment of the subject of advertising with the use and aid of electric lighting. The electrical features of the number are given generous space, and as the articles are illustrated they are unusually attractive to the miscellaneous reader in other lines of trade.

"KILFYRE" MEDAL AWARD.—In noting in our last issue the award of a medal to the Monarch Fire Appliance Company, the source of the medal was not given, which was the Charleston Exposition. The Monarch Fire Appliance Company informs us that the gold medal received was the only medal awarded at Charleston to any fire extinguisher, whether dry, chemical or liquid.

KEYSTONE INCANDESCENT LAMPS.—The Pittsburg Incandescent Lamp Company, Pittsburg, Pa., in a handsome 16-page pamphlet describes and illustrates the various types of incandescent lamps of its manufacture. The final pages gives some instructive information on ordering lamps, with respect to voltage and efficiencies, which should prove useful to all users of incandescent lamps.

TELEPHONE APPARATUS.—The full line of telephone apparatus manufactured by the Sumter Telephone Manufacturing Co., Sumter, S. C., is described in a series of bulletins issued by that company. The list includes long-distance telephones, "Bull's-Eye" express switchboards, lighting arresters, distributing frames, etc. These different instruments are illustrated and briefly described.

MARINE APPARATUS.—The Holtzer-Cabot Electric Company, Boston, Mass., makes a compact and efficient thirty-light marine generating set, which appeals to yachtsmen and other boat owners. Its total weight is only 300 pounds. This apparatus is described and illustrated in Bulletin No. 133 issued by the company. The same bulletin contains descriptions and illustrations of launch motors and other apparatus made by this company.

REYNOLDS-CORLISS ENGINES.—The Allis-Chalmers Company, Milwaukee, Wis., has issued a 184-page catalogue devoted to Reynolds-Corliss and other engines manufactured by the company. The catalogue is well printed on coated paper, and illustrates not far from 100 different forms of engines. The opening pages contain views of the great works of the company, which rank with the largest engineering works in the world.

BUFFALO DISK WHEELS.—The Buffalo Forge Company, Buffalo, N. Y., is sending out a mailing card containing illustrations of three types of Buffalo disk wheels. These wheels are designed for ventilation, cooling and drying, and are adapted to many other requirements and situations. On the front of the card is a yachting scene, with the suggestion that the home or office can be made just as cool by using Buffalo disk wheels.

REMOVAL NOTICE.—The Monarch Fire Appliance Company, New York, has removed its general offices from No. 27 William street to No. 247 Pearl street, where its business, manufacturing and shipping departments will all be under one roof. This change was rendered necessary in order to properly handle the company's rapidly increasing business. The demand for "Kilfyre" is a healthy and steadily increasing one; it is an effective protective appliance and is death to a fire.

THE CONSUMERS' INCANDESCENT LAMP COMPANY, Owensboro, Ky., has been running for three months in the manufacture of the "Premier" incandescent lamp. It has a modern plant, with a daily capacity of 2,500 to 3,000 lamps, and a highly satisfactory outlook. The company reports that its lamps are giving excellent satisfaction, one concern alone having given twenty-four orders in two months. Mr. A. H. Kreitler is secretary and general manager of the company.

FAN MOTORS.—A highly artistic catalogue has been issued by the Emerson Electric Manufacturing Company, St. Louis, with the title, "Fan Motors and Ceiling Fans for Alternating Current—Season 1902." All of the numerous types of Emerson fan motors and fans are illustrated by excellent half-tones. Accompanying each type of fan is a detailed description, and the final pages of the book give directions for putting up and connecting fan motors, and instructions how to order parts and repairs.

KELLOGG TELEPHONE APPARATUS.—The Kellogg Switchboard and Supply Company, Chicago, has issued a catalogue illustrating some of the exchanges which it has installed. Advantage has been taken of the new process of half-tone printing on a roughened surface, and with most excellent results. Among the illustrations are views in Kellogg exchanges at Johnstown, Pa., Wilkesbarre, Pa., Indianapolis, Ind., Columbus, Ohio, Scranton, Pa., St. Louis, Mo., Cleveland, Ohio, and Philadelphia, Pa.

RAW-HIDE GEARS AND PINIONS.—The New Process Raw-Hide Company, Syracuse, N. Y., has issued a neat booklet on its noiseless raw-hide gears and pinions for electric motors and high-speed machinery. The process of preparing the hides and the making of pinions by this new process are briefly described, and the advantages of their use pointed out. The company makes raw-hide washers, bushings, etc., besides pinions. The booklet comes in a substantial wallet to carry in the pocket.

CEDAR TIES.—The Maltby Lumber Company, of Bay City, Mich., recently sent out a special train load of cedar ties to the street railway of Des Moines, Ia. The arrangement with the railroad company was that the train should be run as a special during daylight hours and lay over at nights. This is only part of an order for the same company; previous deliveries have been made, and a second similar shipment will be sent in the course of a week or so. The same company will soon send a train load of cedar poles to Arkansas.

THE FALCON ELECTRIC MANUFACTURING COMPANY, No. 211 East Seventy-first street, New York City, announces that, owing to the large demand for its switches, panel boards, flush receptacles, etc., it has opened an office for the convenience of contractors and the electrical trade at No. 15 Cortlandt street (telephone No. 3901 Cortlandt), where it will carry a complete line of its standard products. In the future all communications with the Falcon company should be addressed to the offices of the company, No. 15 Cortlandt street. Mr. H. O. Swobodo is secretary.

ROLLER BEARINGS.—The question of reduction of friction in bearings is an important one and is of growing interest with the trade in general. Some valuable information on the subject is given in two bulletins (Nos. 23 and 24) recently issued by the Hyatt Roller Bearing Company, Harrison, N. J. Bulletin No. 23 gives the results of comparative tests of the Hyatt flexible roller and solid steel rollers made by the Franklin Institute of Philadelphia, and No. 24 is on the subject of Hyatt flexible roller bushings as applied to loose pulleys. The Hyatt roller bearing is applicable not only to shafting in the mechanical transmission of power, but to all kinds of special machinery, no matter what the conditions of speed and load.

ADJUSTABLE FIXTURES.—The O. C. White Company, Worcester, Mass., manufacturers of adjustable incandescent lamp fixtures, has just issued a very complete catalogue of its products. It would be hard to find a requirement as to the disposition of light that this company has not provided for in its devices. Numerous manufacturing plants are equipped with these fixtures, and many offices, draughting rooms, libraries and banks are using them with advantage. By their use the light can be thrown directly upon the work. The company has lately brought out some new styles of fixtures. These, with all of the earlier styles, are illustrated and described in the new pamphlet. Those who are not familiar with these fixtures would do well to investigate their merits.

NEW YORK EDISON BULLETIN.—The June bulletin of the New York Edison Company is a particularly attractive and interesting number. In addition to much readable matter concerning some of the novelties of that enterprising company, there is a supplement consisting of a handsome reproduction of one of the photograpas of Lord Kelvin, taken while that distinguished gentleman was in this country, last April and May. It represents him reading, the posture being easy and natural. It is a beautiful piece of work, artistically and mechanically considered, and is entirely suitable for framing. A neat little reference is made in the bulletin to the farewell dinner given to Lord and Lady Kelvin by Mr. Anthony N. Brady, president of the New York Edison Company, on May 8. The bulletin itself is an artistic production and is very attractively illustrated.

CHARLES H. BESLY & CO., No. 10 North Canal street, Chicago, Ill., report their business very good. They are receiving orders for Gardner grinders from all parts of the country. Within the past month shipments have been made to California, New York, Rhode Island, Connecticut and New Jersey. The spiral circles in their various forms used in connection with the spiral grooved steel disc, which is the distinctive feature of the Gardner grinder, enables users of the Gardner grinder to do from 50 per cent. to 200 per cent. more work than either solid or coated wheel will do. Many shipments of Helmet oil, Badger and Bonanza grease cups are being made to all parts of the country. Numerous inquiries for catalogues and circular matter relating to their own specialties, as well as requests for general catalogues, estimates and prices on shop equipments indicate a healthy condition of trade throughout the country. Their new 300-page illustrated catalogue will be sent free to any address upon application.

MONARCH ENGINE STOP.—The Consolidated Engine Stop Company, No. [illegible] Broadway, New York, has just issued a very handsome and interesting pamphlet describing and illustrating the Monarch system of automatic safety devices for use on steam and electric motors. By the use of the engine stop the engine is stopped automatically in those emergencies where the loss of property and life may depend upon the promptness with which this is accomplished. The engine may be closed down from any part of the building by pressing a button. The speed limit is a device for automatically preventing an excessive speed of the engine. It is directly connected to the main fly-wheel shaft and can be set to act at any number of revolutions. Another "Monarch" device is a vacuum valve, which breaks the vacuum in the condenser automatically, and prevents the cylinder from taking water when the throttle is closed and the pressure shut off. The circuit-breaker trip for electric light and power plants automatically trips the circuit-breaker in the generator circuit at the same time the engine throttle valve is closed by the stop. The pamphlet is very clearly illustrated, with perspective and sectional views of the various devices, and at the back a list is given of many prominent users of the devices. General managers, superintendents and engineers of power plants and all steam plants will find much of interest to them in this pamphlet, a copy of which may be had on application to the company's headquarters at the address above given.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 10, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

701,453. CARBON SORTING MACHINE; M. M. Zellers, Cleveland, Ohio. App. filed Feb. 15, 1902. The invention includes an open electric circuit in which the carbons may be connected to be tested, a guide-plate by which the carbons when withdrawn from said circuit are guided in one direction or another, and mechanism for controlling the movement of said guide-plate, which mechanism is caused to operate according as the resistance of the carbon being tested is less or greater than the theoretically correct resistance. (Issued June 3.)

701,832. GAME OR PUZZLE; J. H. Bennett and M. L. Zimmerman, Philadelphia, Pa. A... a spider web in which there is a movable spider and fly. To the former is attached a small magnet, and to the latter an armature. The object ... it through the several passages to the center.

701,943. AUTOMATIC CONTROLLER FOR ELECTRIC MOTORS; N. A. Christensen, Milwaukee, Wis. App. filed Oct. 21, 1901. The common core of two solenoidal magnets carries a contact piece which makes and breaks the circuit of a motor adapted to drive an air-compressor.

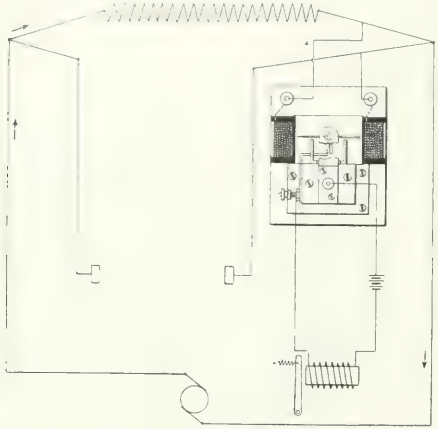
... the other and all strung upon a pin.

... April 11, 1902. A casting adapted to fit over the end of the conductor, ... connections.

701,914. FAN MOTOR ATTACHMENT; W. S. Moody, Schenectady, N. Y. App. filed Oct. 26, 1900. A suspended fan motor is provided with an arm extending from the casing to a point beyond the tips of the fan blades, where it carries a circuit closer, the arm being flexible, so that it may be adjusted to various positions.

701,915. PROCESS OR FORMING SECONDARY BATTERY ELECTRODES; W. Morrison, Chicago, Ill. App. filed June 18, 1900. While the plates are undergoing the forming process, they are protected by a covering of porous material, which prevents the separation of the lead from the plate during the process, while permitting of the escape of the gases. After forming the cover is removed.

701,917. SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed June 18, 1900. The element is made up of sheets of lead leaf, perforated and roiled together.



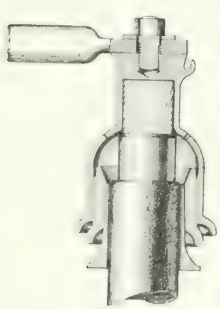
701,453.—Carbon Sorting Machine.

701,918. MEANS FOR PREVENTING THE DISTORTION OF SECONDARY BATTERY PLATES DURING FORMING; W. Morrison, Chicago, Ill. App. filed June 18, 1900. A bifurcated wooden plate straddles the electrode and holds it centered between the walls of the cell.

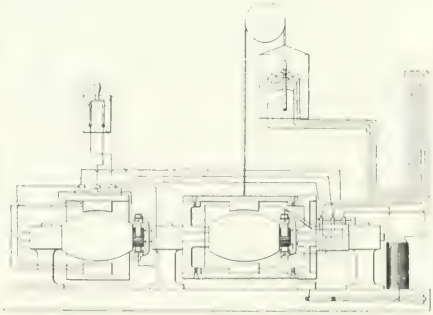
701,925. TROLLEY CROSSOVER; T. North, Aurora, Ill. App. filed Sept. 4, 1901. A device to prevent the trolley wheel from coming in contact with the track on which the car-barn door rides.

701,937. INDICATING INSTRUMENT; L. T. Robinson, Schenectady, N. Y. App. filed Nov. 20, 1899. (See Current News and Notes.)

701,947. MEANS FOR TRANSMITTING SYNCHRONOUS MOTION TO DISTANT POINTS; L. Saxon, New York, N. Y. App. filed Oct. 18, 1901. An actuating device for the main controller comprising a multipolar direct-current motor having a permanently polarized armature and a field magnet containing twice as many poles as the armature and a master controller for alternately energizing alternate poles in order to produce a step by step movement of the armature, in synchronism with the motion of the motor controller.



701,875.—Cable Terminal.



702,155.—Electric Motor.

701,949. ELECTRIC INCANDESCENT LAMP HOLDER; E. G. Sheppard, London, Eng. App. filed Dec. 11, 1900. In lamps requiring three points of contact in the holder, the contacts are arranged so that it is only possible for them to engage to close the circuit when adjusted in one position, where they also become locked.

701,958. AUTOMATIC CUTOUT; C. P. Steinmetz, Schenectady, N. Y. App. filed March 6, 1899. (See Current News and Notes.)

701,959. GLOWER FOR PYROELECTRIC LAMPS, AND PROCESS OF MAKING SAME; C. P. Steinmetz, Schenectady, N. Y. App. filed Nov. 6, 1900. (See Current News and Notes.)

701,965. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed Oct. [illegible]. (See Current News and Notes.)

701,986. TERMINAL FOR ELECTRIC FURNACES; E. G. Acheson, Buffalo, N. Y. App. filed May 24, 1899. (See page 1097.)

702,032. INDUCTION APPARATUS; W. Scheidel, Chicago, Ill. App. filed Jan. 23, 1902. In order to readily assemble the parts, the secondary coil is composed of a series of bobbins supported independently inside the casing, the primary coil being arranged centrally within the secondary coil and supported at its ends independently of the latter.

702,073. SUPPORT AND SWITCH FOR ELECTRIC DENTAL INSTRUMENTS; E. O. Pieper, San Jose, Calif. App. filed Jan. 2, 1902. Details.

702,081. MANUFACTURE OF GLASS BY ELECTRICAL HEATING; A. Voelker, Ehrenfeld, Germany. App. filed Sept. 27, 1900. (See page 1097.)

702,117. ART OF PRODUCING CHEMICALS IN ELECTRIC FURNACES; E. R. Taylor, Penn Yan, N. Y. App. filed Oct. 6, 100. (See page 1097.)

702,142. METHOD OF BLEACHING PAPER PULP, ETC.; F. H. Long, Chicago, Ill. App. filed June 24, 1901. (See page 1097.)

702,028. TELEPHONE SWITCHBOARD; J. M. Overshiner, Elwood, Ind. App. filed Dec. 15, 1900. (See page 1098.)

702,149. SWITCHBOARD FOR ILLUMINATING ELECTRIC LAMP SIGNS; M. Norden, New York, and L. S. Crandall, Brooklyn, N. Y. App. filed March 19, 1902. An arrangement for utilizing the cards of a Jacquard apparatus for displaying different letters and figures successively.

702,152. ELECTRICAL CONTROLLING APPARATUS; R. F. Piatt, Louisville, Ky. App. filed Feb. 25, 1902. Automatic apparatus for controlling the motor of a compressor by means of the pressure and the current delivered to the motor.

702,155. ELECTRIC MOTOR; H. Rowntree, Chicago, Ill. App. filed Nov. 23, 1899. The hoisting drum of an elevator is connected to one of the parts of a motor in which both the field and armature rotate and means are provided for driving one of the parts and for maintaining the rotation of both parts at different speed ratio.

702,184. MAGNETIC ORE SEPARATOR; J. W. Carter, Franklin, N. J. App. filed Nov. 29, 1901. Details relating to the arrangement of the magnets with reference to the chute.

702,192. GAS LIGHTING OR EXTINGUISHING DEVICE; V. Forti, Paris, France. App. filed Oct. 24, 1900. Details.

702,213. ELECTRICITY METER; E. G. Holm, Berlin, Germany. App. filed Dec. 21, 1901. (See Current News and Notes.)

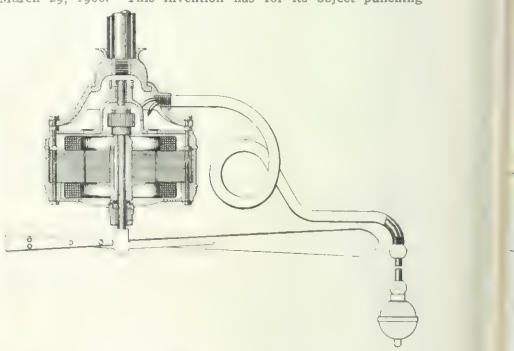
702,247. ADJUSTABLE SWITCH OR OUTLET BOX; J. H. Rusby, Nutley, N. J. App. filed Dec. 23, 1901. Means for adjusting or leveling the box against the wall.

702,263. AUTOMATIC TELEGRAPHIC TRANSMITTER; J. A. Toomey, Goshen, Ind. App. filed Feb. 18, 1902. Openings are cut through a tablet of insulating material to expose a conducting surface, said openings representing Morse characters, which are transmitted by dragging a "toucher" over the characters.

702,272. COMMUTATOR SEGMENT; W. H. Windle, Philadelphia, Pa. App. filed April 21, 1902. A commutator segment having a finger bent upward therefrom at one end and adapted to be connected with the armature coil.

702,314 to 702,321. ELECTRIC TUBE LIGHTING; D. McF. Moore, Newark, N. J. Apps. filed Dec. 18, 1901, and Jan. 2, 1902.

702,339. TELEGRAPHIC APPARATUS; S. G. Brown, Putney, England. App. filed March 29, 1900. This invention has for its object punching apparatus which is adapted to be automatically operated by signaling impulses received at siphon-recorded speed from a cable or line section in such manner as to punch signaling perforations in a tape after reinserting or interpolating the impulses that may have been lost, so as to assure accuracy in the reproduction of the signals.



701,914.—Fan Motor Attachment.

702,361. STORAGE BATTERY; A. D. Edgerton, Philadelphia, Pa. App. filed Nov. 13, 1900. The plates are in the form of lead pans, one above the other, the rims of which are perforated to allow the solution to overflow from one pan into the next below it and thus maintain a uniform specific gravity of the solution throughout a number of cells connected together.

702,362. TEST CUP; W. W. Emmons, Boston, Mass. App. filed Nov. 6, 1901. The cup is inserted in the armor of the cable and contains cable terminals from which tests may be made.

702,364. ELECTRIC SWITCH; J. J. Flint, Denver, Colo. App. filed July 29, 1901. Details.

CONDUITS FOR TELEPHONE WORK.

GENERAL CONTRACT AND SPECIFICATIONS.

GENERAL CONTRACT AND SPECIFICATIONS

FOR

UNDERGROUND CONDUITS.

THIS AGREEMENT made and concluded this.....
day of.....in the year Nineteen Hundred and
.....by and between the.....
COMPANY, a corporation organized and existing under the laws of the
State of.....having its principal business office in
....., party of the first part, and
.....of the
city of..... State of .....
party of the second part, WITNESSETH:

SECTION 1.

1 Contract

That the party of the second part has agreed, and by these presents does agree with the party of the first part, for and in consideration of the prices, and agreements hereinafter set forth, well and truly to be paid and performed by the party of the first part, and under the penalty expressed in a bond bearing..... date with these presents and hereunto attached, to perform at his own proper cost, all of the work or portions thereof, and to furnish all labor, materials, machinery, tools and appurtenances herein specified, entirely in accordance with the specifications and plans hereinafter referred to, and subject to the approval of the city authorities of the.....

SECTION 2.

2 Definitions

All words referring to the respective parties shall be taken to be of such number and gender as the character of the parties require.

(a) The word "Company" shall mean the ..... COMPANY, which has entered into this contract as party of the first part.

(b) The word "Contractor" shall mean the party of the second part hereto, who has entered into this contract to perform the work called for by the specifications.

(c) The word "Engineer" or "Superintendent" shall mean the Engineer or Superintendent of the..... COMPANY as the case may be, acting either directly, or through his proper agents.

(d) The word "Conduit" shall mean the aggregation of a number of hollow tubes of duct material arranged to furnish so many longitudinal passage ways in the streets, for the reception of electric cables. A section of conduit shall mean such a portion of conduit as connects any two adjacent manholes, measured between the centers of these manholes.

(e) The word "Duct" shall mean a single continuous longitudinal passage way extending between any two adjacent manholes, or from one manhole to any distributing point.

(f) The phrase "Duct Material" shall mean any suitable material out of which ducts may be built.

(g) The term "Manhole" shall mean an underground vault or chamber so built as to give access to a portion of the conduit, and into which the conduit is built, including an opening from the street surface by which access may be had thereto.

(h) The word "Lateral" shall mean one or more ducts extending from a manhole, or from one or more of the main conduit ducts to some distributing point.

SECTION 3.

NO. 1. GENERAL SPECIFICATIONS.

3 Description and Location

The work consists in furnishing all labor, materials, machinery, tools and appliances that shall be needed to build and complete, including all excavations, refilling and repaving, in accordance with these specifications and plans, the requirements of the Engineer or Superintendent and City authorities, the Underground System, as indicated in the schedules and plans accompanying these specifications, together with such additions or subtractions as may be directed by the Engineer or Superintendent, from time to time during the progress of the work, as hereinafter provided.

NO. 2. SCHEDULE A.

List and location of Conduits.

NO. 3. SCHEDULE B.

List and location of Manholes.

NO. 4. SCHEDULE C.

List and location of Laterals.

SECTION 4.

4 Changes in Location

The Schedules A, B, and C give the location and enumeration of the conduits, manholes and laterals that it is now the intention to build, but it is agreed that from time to time during the prosecution of the work, and before the final completion thereof, any additions, extensions or subtractions shall be constructed by the second party if required by the first party. The terms and conditions of this agreement shall apply to, and cover all such additions and extensions, provided that such work is reasonably similar to that which is now contemplated by said schedules. It is also agreed that the first party may decrease the amount of work in any way it shall deem advisable, without becoming liable to the second party for any compensation or damage from such change, provided the first party shall notify in writing the second party of any and all changes before instructions are given for the commencement of work upon the portions where so changed.

SECTION 5.

5 Delivery of Material Supplied by the Company

. . . . . shall be delivered to the Contractor, either in F.O.B. cars or boat in . . . . . City, or at the store yard of the Company, at . . . . . and the Contractor must provide sufficient facilities to haul away and to store the duct material as fast as it shall be received. If delivered to the Contractor F.O.B. cars or boat, he shall be responsible for all damage or demurrage charges which may be incurred by failure to remove the material from the cars, freight yards or freight houses within the time usually allowed by the transportation companies for this purpose.

(Cancel paragraph (a) if duct material is supplied by Contractor.)

(b) The iron work for the manholes shall be delivered to the Contractor either at the foundries making the same or at the store yard of the Company . . F.O.B. cars or boat in the City of . . . . . The Contractor must provide sufficient facilities to remove, haul and store this material as fast as it may be delivered.

(Cancel paragraph (b) if iron work is supplied by Contractor.)

(c) Upon the delivery of any material to the Contractor, he shall give a written receipt to the Engineer or Superintendent for the same, and after the delivery the Contractor shall be responsible for the safety and care of all such material, shall do all the handling and storing at his own expense, and shall replace at his own expense any and all material which may be lost or injured. On the completion of the work herein called for, the Contractor shall deliver at ...s own expense to the store yard of the Company any and all surplus material of this kind. If the Company shall fail to deliver to the Contractor from time to time any of the material herein specified to be furnished by the Company, the Contractor shall not allege any such failure as any ground for damages. But for each and every day that the Contractor is delayed by the failure of the Company to deliver said material, he shall be allowed one extra day's time over and above that hereinafter stipulated for the entire completion of the work called for.

SECTION 6.

6 Power of Engineer or Superintendent

All work under this contract shall be done to the satisfaction of the Engineer, or Superintendent, who shall, in all cases, determine the amount, quality, acceptability and fitness of the several kinds of work and materials which are to be paid for hereunder, and who shall also decide all questions which may arise as to the fulfillment of any or all of the several clauses of this contract and specifications. The decision of the Engineer or Superintendent shall be final, and binding on the Contractor, and in case any question shall arise, such decision shall be a condition precedent to the right of the Contractor to receive any money hereunder.

SECTION 7.

. . . . . IN CONTRACTS

7 Work to Be Done in Accordance With Plans, Specifications and Instructions

Attached to this contract are plans showing the general location of the Underground System herein called for, so far as this location can be pre-determined, but during the progress of the work the Engineer or Superintendent will give to the Contractor such specific instructions and plans as will fix the exact location upon each street of the conduits, manholes and laterals, both line and grade, and the work shall be done in accordance with the plans and specifications annexed and in accordance with such additional plans and directions as may be given. For each section of conduit, for each manhole and for each lateral the Engineer or Superintendent shall give to the Contractor a detailed plan and working instructions. Such plans or instructions shall show the location of the center line of the excavation with reference to the center of the street, the width and the depth of the trench for the conduit, the laterals and the manholes, and shall specify any points intermediate between manholes, at which there may be any change in width or grade. These plans and working instructions shall specify the grade of the center of the conduit with reference to a level line. The plans and working instructions shall give the number of ducts in each section, and the arrangement of these ducts, both vertically and horizontally, shall show the kind, location and grade of each manhole.

NO 2. ERRORS IN PLANS OR SPECIFICATIONS.

The plans, sepcifications and instructions are explanatory of each other, and are intended to be sufficiently explicit to cover the proper construction of the work, in so far as it is possible to define work of this character. The Company, however, does not warrant the plans to be absolutely correct, nor that every possible contingency can be covered, but should any discrepancy appear, or any misunderstanding arise as to the import of anything contained either in the plans, specifications or instructions, the Contractor agrees to accept the explanation of the Engineer or Superintendent as final and binding. Any correction of errors or omissions in the plans and specification may be made by the Engineer or Superintendent when, in his judgment, such correction is necessary for the proper fulfillment of the intention and meaning of the plans and specifications.

SECTION 8.

8 Orders to Contractor

Whenever the Contractor is not present in person upon any part of the work where it may be necessary to give instruction such instructions as may be given by the Engineer or Superintendent shall be received and obeyed by the Foreman, or other person in charge of the particular work in reference to which orders are given.

SECTION 9.

9 Access to Work

The Contractor shall at all times afford the Engineer or Superintendent access to any and every part of the work and enable him to examine and inspect all machinery, materials or appliances which are used thereon, and all facilities for ascertaining the skill and competency of any and all men employed.

SECTION 10.

10 Competent Men, Suitable Tools and Acceptable Materials

The Contractor shall employ only skilful, competent and orderly artisans who are thoroughly familiar with and able to do the several kinds of work to which they are assigned. If the Engineer or Superintendent shall find men who, in his opinion, are unskillful, or who are not thoroughly carrying out the provisions of the specification or who are disorderly, or who are not suitable, he shall notify the Contractor in writing of his disapproval of such men and upon receipt of such notice, the Contractor shall discharge from the work any and all such men, and shall not again re-employ them upon this work. The Contractor shall supply all necessary and suitable tools, appliances and machinery for carrying on the work in a proper manner at such a rate as may be requested by the Engineer or Superintendent. If the Contractor shall fail to supply appropriate tools and appliances or a sufficient amount thereof, the Engineer or Superintendent shall notify the Contractor in writing of this failure, and if the Contractor shall continue to fail for five days to supply such a quantity or quality of tools, machinery or appliances as shall, in the judgment of the Engineer or Superintendent, be suitable and adequate for the purpose, or if the Contractor shall fail to constantly keep all tools and machinery in proper and adequate repair, the Company may then consider that the Contractor has failed in the performnce of his part of the contract, and may assume and carry on any or all such portions, and shall charge against the Contractor any and all expense required to complete the same. The Contractor shall also supply a suitable quantity of acceptable materials, which shall meet in all respects all the provisions of these specifications. In case any material whatsoever shall fail to meet the material specifications, or any of the tests prescribed thereunder, or shall not be in accordance with the samples submitted as provided for in these specifications, or shall not be supplied in sufficient quantity, the Engineer or Superintendent shall notify the Contractor in writing of his failure to supply appropriate materials or sufficient quantity thereof, and on receipt of this notice the Contractor shall immediately replace such rejected materials with such as shall fulfill all of the provisions of the specifications, or shall increase the quantity delivered as may be requested. If, forthwith, after such notice the Contractor fails to supply appropriate and acceptable materials or a sufficient quantity thereof, the Company shall have the right to assume and carry on the work under the clauses for abandonment, as hereinafter specified, and shall charge against the Contractor any and all expense required to complete the same.

SECTION 11.

11 Replacement of Defective Work

If the Engineer or Superintendent shall discover that any portion of the work is not constructed in accordance with the specifications, plans and directions, or if he shall find that any portion of the work has been constructed with poor materials, or unskilled labor, or is in any way defective, he shall notify the Contractor in writing of such imperfections and the Contractor shall, upon receipt of such notice, remove at once all such defective work and shall replace the same with that which is in accordance with the plans, specifications and instructions, and which shall meet the approval of the Engineer or Superintendent. In case the Contractor shall fail to remove or replace any or all such defective work forthwith, after receipt of notice of rejection, the Company shall have the right to remove such defective work and to correct or replace same with such as is in accordance with the specifications, and shall charge against the Contractor any and all expense of such replacement.

SECTION 12

12 Legal Authority

The Company shall obtain legal authority to occupy and open the streets upon which the underground system is to be placed shall be obtained by the Company, in the form of the customary written permits for such occupation and opening and shall be delivered to the Contractor as his authority for the work. If after the receipt by the Contractor of this permit the same shall be lost or destroyed, the Company shall on written notice from the Contractor take out a new permit and shall charge against the Contractor all the necessary expense of obtaining such duplicate permit.

SECTION 13.

13 Work to Be Done in Accordance with Law and City Regulations

In all operations in any way connected with the work herein specified, the Contractor shall comply with all the laws of the land, and with all the city rules, ordinances and regulations affecting in any way the conduct of those engaged, or the methods of doing the work, or in the use of materials, tools, appliances or machines.

SECTION 14

14 Responsibility of Contractor

During the progress of the work the Contractor shall take all precautions and shall assume all responsibility of whatsoever nature for the prevention of any and all injuries to any person whatsoever, whether employed by the Contractor or not. He shall and does hereby assume all responsibility and liability for any injury or damage of whatsoever nature, to any property or persons, and shall and does hereby assume all liens, suits or claims for damages, either to life, limb, property or persons, arising from any act or omission, or from the amount or character of the work, or the way in which it is done, and shall and hereby agrees to save harmless the Company, its officers and agents from all claims relating to any damage or injury, actual or consequential, present or future.

SECTION 15

15 Liens Upon the Work

Upon the completion of the work and before the final payments are made to the Contractor, he shall file with the Company suitable evidence that all claims or causes of action for damages, that all liens, for payment of wages or payment for tools, machinery or supplies of all kinds have been by him entirely liquidated, released and satisfied, and he shall furnish to the Company a clear title to all the work, and to each and every part thereof.

SECTION 16

16 Subletting or Assignments

The Contractor shall constantly give his personal attention to the faithful prosecution of the work and from the beginning to end shall keep the same entirely under his personal control. He shall not assign or sublet the work, or any part thereof, without previously obtaining the written consent of the Company, nor shall he either legally or equitably assign any of the moneys payable under this agreement, or his claim thereto, unless by and with the previous written consent of the Company. He shall punctually pay all and all workmen employed on the work, in current money.

SECTION 17

17 Time of Commencement and Completion

The Contractor agrees to commence the work within ..... days from the date of execution of this contract, and he agrees to entirely complete, finish and turn over to the Company all of the said work within..... days thereafter, Sundays and legal holidays excepted.

SECTION 18

18 Damages for Delay in Completion

In case the Contractor shall fail to complete the entire amount of work called for in the schedules attached to this contract, within the time specified under Section 17, the Company shall have the right to deduct and retain out of the moneys which may be due, or may become due the Contractor under this contract, the sum of.....dollars per day as liquidated damages for each and every day that the entire work under this contract shall remain uncompleted over and above the time hereinbefore specified in Section 17, Sundays and legal holidays excepted.

SECTION 19

19 Company's Right to Assume Work

If this work or any part thereof shall be abandoned, or if it or any portion shall be sublet or any claim thereunder shall be assigned otherwise than as provided, or if the Engineer or Superintendent shall be of the opinion, and shall so certify in writing to the Company, that the conditions herein specified are not fulfilled, or that the work or any part thereof is unnecessarily delayed, or that the Contractor is violating any of the provisions of this contract, the Company may notify the Contractor to discontinue all work, or any part thereof, and thereupon the Contractor shall discontinue said work, or such part thereof as the Company may designate, and the Company may, by contract or otherwise, as it may determine, complete the work or such part thereof, and charge the expense thereof to the Contractor, and may use therefor any and all materials, animals, machinery, implements and tools of every description as may be found upon the line of said work. The expense so charged shall be deducted and paid by the Company out of any moneys then due, or to become due the Contractor. In case such expense is less than the sum which should have been payable under this contract, if the same had been completed by the Contractor, the Contractor shall be entitled to receive the difference, and in case such expense shall exceed the latter sum, the Contractor shall on demand pay the amount of such excess to the Company.

SECTION 20

20 Extra Work

The Contractor shall do no work nor supply any materials not herein provided for, unless directed in writing by the Engineer, or Superintendent, and he shall make no claim for any extra work or materials excepting as authorized by the Engineer or Superintendent in writing, and the Contractor shall file with the Engineer or Superintendent a statement of all such extra work or materials, with a copy of the order therefor and a statement of the place where such work or materials were furnished, and shall give an itemized statement of, and vouchers for, the quantities and prices of any and all such work, or material.

SECTION 21

21 Acceptation of Work

Upon the completion of any section of conduit or of any lateral, the Contractor shall notify the Engineer or Superintendent that, in his opinion, the said section of conduit or lateral is complete. Within three days after the receipt of such notification, the Engineer or Superintendent shall inspect such section or lateral, and if he shall find this work has been performed in accordance with the provisions [illegible] and additional plans, or directions, he shall then give to the Contractor a certificate of *Preliminary Inspection*. If the Engineer or Superintendent shall find that in any particular this work does not correspond with the plans, specifications or instructions, he shall notify the Contractor thereof in writing, specifying the defects. The Contractor shall then immediately remove any defective materials or rectify any imperfect construction. When such defective work is removed and replaced with such as is satisfactory to the Engineer or Superintendent, he shall issue to the Contractor a certificate of preliminary inspection.

NO. 2. CONDITION OF FINAL ACCEPTANCE.

On the completion of all the work called for in the schedules attached, and any additions thereto, the Engineer or Superintendent shall make a final inspection of the entire work done and shall measure up all of the quantities of work which have been put in, and the amounts of labor and materials supplied. If this final inspection shall show that all the work is in accordance with the plans, specifications and instructions, and completed to the satisfac-

tion of the Engineer or Superintendent, he shall then render the Contractor a certificate of final acceptance of the entire work, and on receipt of this certificate the responsibility of the Contractor for the work shall cease, and it shall then pass to and become the property of the Company. In case the Engineer or Superintendent shall in this inspection discover any imperfection, he shall notify the Contractor of the same, and the Contractor shall immediately replace any defective work or materials with that which is in accordance with the plans, specifications and instructions, and which is to the satisfaction of the Engineer or Superintendent. The fact that a certificate of preliminary inspection may have previously been rendered to the Contractor for the particular portion on which faulty work or materials is subsequently found, shall not operate to release the Contractor from his obligation at the time of final inspection, to make every part of the work satisfactory in all respects.

SECTION 22.

NO. 1. ESTIMATES.

22 Conditions of Payment

At the end of every calendar month during the progress of this work, the Engineer or Superintendent shall examine and measure up the amount of work performed by the Contractor during the month in question. This examination shall be made within the first five days of each succeeding calendar month, and on the completion thereof, the Engineer or Superintendent shall render to the Company a statement in detail of the amount of work accomplished during the preceding month, and shall give the Contractor a copy of same. Within ten days after the receipt of this statement the Company shall pay to the Contractor.....% of the amount called for in the statement, and shall reserve.....% thereof until completion of the entire work.

NO. 2. FINAL PAYMENT.

Upon the entire completion of all the work called for in the schedules, and any additions thereto, and upon the final examination and acceptation of all the work by the Engineer or Superintendent, and upon full performance of this agreement in all other respects, the Engineer or Superintendent shall render to the Company a statement to this effect, and shall give the Contractor copy of same. Within thirty days thereafter the Company shall make to the Contractor a final payment for all the work herein called for, which shall include all the balances which have been reserved from the preceding monthly payments.

SECTION 23.

23 Prices for Work

The Company shall pay as full compensation for everything furnished and done under this contract, including all damage arising out of the nature of the work, or from the action of the elements, and all risks of every description connected therewith, and for all expenses entailed in consequence of the suspension or discontinuance thereof, the following amounts:

NO. 1. PRICES FOR CONDUITS.

The prices for conduit hereinafter stated shall mean the price per linear foot for conduits containing the varying number of ducts stated in Table A, a different price being given for each number of ducts. The term "Conduit Foot" shall mean one complete linear foot of conduit irrespective of the number of ducts therein, measured along the axis of the conduit, and the length upon which the amounts due the Contractor shall be calculated shall be the length of conduit measured between the inside and adjacent walls of any two adjacent manholes. The following prices shall be full compensation for the removal of the pavement, the excavation of the trench, the placing of the concrete foundation, the laying of the duct

and the supply of the same, the

material refilling of the trench

without the supply of the same, the

temporary paving,

and the replacement of the and the

permanent paving,

rodding of the ducts as herein specified in Table A.

NO. 2. PRICES FOR CONCRETE MANHOLES.

For each and every standard manhole built of concrete as hereafter specified, and of the general shape and dimensions shown in Plan I attached, including the removal of the paving, the necessary excavation, the supply and manufacture of the mould, the supply, manufacture and placing of the

the supply and placing of the iron cover;

concrete : the

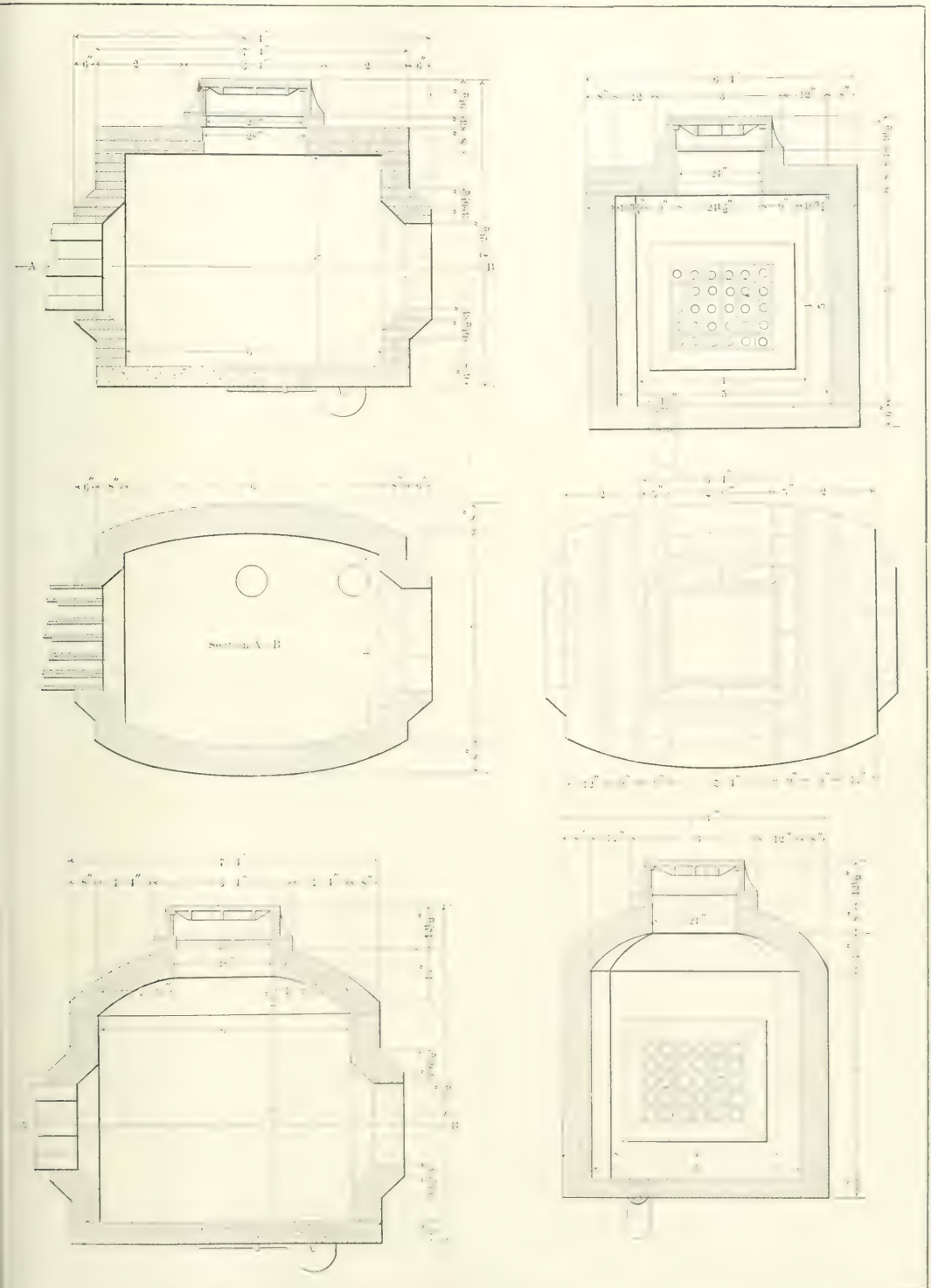
the placing of the iron cover supplied by the Company

refilling of the excavation, replacement of the paving and clearing of the street, all as hereing specified, the sum of..... dollars.

TABLE A.

Contract Prices to be Paid per Conduit Foot.

No. of Ducts.	KIND OF DUCT MATERIAL. Iron Pipe.	Pump Log.	Creosoted Wood.	Cement Pipe.	Hollow Brick.	Multiple Duct.	Paper Tube.
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
18							
20							
21							
24							
27							
30							
36							



STANDARD MANHOLES.

... concrete ... the bottom, all the bricks, mortar, masonry, and labor of laying

the supply and setting of the iron for the roof, and iron cover, the same the re-

the setting of the iron for the roof and iron cover supplied by the Company fillment of the excavation, replacing of the paving and cleaning of the street, all as herein specified, the sum of. ..... dollars.

NO. 4. PRICES FOR SEWER CONNECTION.

For each and every sewer connection made to any manhole, including necessary excavation, the furnishing and laying of sufficient 4-in. tile drain pipe to the sewer, and the connection of the outer end thereof, to the sewer and the inner end thereof to the sewer trap, the furnishing of the sewer trap as specified, including obtaining the necessary sewer permit from the City; the refilling and repaving the excavation, the sum of.....dollars.

NO. 5. PRICES FOR EXTRA WORK.

For all extra labor or materials supplied in accordance with the written instructions, from the Engineer or Superintendent, the Contractor shall charge cost plus 10% (ten per cent.) excepting for such labor or materials as are specified in No. 6.

NO. 6. PRICES FOR SPECIAL EXTRA MATERIALS AND LABOR.

(a) For all extra concrete, including all materials and labor for mixing and placing the same, the price of.....dollars per cubic yard.

(b) For all extra brick work, including the necessary brick work, mortar and labor of laying the same, the price of.....dollars per 1000 brick laid.

(c) For all extra lumber, including the cost of furnishing and placing the same, the price of.....dollars per 1000 fet. board measure.

(d) For all excavation not otherwise included in these specifications, including the removal of the pavement, the rfilling of the excavation, the replacement of the paving, and the cleaning up of the street, the sum of .....cents for each and every cubic yard of actual space excavated.

SECTION 24.

NO. 1. HOLLOW BRICK OR "SINGLE DUCT" MATERIAL.

24 Material Specifications

Hollow brick duct material shall be made of well burnt vitrified clay. There shall be two kinds of pieces—standard pieces and special pieces. All standard pieces shall be not less than 18 in. long. Special pieces shall be 6 in., 9 in., and 12 in. in length, and such a number shall be delivered for each section as may be directed. All pieces shall be either plain square, fluted square, octagonal, or round, in general shape, and joints shall be either butt joints, with or without dowels, or socket joints, as shall be specified for each location.

For butt joints without dowels the outside diameters shall be within reasonable manufacturing limits, 4½ in.; for single dowel joints, 4¼ in.; for socket joints, plain square, or fluted square, 5 in.; for round and octagonal socket joints, 4⅞ in. For all shapes the bore shall be not less than 3¼ in. diameter at any place; shall be truly circular, centered throughout the entire length of each piece, smooth, clean and free from all teats, nodules or rough spots. Butt joints shall have the mouth of each piece at each end reamed to a radius of about ½ in., and each piece shaped true and square with its axis. Dowel joints shall have at least two dowel holes moulded in each end of each piece. These holes shall be accurately moulded and shall match the pins—all of which shall be interchangeable among all pieces. With each piece the requisite number of dowel pins shall be supplied to fill one half the sum of the dowel holes in both ends. Socket end material shall have one end of each piece bell-mouthed, the other chamfered to fill the bell; all pieces shall be mutually interchangeable. Sockets shall be so designed and made that the addition of a little mortar shall make a tight joint and produce a straight uniform cylindrical cable space.

All hollow brick tile shall be of good, finely ground clay, mixed in the proper proportions and burned thoroughly hard clear through. Each piece shall be well vitrified, but shall not be burned so hard as to be fused or scoriated. The surface of each piece both inside and out shall be thoroughly and uniformly glazed with good salt glaze, and shall not contain cracks which extend into the surface more than 1-16 in. Each piece shall be sound, without soft spots, stones, gravel or any other imperfections. Each piece shall be straight, true and fully up to dimensions specified. The bore of each piece shall be tested and shall pass a standard 3 3-16 in. gauge. All pieces which shall have a bow or curve or kink of more than one fourth inch shall not be accepted, and no piece shall be accepted if it shall have any curve in more than one plane. All hollow brick tile shall be examined by an inspector appointed by the Company at such a place as shall be directed, and only such pieces accepted as shall fulfill all of these specifications. If required, the Contractor shall scrape or clean each piece through the inside of the bore by an appropriate scraper or cleaner, which shall be subject to the approval of the Engineer or Superintendent. All damaged or rejected pipe shall be removed by the Contractor.

NO. 2. MULTIPLE DUCT MATERIAL.

Multiple duct material shall comply with all the provisions of Section 24, No. 1, so far as quantity of material, size and location of bore, dowels, etc., and shall be of the general dimensions shown in Table B, depending on the number of cable spaces.

TABLE B.

DIMENSIONS OF MULTIPLE DUCT PIECES.

THREE INCH DUCTS.

Number of Ducts.	Height and Width of End Section in Inches.	Standard Lengths in Inches.	Special Lengths in Inches.	Approx. Weight per Duct Foot.
Two Duct.....	4⅞x 8¾	24	6 and 12	8¾″
Three Duct.....	4⅞x13	24	6 and 12	8½″
Four Duct.....	8¾ 8¾	36 and 48	6, 9 and 12	8″
Four Duct.....	4⅞x17	24	6 and 12	8″
Six Duct.....	8¾x13	36 and 48	6, 9 and 12	8″
Nine Duct.....	13 x13	36	6, 9 and 12	7¾″
Twelve Duct...	13 x17	30	6, 9 and 12	7¼″
Sixteen Ducts...	17 x17	30	6, 9 and 12	7¼″

NO 3. CEMENT LINED PIPE DUCT MATERIAL.

The dimensions of each piece of cement lined pipe shall be: length not less than 6 ft.; diameter of bore not less than 3 in.; the thickness of cement not less than ½ in.; the thickness of the iron casing, N. 24 B. W. G. Each piece shall be of uniform section, with bore concentric with shell, straight and truly circular throughout its length. The iron casing shall be of good iron, riveted with ⅛ in. rivets set 1½ in. on centers, and painted on the outside with the best quality of coal tar paint, asphalt or other approved coating material applied hot. The lining shall be of pure first-class hydraulic cement without admixture of sand or any foreign material, which shall be applied a sufficient time before shipment to become thoroughly set and sufficiently strong to bear transportation. The cement used for lining shall be an approved quality hydraulic cement, and if required the results of tests for fineness and tensile strength, made as specified in Section 24, No. 7 a, shall be submitted to the Engineer or Superintendent for approval. Pipe made from unapproved materials may be rejected. Each piece shall be supplied with approved cast iron, socket ends thoroughly and securely attached, of such design as shall make a concentric tight joint. Each and every piece shall be free from cracks, indentures, teats, nodules, depressions, breaks or rough surfaces of any kind; shall be straight, true and full to all dimensions; and shall not have a bow or curve of more than ⅛ in. in any plane; and no bend in more than one plane. All pipe shall be cleaned and inspected at such places as may be directed.

NO. 4. CEMENT PIPE DUCT MATERIAL.

Cement pipe shall have an outside diameter of not less than 4⅞ in., and inside diameter of not less than 3⅜ in., and a thickness of not less than ¾ in. It shall be made of a mixture of first-class Portland Cement, and fine crushed stone pressed into an appropriate form. The cement shall be an approved quality of Portland cement, and if required the results of tests for fineness, tensile strength, etc., made as specified in Section 24, No. 7, a, shall be submitted to the Engineer or Superintendent for approval. Pipe made from unapproved materials may be rejected. Pipe shall be supplied in lengths of not less than 6 feet, straight, true and fully up to dimensions in every respect, with no bend of more than ⅛ in., and no bend in more than one plane. The inner surface shall present no lumps or roughnesses or be in any way injurious to the cable sheath. The inner edge of each end of each piece shall be rounded to a radius of at least ½ in. Pipe shall have been made a sufficient length of time to be amply strong to bear hauling without breakage. The pipe shall be fully equal in quality to that of the standard sample which shall be deposited with Engineer or Superintendent prior to the award of this contract.

NO. 5. CREOSOTED WOOD DUCT MATERIAL.

a. Pump Logs, Square and Round.

Creosoted wood duct material shall be made of first class, thoroughly seasoned, white or yellow pine. Each piece shall be not less than 4 ft. in length

and 4½ in. x 4½ in. outside [illegible] not less than 4⅜ diameter for round log. The sides of each piece of square log shall be at right angles to each other, smooth and true. Round logs shall be turned smoothly and truly from end to end throughout the center of each piece. There shall be a bore fully 3 in. in diameter accurately centered and truly circular. At one end of each piece there shall be a tenon 1¾ in. long and not less than 3½ in. outside diameter. On the other end of each piece there shall be a mortise not less than 1⅞ in. deep and a snug fit for each tenon, but this fit shall not be so tight as to cause the wood to split when successive pieces are driven together. All pieces shall be interchangeable. After the pieces are milled they shall be creosoted by the following process:

1st. The lumber shall be steamed in a closed tank with steam at not less than 45 lbs. gauge pressure for at least four hours.

2nd. A vacuum of at least 20 in. shall be applied to the tank and the drainage of sap from the timber pumped away. This vacuum shall be continued as long as any sensible drainage of sap or moisture is discharged by the pump.

3rd. Pure dead oil of tar shall be pumped into the cylinder and an hydraulic pressure applied sufficient to force into the timber at least 14 lbs. of oil per cubic foot of timber in the charge. The absorption of the oil by the timber shall be determined by measuring the total quantity of oil pumped into the treating cylinder and comparing this quantity with the difference between the volume of the cylinder and the volume of the charge under treatment.

4th. All oil used in treatment shall be pure deal oil of tar and shall be subjected to a chemical analysis and proved to contain no deleterious substances. It shall possess the following characteristics:

a. It shall be completely liquid at a temperature of 100° F.

b. It shall contain at least 25% of constituents that do not volatilize at a temperature of 600° F.

c. It shall not contain over 5% of tar acids.

d. It shall contain no admixture of any substance not obtained from the distillation of coal tar.

5th. After creosoting is completed all duct material shall be allowed to season at least three months in the open air before being laid.

[illegible]

All lumber used for Valentine conduit shall be of the same quality and treated in the same manner as specified under Section 24, No. 5 a.

The following Table C specifies the cross sectional dimensions of the woodwork for 1½ in., 2 in., 2½ in. and 3 in. ducts:

TABLE C.

VALENTINE DUCT MATERIAL.

[illegible]

1½ INCH CONDUIT.

Conduit containing	1	ducts, dimensions	3	×	3
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	4	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		

INCH CONDUIT.

Conduit containing	1	ducts, di[illegible]	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		

[illegible] INCH [illegible]

Conduit containing	1	ducts, [illegible]	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		

[illegible]

Conduit containing	[illegible]	[illegible]	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	4	"	[illegible]		
" "	[illegible]	"	[illegible]		
" "	[illegible]	"	[illegible]		

Wood slabs shall be supplied in lengths of not less than 8 ft. The top and bottom slab shall be plain and free from grooves on the upper and under sides respectively. Along each edge of each piece outside the outer cable space a groove shall be cut into which a dovetail shall be fitted capable of making a tight joint with the succeeding slab. All dovetails and grooves shall be accurately and carefully milled and all pieces shall be mutually interchangeable in such a manner that when assembled all cable spaces shall be truly round and circular and in their proper mutual relative position.

NO. 6. WROUGHT IRON PIPE DUCT MATERIAL.

Wrought iron pipe duct material shall be of good quality of wrought iron or mild steel, known as casing pipe. The pipe shall be supplied in lengths of..... .....ft., weighing about four pounds per lineal foot, having a thickness of about ⅛ in., and shall be supplied with a right hand male screw thread at each end. Each piece shall have fully 3 in. on the inside diameter, and be smooth, true and round in every respect. Pieces having fins, cold shuts, nodules, bad welds or rough places upon the inside, or containing kinks, bends or imperfections of any kind, shall be rejected. The end of each piece shall be cut true and square with the axis and reamed out to free it from any fins or projecting slivers. The thread upon each shall be standard casing pipe thread, 14 to the inch, truly and smoothly cut and at right angles to the axis. One end of each piece shall be supplied with standard casing pipe socket threaded through to fit the pipe. Each piece shall be thoroughly painted inside and out with two coats of tar paint, asphalt or other approved coating material applied hot.

[illegible]. CEMENT.

For all concrete and mortar, an approved quality of cement shall be applied; [illegible] shall be subjected to the following tests [illegible]

[illegible]

Before using any cement the Contractor shall submit to the Engineer or Superintendent samples of any brands which he proposes to employ, and if at any time the Contractor wishes to change the kind of cement, he shall again submit a sample for inspection. Each sample shall contain about 50 lb. and from each sample a sufficient quantity shall be taken to make ten lots of briquettes, each lot containing ten briquettes, of American Society of Civil Engineers standard. The first lot of ten briquettes shall be mixed with 15% of water by weight, the second lot with 16%, the third with 17%, the fourth with 18%, the fifth with 19%, the sixth with 20%, the seventh with 21%, the eighth with 22%, the ninth with 23%, and the tenth with 24% of water. Briquettes shall be made by thoroughly mixing each weighed quantity of water with the weighed quantity of neat cement and ramming into briquette moulds. When sufficiently set, briquettes shall be placed under a damp cloth and kept for twenty-four hours from the time of mixing. Then each lot shall be broken by tension in a standard cement testing machine. The amount of water used with the lot developing for the average of the entire ten the greatest tensile strength shall be taken as the proper quantity of water for mixing with the brand of cement in question. All subsequent tests on this brand shall be mixed with the same per cent. of water. From every lot of cement delivered upon the work, the Engineer or Superintendent shall sample such a number of bags, barrels or packages as shall in his opinion be sufficient to determine the quality of the entire lot. If only 60% of these samples tested as above specified shall average 250 pounds per square inch, the lot of cement from which these samples came shall be rejected. If 70% of these samples shall reach 250 pounds, this lot of cement may be either rejected or re-tested, as the Engineer or Superintendent shall see fit. If over 70% shall reach 250 pounds per square inch, the lot shall be accepted.

[illegible] Test.

Each lot shall be tested for fineness, by sifting a weighed portion through a No. 100 sieve, or one containing 10,000 meshes per square inch. At least 90% of each sample shall pass the sieve.

(c) Setting Tests.

Each lot shall be tested for setting mixed with 5% more water than in the specification for tensile test. Three minutes after the application of the water, a Gilmore needle, namely, wire 1-12 in. in diameter and loaded with ¼ pounds, shall be placed on the mixed sample and the length of time and the distance the needle penetrates noted. All samples shall allow the needle to penetrate for at least one minute, and for at least one inch.

[illegible]

All cement shall be delivered in original packages bearing the mark, brand or designation of the maker. The Contractor shall store cement in such a way as to keep it free from injury by weather. All barrels, bags or packages shall be raised from the ground upon suitable supports, and at all times covered with [illegible] coating. [illegible] shall [illegible] [illegible]

rejected, the Contractor shall within 24 hours thereafter remove same, and during the said 24 hours he shall take suitable precaution to prevent the rejected cement being used. If the Engineer or Superintendent believes that rejected cement has been used, he may order such work to be taken out and replaced with that made with accepted cement.

[illegible]

The Contractor shall at all times provide such a supply of cement as shall give a sufficient quantity to use for at least 48 hours in advance of any additional deliveries, to allow sufficient opportunity for tests, and in case the Contractor shall not provide sufficient cement to allow the specified 48 hours the Engineer or Superintendent shall summarily stop the work until a sufficient quantity of cement shall be delivered ahead to allow of 48 hours for testing. For any stoppage of work of this kind the Contractor shall make no claim for delay, and such failure to deliver cement shall not release the Contractor from liability for non-completion, as in Section 18.

[illegible]

All sand shall be first-class fine, sharp, silicious sand, preferably beach, river or lake sand or fine crushed stone, which is not worn or washed. All sand shall be free from loam, dirt, mica, scales, dust or other foreign matter, and when tested by shaking in water it shall not show more than 1% of suspended matter. Sand shall be tested by sifting samples, and at least 75% shall pass a No. 16 sieve and be retained by a No. 40. Previous to the commencement of the work the Contractor shall submit a sample of sand which he proposes to use. If this sample be approved it shall be retained by the Engineer or Superintendent. All sand used on the work shall correspond with the sample.

[illegible] BROKEN STONE.

All broken stone shall be a first-class quality of granite, gneiss, trap or limestone. It shall be broken to have sharp and irregular angles and shall pass in all directions through a 1½ in. ring and also be screened to remove dust. Broken stone shall be clean and free from sand, loam or other admixtures. The Contractor shall submit a sample of broken stone, and if approved the Engineer or Superintendent shall retain the same. Stone subsequently delivered shall correspond to the sample.

NO. 5. BRICK.

All brick shall be first-class hard burned sewer brick, fully up to all dimensions, true and square, with all the faces at right angles, sharp clean edges, thoroughly hard burned clear through. All brick shall be free from bats; broken bricks, light hards or other imperfect brick, shall be thoroughly culled before being delivered, be uniformly and evenly burned. The Contractor shall submit to the Engineer or Superintendent samples of brick, which if approved shall be retained, and all brick shall correspond to the sample.

SECTION 22.

NO. 1. TEST HOLES.

(a)

25 Construction Specifications

If required the Contractor shall dig not to exceed one (1) test hole for every running block of street along the line of the proposed conduit. These holes shall be dug to any depth not to exceed ten feet (10 ft.), and of any width not to exceed three feet (3 ft.), and of any length not to exceed the width of the street. The Contractor shall make no extra charge for any such test holes, but if more than one test hole per linear block is requested, or if the dimensions shall be greater than those specified, the Contractor shall be entitled to extra compensation for all excavation over this amount.

[illegible]

For each and every section of conduit, for each manhole and for each lateral, the Engineer or Superintendent shall give to the Contractor a written notice, stating the time at which he shall commence work upon the section, manhole or lateral in question.

[illegible]

All trenches or excavations shall be dug of such size and to such depths as shall in the opinion of the Engineer or Superintendent give suitable and adequate room for the structures they are to contain. On the average, trench for conduit must be about 2 ft. in width by 4 ft. in depth, and excavations for manholes about 6 in. greater in dimensions than those of the vault upon Plan I, but in order to provide for the possibility of unforeseen street obstructions, the [illegible] conduit, of any width up to 3 ft., and of any depth to 5 ft., measured below the street paving, and may direct for any manhole an excavation not to exceed 3 ft. greater in length and 2 ft. in breadth than the dimensions above specified, and of a depth not to exceed 10 ft. measured below the street paving. For laterals a trench 18 in. wide and 2 ft. in depth will usually suffice, but the Engineer or Superintendent may require the Contractor to open the trench not to exceed 2 ft. 6 in. in width and 4. ft. in depth. For any and all such excavation the Contractor shall make no extra charge. In case the Engineer or Superintendent shall require the Contractor to open any trench or any excavation which is greater than the dimensions herein specified, he shall give the Contractor a written order for such extra excavation which is over and above in amount herein called for, and this order shall authorize the Contractor to make the specified extra amount of excavation at the prices for extra work of Section [illegible] No. [illegible]

NO. 2. WAY IN WHICH EXCAVATION SHALL BE MADE.

On receipt of notice to commence work, together with directions giving the location and size of the excavation, the Contractor shall remove the paving along the line specified and shall dig the excavations in accordance with the dimensions given. For each section the Contractor shall open the trench completely from one end to the other, including the manhole excavations at each end thereof, and shall carry all excavations completely down to the specified depth.

Upon the removal of the paving, the Contractor shall pile same neatly along the line of trench or shall make any other disposition of same as may be directed. He shall pile the excavated material along the side of the trench, provided the same can be done without unreasonable interference with traffic, but in crowded localities or if directed by the Engineer or Superintendent, the Contractor shall remove any and all excavated material whatsoever from the line of the trench, leaving the street free and clear, with the exception of the actual opening. The Contractor shall preserve all the material excavated, and shall use the same for refilling and repaving as shall be directed.

The Contractor shall make all the requisite excavations as herein provided, in whatever materials, wherever found in the streets. If the Contractor shall encounter any rock, old masonry, walls, concrete, hard pan or other material, he shall make the excavation in same without extra charge. If the nature of the material is such as to require blasting, the Contractor shall conduct any and all such operations strictly in accordance with all city rules and regulations therefor. He shall use the minimum amount of explosive for the purpose, and in all cases blasts shall be carefully protected to prevent injury by flying debris. He shall use the most approved appliances and skilled labor which shall conduce to the safety of the public and of his employees in every manner whatsoever. The Contractor shall do all pumping and bailing necessary to keep the trench free from water and in proper condition to receive the ducts. He shall do all sheeting, bracing, shoring or supporting, and shall keep all excavations dry during such time as may be required for the proper setting of all concrete or masonry, all fencing and all other things, needful to constantly protect and maintain the sides and safety of the excavation, and to care for all gas pipes, water pipes, sewers, drains, electric conduits, railways or other structures encountered, and shall maintain and protect all buildings, railways and other structures which may be found during the progress of the work. He shall further provide all crossings and bridges which may be necessary to maintain travel uninterruptedly on all streets and alleys, and shall guard and watch all excavations in complete accordance with all the rules and regulations of the City of.....or any directions which may be in future given by the City authorities or the Police Department. At night all excavations shall be properly fenced, lighted and guarded to insure the safety of the public. During the progress of the work, any gas pipes, water pipes, sewers, drains, electric conduit, catch basins, buildings, railways or other structures which may be uncovered or undermined by the Contractor shall be restored and left by him in equally good condition, or if injured or harmed in any way, shall be replaced by him without extra compensation therefor, in as good condition as that in which they were found. During the progress of the work all supplies, materials, tools and machinery shall be neatly distributed along the line of the street to least obstruct the traffic or if directed the Contractor shall store all material, tools, machinery or supplies off the line of work, and in all cases particular care shall be given to providing free access to water hydrants and shut-offs and to arrange for free passage ways for the Fire Department. Upon the completion of any section of conduit, manholes or laterals the Contractor shall remove therefrom any sheeting, shoring or bracing which may have been introduced for the purpose of holding the sides of the trench or maintaining any street structures, unless the Engineer or Superintendent shall direct the Contractor in writing to leave same in place. If the Engineer or Superintendent shall elect to leave any sheeting, shoring or bracing in place, he shall give a written order to the Contractor authorizing such as extra materials and work, with extra compensation therefor, as per Section 23, No. 6, c.

NO. 3. FINAL ALIGNMENT AND GRADE OF EXCAVATION.

Upon the completion of any excavation to the dimensions specified, the Contractor shall notify the Engineer or Superintendent that he is ready for final line and grade. The Engineer or Superintendent shall then drive one stake at each end of the excavations for the manholes, and one stake along the line of conduit at intervals of about ten feet. In manhole excavations stakes shall be so driven as to locate the center of the manhole, while the top of the stakes shall be at the grade of the top of the bottom thereof. In the trench the stakes shall give the center line of the conduit, the top of the stakes indicating the top of the concrete foundation. In all cases the exact center line shall be indicated by a tack driven in the top of the stake. As soon as the stakes have been

driven, the Contractor shall trim the sides and the bottom of the trench, in such a manner as to give adequate room to place the structures.

The Contractor shall make no extra charge for the final trimming or any excavation which may be necessary to bring the excavation to the proper line and grade, as given by the final stakes. In case the opening of any excavation shall disclose any obstacles that render it advisable in the judgment of the Engineer or Superintendent to change either line or grade or both, he shall have the right to make any and all such changes as he may see fit, and in so far as any such changes do not require the Contractor to open excavation of greater dimensions than called for in Section 25, No. 1, c, no extra charge shall be made. In case the grade of the conduit shall be raised, and if the Engineer or Superintendent shall order the concrete foundation to be increased in thickness to accommodate such change, he shall give the Contractor an order for all extra concrete required over and above the amount hereinafter specified for foundations. But in case such change in grade shall be made by refilling and material excavated, no claim shall be made by the Contractor for any extra work for such change.

NO. 4. OBSTACLES.

Whenever it shall become necessary to change the location, either temporarily or permanently, of any water pipes, gas pipes, sewers, drains, electric subways, electric mains, catch basins, railways or other structure encountered the Contractor shall send notice of the existence of any such obstacles to the Engineer or Superintendent, and if in his judgment such changes are deemed necessary, he shall notify the owners or those in charge of such structures, and any and all changes shall be effected in accordance with the directions and under the supervision and subject to the approval of such owners or persons in charge. In case the Engineer or Superintendent shall call on the Contractor to do any of the work of the removal or changes in any street obstructions, the Contractor shall supply any and all work, labor, tools, appliances or material such as shall in the opinion of the Engineer or Superintendent be desired for this purpose. All such labor, work, tools or materials shall be the subject of an order for extra work, which shall be given to the Contractor by the Engineer or Superintendent in advance of the performance of the work, at the prices specified in Section 23, Nos. 5 and 6. For all time which in the opinion of the Engineer or Superintendent the Contractor is delayed by the non-removal of any street obstructions, the Contractor shall be allowed a corresponding number of extra days' time over and above that herein stipulated for the completion of the entire work called for by this contract. If in the opinion of the Engineer or Superintendent any such time allowance is due, he shall give to the Contractor a certificate of extra time allowance, specifying the number of days.

NO. 5. MORTAR.

All mortar, either for concrete or for masonry, shall be mixed as follows:

A sample of the sand shall be tested to determine the percentage of voids by filling a measured vessel having a capacity of about 1 cubic foot, and then adding as much water as possible without causing the vessel to overflow, and noting the amount which shall be deemed a measure of the voids. To prepare mortar such an amount of packed cement shall be taken as is equal to 125 per cent. of the amount of voids thus shown and thoroughly mixed with sand. Enough water shall then be added (approximately one-third of the cement) and the whole mass thoroughly mixed. After proportions are thus determined the relative quantities of cement, sand and water, as thus shown, shall be used in all work. The relative proportion of water, cement and sand will be about one third part of water, one of cement and two and one half of sand, for such cement and sand as is hereinbefore specified. The proportions thus given are only approximate, and as they will vary with the different kinds of sand and cement which may be used, the exact proportions in each case shall be determined by the Engineer or Superintendent.

NO. 6. CONCRETE.

The voids in broken stone used for concrete shall be determined as previously specified for voids in sand. After the amount of voids is ascertained, a proportion of cement mortar made as specified in Section 25, No. 5, equal to 140 per cent. of these voids shall be used. With the cement, sand and stone previously specified, the proportions for concrete will be one third part of water, one part of cement, two and one half parts of sand and seven and one half parts of broken stone, but as the character of the broken stone may vary from time to time, the proportion of voids for each kind of stone used shall be measured, and the Contractor shall mix concrete in accordance with the instructions given by the Engineer or Superintendent after such determination.

NO. 7. MIXING.

All cement-mortar and concrete shall be made by accurately measuring—not estimating—the proportions of the various ingredients of which they are composed, as directed, by the Engineer or Superintendent. Mixing shall always be done on a mixing board or trough or by a mixing machine—never on the ground. For mortar the proper proportions of cement and sand shall be measured and thoroughly mixed by shoveling over five times, then—not previously—shall the proper proportion of water be added and the mass again mixed by shoveling at least five times. Concrete shall be mixed by adding the specified quantity of mortar to the specified quantity of stone and shoveling at least five times. Mortar shall not be used that has been mixed for more than thirty minutes, and no concrete that has been mixed for more than forty-five minutes. No retempering or the addition of any material whatsoever to either the mortar or concrete shall be permitted after mixing has commenced.

NO. 8. METHOD OF LAYING DUCT MATERIAL.

The Contractor shall place upon the bottom of the trench a layer of concrete 3 inches thick to form the foundation. This layer shall be deposited uniformly and evenly, carefully levelled and scraped so that it shall present a uniform even surface, both longitudinally and transversely to line and grade. The concrete shall be thoroughly packed into place with suitable rammers not less than 6 inches square, weighing not less than 25 pounds, rammed until its surface slightly flushes, and on completion the foundation shall be level and even with the top of all grade stakes. After the concrete is placed, at least six hours shall be allowed for setting before any duct material is laid thereon, unless in the opinion of the Engineer or Superintendent the immediate placement of the conduit is necessary. If the Engineer or Superintendent shall direct the Contractor to place the conduit immediately, the Contractor shall protect the top of the concrete with sufficient planking so that it may not be injured. The duct material shall be laid by placing upon the surface of the concrete foundation a thin coating of cement mortar about ¼in. in thickness, and the first layer containing the number of ducts horizontally specified in the directions of the Engineer or Superintendent shall be placed upon this bed of mortar and laid by line and level. As each piece is laid all of its sides shall be coated with cement mortar to form a solid joint with each neighboring piece, and at the same time the ends of each piece shall be similarly coated to make a sealed joint; no joints shall be laid dry or flushed. All hollow brick shall be laid upon a mandrel, not less than three inches in diameter and five feet in length, excepting in cases of curves where a mandrel three feet in length may be employed. The front end of this mandrel shall be supplied with a ring whereby the mason by means of a long hooked rod can draw it along, and the rear end with a washer of leather or rubber lightly fitting the ducts, the object of which is to scrape away any mortar that may accidentally enter. All hollow brick shall be laid so as to break joints in every direction, both longitudinally and vertically.

As soon as the first few feet of the lower layer of ducts are laid, a second layer shall be started and shall proceed simultaneously with the first, being laid to line and level. The laying shall proceed in a similar manner until such a number of horizontal layers is placed as is called for by the specifications for the particular section.

In laying pipe, care shall be taken to so place each piece that the bend, if any, shall be in a vertical plane. All sections of conduit shall be laid perfectly straight to line and grade, unless by special directions from the Engineer or Superintendent. In case it shall become necessary to make any curves, either vertical or horizontal, the Engineer or Superintendent shall lay out all such curves, and the Contractor shall then lay the duct material exactly to the lines given. If necessary the Engineer or Superintendent may require the Contractor to provide a templet to insure accurate laying.

(b) Hollow Brick or Single Duct Material, Butt ends with Dowels.

When dowel butt ends are used all the requirements of Section 25, No. 8. a. shall be observed exactly as therein specified, and in addition after each piece is laid a dowel pin shall be inserted into each of the dowel holes in the open end thereof, and the succeeding piece centerd by these pins. The use of a laying mandrel shall be omitted.

(c) Hollow Brick or Single Duct Material—Socket ends.

When socket ends are used all the requirements of Section 25, No. 8. a. shall be observed, and in addition special care shall be taken to coat the male end of each piece uniformly and thinly with mortar, and to drive it into the female end of the succeeding piece. The use of a laying mandrel shall be omitted.

When socket ends are used, all the requirements of Sec. 25, No. 8 a shall be observed, and in addition special care shall be taken to coat the male end of each piece unifromly and thinly with mortar, and to drive it firmly home with the female end of the preceding piece. With dowel or socket ends the use of the mandel in laying may be omitted, if so direct by Engineer of Superintendent.

Multiple Duct Material shall be laid under the provisions of Section 25, No. 8. a. except that no mortar shall be used between the ends of each piece, but instead each joint between successive pieces shall be made by wrapping a strip of burlap 12 in. wide and long enough to make 2½ complete turns around the ends of the piece to be jointed. Prior to wrapping the burlap shall be dipped into melted asphalt, as hot as possible without danger of burning the burlap, and applied hot to the duct material. No laying mandrel shall be used with multiple duct material.

Cement lined iron pipe shall be laid by providing concrete foundation as already specified in Section 25, No. 8. a. Upon this foundation the cement lined iron pipe shall be laid in a manner similar to that specified under Section 25, No. 8. a. and c., but in addition sufficient mortar shall be used to fill completely all of the voids between each round piece of pipe and any and all of its neighbors. No mandrel shall be used.

Creosoted wood duct material shall be laid without any foundation or encasement of concrete. After the trench is excavated the bottom shall be rammed solidly to compact it and then shall be levelled off and graded in the same manner as specified for the concrete foundation. The creosoted wood duct material shall then be laid upon the bottom of the trench to line and grade, as specified in Section 25, No. 8. a. and c., excepting that no mortar, cement or concrete shall be used. Previous to joining the pieces the tenon of each piece shall be painted with hot asphalt and then driven solidly home into the mortise of the preceeding one. At each joint one stake 1¼ in. thick and 3 in. wide shall be driven into the bottom of the trench close to and on each side the duct material to hold the same in place. These stakes shall be of such a length as to be driven into solid material. The top of these stakes shall be driven flush with the top layer of ducts and then shall be secured by a cross batten of 1¼ in. creosoted lumber 3 in. wide, secured to each stake by two wire nails three in. in length. The lumber and nails for the stakes thus specified shall be included in the term "Duct material."

Iron pipe duct material shall be laid in the same manner as specified for cement lined pipe Section 25, No. 8 c. excepting in the case of laterals when the concrete encasement shall be omitted.

Cement conduit shall be laid as specified for cement lined pipe, Section 25, No. 8 e, but in addition shall be laid on a mandrel.

(1) *Laterals.*

Laterals shall be made of any form of duct material, as may be directed by the Engineer or Superintendent, and each lateral shall be laid in the same manner as is specified for the duct material of which it is composed, except that the concrete foundation and encasement shall be omitted. One end of each lateral shall commence at some distributing point, such as the terminal pole of an aerial line, or on the inside wall of a building. The other end of each lateral shall terminate in some manhole or in some duct of the conduit.

NO. 9. ENCASEMENT.

After all the duct material is laid in any section, a period of not less than six hours shall be allowed for mortar to set before the concrete encasement is put in, unless the Engineer or Superintendent shall direct the Contractor to proceed immediately therewith. The concrete encasement shall consist of a layer of concrete two inches in thickness on each side of the ducts and three inches on the top, so that when joined to the foundation it shall form a complete enclosure for the conduit. This concrete shall be deposited, on each side of the conduit, and on the top thereof, and carefully rammed into place, great care being exercised not to injure or break any of the joints of the duct material. After the concrete encasement is placed, a period of six hours shall be allowed for the setting thereof, before the trench is refilled, unless the Engineer or Superintendent shall direct immediate refillment.

The contractor shall refill into the trench the material previously excavated. This material shall be refilled in layers not to exceed 6 in. in thickness, carefully deposited on and around the concrete, in such a manner as not to injure the bond thereof and each successive layer shall be thoroughly and carefully rammed into place with rammers similar to those specified for ramming concrete. If required, the Contractor shall puddle any and all refill. Upon the completion of each section of conduit and each lateral, the Contractor shall at once thoroughly and carefully clean up the street and sidewalks. He shall remove all surplus dirt, paving material and all tools, materials and supplies of whatever nature and description, and in every respect except the strip of paving removed, the street shall be restored to as good condition as before the opening was made, and shall meet the approval of the city authorities in all particulars.

(a) As soon as the refillment of the trench is completed, the Contractor shall restore the paving in such a manner as to make the streets safe and suitable for traffic. If any of the cross walks, paving blocks or other paving material has become lost or injured or is in any way unsuitable for this purpose, the Contractor shall supply, at his own expense, a sufficient amount of suitable paving material to make good the street. In this replacement of paving the Contractor shall not be required to make finished and permanent repaving, but shall merely replace in such a manner as is necessary to allow for the refill to settle and compact itself sufficiently to warrant permanent repaving.

(Cancel paragraph b. if paving is done by conduit contractor.)

(b) It is further specified that on the replacing of the pavement in the temporary manner thus specified, the work of the Contractor upon this section of the conduit in so far as the street paving is concerned shall cease, and that the future and final repaving of the same in a manner suitable and acceptable to the city authorities shall be done by the Company.

(Cancel No. 12. a. paragraph if paving is done by Company.)

NO. 12. PERMANENT REPAVING.

(a) After the temporary paving, as specified in Sec. 25, No. 11. a., is done the Contractor shall allow such a time as may be directed by the Engineer for the settlement and compacting of the refill before permanent repaving. When this time has elapsed, the Contractor shall repave all excavations with the same class of paving materials as have been removed. All curb stones, gutter stones, flagstones or sidewalks, and all street paving material which may have been displaced shall be put back in as good or better shape than before the removal. In all paving work the standard specifications or requirements of the City of ——— shall be followed and when the final paving is complete the street shall be finished, cleaned and left in as good, or better, condition than before the openings were made, and shall in every particular meet the approval of the City authorities.

(b) In all excavations the Contractor shall exercise due care not to move or disturb the pavement in excess of that required for the opening specified, and shall be responsible for any and all paving which is disturbed or moved, that is more than six inches away from the line of the excavation as laid out by the Engineer, and in the event of the disturbance of any pavement beyond the six inches herein specified, the Contractor shall replace all such moved or disturbed pavement at his own expense.

If, within a period of one year after the final repaving of any opening, any settlement, heaving or displacement of any of the paving, curb stones, gutter stones, cross walks or side walks shall occur, the Contractor shall repair and make good the same in a manner satisfactory to the city. And to meet the cost of any such repair work, it is hereby agreed that an amount not to exceed 25 per cent. of the estimated cost of paving permanently the whole surface of pavement disturbed by the work specified in this agreement shall be withheld by the Company from any amount which may become due to the Contractor on account of this contract, for a period of one year after the entire completion of the work. And that during said period of one year the Company shall notify the Contractor of any repairs or repaving which may be necessary on account of said work, and the Contractor shall at once, on receipt of such notice, make any and all such repairs, in a manner satisfactory to the city. If the Contractor shall fail upon receipt of such notice to make the repairs therein stipulated within such a time as shall be required by the City, the Company may make the necessary repairs and may deduct the cost of such repairs from the amount held as herein specified. At the expiration of one year from the entire completion of the work herein called for, and upon the completion of any and all repairs to any and all portions of the streets which may have been opened for the construction of the work herein specified in a manner satisfactory to the City, the Company shall pay to the Contractor any and all moneys which may remain over and above the cost of said repairs, from the amounts withheld as above specified.

CONSTRUCTION OF MANHOLES.

(a) *Brick Manholes.*

The bottom shall consist of a layer of concrete 6 in. in thickness, large enough to cover the entire area of the manhole and extend under the walls thereof, as shown upon Plan I. This concrete shall be mixed in the proportions and deposited as specified in Sec. 25, No. 6. After the concrete bottom is in place at least 6 hours shall be allowed for setting before the masonry is commenced, and the Contractor shall protect the surface of the concrete by suitable planking and then shall proceed with the walls, which shall be built essentially as shown on Plan I, so as to construct a vault about 4 feet wide, 6 feet long and 5 feet high inside with curved walls uniformly 8 in. in thickness. The brick masonry shall be laid in cement mortar made as specified under Sec. 25, No. 5. Each brick shall be laid in a full bed or mortar upon all sides; there shall be no slushing of joints after bricks are placed. The masonry shall be laid in alternate courses of headers and stretchers. As nearly as may be the center of each end the wall shall be corbelled as shown, to afford entrance for the ducts, but the exact location of the ducts in each wall shall be given by the Engineer or Superintendent at the time of building. The size of the entrance shall depend upon the number of ducts shall be specified for each wall separately. When the mason work has reached the level of the under side of the ducts, the Contractor shall then build the end of the conduit into each end wall, unless the

Engineer or Superintendent shall direct the manhole to be completed, and the conduit to be subsequently built. If such instructions be given, the Contractor shall leave a suitable opening in each end wall and shall proceed to complete the manhole, and after completion he shall build in the conduit.

The four walls shall be carried up uniformly and as they are built the exterior of each wall shall be plastered thoroughly with cement mortar to a thickness of not less than ½ in. The walls shall be built 5 feet high above the top of the concrete bottom, and shall then be levelled off evenly to receive the top. All masonry shall be laid plumb and true to line and level with not over ⅜ in. joints completely filled with cement mortar, accurately curved to templet, as shown, and shall be in every respect first class brick masonry. The roof will vary according to location in the street, and may be either flat or arched, and may be composed either of concrete or brick laid upon iron as shown.

This shall be made by setting inside of the walls and level with the top thereof, an appropriate form so constructed that after the top is completed the form may be withdrawn through the opening for the cover. After this form is in place a layer of concrete eight in. in thickness, shall be placed on the top of the form and thoroughly and solidly rammed into place. This concrete shall be allowed to set for 6 hours before any refilling is made.

(c) Flat Concrete Roof.

Flat concrete roofs shall be made exactly as specified in Sec. 25, No. 13 b., except the form shall be so made as to give a flat not an arched roof.

Brick roofs shall be built by placing across the walls a series of iron beams made of angle iron, as shown on Plan I and as specified in the attached Bill of Materials headed Brick Manholes. If the Contractor desires he may substitute any other equally strong iron shape such as old rail channels, angles, etc., if approved by the Engineer or Superintendent.

Concrete manholes shall be built of the same general form and shape as shown in Plan I; the bottom shall be put in, in the same manner as specified ready, in Sec. 25, 13. a., and after it is in place and has had six hours' time to set, the Contractor shall place thereon the appropriate form for shaping the concrete. This form shall be made of first class dressed lumber accurately and carefully built in a substantial manner, to withstand without deforming the ramming of concrete. It shall be so built as to easily retain its shape and readily taken apart so the largest piece can be removed through the cover hole. The forms shall be smooth and true so that after the concrete is rammed a finished surface be produced. The Contractor shall constantly maintain the forms in good condition so that they shall yield first class manholes. After the form is properly set the Contractor shall deposit around it the necessary concrete to give a wall 8 in. in thickness. This concrete shall be made as specified in Sec. 25, No. 6, and shall be filled around the form in layers not exceeding 6 in. in thickness, thoroughly rammed in place sufficiently to show a slight flushing. The placing of the concrete shall be uniformly and evenly carried around the entire circumference of the form, layer after layer, until the form is completely covered. To retain the outside of the concrete, the Contractor may either use the earth walls of the excavation or sheeting as he may see fit. The concreting shall be continued without stopping so as to complete the entire manhole at a single operation.

After the roof is completed 6 hours shall be allowed for setting, then a ring of brick masonry of sufficient size and height to raise the cover flush and level with the street pavement shall be built around the opening for the cover and the iron cover be set in its place, as shown on Plan I. After the settling of the mortar the refilling of the manhole excavation shall be done. In this refilling the excavated material shall be deposited in layers of about 6 in. in thickness uniformly all around the manhole walls and shall be solidly rammed into place. If directed, the Contractor shall puddle all the refill. This refilling shall extend to and around the cover to the proper height to receive the paving, which shall then be replaced as specified in Sec. 23, No. 5.

(f) Changes in Manholes.

The Engineer or Superintendent shall have the right at any time to change the size and shape of any manhole to such extent that shall be considered necessary and ordered expedient. The Contractor shall at all times build such special manholes in accordance with any supplementary drawings, plans or instructions, without extra charge, provided such changes do not require the Contractor to supply a greater amount of masonry or concrete than is called for by Plan I and Bills of Material for standard manhole. In case the directions shall increase the volume of masonry in any manhole, the Engineer or Superintendent shall give to the Contractor an order for all extra material so demanded, and this order shall authorize payment to the Contractor of such an amount as shall cover the difference between the amount of masonry in the standard manhole and that in the one called for. This extra compensation shall be at the rate hereinbefore specified in Sec. 23, No. 6. a. and b.

The bottom of such manholes as the Engineer or Superintendent shall direct shall be provided with a drain connecting with the nearest street sewer. This drain shall be made of a sufficient amount of standard 4 in. tile drain pipe. The Contractor shall supply the required pipe, make the necessary excavation, lay the pipe, connect the outer end thereof to the street sewer, and connect the inner end to a sewer trap approved by the Engineer and Superintendent and set same in manhole floor, and repave the excavation. All of this work shall be done by men holding "Sewer Permits," and shall be in accordance with all the City rules pertaining to sewer connections and to the satisfaction of the City authorities. For all such sewer connections the Contractor shall apply for, take out and pay to the City the usaul fee for a sewer permit, and shall file with the Company the receipt for each and every such connection as evidence of his compliance wtih the City rules.

The location of the conduits and manholes shall be, at all times, so planned as to avoid, as far as possible, carrying any gas pipes, water pipes, drain pipes, foreign electric subways or other street structures inside of the walls of the manholes, but where it is impossible to avoid the entrance of such structures, the Contractor shall take particular pains in building the walls of the manhole or other parts of the masonry thereof, around such structures. In any instance where gas pipe, water pipe, electric subway, Edison tubes, drain pipes or other structures shall pass through any portion of any manhole, the Contractor shall turn a complete circular arch in the mason work of each wall intersected by such structure entirely around such structure. This arch shall be so built as to give not less than 1½ in. clearance between the foreign structure and the mason work, solidly built of brick set upon edge, laid in cement mortar with closed joints, and shall allow the foreign structure to pass through the manhole wihout touching any portion of the walls thereof.

(i) Pointing of Brick Work; and Entrance of the Ducts

After each manhole is entirely completed and conduits built into place in each end wall, the Contractor shall go over and finish the same. The finish shall consist in pointing up with neat cement mortar all joints in brick work, and entrance of ducts, and the junction between the masonry of the sides and the bottom and top, the entrance of the sewer trap and the junction of the cover with the manhole top. The pointing shall be done in a neat and workmanlike manner so as to seal and complete all joints. After the pointing is done the manhole shall be thoroughly cleaned out, the bottom-sides and top, including the entrance to the ducts, smoothed off so as to leave the work in a neat and shipshape manner in every respect.

In case any conduits or manholes shall be laid in a wet location and where standing water is encountered in the excavation of trenches, the Contractor shall excavate a proper sump and dig along the bottom and outside of the excavation a proper drain and provide sufficient pumping facilities so that such excavation may be kept free from water during the setting of the concrete or masonry. In such cases the Contractor shall take particular pains with the manufacture and placing of concrete so that when the work is completed all portions of the conduits and all the manholes shall be water tight. In case any portion of conduit or any manhole shall after completion be found to leak, the Contractor shall reopen the excavation and plaster, or in any other manner satisfactory to the Engineer or Superintendent stop any and all such leaks or incursions of water.

26

Rodding

and each lateral, the Contractor shall *rod* each and every duct. This process shall consist in pushing a series of rods of wood or metal composed of sections of such length manhole and arranged to be easily joined to- After the rods are pushed through a duct a rope shall be attached to the rear end of the rods to enable a mandrel to be pulled through the duct, in order mortar, concrete or other obstacles which may have entered therein. This

supplied with appropriate hook and eye at either end, to which the proper ropes may be attached, and furnished at both ends with a sharp cutting edge of steel. The mandrel shall also be supplied with a steel brush not less than three inches in diameter. A specimen mandrel will be furnished to the Contractor by the Company and the Contractor shall build and supply as many mandrels, exactly in accordance therewith, as may be necessary. If, during the rodding the Contractor shall find any obstacle that shall prevent the passage of the mandrel, he shall reopen the street, find the obstruction, dislodge the same, repair the conduit, replace the concrete encasement, refill the excavation, replace the pavement, and then shall repeat the process of rodding until the mandrel shall pass easily through each and every duct. After the mandrel has been pulled through each duct, the Contractor shall pull into and leave in such ducts as may be specified by the Engineer or Superintendent a piece of No. 10 B. W. G. galvanized iron wire long enough to extend entirely through each duct and project about 6 in. from each end thereof. The Company shall deliver to the Contractor at its storehouse all the wire that shall be required for the purpose, but the Contractor shall haul the wire to the work and introduce the same into the ducts without extra charge. Finally the Contractor shall plug each end of each duct with a hardwood plug of sufficient size to firmly stop the ends. This plug shall be of hardwood, turned true and smooth, shall so fit the duct that it cannot be forced inside thereof, and shall project at least one inch inside the end of the duct and two inches outside thereof. The plugs shall be soaked in water for at least twelve hours, before they are put in place so that they may not swell and split the ducts.

IN WITNESS whereof the parties to these presents have caused the same to be signed by their respective executive officers and their respective corporate seals to be hereto affixed the day and year first above written.

(Signature first party)

(Signature second party)

(Witnesses)

BOND

27
Bond

KNOW ALL MEN BY THESE PRESENTS THAT WE ..... as principal, and .....we as surety, ...are held and firmly bound unto the..... COMPANY, of ..... in the sum of.. .....Dollars, to be paid to the said.....COMPANY, its successors and assigns, for which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors jointly and severally by these presents.

Sealed with our seal and dated at this..... day of ....., 1900.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT

Whereas the said above bounden..... has entered into a certain agreement of date herewith in which the..... .....is party of the first part, and the said ....is the party of the second part, for the full terms used and particulars hereof express reference is hereby made to such agreement, and by this reference it is made a part hereof, to which this bond is annexed.

NOW THEREFORE, if the said ..... shall in all things fully and faithfully keep and perform said agreement and each and every term and part thereof, then this obligation shall be void, otherwise it shall remain in full force.

WITNESS OUR NAMES AND SEALS

..... Seal.
..... Seal.
..... Seal.

(Witnesses)

SECTION 27.

Bills of Material.

(*a*) Concrete manhole, flat concrete roof.

28
Bills of Material

Excavation and removal of earth.
375 cubic feet
Concrete .....125 cubic feet
Cover and frame 1
Repaving .....6 square yards

(*b*) Concrete manhole arched roof.

Excavation and removal of earth.....425 cubic feet
Concrete .....130 cubic feet
Cover and frame 1
Repaving .....6 square yards

(*c*) Brick manhole flat concrete roof.

Excavation and removal of earth .....375 cubic feet
Concrete .....52 cubic feet
Brick 100
Cover and frame 1
Repaving .....6 square yards

(*d*) Brick manhole flat brick and iron roof.

Excavation and removal of earth.....375 cubic feet
Concrete .....10 cubic feet
Brick 220
Iron work .....500 pounds
Cover and frame 1
Repaving .....6 square yards

(*e*) Sewer to any manhole (average).

Excavation and refilling .....25 cubic feet
4 in. sewer pipe.....16 linear feet
4 in. sewer trap 1
Repaving .....5 square yards

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Sixth Annual Convention of the Independent Telephone Association of the United States..... Supplement

THE INDEPENDENT TELEPHONE CONVENTION.

With this number is issued a supplement, giving the proceedings of the Independent Telephone Association, whose convention at Philadelphia closed on Thursday afternoon. The meeting, as will be seen, was very much of a success, and it would have certainly been more so but for the recent local meeting at Chicago, which was allowed to fall just far enough ahead to take some of the edge off the larger and more important affair. If one thing stands evident, it is that the work of the national body should be helped and not hindered by that of State and subordinate organizations.

As to the proceedings themselves, it must be confessed that there was by no means the kind of programme that one is entitled to expect after five years of existence, and from a body with so much talent in its membership. There was again too much of the "barbaric yawp" about Bell villainy and Bell tactics and the wiles of monopoly. There are just as many good men and true in Bell ranks as in those of the "independents," and as for "monopoly," the existence of some 5,000 independent exchanges, with more subscribers than the Bell companies, has made the use of the word ridiculous. However, while making due allowance for what after all is not worse oratory and invective than is thrown around at every political election, one turns with a sense of relief to the excellent paper of Mr. Stanton, and it is felt that if the Association management would but engage more of these for its conventions, it would the sooner reach the dignity and the influence that await it. The telephone art to-day belongs to the people who give the best service for the least money. Mr. Stanton laid emphasis on questions of tariff, on improvements in equipment, on features of technical management, and discussed with great ability the three leading problems that confront Bell and independent exchanges alike, and he was not afraid to speak words of praise for "measured service" as scientific, or to insist that in order to give good service telephone companies must at least charge enough to pay their help fairly and maintain their apparatus in efficiency.

THE INSTITUTE MEETING.

Those who contend that it is well for a convention such as that of the American Institute of Electrical Engineers to get away from large cities, will at least find in the brilliant success of the Great Barrington meeting some support of their arguments. At first it seemed strange to many that a leading national technical body should go to a quiet and minute place in the Berkshire Hills, but it soon proved that while the associations with the place were a strong justification, the heartiness of the welcome and the readiness with which the members turned out were an even better evidence of the wisdom that dictated the choice. Once in a while the Institute will have to favor the great cities, but it is likely that such places as Saratoga, Old Point Comfort, Colorado Springs, Geneva Lake, Mackinac, etc., are apt in the future to be considered with a favor altogether disproportionate to their size. There are fewer outside distractions; there is closer attention to the business in hand, and the courtesies extended are always of a sensible, simple and cultivated kind. Anything more idyllic and acceptable than the hospitalities at Great Barrington and Pittsfield last week it would be difficult to imagine, and the sentiment as to the delightful time spent among those peaceful New England hills, from which came such men as the Fields, the Popes, Sprague, Stanley and others famous in electrical arts and history, was as enthusiastic as it was universal.

Electric Railway Systems for Heavy Service.

During the Great Barrington discussion on the application of electricity to heavy railway service, Mr. H. Ward Leonard and Mr. Bion J. Arnold gave the outlines of systems for this purpose which they have respectively devised, and which will soon be tested on a practical scale. The system of Mr. Leonard was in its main outlines described in an Institute paper some years ago, but since then it has been improved in detail, and a complete system of multiple-unit control added. Its salient principle is motor control by variable voltage, employing the method which has been so successfully applied to warship turrets and to elevator and machine-tool operation. Briefly, the system includes the use of single-phase, high-voltage transmission, a single-phase motor driving a direct-current generator which supplies the car motors, the field of the generator being rheostatically controlled to give at the motor terminals any voltage from zero to a maximum. Part of the system consists of an extremely simple method of multiple control, employing merely rheostats in the generator field circuit, thus involving a negligible loss of energy in control. The objection urged against this system has been with respect to the expense, the weight and the space occupied; its advantage otherwise, particularly with respect to heavy work, having been generally conceded. That the above objections may have been overestimated would appear to be a fair infrence from the fact that the Oerlikon works have taken up the system, and are now building a 44-ton locomotive, to be operated from a 15,000-volt transmission line.

While it was quite well known that Mr. Arnold is about to equip with a single-phase motor system a 60-mile Western road, 20 miles of which are now nearly completed, the startling nature of the innovation was not surmised, and his announcement at Great Barrington of its general details formed the sensation of the meeting. The system, in fact, is highly original, both in principle and in details, and if the practical test, soon to be made, should prove successful, it is not too much to say that the matter of long-distance and heavy service railways will pass at a bound from the stage of discussion to that of practical realization. Briefly stated, the system consists in the combination of a single-phase motor having a revolvable stator and rotor, with compressed air engines and air storage, one engine being connected with the stator and the other engine with the rotor in opposite relation. Normally, the motor is always connected to line, and either the rotor or stator, or both, is always in motion. Assuming that the car is at rest, the stator runs at synchronous speed, compressing air for storage. To start, the stator-compressing engine is throttled, whereupon, since the synchronous relation between the stator and rotor must be maintained, the latter begins to rotate, thereby propelling the car. As the stator engine is further throttled, the rotor speed increases correspondingly, until finally, when the stator is brought to rest, the rotor has synchronous speed. Should it be desired to attain a higher speed than that corresponding to synchronism, the stator is by its engine revolved in the same direction as the rotor; and if in starting a torque higher than that of the motor proper is required, the engine of the rotor is brought into action. Further important details relate to the methods of retardation, and restoring energy to the line. Should the car pass through towns where it would be inadvisable to install the high-tension conductor, or be used for switching purposes, it may be propelled by the engines driven from the compressed air storage. The system embodies a number of other interesting features, such as the method of control, both simple and multiple-unit, the incidental use of electromagnetic clutches whereby either the rotor or stator or both may be uncoupled from the wheels when desired to compress air alone, the operations for ascending or descending grades at maximum efficiency and at any given speed, etc.

It will be noted that the method of Mr. Arnold, if successful, would convert the single-phase motor, which has thus far been handicapped by its inflexibility with respect to speed, into a means for attaining a flexibility of speed and torque superior to that possessed by any polyphase motor system yet proposed, and even exceeding in these respects the capabilities of the much-vaunted direct-current railway motor. Moreover, the system would appear to involve a high efficiency, for not only does the motor work at all times at maximum efficiency, but a portion of the energy of retardation and that now wasted in control resistance is saved, and practically a constant load is maintained on the power station. It is interesting to note that all of the control operations are mechanical, the electrical circuits not being subject to manipulation; and that the said operations are all automatically effected beyond the handling, as in present systems, of a controller lever by the motorman. The Great Barrington announcements come almost simultaneously with the notice of a new manufacturing combination about to enter the railway field with the Ganz system, and the situation with respect to long-distance and heavy-service electric traction has thus of a sudden assumed an unexpectedly bright aspect. For the credit of the American electrical engineering profession, we sincerely hope that a goodly portion of the promise held out will soon have fulfillment.

New Electrical Measuring Instruments.

No less than three new measuring instruments were described last week among the convention papers of the American Institute of Electrical Engineers. These instruments are not novel in their principle, being constructed on plans already known; but their utility resides in the details, either of construction or application, whereby their novelty becomes apparent. One of these instruments is the electrostatic wattmeter, described in the paper by Mr. Miles Walker. The principle of this instrument has long been known in connection with the quadrant electrometer, of which it is a linear descendant; but there are various interesting details in construction which appear to make this new apparatus not only less expensive, but also more convenient for special purposes than the quadrant electrometer. It is well known that the torque on the needle of a quadrant electrometer is proportional to the square of the voltage between the attracting quadrants and the needle. If the opposite pairs of quadrants have a small potential difference between them, such as that due to a drop of potential established by a current through a non-inductive resistance, the torque on the needle will be very small, unless the needle is maintained at a considerable voltage from the quadrants. In the latter case, although the torque may be ample to secure a good deflection, this deflection is not proportional to the potential difference between quadrants, or to any simple power thereof; but involves an extra term.

The paper referred to shows that when the potential of the needle is midway between the potentials of the quadrant pairs, this extra term vanishes, and the torque on the needle becomes simply proportional to the potential difference between the quadrant pairs, and also to the potential difference between their mean and the needle. Various ingenious devices are described for obtaining this desired symmetry between the three potentials, under the conditions that apply to commercial measurements. One of these measurements is of the power supplied to condensers or dielectrics, such as those of insulated electric machinery under high alternating voltages, and with a very small power factor. Another is of the power delivered to any high-pressure alternating-current apparatus, such as a synchronous motor. For pressures up to ten kilovolts, the minimum distance between quadrants and needle is recommended as one inch, while the needle is deprived of all sharp edges, and the edges are replaced by cylindrical contours of one-eighth inch radius. Under these

conditions the electrometer is capable of replacing a large quantity of complicated measuring apparatus.

The curve-tracing instrument of Prof. Owens is another ingenious instrument, described in a convention paper. The instrument does not trace curves, but enables curves to be traced conveniently by the observer. It is an electrodynamometer having one suspended and two fixed coils. The cyclically varying or alternating current to be plotted is sent through one of the fixed coils, and, in successive cycles, a synchronous revolving contact-maker permits a feeble direct current into the movable coil for a brief interval depending on the breadth of the contact-maker surfaces. These cyclic current impulses would naturally tend to displace the movable coil of the instrument in one direction or the other, to an extent depending on the magnitude of the alternating current in the fixed coil at the instants of contact. Instead, however, of attempting to obtain a measured deflection of the movable coil, the device is adopted of sending a direct current through the second fixed coil, and adjusting this current until no deflection is obtained, in which event the strength of the direct current is either equal to or a known fraction of the momentary value of the alternating current at that point in the cycle. The contact-maker is, therefore, carried step-by-step through a cycle, and the direct current in the fixed coil, which by adjustment cancels the effect of the alternating current, is correspondingly recorded and plotted. This gives a convenient null method of measuring a cyclically varying current through a dynamometer.

Heavy Electric Railroading.

The Institute meeting was noteworthy for a group of railway papers of no little importance. Two of them, by Arnold and by Arnold and Potter, rationally belong together, and constitute, on the whole, the most important discussion of large electric railway work that it has been our fortune to see for many a day. The work bearing on the change of motive power at the New York Central terminus is by far the most thorough experimental investigation of the important questions concerned that has yet been made. And yet, well as the work was done, the investigation was, through no fault of Mr. Arnold, narrow in its scope. It dealt not with the large problem of general treatment of the entrance to a great city, but with the single phase of it involved in changing the motive power near the terminus. This is not at all the same thing, for it merely has to do with a change of apparatus—electric motive power instead of electric railroading. Within the scope of the investigation set before him, Mr. Arnold did an exhaustive piece of work, of very great value to the engineering profession. Beginning with a thorough investigation of the load, the whole question of the replacement of steam by electric locomotives was overhauled and the matter of costs was worked out for every set of conditions that seemed at all worthy of consideration. The net result was what one might reasonably have expected, a small saving in the use of electric power, amounting to approximately two per cent. of the total cost per locomotive mile, including all fixed charges. The adoption of anything but the most carefully considered and economical system would have turned the balance the other way. To tell the unvarnished truth, the problem placed by the New York Central officials before Mr. Arnold was one in which all the conditions were so unfavorable for electric traction as could have been devised. There was no freedom of action allowed—it was the simple substitution of electric for steam locomotives in an enormous terminal yard. That electric power could show any saving whatever, even on paper, is the strongest possible proof of its importance in heavy railway work. The bloody record of the tunnel demands the abolition of the steam locomotive, irrespective of expense, and at anywhere nearly equal costs of operation. The New York Central management evidently realizes this, and is to be commended for the effort it is making in the right direction, as revealed in Mr. Arnold's paper.

To the engineer the most interesting part of the Arnold paper is a table, in which the costs of operating the proposed system by various methods to the number of a dozen, is carefully worked out. Mr. Arnold is well-known as a believer in alternating-current traction, but in this instance he very wisely confined himself to direct-current methods, as being the only ones so far developed as to permit immediate installation with existing apparatus. His tabulated results are a beautiful demonstration of the economic importance of simplicity. A straight 600-volt distribution from a single centrally located power house was decidedly the cheapest method of attaining the desired result. Then came the combined alternating and direct-current power house near one end of the line, with a transmission to a substation with rotaries near the other end. Next in order was a 600-volt direct-current station and a pair of battery substations, and a combined station with a single substation with rotaries plus a battery reserve at each point, which was the plan recommended. This was a little more than 10 per cent. less economical than the simple 600-volt distribution, but had a somewhat greater factor of safety, and did not demand a power house at a point where it would have been, perhaps, unattainable. The only surprising thing in the list is the remarkably good showing made by the plan with battery substations. In this connection it must be remembered that so long as the motors are of restricted voltage, there will be a very heavy charge for the working conductors not to be lessened by any scheme that does not increase the number of substations. Rotaries and batteries are of economic value only as they enable this to be easily done.

The paper by Arnold and Potter is a careful study of the relative capabilities of steam locomotives and electric motor cars for securing the acceleration necessary in heavy and fast suburban service. The comparison was made with a powerful consolidated engine for this class of work, and hence the results have a value that they would lack had the test been made with an ordinary locomotive not specialized with acceleration in view. As might fairly have been predicted, the motor cars equipped with motors of ample power and with all their weight upon driving wheels have made a much better showing than the locomotive in accelerating trains of equal weight. Not only did the motors give a greater maximum drawbar pull, but they could keep up the work, giving quicker acceleration, and hence a lower maximum speed for the same schedule than in the case of the locomotive. The latter tended to lose steam pressure rapidly under continued effort—only aonther proof of the disadvantage of carrying its own power station. Electrical engineers have long been cognizant of the advantage of electric traction in such work, but positive figures from the latest types of suburban service locomotives have until now been lacking. So far as energy and cost of energy is concerned, electric traction has a manifest advantage, and we are sorry that in opening up the study of conditions at the New York Central terminus, these conditions were not so broad as to take into account the transformation of the entire suburban service as part of the general problem. It does not follow from the experience of railroad men in arranging terminal facilities for traffic along steam railway lines, that the same methods which there prove best will still be preferable when electric traction is adopted for the whole work. There is a certain result to be attained in each case, but an electric suburban service offers some material advantages of its own, and when combined with the general terminal service leads to new economic conditions there. Still, it is no small thing to have made the investigations merely on the terminal part of the problem, and the results are of very great value as a guide in work in the larger field. The locomotive is no mean rival, and even a small victory is well won.

Charles T. Child.

We regret to announce the death of Mr. Charles Tripler Child, technical editor of the *Electrical Review*, which occurred June 25, at Gleasondale, Mass. Mr. Child was taken ill several weeks ago, and upon the symptoms becoming serious was removed from his home, at Montclair, N. J., to the residence of his wife's father, the Rev. J. R. Cushing, where he died, the immediate cause of death being typhoid fever.

Of a sympathetic and social nature, Mr. Child endeared himself to hosts of friends, and was one of the most popular and highly-esteemed members of the electrical fraternity in general. Through his brilliant gifts of mind and literary expression he was widely known as a lucid exponent of engineering science, to which also he made several contributions of an original character. As an engineer and designer, Mr. Child also had an enviable record. Many will mourn in him a warm-hearted and sympathetic friend and a genial companion, whose brilliancy of mind and conversation enlivened every occasion. Through his death the world is poorer by a brilliant technical writer, a cultured gentleman and a kindly spirit.

Mr. Child was born in Richmond, Va., November 1, 1867. His education was conducted by a private tutor until his entrance at Richmond College, in 1880. Leaving this college in 1885 he entered the Johns Hopkins University as a special graduate student in physics and mathematics under Professors Rowland, Clark and



Franklin. The next year he was a member of the newly organized class in electricity, under Dr. Louis Duncan, and had also a course in chemistry.

In the summer of 1887 he entered the service of the Sprague Electric Motor Company, in New York City, and in the autumn of the same year he was in charge of the wiring and equipment of the cars for the Richmond Railway and Electric Company's historical railway line.

Desiring to acquire experience in the operation of electric lighting apparatus, he went, early in 1888, to Kansas City, Mo., and entered the service of the local electric light station as a laborer, becoming finally assistant to the superintendent. After a year spent in acquiring this experience he returned to New York, where he became office engineer for the company building electric railways under the patents of Mr. Leo Daft. In this connection he made the specifications and supervised the construction of twelve electric railway installations, took part in the experimental work in heavy electric traction conducted on the elevated railway system of New York, and in the operation of the first storage battery traction lines in the United States, at Toledo, Ohio; Newark, N. J., and in Madison Avenue, New York.

Upon the liquidation of this company, in 1891, he went to Richmond, Va., and formed, with a number of local parties, a manufacturing company for the construction of dynamo machines and motors, and the construction and operation of a water-power electric light and power supply station. This concern did an excellent business and was, the next year, consolidated with other electric lighting and railway enterprises in Richmond. He designed and built for this company many types of direct and alternating-current apparatus, including the lighting alternators used in its central station service.

Going to Washington in 1892, he became aid-in-charge of the United States Astro-physical Observatory of the Smithsonian Institution, wherein was conducted, under his supervision, the elaborate researches of Professor S. P. Langley, on the infra-red solar spectrum, employing the bolometer and other electrical apparatus. Much of this he designed and constructed.

Leaving this service the next year to conduct experimental work for the development of certain of his patents on electrical apparatus, he was later recalled to Washington to reorganize the research work of the Observatory. This being accomplished, he returned, in 1895, to his home at Richmond, Va., and opened an office for the practice of consulting electrical engineer. He designed the plant and equipment of the Richmond Traction Company and the telephone exchange of the Richmond Telephone Company, then the largest independent telephone exchange in the world.

In 1897 he was tendered editorial charge of the *Electrical World*, of New York, a position resigned some two years later for a similar connection with the *Engineering Magazine*. In 1899 he became technical editor of the *Electrical Review*, which position he occupied at the time of his death.

The honorary degree of B. Sc. was given Mr. Child by his *alma mater*, Richmond College, in 1893. He was a member of the American Institute of Electrical Engineers and of the several other technical and scientific societies. Mr. Child was married, Nov. 30, 1899, to Miss Bertha Cushing. Mrs. Child, a daughter and twin sons survive him.

Modern Banking by Telephone.

A novel device for avoiding the imposition of New York Clearing-house charges for the collection of country checks has been adopted by two or three trust companies located in suburban territory. The practice, as reported by the New York *Evening Post*, applies to very profitable business and involves giving a customer credit at a New York bank for funds deposited at some New Jersey point. As admitted by a director of one out-of-town trust company, the procedure follows this order: A man deposits $100,000 in a trust company located 30 miles from New York. On opening his account, he is given two check books, one on the out-of-town trust company, the other on a New York bank with whom he has no direct relation. The bank is immediately advised to honor the checks that he draws, charging their amount daily to the trust company's account. This done, the man checks at pleasure upon his New Jersey funds, the New York bank notifying the New Jersey trust company each night by telephone how the account stands.

This, in short, is the latest development of "banking by telephone." Its conveniences, as stated by the banker himself, are as follows: "You see the Clearing-house people cannot reach us, for we do not cash New Jersey checks at par, only items drawn on one New York depositary. The system was devised to relieve our customers of the necessity of paying the one-tenth of one per cent. charge exacted by Clearing-house banks for collecting our checks, and while it may violate the spirit of the rules, it comes within the letter of the law so far as the New York bank is concerned. Then, too, there is very little risk about the matter, for if our customer draws too heavily for the New York bank to honor without question, five minutes at the telephone will straighten out all difficulties. Of course, it would not be practicable to extend such facilities to very small depositors, but the man whose account is worth having need never be at a disadvantage so far as paying the out-of-town check collection rebate is concerned. We can fix him up all right."

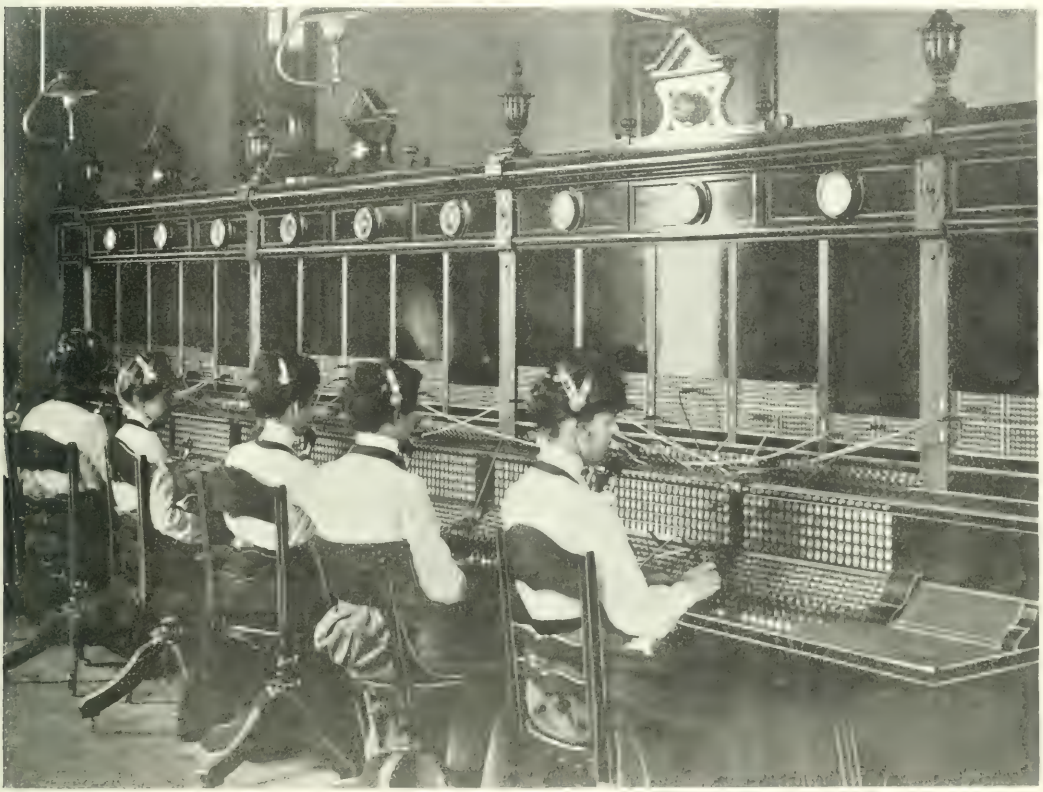
Another incident, which happened only a few days ago, shows the same practice in another light: A man who kept a large account with a New Jersey trust company had occasion to strengthen his balance at a New York bank. He wanted to certify for a large amount, and fell some $20,000 short of the sum required. To cash a New Jersey check for that sum meant paying $20 in collection charges, so, explaining matters to an officer of the bank, he asked to have a credit for $20,000 transferred from the New Jersey account to his own, giving the bank a check to protect it. The officer winked, said he thought it could be arranged, and certified the customer's check for $20,000 more than his account showed, making good the difference out of the trust company's funds.

Telephone Exchange at Dubuque, Iowa.

In November, 1900, a [illegible] business men of Dubuque, Iowa, headed by Mr. Victor H. Stevens, started the Dubuque Telephone Company, in order to secure a good telephone service at reasonable rates. It began in a small way with a single section of a 100-drop switchboard, but so rapidly did the company grow in favor that it was obliged to increase this, section by section, until it had seven hundred subscribers and calls for many more instruments. In order to anticipate the future requirements it was decided to purchase a multiple board, and in May, 1901, a 900-drop standard Ericsson multiple board, as shown in the accompanying illustration, was purchased. While the service had always been good, this new board enabled the exchange to make more rapid connections and give better service in general, and the result [illegible] all of which are under Mr. Stevens' management, bids fair to become the nucleus of a powerful telephone community.

It may be of interest to know of the low rates made by the Dubuque Telephone Company, which are as follows:

Business, individual circuit, per year	$24.00
Residence, individual circuit, per year	15.00
Business, party line circuit, per year	18.00
Residence, party line circuit, per year	12.00
Long distance, or desk sets, per year additional	3.00



GENERAL VIEW OF SWITCHBOARD IN DUBUQUE EXCHANGE.

a short time when another section was added to accommodate the increasing patronage.

From the present indications this section will soon be filled and another one will be necessary, as the people of Dubuque realize that the intentions of the company are to give perfect service at a minimum charge, and hence are responding freely with their subscriptions. The Ericsson apparatus is used exclusively in connection with this exchange and the results have been most satisfactory, owing to the small amount of repairs necessary to maintain the efficiency of the exchange.

In some of the banks, hotels and private houses complete imported telephones have been placed. These are considered by the users to be very much handsomer in appearance than the ordinary telephone, and serve both as an ornament and an article of utility. The switchboard was manufactured at the Ericsson factory in Stockholm, Sweden.

The exchange has a capacity of 3,000 subscribers, and in connection with the Standard and Interstate Telephone Companies,

Coronation Honors.

From the sick-bed King Edward sent the order on Wednesday that the list of honors prepared for the coronation should be published at once. Several of those favored are names well known in scientific circles. An "Order of Merit" has been instituted, and among those honored in this connection are Lord Kelvin, who stands in the list with such names as Earl Roberts and General Kitchener. Lord Kelvin was also appointed a Privy Councilor. Knighthood was conferred on Dr. Oliver Lodge, and Prof. Ramsey was named a Knight Companion of the Order of Bath. It was stated that the newly-formed Order of Merit will include distinguished foreigners [illegible]

Postal Telegraph and P. R. R,

The directors of the Pennsylvania Railroad Company on Wednesday authorized the signing of a contract with the Postal Telegraph Company to cover a period of 15 years. It is said that the Postal Telegraph Company is to pay the Pennsylvania Company $70,000 annually for the privileges that it receives, and percentage on its commercial business. The railroad company is to furnish poles to the telegraph company for the extension of its lines, and is to be limited to 100,000 free messages, which is about 50,000 less than the number used.

Plans for Laying Pacific Cables.

The project for a subsidized American Pacific cable is killed for at least the present session of Congress, as noted briefly in these columns last week. On June 10, Mr. Dalzell (Pa.) in the House presented the special order for the consideration of the Corliss Pacific Cable bill. By its terms four hours were to be allowed for general debate, and any Pacific cable proposition was made germane to it. Mr. Dalzell called attention to the fact that by the terms of the rule the whole question of the Pacific cable would be before the House.

Mr. Adamson (Ga.) protested against the building of a cable by the Government. He argued that the private company which had planned to lay a cable to the Philippines should be allowed to do so without let or hindrance. He protested against the Government entering into a conflict with capital and labor engaged in private enterprises. The Government had the privilege of seizing and using the Commercial Company's cable after it was built. Mr. Richardson (Ala.) argued that there was no necessity for the construction of a government cable when private enterprise already had begun the construction under terms advantageous to the Government.

Mr. Dalzell announced that he was opposed to the construction of a government cable. The experience of foreign countries as regards both railroads and telegraphs was against it. Nor did he favor the proposition of the Commercial Pacific Cable Company, of which Mr. Mackay was the head. His information, he said, was that English capital was behind that company. Mr. Mackay might be a loyal American, but it was many years since he had lived in America. He belonged to that class of Americans who were denominated "expatriated Americans."

Mr. Corliss said that the bill provided for a government cable uniting our islands with the American continent. By its terms the cables shall be American made, laid by American ships, and managed by the American Government. He placed the cost of construction at not exceeding $10,000,000, and the cost of operation at $400,000 per annum.

While this debate was going on, the Commercial Pacific Cable Company announced that 1,000 miles of its cable have been laid between San Francisco and Honolulu. Mr. Cannon, also in the House, chairman of the Appropriation Committee, called a halt on further public expenditures. He stated that estimates for next year made receipts $639,000,000, while appropriations already made by this Congress for next year exceeded estimated revenues by $52,000,000. He opposed vigorously any appropriation for any Isthmian Canal or cable to the Philippines, and warned the House that the present surplus in the treasury, $175,000,000, would be soon exhausted if further appropriations be made on the scale that has prevailed heretofore.

On June 11 the House went into Committee of the Whole, and resumed the debate upon the Corliss Pacific cable bill, when Mr. Richardson (Ala.) took the floor in opposition to the bill. He called attention to the speech of Mr. Cannon, in which the latter [illegible] the appropriations for the next fiscal year already exceeded the estimated revenues by $51,000,000, and urged this as the first reason why the Government should not enter upon the expensive work of building a cable to the Philippines. He referred to the possibilities in the development of wireless telegraphy, and argued that it would be unwise, on the threshold of the development of the new system, for the Government to expend $15,000,000 or $20,000,000 for a submarine cable which might be valueless in a few years.

Mr. Corliss asked if the Attorney General had not refused to consider the contract which the Commercial Cable Company had offered to make.

Mr. Richardson replied that the Attorney General and other Government officials had declined to interfere in the matter, and that the company was proceeding to lay the cable under the Post Roads act. In explanation of the reason the cable was being built in England, he said that the English company were building a cable which they guaranteed for two years. No other company would guarantee a cable for 30 days, he said. He read a letter from John W. Mackay, of the Commercial Company, addressed to Mr. Hepburn, chairman of the committee, and says:

"My cable engineer, Mr. Cuttriss, through your kind offices and the courtesy of Mr. Moody, the Secretary of the Navy, and of Admiral Bradford, has been allowed to examine the charts of soundings on file in the Navy Department, showing that it is feasible to land a submarine cable on the Island of Guam, in the Pacific Ocean. Mr. Cuttriss has just telegraphed me that these soundings show that such a landing is practicable. This removes the only doubt as to the feasibility of an all-American cable from San Francisco to Manila, and I write this letter to you to state positively that the submarine cable, which the Commercial Pacific Cable Company has agreed to construct, lay and operate from San Francisco to Manila, will be an all-American cable, and will not touch on any foreign island or territory whatsoever. I give you my personal assurance to that effect. The first section of this cable will be in operation in November, 1902, and we expect to be able to arrange for the remaining sections to be completed and opened for traffic during the year 1904."



NEW CABLESHIP "COLONIA."

Mr. Newlands (Nev.) paid a high tribute to Mr. Mackay. He said Mr. Mackay had entered a contest on the sea against the great Atlantic cable monopoly, and on land against the Gould telegraph system. He also had built the Haiti cable, the control of which was surrendered to the United States during the Spanish war.

Mr. Loud (Calif.) opposed the bill on the ground that Government operation of telegraph systems in Europe was not a success. Since 1872 England had lost about $35,000,000 in the operation of her telegraph system. He concluded by expressing the hope that the House would kill all the bills and leave the Pacific Ocean open to any company which cared to undertake the laying of a cable. (Applause.)

Mr. Adamson (Ga.) moved to strike out the enacting clause of the bill. To prove that the Commercial Cable Company was proceeding with the work of constructing the cable it proposed to lay, he read a cablegram from London, signed by G. G. Ward, vice presi-

dent, certifying that 1,065 nautical miles of the cable to be laid between San Francisco and Honolulu had been completed, and that the work was proceeding at the rate of 26 miles a day. The cablegram said that a steamer would leave with the cable for San Francisco before August 1.

Mr. Adamson's motion to strike out the enacting clause on a yea and nay vote was carried 116 to 77. The measure was therefore lost.

In this connection we are able to illustrate the new cable ship "Colonia," just built and engined by Wigham, Richardson & Co., of Newcastle-on-Tyne, for the Telegraph Construction and Maintenance Company, Limited, of London, whose mission it is to lay the British cable. The conjunction of events gives unusual interest to her successful trial trips now made prior to her departure. The vessel is 500 feet in length, with beam of 56 feet, and is designed to carry close upon 10,000 tons dead weight. When loaded she is to steam 11½ knots. The length of cable that she can carry is about 4,000 miles, which is a greater length than could be put on board the "Great Eastern" when she was engaged in her cable-laying expeditions. From the photograph which we herewith reproduce, it will be seen that the builders have designed an elegant looking craft in spite of the special conditions which had to be fulfilled, and in this respect the "Colonia" is a pleasing contrast to cableships afloat. The spar deck of the ship is of teak, and is flush right fore and aft, making a magnificent and spacious promenade. Amidships is accommodation for the officers and numerous electrical experts. There are also bathrooms, large galley, butchery, bakery, and on the deck below a refrigerating chamber. Adjoining the cabins is a spacious dining saloon, panelled in oak and fitted with great elegance even to the minutest detail. On the bridge deck above are the apartments of the captain, being a suite of three rooms. Next to these is a chart room of ample proportions, and above it is the navigating bridge and boat deck.

In the afterpart of the vessel on the spar deck are two houses of special interest to electricians, one of them being the test room, and the other the drum room. These have a very complete installation of galvanometers and other testing instruments, together with a quantity of the special appliances, by means of which all the calculations are made as to the amount of cable paid out, the strain on it, and its electrical resistance. The aftermost deckhouse is occupied by the powerful steering apparatus, which is a combined hydraulic and steam-steering engine, actuated by a telemotor on the flying bridge.

The vessel is lighted throughout with electricity, and as much of her work is in tropical seas, special attention has been given to ventilation. On the main deck is accommodation for the crew, the cable hands and the stewards, and there is also a well-aired hospital. Amidships will be found an engineer's repairing shop with a lathe, drills and several other machines.

Below the main deck are the four huge cable tanks, two of them being forward of the bridge and two aft. The propelling machinery consists of two sets of triple-expansion engines, working at a pressure of 190 lbs. per square inch. The outfit of pumps, feed-water heaters, evaporators, filters and other auxiliary machinery is exceptionally complete.

As soon as the cables have been loaded, the "Colonia" will proceed on her long journey, via the Suez Canal, to Vancouver. She will then lay the cable from that point to Fanning Island, the little patch of dry land in mid-Pacific. The cable from Fanning Island, Fiji, New Zealand and Australia has already been laid, so that as soon as the "Colonia" has accomplished her work in hand, the British nation will have a complete circle round the world of telegraphic cables, all of which lie between points of British territory. This is a possession of which no other nation can boast.

Wireless Telegraphy for Alaska.

Gen. Greely, chief signal officer, has contracted with the Marconi Wireless Telegraph Company for the erection of two wireless telegraph stations, connecting Fort Gibbon, Alaska, with Bates Rapids, on the Tananap, a distance of 165 miles in an air line. The company undertakes to have the stations in working order by the 1st of October next. Gen. Greely already has an overland wire from Nome City to Fort Gibbon, and with other existing lines in Alaska this wireless system will complete a circuit from Behring Sea down to the south coast. The company's undertaking is to supply a system that shall work every day without interruption, else the Government will not be [illegible]

The Present and Future Status of Wireless Telephony.

By A. Frederick Collins.

It is a noteworthy fact that as quickly as a principle has been demonstrated to have a commercial value, a large number of workers is at once attached to it, and with their bended energies a rapid and broader development naturally results.

As an instance, the successful employment of wireless telegraphy has led many experimenters and inventors into the field of action, but who, a few years ago, would have hardly dreamed of the great possibilities Hertz's experiments offered. Wireless telephony stands in practically the same position that wireless telegraphy did prior to 1897, for the reason that its great value is seen through a glass darkly, since it has not been tried by the crucial test of commercial usage. A a consequence there are very few persons engaged in solving the riddle of making it an instrument of wide range and indispensable utility. This may seem a little strange considering that many who devote their lives to original investigation, as well as practical men in the course of routine engineering, have been led to the very threshold of wireless telephony in their researches in induction, electrolytic conduction, light and Hertzian wave and other phenomena of forces acting at a distance without the customary connecting medium in the form of a metal conductor; but with very few exceptions have the experiments been carried further with the idea in mind to transmit articulate speech without wires. In England, Sir William Preece has made an exhaustive study of both the inductive and conductive method of telephoning without wires. In France, M. Ducretet made some clever experiments very recently, using the catacombs for one of the terminals of the grounded wire, whilst the other rested on the surface of the earth; M. Machie is at present making some tests in France, and in this country, the writer has made experiments with the result that the distance to which speech could be transmitted was sufficiently great, and the voice clear enough to say that the instruments were of commercial worth.

This brings up the question of what really constitutes a commercial wireless telephone. There are a class who assume that a wireless telephone should be in such a perfected condition when placed upon the market that it would be possible to replace the ordinary telephone by it; this is, however, an idealistic view of the matter. On the other hand, a wireless telephone having a carrying capacity of a fourth of a mile would fufill certain requirements up to that distance, and good instruments for even this distance would have a ready market. But with a carrying capacity of from one to five miles, the wireless telephone would at once spring into popularity upon its practical value being shown.

There are many instances where an ordinary telephone cannot be employed. As an illustration, let me cite a few cases. (a) Two families lived only 1,500 feet apart, and where telephones costing $25 per pair would have answered the purpose, but owing to a railroad operating the adjoining properties, permission could not be obtained to stretch the wires; as an experiment the wireless telephone was tried, and with success. (b) Another case was in the Thousand Islands, where a cable was laid from an island to the main land, at a cost of $2,000; here again a wireless telephone could have served the purpose at a cost not exceeding $200. (c) A third case is in Narbeth, where the borough officials will not permit the Bell Telephone Company to erect poles; two physicians have had telephones in their residences for nearly a year, hoping that the Bell people would effect connection with their lines, one-fourth and one-half mile away. The contention between the Bell and borough was a matter of one narrow street. This distance could have been easily bridged by means of a wireless telephone; in fact, communication was established between one of the residences and the writer's laboratory, where three streets intersected the line of wave propagation, but as it took place under the surface of the earth, no one objected to it.

But the most useful sphere of the wireless telephone, and the one which the writer has ever advocated, is its application to vessels in harbors. The wireless telegraph is pre-eminently a long-distance system, but used in harbors experienced operators would be required to transmit and interpret the messages after the captains had given them. The wireless telegraph is at present too complicated and too uncertain where thousands of lives depend absolutely upon the accuracy of the transmitted signals. Here the wireless telephone is needed, for the wireless telegraph is just as inapplicable for short

ordinary telephonic purposes. The wireless telephone is a first-hand instrument; it is simple, reliable, and it may be applied to any vessel at a comparatively small cost.

Just recently two accidents occured in the North River because of a misunderstood signal. The first was when the yacht "Aileen" rammed a ferryboat, and the second was a collision between two ferryboats. In a fog, where there are a dozen ferryboats with whistles shrieking continuously, the pilot, not having a synchronized ear, hears all of them at once, and knows not whither he should turn his ship.

The steam whistle did very well immediately after Fulton had made steam navigation possible, and when there were only one or two vessels, but now, where there are a dozen in the same zone, and the speed is such that it makes a stranger's hair stand on end—not at his own wonders, as was said of Cornus, the magician—but at his own temerity in riding on vessels where, in broad daylight, the frightfully close proximity of the vessels under steam seems certain destruction, should not more modern appliances than a steam whistle be used in signalling? Even the blasé New Yorker, who of necessity becomes hardened to tunnel accidents and harbor collisions, must at times feel a little awed as he stands under the shadow of the steam whistle. The wireless telephone is the remedy. It may be argued that it is not synchronized either, but here the range may be extended or decreased at pleasure, and those a quarter or a half mile away may be excluded while orders are passing between the vessels nearest to hand. In other words, it would prove a conditional block signal system.

The future of wireless telephony is not, evidently, to eliminate the wire system, yet even stranger facts have come to pass in our time and generation; but excluding this optimistic view of the situation, it must be admitted that it would form a valuable adjunct to the efficient wire systems now in use.

The syntonization of wireless telephony is one of the knotty problems. It is this question that staggers the most sanguine; but if one had asked Prof. Bell, in 1876, how any two of 40,000 subscribers might be put into instant communication one with the other, he, doubtless, would have found it difficult to even picture in his mind's eye the modern central station switchboard.

It must be remembered that the wire telephone has had engaged in its improvement the brightest scientists, the most original investigators of the world for a period of over a quarter of a century, and this experience and application has brought the "toy" to one of the most potent factors of the commercial world. Would that a little of such applied energy could be put on the wireless telephone.

When a system is perfected for multiplexing ordinary telephonic messages, and the syntonization of wireless telephony is a fact, the combination of these two devices will produce a new service, wide-reaching and bringing the cost of installation down to a miuimum.

Galileo Ferraris Award.

The committee for the "Galileo Ferraris Award," instituted in 1898, and composed of the representatives of the executive committee for the General Italian Exhibition, held in Turin, in 1898, of the chamber of arts and commerce, of the Royal Academy of Science and of the Royal Industrial Museum in Turin, have decided to open an international competition for the award of said prize on the occasion of the unveiling of the monument to Ferraris, in Turin, in the latter half of the month of September next. The award is 15,000 lires ($3,000), together with the compound interest accumulated since the year 1899 up to the day of the award. It will be granted to the inventor of some practical application of electricity likely to lead to noteworthy progress. Competitors may submit either pamphlets, projects and drawings, or machines, apparatus and appliances relating to their invention. The jury, composed of the aforesaid committee, shall have full power to cause practical experiments to be made upon the inventions entered for competition, and upon the corresponding apparatus. Competitors are to file their application and deliver their credentials appertaining to their invention not later than 6 o'clock P. M., on the 15th of September, 1902, at the office of the secretary of the committee, care of the Administrative Committee on the First International Exhibition of Modern Decorative Art in the buildings of the Chamber of Commerce and Art, 28 Via Ospedale, Turin, Italy.

The Great Barrington Convention.

The nineteenth annual convention of the American Institute, held at Great Barrington, Mass., adjourned Saturday, June 21, after the most successful meeting in the history of the Institute. More than 250 members and guests were registered, and the most gratifying interest was manifested in the proceedings, both with respect to attendance at the meetings and in the discussion of papers. The social features of the convention were particularly agreeable, and very wisely had been so arranged as not to interfere in any manner with the main objects of the meeting.

At the session of Thursday morning a telegram was received from the Pacific Coast Transmission Association, in meeting assembled, sending greetings. The telegram also stated that the association had passed a resolution condemning the proposed underwriters' rule, which would limit overhead street voltage to 3,500 volts, which rule was pronounced unjustified and prejudicial to vested interests. Action of the Institute being requested by the association, the matter was referred to a committee with instructions that it report on the subject to the council.

A letter was also read from President-elect Chas. F. Scott, dated Berlin, Germany, sending greeting and expressing the hope that all would aid in making the coming Institute year as fruitful as the very successful present year under the administration of President Steinmetz.

During the discussion on Friday, Prof. Owens advocated holding, at Montreal next year, a joint meeting of the American and British Institutes of Electrical Engineers. After some discussion, a motion was carried that the British Institution be invited to take part in a joint meeting at some time in the future, to be mutually agreed upon —probably in 1894. during the St. Louis World's Fair.

THURSDAY'S SESSION.

The session of Thursday was opened by a paper of Mr. C. O. Mailloux, entitled "Notes on an Experiment with Single-Phase Alternators on Polyphase Circuits," an abstract of which appeared in our issue of last week. In this paper an account was given of successful experiments in operating two single-phase machines on a two-phase circuit, the phase relation being maintained by means of a rotary converter operated on the circuit.

Following the reading of his paper, Mr. Mailloux replied to several questions suggesting other methods of starting the system, saying that the conditions made more convenient the procedure actually followed; if, for example, the rotary were separately excited, the alternators could at once be thrown on. Mr. Steinmetz said that about 1894 he had experimented with single-phase alternators connected to a polyphase circuit. In one case three single-phase machines in closed series supplied three-phase currents to a circuit, the three legs of which were respectively connected between the alternators. He gave a remarkably simple graphical generalization as a criterion to apply in determining if a given arrangement of machines will prove a stable combination. A single-phase machine is represented by a straight line, a two-phase machines by two lines at right angles, and a three-phase machine by an equilateral triangle. If now any combination of these lines and figures forms what in statics is known as a stable figure, the corresponding combination of machines and circuits is possible. For example, three lines form a triangle which is a stable figure, and consequently three single-phase machines in closed series will supply a three-phase circuit. Again, four lines arranged as a square is an unstable figure, but if strengthened by two diagonals becomes stable; therefore, four single-phase machines can be used in combination with a two-phase machine to supply a two-phase circuit. The generalization may be extended to include also the use of synchronous motors and rotary converters in combination with single-phase generators.

In reply to a question, Mr. Mailloux said that a single-phase machine could be used in parallel with one or more phases of a polyphase machine, as, for example, to assist at the peak of a load; in reply to another question, he said that the rotary might be a two-phase machine on a two-phase circuit, or a three-phase machine run from a two-phase three-phase transformer—there being no difference in action involved.

Mr. Murphy, of Ottawa, said that the case described by Mr. Mailloux represents exactly the existing conditions of affairs at Ottawa, Ontario, if two-phase apparatus and a 2,200-volt line were substituted for the three-phase machines and 25,000-volt line shown.

Before the station, which was subsequently equipped with two-phase machines, was ready to run, a rotary converter was installed and operated from a single-phase generator at another point corresponding to the steam station of Mr. Mailloux. This converter was started up by current from a storage battery and one of its alternating-current circuits synchronized in the usual way (with a single-phase generator)—lamps being used for this purpose at first, and later on, when the Lincoln synchronizer was developed, these were replaced by the latter instrument. The rotary converter was used in this manner for about a month, and was called upon to do about two-thirds of its rated working capacity. During the past winter one of the single-phase generators of the Ottawa plant has been operated in parallel with one phase of the two two-phase machines, sufficient incandescent load being placed on one side of this combination as to keep the single-phase machine carrying the difference of load between the two phases. This method of operation has worked so satisfactorily that arrangements have been made to run the rotary converter from the two single-phase machines—only one of which was available when the rotary converter was used as a single-phaser—should it ever be necessary to shut down the two-phase station; the rotary will then keep the single-phase machines in proper phase relation. Mr. Murphy said that the fact that Mr. Mailloux has already accomplished this is a matter of considerable satisfaction to the engineers of the Ottawa plant.

Mr. Mailloux's paper was followed by the four railway papers on the programme, discussion being deferred until after all the papers had been presented. Abstracts of two of these papers appeared in our issue of last week, namely, those by Messrs. Arnold and Arnold and Potter. The paper by Mr. Arnold was by far the most prominent presented at the meeting, and of particular timely interest, on account of disclosing the plans for the electrical equipment of the New York Central metropolitan terminus. The joint paper of Messrs. Arnold and Potter gave an account of experiments to determine data for a comparison of steam and electric traction under certain conditions, and forms a contribution to electric railway literature of permanent value.

A STUDY OF THE HEATING OF RAILWAY MOTORS.

A paper with the above title, read by Mr. A. H. Armstrong, forms a valuable and much-needed contribution to electric railway literature. The paper is illustrated by 14 sets of curves, and as much of the text is in reference to these curves, the reader who wishes to follow closely the study of Mr. Armstrong is referred to the complete paper, in the *Transactions* of the Institute..

Mr. Armstrong prefaces the paper with the statement that as regards the tractive effort required to propel trains of one or two cars at speeds of 60 miles per hour or more, there is almost a complete lack of experimental data. Formulæ based upon tests of steam trains, made up of a number of heavy coaches, cannot be applied with any accuracy to the operation of single car units. A series of tests made by the General Electric Company on the Buffalo and Lockport tracks, with trains of different sizes, provides almost the only data upon which to base such calculations. These tests were carried up to speeds approaching 60 miles per hour, with ordinary steam railway coaches, hauled by a 38-ton electric locomotive, and are used as the basis of the calculations given in the paper.

The curves of the above test are given, and from these are deduced speed time-curves for certain cases considered. As the heating of a motor is the result of the average losses within it, the average losses and their distribution up to any moment of shutting off power must be determined. Such losses are shown in Fig. 1 for a 35-ton car equipment, the speed and ampere curves of which are given by the above-mentioned curves. The curves show that while there is a total average copper loss of 5,000 watts during acceleration upon resistance, the copper loss curve becomes flat in about 400 seconds at the value of 1,800 watts in the copper, with the motor constants chosen. As an equipment geared for a maximum speed of 60 miles per hour would hardly be used for an average run of less than 15,000 feet requiring power on for fully 160 seconds for its accomplishment, it will be seen that the acceleration losses play a comparatively unimportant part in very high speed work, so far as the motor heating is concerned. That this is not true of low-speed work is discussed elsewhere in the paper.

The following instructions are given for making a test: Suppose we take our motor equipment, place it upon a car and run it over a measured length of level track, keeping an accurate record of the current input and voltage per motor at each instant. Then let this sample run be repeated successively for a period of ten hours, or long enough for the motor temperatures to have reached their maximum, and we have the relation between energy lost in the motor and its temperature for a given set of conditions. Vary the length of the test run and repeat the ten-hour test, and we have another relation between temperature rise and energy loss for another set of conditions.

It may be urged that it is difficult to reproduce with any accuracy the sample run agreed upon, or that it is difficult to follow through and keep an accurate record of just what takes place in the

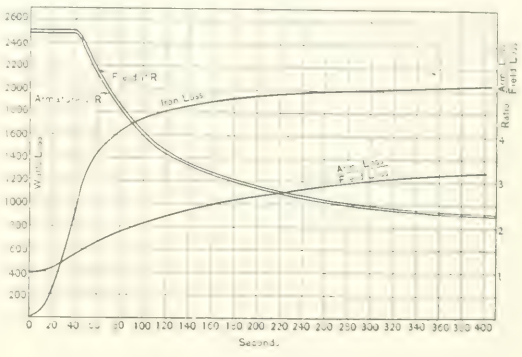
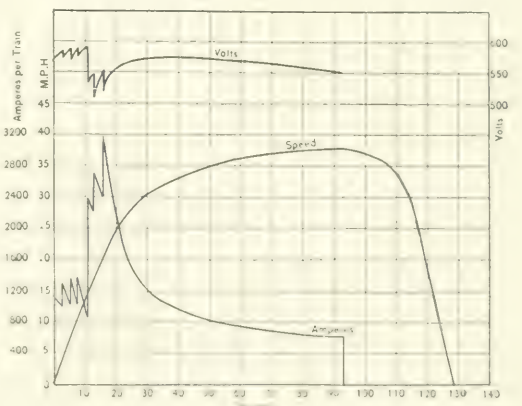


FIG. 1.—CURVES OF LOSSES FOR 35-TON CAR EQUIPMENT.

motor during its cycle of operation. If necessary, an automatic device for applying the current could be used, such as a motor to throw on the controller at a predetermined speed. Sufficiently good results can be obtained, however, by ordinary hand control with a trained operator, while sample runs taken every few minutes by recording instruments, serve as a check and furnish the material upon which to base the motor's performance during the test.

A sample set of curves of such a test is shown in Fig. 2, indicating voltage, amperes and speed upon a time basis, all taken by recording instruments. The voltage indicated is that between third-rail and ground, but the motor voltage during running upon resistance may be taken as proportional to its full internal voltage at the



moment of cutting out final starting resistance, without making any appreciable error in arriving at iron loss values. The ampere curves give the means of determining the copper losses by plotting on polar co-ordinates and determining the area by a planimeter giving directly the square root of mean square value.

By using recording instruments and by taking a sufficiently large number of curves, it is possible to determine very accurately the average losses dissipated as heat by the motor during the test run, and also ascertain the distribution of these losses in the several parts of the motor. The motor ventilation is the same as in a service run;

it is operated at varying speeds, remains at rest the required proportion of the total cycle ,and in every way the average conditions pertaining to a service run are reproduced in the test run, thus making the data so obtained directly applicable to service problems without the use of any constant.

A curve showing the results of a number of such tests is given in Fig. 3, indicating the degrees rise per watt loss in field copper and in armature with any relation between total armature and field loss. Here also, the total iron loss is assumed to be in the armature, and this loss, added to that of the armature copper, gives its total loss, used in determining the "ratio of losses."

Mr. Armstrong then proceeds to apply data as above obtained to the study of 25, 35 and 45-ton cars. A study of the resulting curves indicates that so far as motor heating is concerned, it is preferable to use the largest gear ratio and highest rate of acceleration possible for the accomplishment of the service contemplated, provided the maximum speeds are low, but that practically any rational rate of acceleration can be used where speeds approach a maximum of 60 miler per hour. As will be shown later, the energy consumption is less for a higher rate of acceleration permitting more coasting, but unforunately the fluctuations on the distribution system and the load curve on the generating station may both be much poorer if the accelerating rate is carried too high and the number of units in service is small. In the choice of gear ratio for a given service, therefore, not only must account be taken of the question of motor heating with different rates of acceleration, but due heed must be

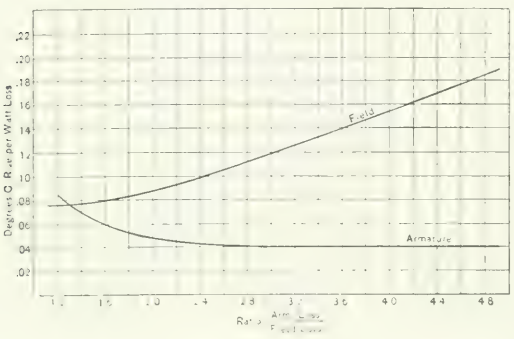


FIG. 3. CURVE OF TESTS.

paid to the question of line fluctuations, station load and energy input. It may be possible that what is gained in car energy by a more rapid acceleration, may be lost by the poorer coal economy resulting from a more irregular load curve upon the generating station.

Curves are then given for the case of a specific motor for any schedule, any gear ratio and any frequency of stops. These curves show that the motor operates between the limits of one stop in two miles and four stops per mile, making a schedule of from 40 miles per hour down to 14 miles per hour, with approximately five tons per motor in all cases, and the same temperature rise. In other words, an equipment of this character is protected from overheating by properly proportioning its gear ratio to the car weight. The possible schedule speed for a given gear ratio is controlled by the number of stops per mile, but the heating of the equipment, with the proper weight of car, will be the same over a very wide range of schedules and stops. The curves, also, bring out very forcibly the importance of properly gearing an equipment for the work which it has to do. For instance, a gearing giving 60 miles per hour on a level track can make but 20.5 miles per hour schedule with two stops per mile with a train weight of 5.6 tons per motor, while the same equipment geared for 47.5 miles per hour can perform 20 miles per hour schedule (practically the same), but can do so with a total train weight of 12.8 tons per motor, or more than double the train weight possible for the same temperature rise with the 60 miles per hour equipment. In other words, the equipment should be geared for the lowest possible maximum speed that will permit the maintenance of the schedule in question, as a gear ratio giving too high a maximum speed for the work to be done not only overheats the motors, but produces needless demands upon the generating and distribution systems.

The motor in question at 60 miles per hour, when operating a single car has a capacity of but 5.3 tons per motor for 60 degrees rise, while if two cars are coupled together and operated as a single train, the reduction in wind friction per ton of train weight increases the capacity per motor of 7.5 tons for the same 60 degrees temperature rise, an increase of 42 per cent. This opens up a new field of inquiry as to whether it is commercially advisable to run single car units at this high speed when the motive power, and as it will be shown later on, the energy input, are both larger than would result from operating the same seating capacity in trains of two cars or more, with a correspondingly increased time interval between trains. In other words, is the electric traction idea of small units at frequent intervals a proper method of attacking the very high speed electric traction problem, or are we compelled to go back to the steam method of operating heavier trains at more infrequent intervals, in order to prevent a prohibitive investment in motors, and generating and distributing systems, and a ruinous expense for operation? It is true that the electric system, being eminently adapted to subdivision, has created the demand for travel, by means of its frequent service, where none previously existed, but it may be possible that for very high speed work too great a price may be paid for the privilege of operating very frequent small units.

The present method of rating railway motors is to determine the current which they will carry at 500 volts on a stand test, giving a temperature rise of 75° C. in the hottest part after 60 minutes' run. In other words, the one-hour rating of railway motors gives only an indication of the comparative capacity of two motors in actual service, and affords no data to serve as the basis of calculating the service capacity of the motor. It does determine the mechanical qualities of the motor, as the one-hour test is generally very severe, and it also affords a means of observing commutation at the maximum current for which the motor will probably be called upon in service operation. Mr. Armstrong considers that some method of rating railway motors which would give an accurate comparison of their service capacity under different conditions, if such a rating is possible, would be of great advantage over the present very general one-hour rating. He has not, however, arrived at any commercial rating of a railway motor which serves its purpose better than the one-hour test now universally used. Admitting that such a test does not give the comparative size of different motors, it does serve the purpose of largely determining its commutating qualities and possesses the advantage of being commercial. Unless a rating can be proposed which will indicate accurately the relative size of motors, the present method of one-hour rating possesses advantages which would hardly warrant its being superseded.

The paper next proceeds to a discussion of train energy, which subject is shown to be intimately interlined with the question of train friction and coasting. From curves figures are secured as to the cost of operation of a single car, and also trains of two or more cars, where the maximum speed is 60 miles per hour, and the stops very infrequent; that is the more advanced type of our private right-of-way suburban road. A single 35-ton car, having a friction, say, of 50 lbs. per ton at 60 miles per hour, will consume 119 watt-hours per ton mile at a schedule of 52 miles per hour with one stop in eight miles. Let two such cars be coupled together in a train, reducing the friction to 33.5 lbs. per ton, and the train will require an input of only 78 watt-hours per ton mile, or 65.5 per cent. of the energy rate per ton required in single car operation. In other words, single cars on 30-minute headway would require 52.5 per cent. more energy for their operation than would two-car trains on one-hour headway. With five-car trains, composed of 35-ton cars, the energy is reduced to 56 watt-hours per ton mile for the same schedule, or less than half what will be required per ton for the operation of single car trains.

From a purely energy standpoint it would seem that the operation of single-car trains was disadvantageous, but experience has shown that it is not fair to assume that two cars operated every hour will attract the same custom as one car operated every 30 minutes. In other words, the frequency of service creates travel, and in many cases warrants the extra expenditure for coal. There is another aspect of the case to be considered, and that is that with two-car trains at more infrequent intervals, the load upon the feeding points is more fluctuating, the size of rotary converters must be somewhat increased, and in all probability a larger amount of feeder copper will be required to keep the drop within the same limits. Although a saving may be effected in the coal pile by increasing the train

headway and give [illegible] cars, there is every reason to expect a call for a greater expenditure of money to install the road, and an increase in interest and maintenance account that may go far toward eating up the saving in the fuel expense.

In conclusion, Mr. Armstrong states that while it is possible to prepare a set of energy curves which are of fairly general application to all problems, it is only feasible to express the relation between motors of different capacity by a series of the special curves with which the paper largely deals. It is entirely possible to approximate the probable heating of motors of different sizes when the resistance, core loss and general construction is known, but such short-cut methods are at best only approximations and no true comparison of different motors can be made which will take into account their different losses for the same work performed and their capacity for radiating these losses at different speeds, without considering the subject in detail for each motor alone along the general lines indicated in the paper.

In dealing with the railway motor where the temperatures approximate 60° C. rise in practice, with an air temperature in summer reaching 30° to 35° C., there is not much leeway below a temperature injurious to the insulation, and approximate methods giving rise to errors of 10° or 20° C. in temperature cannot be seriously considered in such important calculations as the determination of railway motor temperatures. For this reason the methods outlined, although entailing a large amount of experimental work and subsequent calculations, are believed to provide an accurate method of determining the temperature of railway motors operating under any known conditions; and although they fail to provide a method of rating railway motors, it is due to the fact that such a method of rating cannot be expressed by any short term, but necessitates some such general curves as are also indicated in the paper.

RAILWAY SPEED-TIME CURVES.

Mr. C. O. Mailloux read from manuscript a paper with the above title, which dealt in an extremely complete manner with graphical treatment of street railway problems involving time and speed. The underlying principles were established analytically, and the method of their graphical application pointed out. It was shown that by such a system of treatment it becomes a comparatively simple matter to attack even complex cases arising in electric traction engineering.

The paper referred to the speed-time curve as the key to the solution of the general problem of determining or predetermining graphically the movement of a train at different intervals of time. Mention was made to the early use of speed-time curves, including their use by the author and Mr. S. T. Dodd, in 1898, and it was pointed out that the improvement in electrical engineering methods has given the speed-time curve additional interest and importance. It was shown that these curves may be used either as an approximative method, or as a method of precision. In the former method, the plotting of the curve is simplified by making certain assumptions; in the latter, such assumptions are to be avoided as much as possible.

The object of the paper is stated to be to facilitate the use of the speed-time curves as a method of precision, by simplifying their use. The paper then gives the technical definitions of the various kinds of terms. This is followed by a reference to analytical definitions, which are not contained in the body of the paper, but which are given separately in appendix portions—A, B, C and D.

Appendix A relates to time function curves of rectilinear motion. It begins with the fundamental definition of motion and develops the subject until an analytical definition is reached for time-rate of velocity, which is time-rate of acceleration.

In Appendix B the subject is further developed by starting from the fundamental equations of energy, until an expression is obtained for acceleration in engineering terms, in which speeds are measured in miles per hour, and velocity in seconds—time-rates of velocity being, therefore, equal to miles per hour per second. The subject is then further developed until it is shown that any force concerned in the movement of a train may be expressed in terms of an equivalent acceleration, and the important though simple theorem is developed showing that the effective acceleration in any concrete case is equal to the algebraical sum of the accelerations which will be produced by each of the forces acting independently and alone, and is consequently equal to the algebraical sum of the differential coefficients due to said forces. The first subdivision of the subject in the body of the paper is on the analysis of train motion. This subject is analyzed briefly, reference being made to the analytical treatmen in Appendix A and Appendix B. General analysis of this subject is followed by the specific analysis of the different forms of variable motion, including positive acceleration, and the two forms of negative acceleration, corresponding to the motion of trains while drifting and braking.

The second subdivision of the subject is on the plotting of speed-time curves. This subject begins with certain preliminary considerations, and then discusses separately the plotting of acceleration curves, drifting curves and braking curves. In this portion of the paper the author, after briefly referring to two other methods of plotting these curves, describes a new simple graphical method of plotting speed-time curves of all kinds, based upon the theorem developed in Appendix B, and also upon a formula for the time values corresponding to speed values as developed in Appendix C.

The method requires the use of two charts, designated in the paper as the chart of coefficients and the chart of reciprocals. The chart of coefficients contains various curves or lines, each giving as a function of the speed, the "equivalent" acceleration due or corresponding to each of the components of the effective acceleration. Thus, for instance, there is a curve giving what is termed the gross acceleration of the motor, or the acceleration which would be obtained if the tractive force of the motor were the only one concerned in acceleration. In like manner, there is a curve giving the equivalent acceleration corresponding to train resistance at various speeds. There are also various curves which correspond to the equivalent acceleration of grades, these being straight lines parallel to the axis of X, the distance above and below the axis of X being proportional to the percentage of positive or negative grade according to the case. In like manner, a curve of braking coefficients is drawn, giving the negative acceleration corresponding to each speed. When the braking rate of retardation is assumed constant, this curve becomes a straight line like the coefficient curves corresponding to grades.

The number of coefficient curves depends upon the number of components into which the speed-time curve is to be analyzed, or from which it is to be built up, in any particular case. A coefficient curve is required for each component. By means of these curves, plotted on the chart of coefficients, it is easy to obtain the algebraic sum of the various components, this being done by taking the difference between the sum of all coefficients which are positive, and the sum of all coefficients which are negative, all measured on the ordinate line corresponding to each particular speed. The resultant value, equal to the distance aforesaid, is then transferred to the chart of reciprocals, by means of which the time increment value corresponding to each speed is to be determined. On the chart of reciprocals, the ordinate values represent acceleration coefficients, just as in the chart of coefficients. The abscissae represent time values. The generic reciprocal curve is drawn, such that the product of the speed value by the acceleration coefficient is always equal to unity. Other curves are drawn in similar manner, which contain one-tenth, three-tenths, five-tenths of the reciprocal value, and other curves may also be drawn giving twice, three times, five times, and ten times the reciprocal value. The particular reciprocal curve used for determining time increment values is determined by the number of steps required in plotting the curve. These steps are determined in terms of speed increment. Thus, if the curve is to be plotted at points corresponding to every speed difference of one mile per hour, the generic curve will be used. The point at which the ordinate of this curve equals the resultant coefficient will have for its abscissa the time increment which is to be used in plotting the curve. If the point is to be plotted for every speed increment equal of one-half mile per hour, the curve giving the half reciprocal values on the chart of reciprocals must be used. In like manner, if the curve is plotted for every tenth mile, the corresponding reciprocal curve must be used. The author points out in the paper that while the plotting points may, without sacrifice of accuracy, be made farther apart in vertical distance, when the rate of acceleration is great, that is to say, when the curve has a relatively steep incline, this vertical distance must be reduced when the value of the acceleration coefficient decreases. The paper concludes with a practical illustration of the use of this method in plotting a run curve corresponding to a run on which there are grades and curves.

Mr. W. B. Potter referred to the fact that in some cases of steam railroad passenger traffic, the live load was but 1½ per cent. of the dead weight. At an acceleration of 2 m. p. h. per second, he said

that both starting and stopping acceleration curves should be hollow.

The general discussion was opened by Mr. Frank J. Sprague, who said that the Institute was to be congratulated on having so able an analysis of a problem of immediate and pressing importance presented at its meeting. He was glad to note that the power requirements agreed very closely, considering the changed conditions, with the result of a similar investigation made under his direction some three years ago. Mr. Arnold had very wisely confined himself to the problem of train movements within the limits of New York City, instead of complicating his report and confusing his clients by speculations as to the possibilities of through electric service, the methods for accomplishing which were still, and for some time were likely to be, matters of discussion and probable disagreement among the ablest engineers. For the specified service, the use of continuous current motors, to be operated at a moderate pressure, was the only safe recommendation. Mr. Arnold's paper had made a special comparison of steam and electric operation in the matter of economy, with the result that no special advantage had been shown in favor of one or the other. Economy, however, was in this particular case the least important consideration, and he did not doubt that Mr. Arnold believed with himself that while this comparison was a necessary thing to be presented, there was no question, not only as to the practical possibility of electric operation, but of its wisdom and even imperative need on the score of comfort and safety; and furthermore, that the financial results would also entirely justify the change. On account of the special nature of the problem, if the railway company should defer the adoption of electricity until some great saving in car-mile operation was manifest, steam would continue to be the motive power of the tunnel. Safety, cleanliness and comfort, however, being assured, increased dividends would most assuredly result from increased traffic.

The problem was a two-fold one—the replacing of the steam locomotive on through trains and the operation of the suburban service. The requirements were to be met in different ways. At present both were train services—locomotive operated. The through service must remain such, but the suburban could be readily changed. No less than ten or a dozen types and sizes of locomotives were now in use, and at limited speeds. Train weights vary from a hundred and fifty to six or seven hundred tons. It would seem, therefore, that in so far as locomotive service was concerned, it could best be performed by units of, say, 30 to 35-tons weight, and of 700 to 800 hp., these units to be so equipped and controlled that one could be used for the lighter service and two operated as a single-unit for the heavier.

This condition made imperative what has already been well settled —electrical instead of hand operation of control equipments, and the grouping and simultaneous control of units; in short, the multiple-unit system of operation. For suburban service, individual equipment of cars and like control of any required number was now beyond question. Another thing should be borne in mind, and that was that electrical equipment not only would insure greater safety of operation by clearing the tunnel of smoke and condensed steam, but the adoption of electrical control would leave the engineer free to devote himself to the safe piloting of his train, untrammelled by the distractions of other duties. Mr. Sprague concluded by saying that, so far as the possibilities of the case were concerned, he would not hesitate—and he felt sure that he voiced the conviction and readiness of others in the room—to undertake the feat of putting the heaviest train from Mott Haven to the Grand Central Station under electric power on schedule time within six months. Of course, such demonstration would be a special one, for considering the many civil engineering and railway problems involved, from two to three years would be necessary to make a general change.

Mr. F. S. Pearson highly complimented the work of Mr. Arnold, and spoke of the especial value at the present moment of the profession of papers like those of Messrs Arnold, Mailloux and Armstrong. At the present time he considered the subjects of electric suburban and long-distance high-speed traction of more importance than that of electric freight traffic. He expected within not many years to see 10-hour electric trains to Chicago. The steam locomotive was limited by the boiler, whereas electric traction was feasible and safe at 125 to 150 miles per hour.

Mr. Oberlin Smith considered that high-speed electric traction demanded a better roadbed than those of present steam roads, and also better types of cars and of a kind that could not be got off the road at high speed.

Mr. Stevens referred to the rapid development of the past few years in the theoretical branch of electric traction. A few years ago an electric railway project demanded scarcely any thought from the mathematical side, but now calculations of great refinement are necessary. There must be considered variation of friction with speed, momentum of parts of motors, etc., and a great amount of experimental data had already accumulated. Formerly, speed alone was considered, then its second differential or acceleration, and now its third differential or variable acceleration, and maxima and minima enter into problems. If through such refinements an increase of acceleration of one mile per second follows, it will mean much to rapid transit.

Mr. H. Ward Leonard recalled that in an Institute paper, read almost 10 years ago, he had described a system for long-distance traction. There was now being constructed at Oerlikon, according to that system, an electric locomotive for a railway that will have stations 17 miles apart, supplying single-phase current at 15,000 volts. The current will be transformed by a motor generator on the locomotive to direct current and supplied to motors that will give 700-hp at the drawbar. The weight of the locomotive will be 44 tons, all on the drivers, and the efficiency is calculated at 75 per cent. The cost of the conductors will be only $1,200 per mile. For control there will be no idle resistances nor opening of heavy currents. Variable speed will be obtained by varying the voltage of the direct-current side of the motor generator. The system allows close control of acceleration, and the restoration of energy at stopping and on down grades at any and all speeds. The method permits of a very perfect system of multiple control, involving no appreciable loss of energy, and of the utmost simplicity. The shunt motor employed obviates the objections inherent to the series motor.

Mr. A. H. Armstrong considers that long-distance, high-speed traction is entirely feasible from the electrical standpoint, using alternating current. The problem is really a mechanical one, and involves considerations with respect to roadbed, wheel-base, wheels, etc. While employing alternating currents, it is a question as to the employment of rotaries and direct-current motors or alternating-current motors.

Mr. W. B. Potter expressed the opinion that whatever type of current is used in long-distance traction, it should be used in the motor. The single-phase motor is the ideal motor; polyphase apparatus can be used, but it seems hardly probable that the development will be in the direction of the Leonard system. The indications point toward the three-phase motor for long-distance work. The present track gauge is small for high-speed motor equipments; six feet would be better. The present wheel-base and diameter of wheel should also be increased.

Mr. Bion J. Arnold made an important announcement concerning a single-phase railway system he is installing on a 20-mile road in Michigan. Mr. Arnold prefaced his remarks by saying that during the past three years, as many of the members of the Institute know, he had advocated the use of the alternating current motor for certain classes of railway work somewhat earnestly, and had often been asked by friends why he believed so thoroughly in the alternating-current motor, and was questioned at times for particulars regarding a certain system which he has been working upon. Mr. Arnold said that long before he had any fixed ideas as to a system of his own, a study of the railway question from an engineering standpoint partially convinced him of the necessity of the ultimate abandonment of the direct-current motor for heavy and long distance service, owing to its low working voltage limitation and the resulting heavy investment in transmission lines thereby required, as well as the many translations between the power station and the car when any great distance is to be taken into account.

An active connection with the development and construction of electric railways in this country impressed him with the correctness of preconceived ideas to such an extent that they finally crystallized into a system of electric railway construction upon which he has been working for several years. The statement was then made that twenty miles of road have been constructed for this system, together with the necessary trucks and motor equipments. Before entering into a description of the system, Mr. Arnold said that, as he had previously stated before this Institute, he is particularly anxious that American engineers shall keep abreast with European engineers in the development of the alternating current electric railway, and while

some brother engineers may not agree as to the practicability of his ideas, there are others in the Institute who believe as thoroughly in the alternating current motor for railway work as he does; and whether the system about to be described proves the correct solution of the question or not, he expressed the firm belief that the alternating current motor will finally prevail for heavy railway work.

The principles underlying the system, which Mr. Arnold names the electro-pneumatic system, are as follows:

1. A single-phase or polyphase motor, mounted directly upon the car, designed for the average power required by the car, and running continuously at a constant speed and a constant load, and, therefore, at maximum efficiency.

2. Instead of stopping and starting this motor and dissipating the energy through resistances, as is customary with all other systems proposed, the speed of the car is controlled by retarding or accelerating the field or stator of the motor, by means of compressed air, in such a manner that a portion of the energy is saved which is ordinarily dissipated through resistances, and stored to assist in starting the car, helping over grades, for use in switching purposes, and for the operation of the brakes.

3. By this method of control an infinite number of speeds are secured from zero to the maximum speed of the car, which latter may or may not be at the synchronous speed of the motor; for with the air-controlling mechanism working compressing, the speeds below synchronism are maintained, and by reversing the direction of the air through the controller, speeds above synchronism may be attained for reasonable distances. This feature gives to the alternating-current motor the element absolutely essential for practical railway work, for it permits a car or train to ascend a grade at any speed with the motor working at its maximum efficiency, and imparting its full power to the car. When descending the grade the motor may utilize its full power drawn from the line in compressing air, or it may be used to compress air with the stored energy of the train, thereby acting as a brake.

4. By virtue of the air-storage feature each car becomes an independent unit and capable, in case of loss of current from the line, of running a reasonable distance without contact with the working conductor, and this without the aid of storage batteries. This feature will enable a car to work on a high-tension trolley wire or active conductor over private right of way, and allow the active conductor to be stopped where the private right of way ceases, and the car to proceed through a city or town on any tracks, whether electrically equipped or not, until it reaches the outskirts of the city or town, where it can take up the working conductor again on private right of way. This feature is also valuable in switching work, for each car being independent it can leave the main line track and operate over switches or sidings without complicating the yards with additional overhead or third rail conductors, thus necessitating through line conductors over main line tracks or tracks only.

5. Since a single-phase motor can be used, the motors can be supplied with current from a single overhead wire or third rail, and with a single-rail return circuit, thus permitting the overhead constructions or third-rail construction to conform to the standard of to-day, except that a much higher working voltage can be used, provided the insulation is taken care of. Furthermore, in steam railway work this system, by virtue of its single-phase feature, will only require the use of one of the track rails for the return circuit, thus leaving the other rail for the use of the signal system, which, up to the present time, does not seem to have been satisfactorily solved without the use of one of the track rails.

6. The current will be taken from the working conductor at any voltage up to the limit of the insulation, and in case this voltage is high (the line is being built for 15,000 volts), a static transformer will be carried upon each car and the pressure reduced from the line voltage to the voltage of the motor, which in the case under construction is designed for 200 volts. Where it is unnecessary to utilize so high a line pressure, the motor may be designed for the working voltage and the current fed directly from the working conductor into the motor, thus eliminating the static transformer. When a high-voltage working conductor and static transformer are used, and it is thought advisable to use a working conductor through cities or towns this working conductor will be supplied with energy through a stationary transformer at each city limit, thus making the working conductor through the cities or towns safe.

7. By virtue of the speed of the motor and its constant load, either when the car is in motion or when it is standing still, and the motor is compressing air, the variable load now customary in electric railway power plants is eliminated, and the power station works at practically a constant load, thereby eliminating a large part of the investment at present requisite in power station and line construction. Furthermore, by virtue of the air storage feature, each car, in the particular apparatus designed, is capable at any time when current is on the working conductor, of delivering to the car wheels a much greater torque in proportion to the capacity of the motor than is possible with any electrical system known to-day.

In conclusion Mr. Arnold said he believed that by the adoption of this system the following results will be accomplished:

1. The entire elimination of the present standard system of rotary converter substation plant, together with the maintenance thereon and the cost of the necessary attendants.

2. It would absorb and render available for useful work in starting, or otherwise, a large percentage of the energy stored in the moving mass which under the present methods of operation is dissipated at the brake shoes.

3. A large reduction in the first cost of electrically equipping long distance railroads, thereby making it feasible, from an engineering and business standpoint, to equip many roads which cannot now be shown to be advisable, thus opening up the steam railway field to the industry in which we are now engaged.

FRIDAY'S SESSION.

At the session of Friday, six papers were read. One had been withdrawn from the programme of that day—the paper by Prof. Matthews on "A New Photometer for Incandescent Light and Insular Sources"—and the paper by Prof. Herdt carried over from Tuesday's programme substituted. The discussion of the papers took place after the last on the programme had been read.

The papers by Messrs. Thomas and Walker and Prof. Herdt appeared in abstract in our issue of last week. Mr. Thomas' paper gives an elaborate investigation of the principles of cylinder lightning arresters for high-tension lines, and with particular reference to the suppression of the arc which tends to follow a simultaneous charge to ground from the two legs of a circuit. A new type of arrester for this purpose was described which involves the use of series and shunt resistances in connection with the multi-gap arrester. A resistance is in series with the arrester, and a portion of the gaps are shunted by a resistance. In case a current from the generator follows a lightning discharge, the shunt will divert part of this current from the shunted gaps and the arc will then not hold in the latter; the combined effect of the shunt and series resistance will then so decrease the current that the unshunted gaps will be able to suppress it. The paper by Mr. Walker described the application of the Kelvin quadrant electrometer to the measurement of alternating-current energy, and particularly for testing purposes. Prof Herdt in his paper described indirect methods for determining alternator characteristics, and showed the dependence of synchronous reactance on the field excitation.

The paper by Mr. Thomas led to a discussion of considerable length. Dr. Perrine expressed the belief that it is impossible to protect long-distance transmission lines with any number of gaps, and that while the work which Mr. Thomas has done was of value, there is yet need for much more. One point not covered in the paper was the change in frequency when lightning occurs. The directions laid down by Mr. Thomas may apply to the power house, but they do not apply to installations on the end of a long line or in connection with heavy cable. He referred to a recent case where resonance occurred in a substation cable, the result of which was a short-circuiting of the cable and the destruction of a switchboard. The arc produces a high frequency, which may cause resonance, and as a consequence a cable may become distortionless and a large current flow. Such a condition cannot be overcome with any ordinary values of non-inductive resistance. Dr. Perrine suggested the use of selective resistances to meet the case of resonant frequencies. No satisfactory solution will be arrived at until investigations are practically applied

to cables and long-distance transmission lines. Prof. Elihu Thomson agreed with Dr. Perrine that laboratory experiments are not sufficient, it being necessary to experiment with actual lines. Mr. Steinmetz discussed at some length the theory of lightning arresters. The three principal requirements are series resistance, many spark-gaps and a large sparking surface. The ideal case would be where no resistance was offered to the discharge, but short-circuited arcs are dangerous on account of the surgings to which they give rise, and, therefore, enough resistance should be used to damp out oscillations. The lightning arrester should, therefore, discharge without holding an arc, and consequently the voltage to maintain the arc should be less than the sparking voltage. Curves were given, showing the relation between the voltage to sustain an arc and the voltage necessary for sparking. By plotting such curves it will be found that they cross and the gap distance should correspond to an ordinate less than that of the common point. Curves were also given showing the variation of the arc distance with the current and with the temperature. In the design of lightning arresters the amount of current apt to follow an arc, the temperature at the sparking surface, and the proper relation of the e. m. f. to cause sparking and that to maintain sparking are all factors. Not only does the amount of surface of the sparking cylinder enter, but also the character of the material. Prof. Thomson referred to some investigations made by him some years ago, in which he used condensers for shunting spark-gaps. By employing condensers the series of gaps would break down more easily. Mr. Percy H. Thomas said that the resistance in the lightning arrester tended to overcome resonance. Instead of shunting a number of gaps the shunts might be across pairs.

ENERGY LOSS IN COMMERCIAL INSULATING MATERIALS WHEN SUBJECTED TO HIGH POTENTIAL STRESS.

In a paper with the above title, Mr. Charles E. Skinner gives a very complete account of tests made on various insulating materials used in commercial manufacture and also on the insulation of finished apparatus. For these tests, alternating current at frequencies of 25, 60 and 133 cycles was used, the e. m. f. varying from a few thousand volts to 100,000 volts. The results have a direct bearing with respect to the dielectric strength of finished apparatus at very high voltages. The tests were usually made by placing the material between metal plates, which were connected to the terminals of a high potential transformer. To measure the temperature usually a small coil of very fine copper wire was placed in the material, and the temperature determined by its increase of resistance. The most satisfactory temperature readings, however, were obtained by placing at the point where the temperature was to be measured a copper-lead couple connected to a sensitive galvanometer. The following are the results given of a series of tests on the variation of temperature due to variation of stress:

1. With moderate stress the temperature of the material rises rapidly at first, then more slowly, then becomes constant. The actual rise in the temperature for a given voltage depends on the facility with which the material can dissipate its heat and on the temperature of the surrounding medium.

2. As the stress is increased a point is finally reached where the heat is developed at a greater rate than it can be carried away, and temperature then rises until the material chars and break-down results.

3. When material is not thoroughly dried, the temperature rises much more rapidly than in well-dried stock. The increased temperature cannot be accounted for by the increased $C^2 R$ loss due to lower insulation resistance. The heat generated tends to dry out the material and the temperature may fall as the drying proceeds.

4. With a considerable area of material under test, the temperature of small portions frequently rises above that of the surrounding material to such an extent that on examination these portions are found much discolored, while the surrounding portions remain unchanged. This effect is especially noticeable with treated material not perfectly cured. The final break-down in such cases is invariably found in one of heated areas.

5. The final break-down in fibrous materials usually results from the burning of the material and not from mechanical rupture. When the e. m. f. applied is far above the dielectric strength of the material, the break-down may be due to a mechanical rupture. If, however, the e. m. f. is sufficiently low, so that an appreciable time elapses before break-down occurs, the break-down is probably due to burning, caused by the heat generated in the material. There may be some attendant chemical action, but this is thought to be a result and not a cause of the excessive heat. The lower the e. m. f. applied, the longer the time required to produce break-down under a given set of conditions.

6. It follows from (5) that if the temperature is kept low, either by providing good ventilation or by artificial cooling, the stress required to cause break-down in a time test will be much greater than if the material is not so cooled.

7. The actual temperature measured in most fibrous materials before break-down occurred was usually 175° C. or more. In no case did a break-down occur directly at the point where temperature measurements were being made, and the temperature at the breaking down point was probably higher than measured, especially as the rise in temperature seems to be very rapid at the point of break-down just before this occurs.

8. With a given stress, the initial and surrounding temperature has much to do with the rise. This is due to the fact that the loss in the material increases rapidly with temperature. For example, if the material and surrounding air are at 20° C., and the stress applied is 20,000 volts, the rise in temperature will not be nearly so great as if the initial and surrounding temperature is at 80° C. Tests have shown that break-down frequently results under the latter conditions from a stress that would not injure the material under the former.

The paper gives a number of characteristic curves of rise in temperature of insulating materials when subjected to high potential stress. The variation of loss due to variation of temperature was investigated, measurements being made by means of a calorimeter in some cases, and in others by a special static wattmeter. The following are the conclusions from this series of tests:

1. The energy loss in fibrous material increases with temperature, the rate of increase in the loss being greater than the rate of increase in the temperature.

2. The rate of increase depends upon the kind of material and on its condition with respect to dryness, etc.

3. The local heating found in a mass of poorly ventilated material is due to a greater initial loss in one portion, causing increased heating, this in turn causing greater loss, etc., until the temperature finally reaches a point at which charring and break-down result.

4. The curves plotted from the tests show that the rate of increase of loss is greater at high than at low temperatures, therefore giving the reason for the greater rise in temperature with a given stress when the initial temperature is high than when it is low.

5. The loss increases very rapidly, indeed, when temperature approaches the charring temperature of the material.

6. Losses as great as 5 watts per cubic inch have been measured in material before serious injury resulted, due to charring. A considerably less loss than this will, however, char the material unless special means are taken to dissipate the heat generated.

7. It follows from considerations of rise of temperature due to increased stress, and increase in loss due to increase in temperature, that a long-continued test at high stress may seriously injure the insulation of a piece of apparatus without this being made apparent by the test. This has often been spoken of as "straining the insulation" for want of a better term, the idea being that this was in some way analogous to the straining of a piece of metal beyond its elastic limit. It is probable that this "straining" is always due to charring.

Still another series of tests were undertaken to determine the variation of loss of voltage, the voltage remaining constant. The tests showed a fair agreement with the Steinmetz law, the increase in loss usually being slightly greater than the square of the e. m. f. With respect to the variation of loss with voltage, the temperature varying, due to the loss itself, there is, as stated above, a rapid increase in the energy loss in a body of insulating material, due to increase of temperature; also that the energy loss varies approximately as the square of the voltage when the temperature remains constant.

1. It follows, therefore, that under the usual conditions of high potential stress the loss will increase more rapidly than the square of the voltage, because the temperature increases at the same time.

2. The rate of this increase will depend on the facility with which the material can get rid of its heat, and on the length of time the material is subjected to each successive stress in carrying out the test.

3. It will also depend on the initial temperature of the material and the temperature of the surrounding medium.

It will be seen that many of the conditions named under variations of temperature, due to variation of stress, apply to this case.

The variation of loss due to variation of frequency was also deter-

mined, and the results plotted as curves. The curves show that the rate of variation is approximately in proportion to the frequency at the lower temperature, but follows a different law at the higher temperatures. In some tests which were carefully made, the loss varied approximately as the square root of the frequency, but Mr. Skinner does not consider that these results are sufficiently well substantiated to be announced as a law.

The final section of the paper deals with energy loss in the insulation of large alternators. The measurements were made to determine the energy loss in the armature insulation of the 5,000-kw Westinghouse alternators, built for the Manhattan Railway Company. These alternators are star-connected, three-phase, 11,000-volt machines. Loss measurements were made at approximately 5,000, 10,000, 15,000, 20,000 and 25,000 volts. The amount of insulated material under stress in these tests was approximately 19,500 cu. ins., giving a maximum measured loss of .35 watt per cubic inch at 25,000 volts. At a stress of 11,000 volts between the windings and the frame, the loss measured was less than 1 kw total for the machine; the total loss, however, at 11,000 volts is less than ½ kw under normal conditions.

The curves plotted from these tests show that the variation in loss due to variation of stress is slightly greater than the square of the stress applied, which increase cannot be due to temperature, as the total loss is not sufficient to cause appreciable heating. The increased loss at the higher temperature is somewhat greater than was to be expected from measurements made upon the small samples of material. The loss at 25,000 volts is not sufficient to cause any injurious heating even in a long continued stress. The rate of increase of loss indicates that at a point not far above 25,000 volts the loss will be sufficient to cause heating and possibly damage to the insulation if the stress were applied for any considerable length of time.

Mr. Skinner concludes that it is not possible to state in general terms the safe limiting stress which can be applied in a time test to a piece of high potential apparatus, but measurements of the loss and a knowledge of the materials used will give the designer some idea for any particular machine. Such tests are very rarely necessary, and should not be required on ordinary commercial apparatus. When a time test is required, it should be at a voltage much below the dielectric strength of the insulation under test.

In the discussion of Mr. Skinner's paper, Prof. Nichols pointed out that the breaking down of an insulation must sometimes be ascribed to local heating rather than to dielectric stress. Mr. W. S. Andrews said that mica is more easily punctured if oil is present, and Mr. Skinner added that a slight film of oil on mica will largely reduce its dielectric strength. Prof. Perrine pointed out the similarity of the curves in Mr. Skinner's paper with those of long cables for high potential, and insulated with gutta-percha. Cable work has shown that the presence of slight moisture will increase the heating and result in a breakdown. In testing, it is often found that the heating largely exceeds that due to C^2R, and this excess comes from the presence of moisture. Where there is moisture there is electrolytic conduction, and it is found that a disconnected cable as a consequence may act as a storage battery. In one case a certain cable could not be used in testing for this reason. Some experiments made by Mr. Newbury, of Roeblings, indicate that when the diameter of a cable is increased above a certain point, any further increase does not increase the disruptive strength. Dr. Perrine also ascribed the lowering of disruptive strength to conductive vacuous spaces, and an examination in some cases when rubber cables had broken down under less than the proper e. m. f., had disclosed such vacuous spaces. Prof. Elihu Thomson agreed with Dr. Perrine as to the non-effectiveness of insulation beyond a certain thickness, and offered the explanation that the stress being a radial one, increases in diameter beyond a certain point, does not change the intensity of the stress; the remedy is, therefore, to increase the diameter of the metallic portion.

Referring to an oil film on a mica plate, Prof. Thomson expressed the opinion that the effect of oil was to concentrate the stress at the thin portions of the film. Mr. C. O. Mailloux referred to some experiments which showed that glass between two e. m. fs. may increase the intensity of the stress over that of dry air. In certain cases of insulating materials that become softened at a certain temperature, in every case the area about the puncture became thin before the puncture occurred. In this case there are three actions leading to disruption, namely, dielectric stress, increase of temperature and thinning. Mr. Percy H. Thomas called attention to the fact that the results given in Mr. Skinner's paper are the result of many years of practical work dealing with commercial materials. While not directly applicable to cable work, yet they apply to materials for cable insulation.

Mr. Wm. Maver said that in the manufacture of cables, if the insulation is very thick the moisture is not expelled by the usual application of heat, and there is not proper penetration of the compound when plunged in the same. The remaining moisture not only reduces the dielectric strength of the cable, but the resulting heat also leads to deterioration. Prof. Woodworth, of Lewis Institute, Chicago, gave the result of some experiments as to the effect of moisture in transformer oil. The presence of .9 per cent. of moisture caused the insulation strength to drop in the ratio of 16 to 2, at the latter point being less than that of air. Mr. Steinmetz corroborated the statement, and added that after a transformer has been in operation some time the insulation increases, which is to be ascribed to the drying out of the moisture by the heat. Referring to the remark of Mr. Mailloux concerning thinning out under dielectric stress, Mr. Skinner said that he had noticed pitting and grooves in glass subjected in oil to dielectric stress, and that there was undoubtedly a mechanical action. He also confirmed Mr. Steinmetz's statement that heating oil increases its dielectric strength. Mr. Steinmetz said that in some experiments with paraffine he found that with frequencies from 1 to 250 the energy loss varied as the square of the voltage, and the power factor was independent of the frequency, but that the second power variation only held up to the dielectric elastic limit. A great source of loss in dielectrics is occluded air.

A NEW WAVE TRACING INSTRUMENT.

Professor R. B. Ownes, gave an account of a new method for conveniently and accurately tracing current curves in circuits of small resistance and inductance without appreciably altering their time constants. As will be noted from the illustration, Fig. 1, in general appearance the instrument is similar to the ordinary differential galvanometer with the exception that the usual suspended permanent mag-

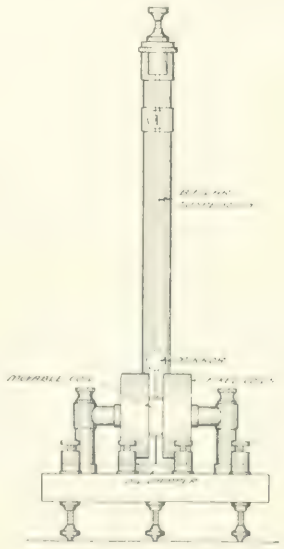


FIG. 1.—WAVE TRACING INSTRUMENT.

net with attached mirror is replaced by a circular coil of fine wire supported by two thin phosphor-bronze suspensions.

The action of the instrument is as follows: The variable current of which a trace is desired is introduced into, say, the outer pair of the two concentric coils, a suitable direct current is sent into the inner pair of coils and a contact maker sends an impulse of current from a constant source of e.m.f. through the movable coil. If the the D. C. current in the inner fixed coil is equal and opposite in magnetic effect to the instantaneous value of the variable current at time of contact, no deflection of the movable coil will be observed.

If a deflection, however, does occur, the D. C. current is carried until such deffection becomes zero, then the D. C. current, as read by an ordinary Weston ammeter, equals to within a constant the instantaneous value of the variable current for the particular setting of the contact maker used. The constant of the instrument is readily obtained by measuring the ratio of the currents in the two fixed coils required to produce no deflection of the movable coil when a small current from a separate source is sent through it.

Shifting the contact maker arm, as many points may be obtained as are desired. The instrument is extremely sensitive, allowing perfectly satisfactory traces of currents a fraction of a milliampere effective value to be obtained, and its range can be varied to almost any extent by the addition of fixed coils. When measuring very small currents it must, however, be shielded or corrected for stray fields.

Some of the applications to which the method has been put are as follows: The tracing of alternate current e.m.f., and waves; obtaining curves of growth and decay of currents in inductive circuits, when constant e.m.fs. are applied; obtaining curves of rate of growth and decay of such currents; obtaining leakage coefficients of large generators, the time constants of whose fields make the use of ballistic or of damped galvanometers for accurate work impracticable; the determination of the variation in a single revolution of the angular velocity of engine flywheels; the determination of the fluctuations in currents from commutating machines.

Fig. 2 gives the connections for obtaining an ordinary current wave from an alternating-current generator. A milliammeter is put in series

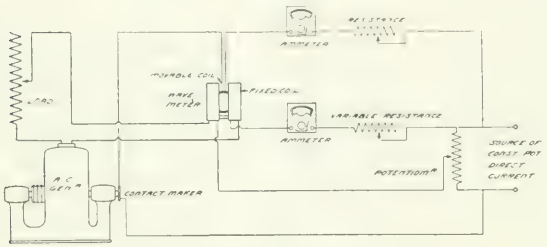


FIG. 2.—DIAGRAM OF CONNECTIONS.

with the movable coil of the instrument as a convenient means of knowing whether or not the contact maker is operating satisfactorily. The average curent ned not exceed four or five milliamperes. For obtaining the e.m.f. wave of an alternating current generator, a larger number of turns of fine wire are used in the outer fixed coils, together with a suitable non-inductive resistance in series with them, the whole being connected across the generator terminals.

The variation in a single revolution of the angular velocity of an engine flywheel may be measured as follows: A disc dynamo with fields constantly excited is directly driven from the engine shaft and the curent trace from it obtained as a function of angular displacement, such current at any instant being proportional to the angular velocity of the flywheel at the same time. It is necessary to use a disc dynamo or one having a great number of commutator segments, as otherwise the variations in the curent due to the angular displacement of adjacent armature coils will mark the variations due to a change in angular velocity. The value of the method described by Prof. Owens lies largely in the fact that it is a zero method.

STANDARDIZATION REPORT.

Dr. A. E. Kennelly presented the revised report of the committee on standardization, and explained the changes that had been made by the committee. The report differs from that of 1899 mainly in the addition of a number of paragraphs, though some changes appear in the older part. Prof. Owens criticized the method of computing the regulation of synchronous machines. Dr. Kennelly and President Steinmetz in reply said that the method is supported by practical experience, and that while the rule might not apply exactly in abnormal cases it covers all commercial machines; moreover, the general method given is much better than special methods, and it is not possible commercially to obtain the data by actual tests, owing to the size of machines and the circumstances under which they are manufactured and operated. Considerable discussion ensued on the rating of incandescent lamps. Mr. John W. Lieb, Jr., said that while mean horizontal candle-power is not scientific and does not take in flux of light, it is so rooted in the art that it would be unwise at present to make a change. At the beginning the incandescent lamp was handicapped through the adoption of the method employed in determining the candle-power of a gas jet, and to adopt now the spherical rating would act still further to handicap it with respect to gas. Prof. Matthews referred to a photometer, which he has recently devised, which gives a mean spherical candle-power at one setting. He defended the Heffner unit, and believes that ultimately we will have to come to a complete system of photometric units. Prof. Nichols supported the method of Institute rating, and congratulated the committee for putting emphasis on the total flux and for defining the Heffner unit. Mr. Hering said that the National Bureau of Standard favors the Heffner constant adopted—.88—and Mr. Lieb added that the Reischanstaldt employs that ratio. Prof. Nichols said that owing to the great variation in candles, the ratio of the Heffner unit to the candle-power unit could not be experimentally determined, and, therefore, must be assumed at an average value, and he considered that .88 is the best value to fix upon. Mr. Lieb suggested that the Institute adopt rules for making electrical measurements and determining the commercial accuracy of instruments, which suggestion was supported by Mr. Calvin W. Rice, it being held that an expression of opinion on the part of the Institute as to determining the commercial accuracy of wattmeters especially was very valuable. Elsewhere in this issue the revised report of the committee on standardization is referred to editorially.

DETERMINATION OF ALTERNATOR CHARACTERISTICS.

In the absence of the author, Prof. R. B. Owens read the paper of Prof. L. A. Herdt on the indirect determination of alternator characteristics. Prof. Owens laid stress on that part of the paper which deals with the influence of field excitation and armature reaction on the determination of the regulation. If the determination factor of synchronous reactance does not consider field excitation, the result will be incorrect if, as in the case of the short-circuiting method, the field excitation is much below normal.

President Steinmetz complimented very highly Prof. Herdt's paper, which he pronounced a valuable contribution to the subject of determining the synchronous reactance from an actual machine; moreover, he admired the method of the paper, which was not only engineering in character but also strictly scientific. While the paper does well in bringing out the discrepency that may exist between the calculated and the actual synchronous reactance in abnormal cases, in point of fact the commercial machinery the difference disappears in the testing room. Prof. Goldborough pointed out that in a paper read by him at the Elliott, Maine, Institute meeting, in 1896, he showed the effect of variations due to loading and the variations due to the relative positions of a coil and the pole. Prof. Owens considered that the paper showed conclusively that a large error is apt to arise if the synchronous reactance is calculated by the method given by the report of the Institute's Standardization Committee. While the accuracy was quite good with high excitations, this was not true with low excitations. In commercial testing, Dr. Perrine considered that the characteristics could be predetermined without considering the degree of excitation. In reply to a question, Prof. Owen said that the Herdt m. m. f. method applied both to the inductor and to the revolving field machine. Mr. C. H. Himes referred to the great difference that appears to exist in the rating of motors of the railway type. He finds that in the case of motors rated at 50-hp they may run up as high as 80-hp. This discrepency, he said, introduced complications in buying motors for a given work, particularly in the case of steel plants where inexpert operators may endeavor to get the same power out of motors having different actual capacities.

SATURDAY'S SESSION.

The session of Saturday was opened by President Steinmetz, who had chosen as his presidental address the subject of engineering education. We reprint below the address in full:

With to-day's meeting ends the first Institute year in the new century, and it may be appropriate then to look back into the work achieved and forward into the future.

At the entrance of the 19th century we see empirical science struggling for recognition against metaphysical speculation. At the entrance of the 20th century metaphysics has practically ceased to be considered and empirical science is universally acknowledged as the [illegible] in gradual advance from success to

success this victory has been won. Without any restraint empirical science can now expand. But with the removal of the opposition of an hostile philosophy, has been removed also the searching criticism into the correctness of the results, the methods and the theories propounded by empirical science, and thereby the absolute safety which characterized the work of the earlier period. Herein lies the greatest danger to the unbroken progress of science.

Facts, whether incidentally observed, or intentionally, by experiment, are the foundation of science. But the mass of facts has accumulated so as to be beyond comprehension, and we are forced thereby to work with the conclusions from the facts, the empirical rule, theory, hypothesis, and have become so used thereto that gradually the dividing line between the theory and the underlying facts has become blurred, and we consider the theory and attribute to it the same certainty as only the facts have on which it is based. But, however well a theory represents the facts and proves its value in successful application, it unavoidably contains besides the facts on which it is founded, foreign elements, mainly the personal equation of its originator and the personal equation of its times. And when building upon theories, the danger exists that instead of upon the facts represented by the theory, we may build upon the personal equation of the time without realizing the unsafe foundation of our structure.

The reverence for the facts as the foundation of science has been extended to the theories based thereon. But when by building theories upon theories, conclusions are derived which cease to be intelligible, it appears time to search into the foundations of the structure and to investigate how far facts really warrant the conclusions. If we are told of matter moving in a vacuum tube with velocity comparable with that of light, of small chips breaking off atoms, of free atoms of chlorine and sodium floating around in a salt solution charged with opposite electric charges, whatever that may be, of electricity being propagated not through the conductor, as we used to assume, but through the space surrounding it, etc., it is time to pause and try to understand.

In the gradual replacement of facts by the belief in theories, more or less inadequately representing the facts, lies the chief danger to further scientific progress. Here is a field where splendid work can be done and should be done, in destructive criticism, by the younger generation, which, after leaving college with all the theoretical armament required, is not yet handicapped by personal relations with the men whose names are identified with the ruling theories.

Especially for our branch of electrical engineering, this is of fundamental importance, since all the success of our work depends upon the absolute safety of the foundations on which we build.

All future progress in science and engineering depends upon the young generation, and to insure an unbroken advance it is of pre-eminent importance that the coming generation enters the field properly fitted out for the work.

Here the outlook appears to me by no means entirely encouraging.

It is not the object of the college or university to turn out full-fledged engineers who can handle any engineering problem of any magnitude. Heretofore the available time is altogether too short, and especially a very great deal of practical experience is required, which is not available to the educational institution. It is not necessary, either, and the college graduate is not expected to take immediate charge of engineering works of great magnitude. All the educational institution can do and should do is to fit the student so to take up the practical work as efficiently as possible, and that is to give him *a thorough understanding of the fundamental principles of electrical engineering and allied sciences*, and *a good knowledge of the methods* of dealing with engineering problems.

The average college course at present does not do this.

One of the reasons of the inefficiency of the present college course is the competition between colleges. By trying to teach more than other colleges, gradually the quantity of material taught by our colleges has increased so that it is not possible any more to give a thorough understanding, and memorizing takes the place of understanding. Memorizing, however, is an entirely useless waste of energy, since anything that is not perfectly understood, but merely memorized, will be forgotten in a short time if not continuously applied, and if continuously applied it would be remembered anyway. If of the amount of material in electrical engineering as well as other branches which the educational institution of to-day attempts to teach, one-half or more would be dropped altogether, but the rest taught so as to be fully understood, with special reference to general principles and methods, the product of the institution would be far superior and more successful in practical life. To be dropped, then, are all formulæ, rules, etc., beyond the most simple ones, of the scope of the multiplication table, etc. When needed, formulæ can be derived from the fundamental principles or looked up in the literature, and their memorizing is a mere waste of valuable time, unless since the memory cannot retain them if the understanding cannot reproduce them from their premises. This, for instance, applies to the various formulæ of electromagnetic induction, the equations of the transformer and other apparatus, and theoretical investigations in general.

Still more than in electrical engineering this applies to the allied branches of science and engineering, of which the electrical engineer should have a fair understanding. Here anything beyond fundamental principles is objectionable. The electrical engineer should understand the principle of the steam engine, of the hydraulic turbine, know why the spouting velocity and the peripheral speed of the water-wheel are related to each other theoretically, and how this relation is modified actually, but should not memorize the mathematical theory of the turbine with its half dozen unknown friction coefficients. He is not expected to design turbines, and if he did, his design would surely be a failure, but he is expected to understand the turbine, the steam engine, etc. The engineering graduate should know the principles of the strength of materials, the distribution of forces in the loaded beam, the reasons leading to the I-beam, to the triangle in bridge and roof construction, but time should not be wasted in calculating bridges or deducing elastic curves, etc.

In short, in electrical engineering, and more still in all allied branches, nothing beyond the general principles is needed for success, but the principles should be fully understood, and with the limited time at disposition this cannot be done if time is wasted in memorizing things to be forgotten afterwards.

One of the objectionable features of the instruction of most colleges is the step by step method. One subject is taken up, by application of sufficient time and energy pushed through, and then after passing an examination dropped to take up another subject. It is true that by steady application to one subject a great deal can be learned, and so splendid results derived in the examination papers, but all that is learned in this manner is forgotten just as rapidly. To understand a matter thoroughly, so as really to have a lasting benefit therefrom, and not only make a good showing in examination papers, requires several years familiarity therewith. Any subject, therefore, that is not kept up during the whole college course might just as well be dropped altogther and the time spent therein saved.

We hear that college graduates have no mastery of the language, cannot express themselves logically, and, therefore, recommend that more time should be devoted to literature and instruction in the English language. But as long as we do not teach logic, but have English language taught by philologists, more or less of the character of the florid newspaper style, that is to write very many words on a very small subject, no useful results can be expected. Logic should be taught by a scientist, and the principle of English teaching to engineers should be to enable them to explain a subject intelligently and logically, with as few words as possible. That is, Faraday's reasearches, and not the product of the successful novel writer should be the example aimed at.

The combination of text book and home work offers a splendid means for incompetent instructors to make an elegant showing in the examination papers and turn out a very inferior grade of men, men who sometimes do not even know what real understanding means. Free lectures on subjects which the instructor himself thoroughly understands (which is by no means always the case now) make it possible to direct the course so that the student's understanding follows the course, and in this case home work becomes superfluous, excepting in connection with the laboratory. Reviewing the lectures and filling out the gaps to absence, etc., appears to me the only legitimate requirement on the student's time outside of the lecture room.

The present method of examination, which consists in expecting the student to answer ten questions or so within a few hours, is [illegible] he understands it. Furthermore, the brilliant student who usually answers nine out of ten questions correctly, and would have answered the last if he had not made a slight mistake, displaced a decimal point or so, in practical life may be utterly useless, since while doing

very rapid work, his work is not reliable, while a slow man who, however, can absolutely rely on the correctness of his work, will be very successful in practice while hardly passing the college examination.

What, then, should an ideal electrical engineering course consist of?

Of mathematical, plain and some solid geometry, arithmetic, and a good knowledge of algebra. Plain trigonometry—no spherical trigonometry required—and a thorough understanding of analytical geometry and of calculus, but no memorizing of integral formulæ, etc.; they can always be looked up in a book when needed.

A thorough knowledge of general physics, especially of the law of conservation of energy, which, I am sorry to say, is not yet an integral part of our thinking, and of chemistry, especially theoretical chemistry and chemical laboratory, in the latter freely using tables, etc.

The electrical laboratory work should be taken up right in the beginning. Even before taking up the theory of apparatus, the theoretical investigation of alternating currents, self-induction, transformers, etc., the student should have met this phenomena and handled the apparatus in the laboratory. Only after seeing the effects of self-induction, for instance, on the alternating-current circuit in the laboratory, the theory of self-induction will have any meaning and make an impression on the student. What the student has seen practically in the laboratory he will then take up in the theoretical course, to understand it, learn to calculate and control, and afterwards going back once more to the laboratory, apply it. It is here where the average college graduate is inferior to the practical man, and in spite of his handicap regarding theoretical knowledge, the latter frequently pushes ahead of the college graduate by his superior understanding of the phenomena, based on his familiarity with them.

Design of electrical apparatus is of very secondary utility, and rather objectionable, with the exception, perhaps, of some very simple apparatus. The considerations on which designs are based in the engineering departments of the manufacturing companies, and especially the very great extent to which judgment enters into the work of the designing engineer makes the successful teaching of designing impossible to the college. Far better is the reverse operation, the analytical investigation of existing apparatus, and more instructive to the student. That is to derive from existing first-class apparatus by measurement and test, the constants of the apparatus, and to calculate these constants and compare them with tests. Besides, a very small percentage of the college graduates enter the field of designing, but most of them will have to handle apparatus, and it is, therefore, very much more important to be familiar with the completed apparatus in all its characteristic features, in normal and in abnormal operation, than to be able to design it.

The preceding naturally can be a short outline only of the work which I consider appropriate to an electrical engineering course, but I believe the general principles of the course can herefrom be understood. They are to give the student all the ground work required to be successful in future practice, but not the impossible aim of giving him a complete education as practical engineer.

After Prest. Steinmetz's address five papers were read on the same subject, the authors being Profs. Samuel Sheldon, R. B. Owens, E. B. Raymond, Wm. Esty and Mr. Harold W. Buck.

Dr. Sheldon pointed out that the determination of a curriculum does not lie wholly in the hands of the officers of the educational institute but is influenced by the student body. The average student attends a technical school in order to get that which will enable him to earn a living, and wishes to be placed in a position to earn such a living as soon as possible. Dr. Sheldon considers that that a course in electrical engineering to meet the desires of its patrons, should be laid out with a view to securing the best possible positions for its graduates. The initial rapidity of the advancement of a graduate depends upon his technical education and could be made a maximum by a thorough understanding between the employer and the educator. His ultimate position, however, seems to be dependent almost entirely upon himself and very little directly upon any special feature in his educational training.

The paper discusses the difference between the electrical engineering courses in this country, and the conclusion is arrived at that the great difference which exists suggests prodigality in the expenditure of a student's time, and also suggests the possibility of obtaining much higher teaching efficiency by the adoption of curricula uniform not only as to the time to be devoted to the different subjects, but also to the topics to be treated in that time and as to the manner of their treatment. Dr. Sheldon considers that the present electrical engineering graduate lacks the broad mindedness associated with graduates from classical and art courses and which, as a whole, is considered as a condition of a liberal education. The average graduate from a liberal classical course possesses a breadth of culture which is easily distinguished as being in excess of that possessed by the average technical graduate. This difference, however, might be largely eradicated by a single carefully planned course of lectures.

Prof. Esty believes that safe rules to follow in laying out a course for electrical engineers are to teach thoroughly those things in college which are fundamental and to devote little time to highly specialized subjects; to introduce the student to those branches of knowledge which in his later life he can obtain only with increasing difficulty if at all; and to increase in him a hunger and thirst for deeper knowledge so that he will remain a student through life. As showing the great strength of the movement toward technical education, Prof. Esty points out that there are now more than 10,000 sudents enrolled in our technical schools, and that more than 50 institutes in this country give instruction in electrical engineering, the students pursuing this course alone numbering over 2500.

The ideal education of an engineer, Prof. Esty considers, would be in following a liberal and scientific course of a general nature, covering 3 or 4 years, succeeded by a special technical course extended over 2 or 3 additional years. Granting, however, that a preliminary liberal college education is a good, if not necessary, preparation for an electrical engineer of to-day, it is of the utmost immediate importance to determine how a technical course should be organized to produce the best possible results in the limited time of four years. The present practice of combining two radically different groups of students in a single four years' course, is pronounced fundamentally wrong. Prof. Esty considers the subject of text-books and points out the importance of the commercial aspect of electrical engineering, which should be recognized by familiarizing the student with trade literature, manufacturers' drawings, photographs and samples, visits of inspection to manufacturing establishments, the encouragement of students to engage in practical work during the summer vacation, and a course of lectures from men of affairs and from specialists in certain lines. The method of teaching in a laboratory is elaborated and the seminary method of instruction is commended. Prof. Esty views with favor the teaching of design not so much for its practical as for its educational value. He lays stress upon systematic laboratory work, but condemns both over-directed and under-directed supervision.

Mr. Harold W. Buck considers that while in the past some of the most successful electrical engineers have belonged distinctively to the class of practical men with little theoretical knowledge, the conditions have changed. The extraordinarily rapid growth of the electrical arts places electrical engineering apart from all the other engineering branches. An engineer whose education is based only upon practical experience cannot keep up with the progress and change resulting from it and falls behind; whereas a man with a knowledge of theory and a mind trained by the theoretical studies and by scientific study, easily grasps the theory of the change and readjusts his mind to the new without difficulty or delay. It is pointed out that of the electrical engineers prominent some years ago only those have retained their positions throughout the growth of the art who have persistently studied along theoreical lines. Mr. Buck believes that the best course of training for an electrical engineer is a broad course of education in general subjects at the preparatory school before entering college, with practical work, if possible, along lines of simple mechanics, such as carpentering, in order to train the mind into a sense of proportion and the relation of parts, which is the basis of all engineering. Next would be a college course with general subjects for the first year and for the remaining years of the course the principles having a direct bearing on the practice of the electrical profession. This should be supplemented with actual daily work with machinery operating by the principles taught and demonstrating all the phenomena incident to the theory.' After graduation an apprenticeship is recommended in some large manufacturing establishment where the commercial relations of the knowledge acquired in college can be clearly set forth. After a few years of this training, specialization may be taken up along the line selected for the life work, but preferably he should acquire first a broad view point from which to make a correct start in the direction for which he is best fitted. This plan perhaps means a small income the year after graduation from college, but it means much more at the end of five years. Mr. Buck

points out that success in engineering not only implies a knowledge of theory and practice, but also includes intrinsic personal qualities. Stress is laid upon a training in the English language, for no man who cannot express himself clearly and easily in writing and in conversation can hope to attain a prominent position in his profession.

Prof. E. B. Raymond, in a paper entitled "A Proposed Reform in Technical Trainings," set forth views on engineering education in some respects radically different from those expressed in the other papers. One of the points of difference is that Prof. Raymond demands rather exceptional personal qualifications on the part of the student; for example, advocating that all studies be dropped from courses which are likely to be taken up after graduation, on the grounds that if properly trained the graduated engineer will devote a portion of each week to study, and will do this from a natural inclination to study.

The plan proposed is that when a boy enters the High School, either parent or teacher should decide upon his line of life work. For the boy in the High School who intends to be an electrical engineer, it is suggested that for about six weeks of his last two summer vacations at the High School, he should work in the machine shop of some manufacturing electrical concern. During his college course the student in electrical engineering should spend a part of each summer in similar practical work, supplementing it, perhaps, with work in a foundry or pattern shop. The draughting room at college would mean much more to such a man than to the ordinary student. From college electrical courses such studies as French and German, rhetoric and English composition, history, English literature and political economy could be dropped. In place of the studies discarded, more stress could be laid upon mathematics, physics, mechanics, chemistry, thermodynamics and the laws of electricity. There should be enough of these studies to give him, in addition to mind training, excellent detail knowledge of the subject studied.

The Moore Electric Light.

On June 10 eight patents were issued to Mr. D. McFarlan Moore on his system for producing electric light, these being in addition to almost a hundred patents previously granted him. We are enabled through Mr. Moore to present herewith the inventions embodied in these patents, as well as the ideas and aims held before himself by the inventor in the development of his ideas.

About seven years ago Mr. Moore gave the first exhibition of his system, and during this period it has been radically changed a number of times. His first experiments were with his "vacuum break" in connection with light production, the lamps used being glass bulbs with special internal electrodes, as shown in Fig. 1.

In 1896 long tubes were substituted for bulbs (Fig. 2), and in April

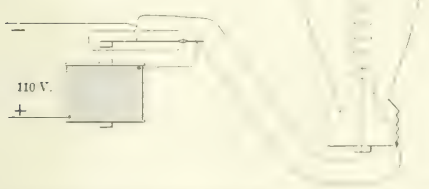


FIG. 1.—VACUUM VIBRATOR AND LAMP WITH INTERNAL ELECTRODES.

of this year he lighted the meeting hall of the American Institute of Electrical Engineers. The tubes were suspended from the gallery on all four sides of the hall. These same tubes were exhibited during the following month at the New York Electrical Exposition, where they attracted much atention. Some of the new features in these installations were the tubes, their operation on commercial circuits, the vacuum break employed, the production of brilliant effects without the use of any secondary coil, and the diminutive size of the apparatus.

At the New York Electrical show of 1898, at Madison Square Garden, Mr. Moore showed a "chapel," lighted by tubes which conformed to the architectural conditions. At this installation he had substituted a "rotator," shown in Fig. 3, for the former vibrator. This was a structure capable of accommodating at least 100 people.

Since the above and some later exhibits, Mr. Moore has radically improved his lighting system, and the light now produced is at least 25 times brighter, per square inch of tube area, than it was in the "chapel" exhibit, besides being perfectly steady.

The objection to the vacuum break for lighting purposes was that

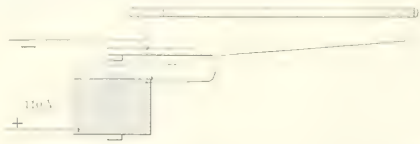


FIG. 2.—VACUUM VIBRATOR AND TUBE WITH EXTERNAL ELECTRODES.

mechanical difficulties limited the size, and a large installation would require too many "breaks" to be thoroughly practical. But Mr. Moore considered that its efficacy lay in the fact that it produced probably the most peaked wave ever obtained, and his next step was to design a dynamo that would give such a wave, and from which the tubes could be lighted directly, this of course, obviating limitations as to the number of tubes that could be operated in parallel from a generator of suitable size. This generator was the subject of several patents, the first dated March 6, 1900, and containing the following claim:

"As a means of producing illumination by the agency of electricity,

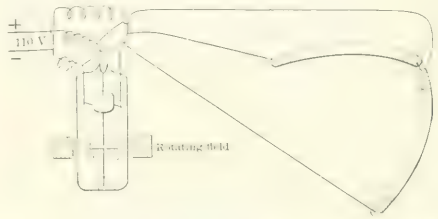


FIG. 3.—VACUUM ROTATOR AND TUBES WITH INTERNAL ELECTRODES.

the combination substantially as described of vacuum-tube lamps having terminals of the character described and an alternating-current dynamo connected directly to said terminals and exciting said lamp to luminosity by the interrupted or continuous application of the alternating electromotive force generated by said dynamo as and for the purpose set forth:" (Fig. 4).

Another patent of the same date sets forth the details of the dynamo and system, while one dated July 9, 1901 demonstrates the great value of the peaked wave (Fig. 5). The patents just issued cover his latest system, which has an efficiency at present equal to that of the incandescent lamp and, furthermore, he has eliminated the necessity of a special dynamo and can produce brilliant vacuum-



FIG. 4.—VACUUM TUBE LIGHTED BY ALTERNATING CURRENTS.

tube illumination from the alternating street circuits without the use of any rotary apparatus. Two of these patents show this accomplished by using the standard eight foot tubes equipped with special caps and condensers, but a broad, and what is stated to be the most important patent of the series, discloses a system not only operative from street mains but designed especially for safety, efficiency and means which permit of increasing the intensity of the light to almost any point desired. Fig. 6 of the patent shows the salient points of this system.

Quoting from patent specifications, "The object of this invention is to avoid the use of electric conductors for distributing the electrical energy to the lamp or light-giving portions of the system,

and to thereby permit the illumination of buildings and contained areas without the presence of conducting wires or circuits of copper distributed through the building or the rooms thereof."

Briefly stated, the invention claimed by Mr. Moore consists of distributing or running a translucent tube or receptacle over areas, spaces or rooms to be lighted, the terminals of the tube being brought to a source of energy outside of the areas or spaces, or in a location where the terminals may be suitably protected against danger of contact or accidental interference, the tube containing a gas which is of such character or degree of rarefaction that by the application of electrical energy or current to the terminals of the tube it will be rendered luminous by the transfer of the energy from one terminal of electrode to the other. In the practical installation of the system the translucent tube of glass may be built up in the position it is to occupy while in use, or otherwise distributed as a tube of glass over the spaces to be illuminated and its terminals, which are provided with suitable energy transferring electrodes or caps, brought to a protecting cabinet or wall pocket, in which they may be connected to the two poles of the energy supplying devices, the latter being mains or wires leading direct from the primary generator of e. m. f., which might be the terminals of suitable transformers adapted to give the required secondary voltage. In practice alternating currents of greater or less voltage, as might be found desirable, would be used.

For illuminating the interior of a dwelling or structure, the portions of the glass tubing which contain the luminous column from which the effective illumination is obtained, would be distributed in any desired way throughout the whole interior of the dwelling or structure as one or more tubes, with the conducting caps or terminals thereof brought from within the illuminated spaces or areas

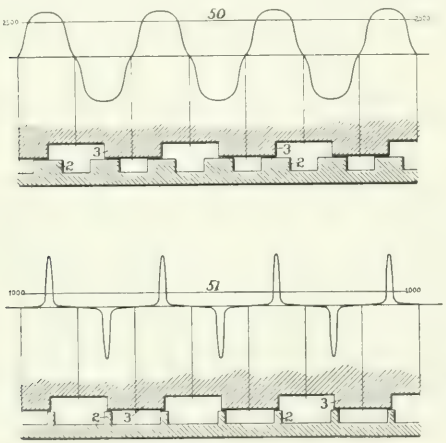


FIG. 5.—"PEAKED WAVE" DIAGRAM.

to an exterior cabinet or receptacle where its conducting caps would be located out of harm's way, and in immediate connection with the source of energy. Or if desired, the energy might be carried into a building and suitable transforming devices located in sealed wall pockets within the same, the terminals of the tube being located in the same manner in the pockets, while the luminous portion of the tube would extend over or through the areas to be lighted, being distributed in any desired form or manner therethrough.

Mr. Moore claims that while his invention may be carried out with any form of lamp having the characteristics above described, namely, a translucent receptacle and energy supplying electrodes at the terminals of the luminous column, he prefers to use for the purpose a form of lamp consisting essentially of a translucent tube whose conducting terminals or electrodes are metal caps or carbon paste attached closely to the exterior of the tube, and transferring their energy by electrostatic action to the contents of the tube itself.

Among the advantages claimed over the present systems of electric lighting are, first, the complete absence of fire risk even when the lamp is operated by high voltages, since it is not necessary to have any metallic conductors within the areas or spaces where danger from fire may exist; second, great economy in installation and in efficiency, owing to the fact that the amount of apparatus required is reduced to a minimum no lamps, and the absence of sockets, flexible cords or cut-outs, wires, moldings or conduits, etc.

Another form of the system consists in distributing with each of the former standard 8-ft. tubes a small transformer, but new type of "long-tube system" is claimed to have many advantages over this.

In many rooms the tubes will be like the picture molding, the absence of fixtures and spots of light being of great advantage both from an artistic and a utilitarian standpoint, because it permits of a practically unbroken or continuous line of pure white light, thus showing things in their true colors; extending as it would around or over the area to be lighted, there would be realizing what has long been sought for in electric illumination, namely, a perfect diffusion of light. Mr. Moore proposes the name of "artificial daylight."

Another of the patents refers to the practical installation of this system, dealing with such points as to the methods of building up such a tube from lengths of tubing short enough to be easily handled,

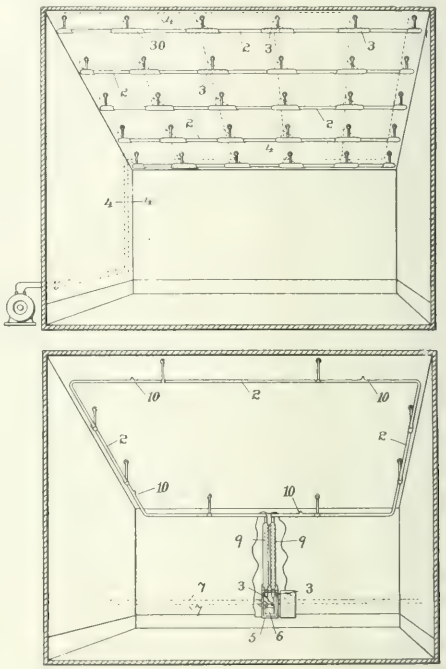


FIG. 6.—ELECTRIC TUBE LIGHTING SYSTEM.

and fusing them together end to end, or joining them in other ways. Mr. Moore has devised ways and means that are claimed to have obviated the many practical difficulties that presented themselves. This patent also deals with the methods of exhausting the tube and the insertion of certain chemicals therein. Another patent gives the details of construction of the terminals and of the terminal-box, one idea being to place it just as the ordinary "panel-board boxes" are now located in the wire ducts of buildings. Another patent deals principally with the efficiency of such a tube. It states that by lengthening out the illuminting gaseous column, that is, using a discharge column of high resistance, the watts per candle will be greatly decreased. For example, with a light column of, say 18 inches, available for illumination the watts were, with a given voltage and cap area, 15. But doubling the length of the light column reduced the watts per candle to 11, and increasing its original length eight times reduced the watts to 4. Mr. Moore for several months past has had a tube over 100 feet long in operation at the laboratory of the Moore Electrical Company, in Newark, N. J. Other tubes of various lengths have also been constructed and tested, all proving the practicability of producing light in tubes of great length, due to the fact that the system does not limit either the cap area or voltage or efficiency. A tube over 100 feet long run-

ning around the sides of a room and shedding a perfectly uniform light of 6 cp to the foot, is said to have an efficiency which varies somewhat with the density of the light—becoming poorer as the candle-power per foot becomes greater. Under some conditions there would be no practical objection to having tubes both around the walls and on the ceiling, and the total length of the tube, lighting a given area, would be such that it could be operated at low density and at about 2½ watts, but an average room can be well lighted by a "picture molding" tube alone at 2 cp per foot at 4 watts. As to the diffusion factor, a great advantage is claimed for the tube, as 16 cp from a source 3 inches long does not produce nearly as good an illuminating effect as 16 cp from a source 3 or 4 feet long. The nature of the tube is such that probably in the majority of installations it will be desirable to place a reflecting coating to the upper or back surface.

When the building to be lighted is furnished with alternating current, the only apparatus required is the tube and a small transformer, but if direct current only is available a small rotary transformer is also placed in the basement.

The illumination is perfectly steady and soft, and can be made of any reasonable intensity while daylight distribution and color values are perfectly produced. While in some cases the special transformer would impress upon the tube 10,000 volts, this voltage does not exist as "wiring" or "circuits," but is all confined to one small steel box, constructed perfectly, electrically, placed outside of the building, if so desired, and extending from it two glass tubes, harmless to either life or property. In the case of a suite of rooms, but one terminal box will be needed for all. In department stores, for example, continuous tubes hundreds of feet long would extend the entire length of the aisles.

It is claimed that so far as diffusion and the approach to daylight is concerned, this system will probably never be surpassed. Its color is white, not a harsh yellowish or red light like the incandescent lamp, but very close to diffused daylight. It is claimed, besides, to have a further advantage in that it is by far the coldest light yet made commercial, "all the other lights in comparison being simply "hot spots," and is suitable for all kinds of illumination; in fact, wherever the incandescent lamp is now used, it is applicable; even streets can be lighted over their whole lengths, not as now in intensely bright 50-ft rings. The tubes can be made of heavy, strong glass, but if they should be accidentally broken they can easily be repaired. It is "wireless" light. You can go into your house and leave pitchy blackness behind you, and after you have shut the door not know, except by memory whether it is noon or midnight. It is light, not lights, and oculists and photographers will be interested.

Another point claimed is that in a room thus lighted there are no shadows and no glaring reflections such as are now always present at certain portions of artifically lighted oil-paintings; therefore, this light is of the highest value in art galleries. By simply changing the character of the gas in the tube, an apartment can be bathed in many successive shades of color, producing results unattainable heretofore, since there is beauty and brilliancy without glare and light, rich with most delicate tints of color that can be made to harmonize perfectly with drapery of any conceivable style.

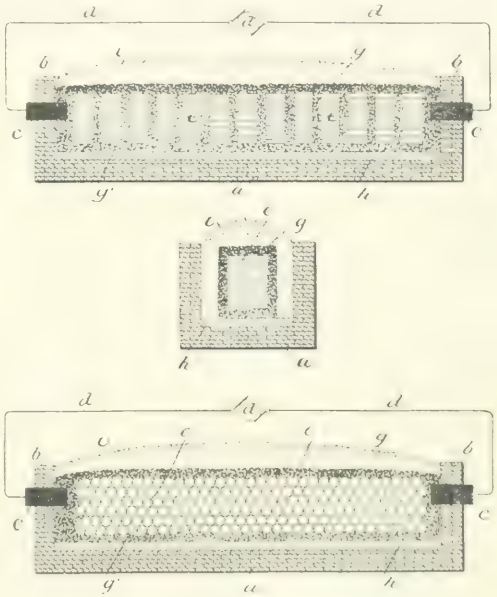
The inventor states that although in many commercial installations, the simple straight tube will be desirable; nevertheless, it is far from the fact to assume that the light is therefore strictly confined to such a tube, for it can actually be fashioned by the glass blowers' art into almost any conceivable size or shape, and, therefore, the field of artistic lighting is far wider than ever before. The tubes, if desired, can be made up in the form of letters of the alphabet, either Roman or script, and 25 feet high if necessary. They have, therefore, a valuable application for advertising purposes. Electrical advertising signs, as constructed at present with incandescent lamps, consume a great deal of current, and their first cost is also high. It is maintained that the Moore tube-signs will consume a far less amount of current and are much lower in first cost, and have the advantage that the letters can be removed at will, thus permitting the sign to be changed to any desired reading. Signs about a foot high and four or five feet long can be used in show windows simply by connecting them with a flexible cord from an incandescent lamp socket. They would be operated by the latest form of the Moore vacuum-break, which is also the subject of one of the patents just issued. Its main advantages are reliability, cheapness and life. The total wattage used is claimed to be almost ridiculously small, as compared to a similar sign made up of incandescent lamps, for example, a sign as above used 7½ watts. Mr. Moore has long contended that this vibrator will be of great utility in X-ray work and wireless telegraphy.

Graphitizing Electrodes.

By Clinton Paul Townsend.

In the issue of the Electrical World and Engineer for April 6, 1901, the writer discussed the historical and commercial aspects of the artificial graphite industry; and in an issue of the current month a description has been given of one of the great terminals of the furnaces now in use. Mr. Acheson, in his latest patent, gives a full and complete disclosure of the present method of graphitizing electrodes and other formed articles at the works of the International Acheson Graphite Company, in Niagara Falls.

The principle is simple; any form of carbon containing impurities in sufficient quantity and of suitable kind may be graphitized. The recation seems to occur through the intermediary of the carbides, and in consequence the impurities present must be of a character capable of combining with carbon, in quantity sufficient to determine the conversion to the extent desired, and the temperature must be



FIGS. 1, 2 AND 3.—GRAPHITIZING ELECTRODES.

above the point of decomposition of the carbides formed. The reaction being progressive, the amount of carbide-forming constituents actually present is relatively small.

The necessary temperature is developed by the electric current, and the present patent deals with the mode of application of the current, the improvement recorded being two-fold in character. Articles to be graphitized are placed in the furnace with their longest dimensions transverse to the direction of flow of the current. If their form be other than cylindrical, they are arranged in vertical piles, separated by powdered coke. Cylinders may be placed in contact, the single contact line reducing the current path sufficiently to develop with economy the required temperature.

The accompanying figures show in longitudinal and transverse vertical section the furnace operating upon a charge of rectangular electrodes; the lower figure indicating the arrangement of cylinders. The furnace comprises a base, *a*, and end wells, *b*, of fire-brick, carbon terminals, *c*, and line connections *d*, *d'*. A bed of carborundum or other refractory conductor, *h*, is laid upon the base and upon this rest the transverse piles, *e*, of the formed articles, the retangular shapes separated, as shown by thin layers of ground coke, *g*, and the cylinders, as indicated in Fig. 3, in lateral contact. Thin layers of

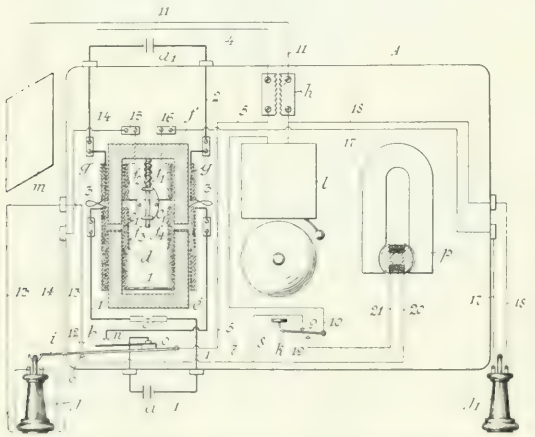
the same material underlie and cover the piles, and a filling of ground coke and sand is placed around and over the conductive charge.

It might be considered a matter of small moment whether the articles be placed parallel or transverse to the lines of current flow; in fact, however, this simple change represents a distinct principle of operation, for it means that the heat is no longer developed within the body of the article but exterior thereto, and either in the separating layers of coke or in the single contact lines of the cylinders. That this represents a very considerable economy of current is apparent from the fact that the cross-sectional area of the terminals may be actually less than that of the conductive bed, the relation between these areas being stated as 100 to 102.

New Telephone Patent.

The solitary telephone patent of the issue of June 17 is a contribution from Austria-Hungary, Mr. Franz Oprendek, of Vienna, being the inventor, and the device, a "sound-strengthening appliance for telephone stations." Telephony is not in a very advanced state in Austria-Hungary, and while the telephones there may be sorely in need of sound strengthening appliances, we hardly think that Mr. Oprendek's method supplies the solution of the difficulty. By turning the induction coil of a telephone transmitter into a horseshoe electro-magnet and supplying this magnet with a horseshoe armature, resting on a spring support which allows of a reciprocal motion of the armature, Mr. Oprendek aims at producing alternating currents by reason of the reciprocating action between the magnet and armature, which will be of the same form as the telephonic currents that cause the reciprocating action and will strengthen those telephonic currents. This sounds a little like perpetual motion or a man lifting himself by his boot-straps, but that reproach is avoided by the use of magnetizing coil on the reciprocating armature energized by a primary battery separate from the transmitter battery.

In the drawing, which incidentally shows that it is Austro-Hungarian practice to use an ordinary trembling bell with a magneto-generator, *e* is the induction coil magnet and *f* the horseshoe armature, upheld by spring f^1, rod f^2 and brackets f^3 f^4. The action of this remarkable device is best described by the inventor himself.



SOUND-STRENGTHENING APPLIANCE FOR TELEPHONES.

"Supposing the primary circuit 1 to be closed, the core *e* will be magnetized by the coils *d*, and when the microphone *c* is spoken to the resistance of the circuit will vary, and the variations of the strength of the current thereby caused will also produce variations of the magnetic force. By the magnetic force the armature *f* is moved toward the core *e*, the poles of which are covered with disks, e^1, of cotton or paper, by which immediate contact and permanent adhering of the armature is prevented. While the armature *f* moves toward the core *e*, it compresses the coiled spring, f^1, and stores power in the same, and as soon as the magnetic force diminishes, the stored power acts for lifting the armature.' By the following increase of magnetic force the armature *f* is again caused to move toward the core *e*, and so on.

"If the work of repeatedly attracting the armature, *f*, and compressing the spring f^1 were to be done at the expense of the energy of the current flowing through the primary coils of the bobbins, *d*, the said current would thereby be weakened, and consequently the induced current, too, by which the telephone receivers are actuated. Now, in order to attain the object in view, which is to strengthen this latter current, I provide a special galvanic battery, a^1, for supplying the energy required for reciprocating the armature *f*. By two bobbins, *gg*, having their thick wire coils included in the circuit 2 of the battery a^1, the armature *f* is so magnetized as to oppose unlike poles to the poles of the core *e*. Every time the armature *f* moves toward the poles of *e*, and thereby puts the spring f^1 in tension, energy is spent by the current flowing through the primary coils of the bobbins *dd*. Consequently an alternating current of the same form and phase as that induced in the secondary coils of the bobbins *dd* will be induced in the secondary coils of the bobbins *gg*. This current can, therefore, be utilized for strengthening the current flowing through the line, this being obtained by connecting the secondary coils by wires 3 3. The effect of this strengthening of the secondary current is different from that which would be obtained by strengthening the galvanic battery *a*, as in the latter case too strong a primary current would flow through the microphone *c*, which thereby would be heated and deranged in its normal operation.

"A further strengthening action upon the secondary current for louder transmission is obtained by extending the bobbins *dd* beyond the poles of the core *e*, as shown, and arranging the ends of the armature *f* within the extended bobbins *dd*. The magnetized armature *f* oscillating within the bobbins *d* induces in the secondary coils alternating current waves, and as the oscillations are in unison with the undulations of the primary current flowing through the microphone, the said alternating current adds itself to the alternating current induced by the undulating current. As in this action the ends of the armature *f* are intended to act upon the secondary coils of the induction bobbins *dd*, the extended ends of said bobbins have the secondary coils of thin wire arranged inside the primary ones, while in the lawer portion of both bobbins *dd*, intended to magnetize the core *e*, the primary coils of thick wire are arranged inside, as usual."

From all of which it appears that the telephonic art in Austria-Hungary is not quite up to the mark reached in these United States.

Electric Light and Power in Venezuela.

U. S. Consul Goldschmidt, at La Guayra, reports that there are three electric plants run by water in Venezuela; the principal one is located at El Encantada, 10 miles from Caracas. During the rainy season it develops 400 hp, but from December to April this is reduced to 100 or less, as in the dry months the water is used for irrigating the adjoining lands. This enterprise was organized in 1897, with a capital of about $200,000 gold. Three vertical turbines are employed, and the generators are alternating current, and develop pwer of 5,000 volts. Most of the apparatus is of Swiss manufacture; the wire came from Italy. The power developed is used by small corn mills; also by printing offices, coffee mills, etc. At night, it is employed to light Caracas, 12 cents per hp per night being paid for this purpose. The other industrial concerns pay from 30 to 50 cents per hp per day of ten hours. The company is now erecting a new plant, 1¼ miles farther away, at a point where there is a waterfall of 300 feet. When this new station is finished, the company expects to obtain 1500 hp.

Another enterprise is at Merida (State of Los Andes). This was established about two years ago, to light the city; only about 150 hp is developed. All the machinery is of American make, and direct current.

San Cristobal (Los Andes) has an electric station of 200 hp to light the city and furnish power for a few industrial concerns. A small plant at Barquisimeto, with French machinery, stopped running two years ago.

The following electric plants have steam as motive power:

Caracas.—Compania de Gas y Luz Electrica de Caracas; capital, $443,900; 300 hp; uses patent fuel, 4 tons daily, and 7,350 gallons of water. The plant has a capacity of 96 arc lamps of 2,000 cp used in the streets, and 4,000 Edison incandescent lamps of 16

cp. For arc lights, 50 cents is paid per night of six and one-half hours; for incandescent, $1.80 per month.

Maracaibo.—An electric plant furnishes light for 300 arc lights of 1000 cp. and about 4000 incandescent lamps. Fuel being cheap, the price of the latter is 80 cents per month for all night.

Valencia.—A plant furnishes electric power for 60 arc and 600 incandescent lights.

Puerto Cabello.—A plant furnishes power for 50 arc and 300 incandescent lights; the arc lights are of 800 candle power.

La Guayra.—The plant has not been used for some years, and is in bad shape. An effort was made a year ago to start a new company, but nothing has been accomplished.

Commencement Honors.

At the commencement exercises at Harvard University, Wednesday, June 26th, President Eliot conferred the honorary degree of M. A. on Mr. Charles Proteus Steinmetz and Mr. Francis Blake, the inventor of the telephone transmitter. Prof. Brainerd Kellogg, of the Brooklyn Polytechnic Institute, was honored with the degree of LL. D. by Middleboro College the same day, and Yale conferred the degree of M. A. on Mr. Henry G. Prout, editor of the *Railroad Gazette*.

CURRENT NEWS AND NOTES.

THE NAVAL ACADEMY at Annapolis is being fitted with a 170-foot wireless telegraph mast. Prof. Terry is equipping a wireless telegraph station for instruction purposes.

GIFT FROM MR. WESTINGHOUSE.—It is reported that Mr. Geo. Westinghouse will present the Western University of Pennsylvania with a complete electrical equipment for the new observatory, now nearing completion in River View Park, Allegheny, Pa.

THE NEW GERMAN CABLE.—A cablegram from Berlin announces that the first section of the new German Atlantic cable, from Borkum to the Azores Islands, will be completed by Dec. 31, 1903. The second section, from the Azores to New York, will be laid between that date and Dec. 31, 1904.

PROF. HENRY A. WARD, of Chicago, has recently returned from Mexico, and will shortly publish a full account of a 50-ton meteorite just found there in the volcanic region near Cohina. Pieces of it have been secured by blasting with dynamite. The total size is 13 ft. 1 in. in length, 6 ft. 4 in. thick, and 5 ft. 4 in. wide.

WIRELESS TELEGRAPHY IN THE SOUTH SEAS.—It is announced from Los Angeles, Calif., that John D. Spreckels is contemplating connecting the Hawaiian Islands by wireless telegraph with San Francisco. Spreckels has refused to become the backer of a cable to Hawaii, because of his faith in wireless telegraphy.

GERMANY AND SCIENCE.—In an address made June 20, by Emperor William, of Germany, at Aix-la-Chapelle, that sovereign made the statement that the Germans were the first to employ discoveries in science, and others only copied them. This remark was made during one of the Emperor's religious-patriotic-histrionic outbursts, and doubtless was highly appreciated by those Germans who are as little informed on the subject as the Emperor himself.

WIRELESS TELEGRAPHY IN THE BRITISH NAVY.—Notwithstanding all of the reports to the contrary, it seems that the British naval authorities have not yet found a satisfactory system of wireless telegraphy. It is stated that it was intended to have communication by means of wireless telegraphy between the various ships that are to take part in the coronation review, but that the idea had been abandoned "for the reason that the system has not been found sufficiently reliable by the navy."

FROM THE FORECASTLE TO THE TROLLEY.—The Navy Department is feeling some concern over the demand on shore for the services of enlisted men who have obtained experience in the mechanical and electrical departments of warships. The warship of the present day has become little more than a vast aggregation of machinery, and enlisted men who gain experience in connection therewith find, upon the expiration of a cruise, abundant demand for their services ashore at a remuneration and under conditions vastly superior to those of naval service. Recent developments render the situation still further unsatisfactory to the naval authorities, due to the opportunities which offer to the unskilled of the enlisted force for employment by trolley companies. It has been found that landsmen and others who have served abroad warships, by reason of their subordination and schooling in discipline, make ideal electric railway motormen.

TROLLEYS FOR MALAGA.—U. S. Consul Benj. H. Ridgely, at Malaga, Spain, says: The municipal council of Malaga has finally authorized the company operating the street-railway system of this city to apply electric traction to the several lines. The mileage of the company at present in operation is comparatively insignificant, consisting of only about eight miles, but concessions have been granted for various other streets, and the system is sure to expand considerably at no distant day. The company owning the system is a joint-stock society, with headquarters in Brussels, Belgium. The corporate name is "Tramways of Malaga." The directors are Messrs. Adh de la Hault, P. Hammebeath, Charles A. Lucas, Paul Mayer and Max Ryndzunsky, all of whom reside in Brussels. It is said to be the intention of the company to go to Germany for its entire electric equipment. It is possible, however, if the matter were thought to be of sufficient importance, that enterprising American agents might interfere with this plan.

ENGINEERING AT HARVARD.—The Harvard Engineering Society has issued the first number of the *Harvard Engineering Journal*, a quarterly, devoted to the interests of engineering and architecture at Harvard University. The first issue, which is dated April, contains an illustrated description by Prof. I. N. Hollis, of Pierce Hall, the new engineering building. Assistant Professor James Lee Love gives a history of engineering at Harvard University, and Prof. Lewis Jerome Johnson writes on instruction and engineering at Harvard. The number also contains a lecture on "The Steam Loop and Holly Gravity Return System," delivered before the Harvard Engineering Society by Mr. Chas. Gilbert Wilson, and the first part of an article on storage batteries, by Mr. Philip Whitney Davis. From the article by Prof. Johnson we learn that at present the teachers in the division of engineering at Harvard number 24, including one professor, five assistant professors, 13 instructors and five assistants. Since then Dr. A. E. Kennelly has been appointed a member of the engineering faculty, with title of Professor of Electrical Engineering. The students of engineering are registered in three different branches of the university, and thus the only adequate means for stating the extent of the interest in engineering at Harvard is to specify the total number of enrollments in its courses. This number for 1900-01 was 1,252, which places the division of engineering third in this respect among the 14 divisions of the faculty of arts and sciences. In making this count, enrollments in half courses have been given, in all cases, half the weight of those in full courses. In total number of full courses or equivalents offered, the division of engineering ranks fourth with 28.5 study courses.

LETTER TO THE EDITORS.

Hand vs. Machine Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—Permit me to make a few comments on the communication of Mr. F. W. Jones regarding the telegraph, printed in your issue of May 31st.

Mr. Jones starts out by stating that he has "no client to defend," meaning, of course, that the criticisms passed upon the Western Union by Prof. Pupin do not apply to his company. Concerning this view, readers of Prof. Pupin's statement may judge for themselves. Having decided this question to his own satisfaction, however, Mr.

Jones puts himself in the position of prosecuting attorney against all methods outside of his company's patronage, and for proof that automatic telegraphy is not as good as the Morse, reference is directed, by chapter and verse, to a gospel paper read by him *five years ago* before the American Institute of Electrical Engineers. It is seldom in these days of progress that one can so complacently refer back five years to a final dictum which all further discussion must only illume as immutable.

Somebody has said that "men's judgments are a parcel of their fortunes"; hence, I presume, the importance attached to them by their possessors. It is well known to all telegraphers that the most important advances thus far made in automatic telegraphy have been brought about within the past five years.

The sum of Mr. Jones' conclusions, concisely stated, may be said to be: that outside of the hours 10 to 3 the telegraph companies have an excess of facilities, and outside of 8 to 5 have wires "to burn."

That the public have the privilege of half-rates, which they use only very sparingly, at which Mr. Jones does not wonder, owing to our excellent mail service.

That "no automatic system has been invented that obviates the expensive and slow preparation of telegrams by special codification and manual manipulation at the sending end, and the special translation and manual transcription at the receiving end," and that not until somebody invents and the companies reject a system wherewith "customers" messages could be thrown into a hopper in New York and come out of a machine in Chicago at the rate of 500 or 1,000 words a minute, correctly printed on blanks and ready for delivery," can the companies be justly charged with old fogyism.

That, indeed, the telegraph owners would be foolish not to adopt such a system, and the nearest approach to this ideal arrangement, in Mr. Jones' opinion, is the work performed over a quadruplexed wire of his company, between New York and Boston, which for 21 days in April, nine hours working, showed a daily average of 41.26 messages per cicuit per hour, or 80 words per minute all told.

Taking these propositions in the order of their arrangement, we have first the admission that the telegraphs are primarily conducted for, and are almost wholly dependent upon the speculative market between the hours 10 and 3, the remaining hours, the four hours 8 to 10 and 3 to 5, evidently being occupied in clearing up the ordinary business of the day which is not of such great urgency, or which has been pushed aside for the broker business, and that the remaining 15 hours of the 24 are unprofitable, principally owing to the competition of the post office.

It is well known, however, that in practice this schedule of operation is seldom realized. No company has more wires than they can fill between 10 and 3. Interruptions start the work of segregation of facilities about in this order: Stock and other exchange wires, leased wires, pool-room wires, cable service, newspaper specials, and, lastly, the business of the unpreferred general public. This latter traffic pushes the full-rate business into the half-rate hours, or into competition with the "sufficient despatch" of the mails.

I have always maintained that the Morse system was the best for exchange business, but the conduct of the telegraph shows that the companies have erred in going upon the principle that this was the only business worthy of quick service, for which is charged a heavy rate, and that all other business, although paying the same tolls, must give way and take its chances.

Taking the two facts that when the wires are all in order they are filled between 10 and 3, and that it is seldom they are all in order, would it not be better to increase the carrying facilities of the remaining wires in proportion to the occurring interruptions, so that no serious congestion could ever exist, rather than place all reliance upon a system circumscribed and inelastic in capacity?

Mr. Jones' remedy would be to construct lines that would never break down, using two and sometimes three poles where one now sustains the burden. That substantiality should be the first aim all must agree, for not even the "hopper" system could be relied upon further than the stability of the lines; but I submit that the course of the telegraph management has been altogether wrong for the past thirty years, and Mr. Jones' advocacy of its continuance and extension at this time is a discouraging sign for the future.

I think it but fair to assume that the policy of hand working and high rates was in a large measure forced upon the telegraph management by the construction of opposition lines, which the main organization felt compelled to buy up from time to time in order to continue a monopoly. In this way stock dividends were vehicled so that $1,000 of telegraph stock in 1858 represented $150,000 of stock and cash dividends in 1890. If the telegraph had been under Government control no such wild-cat construction would have taken place, but instead, substantial lines, operated to their highest capacity, and at low rates, would have developed a telegraph business covering all branches of commercial and social correspondence, and in volume probably twenty times greater than the present restricted traffic.

Where, under present restrictive conditions, the half-rate in no case falls below 20 cents for 10 words, or about 50 per cent. more than what the full rate should be, is it surprising that the public finds small inducement for filing half-rate messages one day for delivery on the day following? People, doubtless, take Mr. Jones' view that the "sufficient despatch and secrecy" of the mails at 2 cents is preferable.

With an automatic system these messages could all be delivered on the same day, and as it costs no more to deliver on one day than another, the public would have the benefit. The present rule forbids the delivery of a half-rate message on the same day, so as to force full payment or submission to the 12 or 15 hours' unnecessary delay. So long as the companies impose this penalty they should at least refund half on all full-rate messages left undelivered until the following morning; for could the sender have foreseen that his telegram would not be delivered on the same day he would naturally have chosen the half-rate plan, or availed of the "sufficient despatch and secrecy" of the post office.

Coming now to the most serious part of Mr. Jones' argument against automatic telegraphy, "slow preparation by special codification and manual manipulation at the sending end, and the special translation and manual transcription at the receiving end, with machinery more complicated than the Morse," here is evidently a plaint over sad experience; but it is not right to hold true automatic telegraphy responsible for a "hopper" disappointment. It is another case of basing a specious argument on spurious premises, to which I took exception in a previous letter.

Briefly stated, automatic telegraphy of to-day is operated as follows: Messages are perforated in Morse code on a simple machine controlled by a Morse key and Morse operator, the work being precisely the same as sending a message over a wire by Morse, with the exception that being a purely local operation, it is never interrupted by "breaking" or line trouble, therefore yielding a higher average speed.

Message tapes are automatically reeled up as they come from the perforator, these reels are handed to the tender of the transmitting machine, where the tapes are run through at any rate desired up to the carrying capacity of the line, which between longest and shortest distances in this country would vary from 100 to 3,000 words per minute. At the receiving station the messages are recorded in plain Morse characters on a tape and automatically reeled up. This reel is handed to a typewritist for transcription, and is printed at an average speed of 20 to 25 words per minute.

The work of perforating is exactly the same as now performed in sending by Morse, and the only difference at the receiving end is in transcription, which is done by sight instead of by sound. The only additional labor lies in the transmission and reception of the message, requiring a machine tender at each end of a line carrying at the lowest estimate, including starting and stopping, as many messages as ten quadruplexed wires, or 40 Morse circuits manned by 80 of the most expert sound reading operators. The cost of the automatic machine tenders would be much less than the expert adjusters required for ten quadruplex sets.

Now, as to the additional delay ascribable to the automatic process, and assuming that in order to keep the wire speed up to the proper standard it would be necessary to handle messages in "takes" of 5, or units of 150 words. Each unit could be easily perforated and placed on the wire in 7 minutes, and could be transcribed by typewriter in 7 minutes more, or say an average of 15 or 16 minutes from the receiving window to the delivery clerk. Owing to the great carrying capacity of the system this average time can be maintained under all conditions of weather. Does the present exclusive Morse methods of handling telegrams do as well? It is well known that the average time at present is over 30 minutes. Exchange business could, of course, be carried on by the Morse, and in time of interruption to lines be greatly expedited by the automatic.

In proudly citing what he considers a great performance of the

quadruplex, 20 words per minute for each circuit over the New York-Boston line, Mr. Jones omitted to mention that this quadruplex is worked on the "piece" plan, which recognizes that 250 messages (14 words per minute) is a full day's work, all messages over that number being paid for at the rate of one cent each. In order to make time the sending operator is allowed to abbreviate or code his messages, the receiver being relied upon to construe the pidgin English correctly. This advance of six words per minute over the standard 14, using a copper wire 250 miles in length, or a total of 80 abbreviated words, marks a long hiatus to the "hopper" system of 500 to 1,000 words a minute already printed, New York to Chicago, the refusal of which achievement would, in Mr. Jones' opinion, alone justify the charge of unprogressiveness against the telegraph companies.

Eighty abbreviated words per minute, constantly increasing wires, with two or three poles for one, presents a rather gloomy forecast for the future of telegraphy from the viewpoint of the electrician of a great company.

A more encouraging outlook is afforded in the contemplation of 30 perforating operators grouped around a single transmitter preparing messages, and 30 transcribing operators grouped around a receiver, all kept busy by a single wire, each pair representing a phantom circuit superior to the average quadruplex circuit. The well known fact that a system capable of this performance has been in operation to the extent of traffic requirements not a hundred miles from New York for the past eight months, confronts the critics of automatic telegraphy with a condition, not a theory—a daily practical demonstration, and one which during the sleet troubles last winter kept traffic clear over a wire subjected to interruptions of a frequency precluding the "balancing" of a quad once throughout an entire day.

You have hit the nail on the head and clinched it at the point in your editorial comment, May 24th, "if the birth of telegraphy had been delayed 40 or 50 years one does not venture much in saying that its evolution would be along entirely different lines than in the past, and, furthermore, that these lines would be fixed by the exigencies of automatic or machine telegraphy."

SOUTH ORANGE, N. J. PATRICK B. DELANY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo Design.—R. KENNEDY.—An article in which he gives the following formula. The total magnetic flux through the armature in Kapp lines is 200 times the square root of the kw-output; 200 is "a constant which different dsigners may alter in value according to their skill"; the lower it is, the cheaper the machine; the higher it is the better the machine. This formula assumes a speed of 1,000 per minute; for other speeds another factor must be used instead of 200. For lower speeds multiply 200 by the square root of the ratio of 1,000 to the given speed; for instance, if the speed were to be 250, then the constant instead of 200 becomes 200 times the square root of 1,000—250, *i.e.*, 400. For higher speeds than 1,000, divide 200 by the square root of the ratio of the given speed to 1,000; thus for a speed of 4,000, the constant instead of 200 becomes 100. When the constant has thus been determined, the total magnetic flux through the armature in Kapp lines is found by multiplying it by the square root of the kilowatt output. "All the rest of the design can now be left to any designer with some experience and a book of reference tables of iron and copper materials." Lond. *Elec. Rev.*, May 30.

LIGHTS AND LIGHTING.

Cooper Hewitt Lamp.—VON RECKLINGHAUSEN.—An illustrated article, in which he first gives a historical summary of previous experiments made with mercury vapor lamps and then describes the Hewitt lamp and discusses the properties of the lighted lamp, the process of lighting, the phenomena at the electrodes, the efficiency and color. The efficiency is much better than that of any other artificial source of light. In some cases an efficiency of one-third watt per candle has been obtained without the resistance in series, and 0.4 watt per candle with the resistance. The Hewitt lamp will have great importance for photographic purposes. A great advantage is that its light is not tiring to the eyes, and it is, therefore, suitable for drawing, reading, etc.—*Elek. Zeit.*, June 5.

REFERENCES.

Arc Lamps.—KOERTING, ROSEMEYER, STOECKHARDT.—Three controversial communications concerning the relative advantages of the Regina enclosed arc lamp and the ordinary open arc lamps.—*Elek. Zeit.*, April 3, May 1, 22.

Incandescent Lamp.—A well illustrated article on the incandescent electric lamp, how manufactured and tested.—*Sc. Am. Lup.*, May 24.

POWER.

Chilean Power Transmission.—RABY.—An illustrated description of an electric transmission plant for supplying power to coal mines in Chile. The power station contains two Pelton wheels of 400-hp each, driven at 214 revolutions per minute, direct connected to two 215-kw three-phase alternators. The current is generated at 400 volts, transformed up to 10,000 volts, and transimtted over the line of 2.3 kilometers length to the mines, where it is transformed down to 500 volts. Electric power is at present used in two pits. In the one the alternating current is converted into direct current for supplying three electric locomotives of 15-hp each, and for lighting. At the other pit, the current is taken down as alternating current, for operating two 2,000-gallon pumps, one 50-kw winding engine and a 36-hp motor, to work an endless chain.—*Jour. of Elec.*, May.

Fuel Oil in Power Plants.—REED.—An abstract of a paper read before the Southwestern Gas, Electric and Street Railway Association, at San Antonio, Texas, April 18, and a discussion of the same subject by F. C. Bitgood. Mr. Reed claims that the Houston Lighting and Power Company, with which he is connected, has had very satisfactory experience with the use of oil, and that they have found that it increases the steaming capacity of boilers in the neighborhood of 35 per cent. The paper enumerates many advantages growing out of the use of oil for fuel, and claims that a saving of 63 per cent. in the fuel bill was effected by the substitution of oil for coal in the Houston plant. It is mentioned, too, that steam can be raised much more quickly with oil burning under the boilers than with coal, but it is pointed out in this connection that there is a danger attending this practice, because of the liability to abuse the boilers by overcrowding them and attempting to get up steam quickly at the expense of the boiler. Mr. Bitgood relates the experience of the Hartford Company in the examination of plants in which oil is used. He calls attention to the injury done to boilers, but admits, with proper care, the wear and tear upon the boiler structure is probably less with oil than with coal.—*St. R'y Jour.*, May 10.

Steam Equipment for Turbine Plant.—A description of the boilers designed for the Cleveland & Southern Railway Company's power plant. The boilers will comprise three sets of 500 hp. each. The superheaters are guaranteed to superheat 150° F. It is proposed to install a stoker for feeding powdered coal if possible.—*St. R'y Jour.*, May 10.

REFERENCE.

Irregularity Factors of Engines.—FRANKE.—The first part of an illustrated reprint, in full, of his German paper "on the determination of irregularity factor engines," which has been noticed before in the Digest.—Lond. *Elec. Rev.*, May 30.

TRACTION.

Electric Railway Practice on the Continent.—VELLGUTH.—A very comprehensive article, reviewing the entire situation in the matter of transportation for cities and also suburban traffic in continental

[illegible] illustrated, and contains views of special features of construction that are characteristic of the principal continental cities. The conditions of practice, which are universal throughout continental Europe, and differ from those of America, are enumerated as follows: Smaller traffic, lower wages and different labor conditions, smaller money unit, difficulties in the way of operating companies through the indifference of municipalities on the pretext of insuring safety and because of their policy of extorting absurdly large fees for franchises and rights of all kinds. This has seriously interfered with the development of electric traction throughout Europe, and has crippled the service where lines have been built. No European city can show traffic approximating that which exists in large American cities. Berlin is far behind New York; the Grosse Berliner Strassenbahn alone, without counting its leased roads, carried, in 1900, 236,300,000 passengers, and in 1901, 306,300,000. The municipalities impose very harsh conditions upon the companies in the matter of contributing towards the general expenses of the city. Very small cars have been adopted in most European cities. A car seating 20 passengers, with standing room for a few more, is the maximum, while most of the cars accommodate not more than 16 passengers. The most annoying features are those which arise from the supervision exercised by the municipalities over the construction and operation of the roads. It is not at all uncommon, for instance, to have a car equipped with three kinds of brakes, namely, the hand brake, short-circuit and magnetic brake, and, perhaps, also a track shoe-brake. Aesthetic considerations also require expensive poles with highly ornamental brackets, and have even induced the municipalities to prescribe accumulator service in fine residence districts by prohibiting poles in these sections. Accumulator cars have been forbidden by the Prussian Minister of Public Works in the cities of Berlin, Hanover and Hagen. The companies are burdened by the restrictions imposed by the state for the protection of the telephone systems, which are generally controlled by the government. After a general review of the situation in all of the continental countries, the author describes in this series the special features characteristic of the standards adopted in Germany, France, Switzerland and Holland. A very vigorous effort has been made to substitute the bow trolley in general practice for the trolley wheel, and the latter is now preferred by many managers of large roads; the chief drawback, however, has been the fact that most of the principal roads had already adopted the trolley wheel, and any change would necessitate the discarding of a large number of these devices and also necessitate a change in overhead construction. Several of the roads have taken up the subject of freight traffic, but this branch of the business has not been very generally followed. In Germany, there are no three-phase roads, excepting the high-speed Zossen Railway, on which the 200 km. per hour experiments have been made. It is quite general practice, however, to use three-phase transmission with rotary substations. The most extensive electric railway system of Germany, and in fact of all Europe, is that of the Grosse Berliner Strassenbahn, which controls the entire traffic of Berlin, with the exception of three small lines, and operates 53 km. of tracks, passing through 27 km. of streets. Nearly all of the lines of the company are electrically equipped. The rolling stock consists of 2,529 passenger cars, including 372 double-truck motors, of which 178 are accumulator cars, and 825 single-truck motors, of which 77 are accumulator cars. The two-motor equipment is unformly adopted. Some interesting statistics upon the operation and capacity of this line are presented.

Among the Swiss roads there are many interesting installations, and because of the peculiar conditions under which these systems are operated many important modifications have been introduced. The electric roads in France represent about 25 per cent. of all the tramways of France, and include the overhead trolley, conduit and contact button and accumulator systems, the last three being in more extended use in France than in any other European country. In no other country of Europe have so many obstacles been placed in the way of the trolley as in France, on the ground that the municipalities desired to preserve the beauty of the streets and to assure safety. Some interesting statistics are presented upon the amount of traffic handled by the several companies, especially those of Paris. It is mentioned that the tramways of Paris represent probably the greatest variety in design and equipment to tbe found in any city in the world. The multiple unit system seems to be particularly favored by the leading Franch engineers. The development of the electric railway in Holland has not kept pace with that of Germany, Switzerland and France, and many important points are entirely without electric service, even Rotterdam, the celebrated seaport, having no electric railway whatever. The articles of which this forms the opening installment, are simply technical descriptions of continental European practice of to-day and an explanation of the conditions under which these railways have been installed and operated. Another article in this series is promised for an early date.—*St. R'y Jour.*, June 7, and *Int. Ed.*, June.

Causes and Remedies for Vibration.—MALLOCK.—A paper forming part of the report of a committee appointed by the Board of Trade, to conduct experiments on the Central London Railway. The writer explains the effect of irregularities in the road construction and defects in wheels in causing vibrations. An analysis of the experiments showed that it was a matter of chance whether a locomotive caused a slight or severe vibration. It is concluded that objectionable vibrations can be avoided by reducing the non-spring borne load on each axle to something under two tons in the case of a train running at speeds up to 30 miles an hour, and on rails laid in any of the usual ways. By the use of rolling stock in which only a small load is constrained to follow the surface of the rail, general security is attained, and the permissible non-spring borne load is quite sufficient to allow for proper strength and dimensions in the wheels, axles and other parts of which it is made up.—*St. R'y Jour.*, May 17, and *Int. Ed.*, June.

Selection of Street Railway Motor Equipment.—JONES.—A paper read before the convention of the Southwestern Gas, Electric and Street Railway Association, at San Antonio, Texas. He starts out with a statement that 50 per cent. of the electric roads of the United States are consuming at least 40 per cent. more power than is necessary to operate their cars and make their schedules; another 25 per cent. are consuming 20 per cent. more power than is necessary; 15 per cent. are using 10 per cent. of needless energy, and only 10 per cent. of the systems are operating on the best possible economy. The source of this data, however, is not given. The paper is intended to treat of only one feature of the equipment, that of the car equipment. The author seems to think that if more care and greater discrimination were exercised in the selection of this important element, the showing of the operating companies would be much better. The conditions, however, which he mentions are not those which are met with in ordinary city practice, and the inference may be drawn that he is dealing with almost ideal conditions. These, of course, are not to be found in everyday work.—*St. R'y. Jour.*, May 17.

London County Council Cars.—An illustrated description of details of the London County Council cars. They are double-deck cars of the Preston pattern, with reversed staircase, and seating capacity for 66 passengers, 28 inside and 38 outside. The trucks will be similar to those operated by the Metropolitan Street Railway Company, of New York, with the exception that they will have wrought forged side frames. Series-parallel controllers have been adopted.—*St. R'y Jour.*, May 10.

REFERENCES.

Railroad Track Tools.—An illustrated description of a roller rail-bender, a drill to hook under the track, a Union track drill and a "Jenne" track jack.—*St. R'y Jour., Int. Ed.*, June.

A Novel Electric Switching Locomotive.—A description of a locomotive, used for handling cars from the tracks of the N. Y., N. H. & H. R. R. R. Co., which connects with the yard tracks of the large manufacturing companies. It is equipped with air brakes, and has a snow plough at each end, and the wheels are in addition protected by diggers and scrapers.—*St. R'y Jour.*, June 7, and *Int. Ed.*, June.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCE.

Manchester.—A well illustrated description of the recently completed extensions of the Manchester municipal electric plant. The system adopted is three-phase alternating currents of a frequency of 50 cycles per second, generated at an extra high pressure of 6,500 volts, and transmitted at this pressure to the substations. The supply from the substations is at 500 to 550 volts pressure for supply to the tramways, and at 410 to 205 volts pressure for lighting and power purposes.—Lond. *Elec.*, June 6.

WIRES, WIRING AND CONDUITS.

Roof Insulation of 15,000-volt Lines.—An illustrated description of a novel method, devised by Beck, for taking high-tension line wires into and out of station buildings. It has been used with perfect success in the Los Angeles substation of the San Gabriel Electric Company, in California, and is now being adopted in all the high-tension distribution work of the company. The pressures insulated by this device range from 2,400 to 15,000 volts. The conductor, which is always of No. 6 B. & S. gauge, is encased in 15,000 volt, solid rubber hoss. Then this is encased in a good quality of three-quarter inch garden hose, the whole being threaded through a special inside porcelain bushing, having a length of 18 inches, an outside and an inside diameter of 1.75 and 1.25 inches, respectively. Next, this bushing is sulphur-cemented into a special white porcelain bushing measuring 8 inches in length by 2.25 inches inside diameter, by 3 inches in outside diameter. The cap is then knocked off a glass insulator (No. 1 Provo type), and the heavily insulated conductor is passed up through it, after which it is carefully taped and P. & B. painted, especially at the point of passing through the insulator top and at the ends of the special insulation of white rubber and selected garden hose, make a sung fit, one over the other. The outside diameter of the three-quarter inch rubber hose must be larger than the pin clearance of insulator, so that the insulator has to be screwed down over the hose until the 18-inch bushing enters the inner petticoat of the insulator, when the two are sulphured together by pouring sulphur into the inner petticoat of the insulator and around the top of the 18-inch porcelain bushing, making the whole one rigid piece. After being placed vertically in a board having the pitch of the roof, it is then ready for use, and, it is said, that it may be relied upon as being both moisture-proof and puncture-proof.—*Jour. of Elec.*, May.

ELECTRO-PHYSICS AND MAGNETISM

Conductivity Produced in Gases by the Aid of Ultra-Violet Light.—TOWNSEND.—An account of experiments made to test the theory of the genesis of ions by collision. The conductivity of a gas was started by means of ultraviolet light. The conductivity was measured between two parallel plates at different distances apart. The light fell on the negative electrode, which was a zinc plate; it has the effect of setting free negative ions from the surface of the zinc plate. These ions, as they move through the gas under an electric force, produce others by collisions with molecules. The increase of conductivity obtained by separating the plates is thus explained. The exeperiments also lead to the conclusion that the ions generated in the gas have exactly the same properties as the ions set free from the zinc plate. He made experiments with air, hydrogen and carbonic acid. The results are given in tables and diagrams. They lead to the conclusion that the negative ions generated in a gas by the motion of the zinc ions set free by ultraviolet light are identical with the ions produced by Röntgen rays in the same gas. These negative ions are small compared with the molecules of any of the gases; the molecule of a gas makes more than four times the number of collisions which a negative ion makes in going through the same distance of the gas at a given pressure; also, the property which they possess of generating new ions does not belong to the positive ions under similar conditions of force and pressure. It is possible to detach a particle from the molecule of a gas which is small, as regards mass and linear dimensions compared with the molecule of hydrogen; the particles produced from molecules of different gases are also identically the same. A considerable number of phenomena connected with the electric discharge in gases may be explained in a general way by taking into consideration the physical properties of these negative ions. Thus some of the effects of variation of pressure, electric force, and distance between the plates can be accounted for. The high conductivity of gases under rapidly alternating forces may also be due to the fact that the negative ions traverse a long distance before they are discharged by the electrodes. There are, however, many phenomena for which these physical properties supply no explanation, such as the appearance, at the electrodes, of the constituents of compound gases.—*Phil. Mag.*, June.

Theory of Electrons.—FLEMING.—Some editorial notes on his recent discourse before the Royal Institute. He assumes J. J. Thomson's hypothesis, which imagines an atom as consisting of a nucleus clothed by negative electrons. Thus an atom, less an electron, is positive, and may be called a positive ion. The electrons diffuse through matter by threading about between the atoms or molecules, while these are vibrating with that motion which we call heat. When a metal is cooled the electrons pass about more freely than before, or, in other words, the electrical conductivity is now greater. If two different substances be placed in contact, diffusion of electrons takes place across the junction with unequal rates in opposite directions; and this process will continue till an electronic pressure is set up, which tends to equalize the rates of diffusion; thus, Volta's contact electricity is explained. If a piece of copper and a piece of zinc be touched together and then dipped in acidulated water, a flow of positive hydrogen ions starts towards the copper to unite with its surplus of electrons, and thus, if the plates be joined to make a voltaic cell, a continual diffusion of electrons takes place round the circuit; the old question as to the whereabouts of the seat of the e. m. f. is thus answered; it is equally distributed in all parts of the circuit. Editorially it is remarked that if the electric resistance of a conductor is due to the clogging action of the moving atoms, there must be a time-lag between the change of resistance and the change of local temperature in any small volume-element of the conductor—Lond. *Elec.*, June 6.

Electrons.—MACKENZIE.—A Franklin Institute paper on "the question of the divisibility of the atom." He first gives a concise review of the various experimental researches which have led to the modern hypothesis of electrons cathode rays, Leonard rays, Becquerel rays, etc., and the Zeman phenomenon. He outlines the different methods by which J. J. Thomson has calculated the relation of the mass of electric charge of an electron and both these quantities separately. The mass in grams of a negative corpuscle or electron in a gas at low pressure is about 3 divided by the 26th power of 10. It is found not only in low pressure vacuum tubes, but is given off by incandescent metals, by metals illuminated by ultraviolet light, and by radio-active substances; and in every case it has the same mass and the same charge, and a velocity which is a large fraction of that of light, the radium corpuscles having the greatest velocity, namely, two-thirds that of light. He freely discusses the bearing of this hypothesis on the structure of matter: "If mass is our criterion, we have in the electron a sub-atom, and since it is the same for all elements, we have by inference the ordinary 70-odd atoms as aggregations of this sub-atom."—*Jour. Frank. Inst.*, June.

Repulsive Forces in the Universe.—DESLANDRES.—A paper in which he calls attention to the astronomical importance of the Maxwell-Bartoli pressure of radiation in the evolution of celestial bodies. Arrhennis' theory of the aurora and of comets may be reduced to the single hypothesis of the projection of cathode rays from the sun. All celestial bodies share a continuity of transition from one type to another. Most nebulæ show evidences of a spiral structure with two spirals diametrically opposed. Any great protuberance of the sun is accompanied by a similar protuberance at its antipodes. The only difference between the sun and the nebula is that in the latter the repulsive force is strong, while in the solar type the attractive force is the strongest. There may be a periodic oscillation from one type to another. He points out that a sudden increase in the light of a comet should take place whenever it is exposed to the rays from a large protuberance or facula.—*Comptes Rendus*, May 20; abstracted in Lond. *Elec.*, June 6.

Production of a Magnetic Field by a Flight of Charged Particles.—WOOD.—A brief communication, giving a preliminary account of experiments made by him and Pender. In the various modifications of Rowland's experiments on electric convections, centrifugal force places an upper limit to the attainable velocity of the moving charge. If the revolving disk is abandoned and a flight of charged particles substituted for it, much higher velocities can be obtained. By driving a cloud of charged particles of solid carbon dioxide through a long glass tube placed under a magnetic needle, a deflection of the needle has been obtained. Reversing the direction of the jet invariably reverses the direction of the deflection.—*Phil. Mag.*, June.

Thermoelectric Hysteresis.—PINEZOWER.—A description of what appeared to him a well defined case of thermoelectric hysteresis; he observed that the thermo e. m. f. between two metals differs accordingly as to whether the temperature of the hot junction is attained by heating, or by cooling from a higher temperature. The theoretical importance of such a hysteresis has led the present author to repeat the experiment with an apparatus of greater accuracy and sensitiveness than Bachmetieff's. The result was negative. A great variety of metallic combinations were chosen, and a wide range of temperature. The e. m. f. was measured by a zero method. The

standard "hot" temperature was that of boiling water, and this was reached either by exposure to steam or by cooling from the temperature of a Bunsen flame, or an oil bath. The e. m. f. was always found to be that corresponding to the interval of temperature, no matter how the temperatures were reached.—*Mitt. Phys. Ges., Zuerich,* No. 1, 1901; abstracted in Lond. *Elec.,* June 6.

Change of the Resistance of Metals when Placed in a Magnetic Field.—PATTERSON.—An account of a series of experiments on some of the non-magnetic metals, to see whether they show a change of resistance in a transverse magnetic field. His results show that such a change exists in the case of copper, cadmium, zinc, gold, platinum, tin, silver, carbon. According to J. J. Thomson, this phenomenon is explained by the corpuscular theory of electric conduction in metals; the electric currents in metals are carried by negatively charged corpuscles moving with a definite velocity under an applied e. m. f.; these corpuscles are considered to act as a perfect gas; consequently they have a mean free path and mean velocity and exert a definite pressure. If the corpuscles are moving under an electric force and then a transverse magnetic force be applied, the particles move in cycloids; their path is thus increased, and consequently the resistance of the conductor is changed. The present author applies this theory to a numerical calculation of his experiments. For platinum he finds that the number of corpuscles in 1 cc. is 1.4 multiplied by the 22d power of 10, and the pressure exerted by the corpuscles is about 700 atmospheres. He also calculates, from the corpuscular theory, the contact-difference of potential of two metals in contact: it is in volts, Cu, Pt 0.0239; Cu, An 0.0177; Cu, Az — 0.0015, etc.—*Phil. Mag.,* June.

Sensitiveness of the Coherer.—WOLCOTT.—An account of experiments made to determine quantitatively the effect of electromagnetic radiation upon coherers composed of metals of various critical potentials, including aluminum, tin, iron, zinc, lead, nickel, copper and silver. He finds that the "electrolytic" theory of Guthe and Trowbridge corresponds most closely with the facts. According to this theory the potential gradient across the coherer causes an attraction of the electrodes to within molecular distances, thus making a continuous bridge. Of all the metals tried, aluminum is the most regular in response. It has been found, however, by Marconi and others, that nickel gives the best results at long distances. This is probably due to the fact that of all metals tried, the surface coating of nickel shows the lowest critical potential, that is, it responds to the least energy; but when the intensity of the radiation is sufficient to overcome the greater critical potential of aluminum, the latter gives better results than nickel, for the regulating of response has been shown to depend upon the metal itself. Accordingly, it appears that the best results would be obtained by using the metal which shows the greatest regularity of response, coated with a medium which gives the lowest critical potential.—*Bull. Wisc. Univ.,* No. 51, 1901; abstracted in Lond. *Elec.,* June 6.

REFERENCES.

Waves.—POLLOCK AND VONWILLER.—An acount of some experiments on electric waves in a short-wire system. Observations were made of the waves along free wires, and also of the vibrations in the two systems formed when the wires are bridged at various points. A sensitive method for finding the specific inductive capacity of solid dielectrics with Hertzian waves, is also described.—*Phil. Mag.,* June.

Coefficient of Mutual Induction.—SEARLE.—A mathematical paper. Maxwell calculated the coefficient of mutual induction of two circular circuits, whose axes meet in a point at any angle. The present author calculates by an analogous method the coefficient of mutual induction when one of Maxwell's circles is replaced by a circuit having two infinitely long parallel sides, the shortest distance between the sides being finite. A telephone circuit with its pair of parallel wires is a practical approximation to such a circuit.—*Proc. Cambridge Phil. Soc.,* May 11; briefly abstracted in Lond. *Elec.,* June 6.

ELECTRO-CHEMISTRY AND BATTERIES.

Influence of Temperature on the Capacity of Accumulators.—HIBBERT.—An article in which he first refers to the papers of Schoop, Heim and Liagre (all of which have been abstracted in the Digest), who had found that a rise in temperature causes a marked increase in the ampere-hour capacity. He points out that this is in close connection with the concentration changes in the electrolyte; at higher temperature diffusion acts more quickly; it can more quickly replenish the acid consumed in the pores of the plates during discharge and so keep up the e. m. f. Similarly, during charge, strong acid can more quickly diffuse out of the pores of the plates, and the e. m. f. never rises so high. At ordinary temperatures the diffusion rate during discharge is too slow to keep up the acid strength when about half or one-third of the active material has been changed to sulphate, owing to the partial clogging of the pores. But at higher temperatures the diffusion rate is able to keep up a sufficient acid strength in the pores till a much greater degree of clogging has occurred. He then discusses whether it would be advisable to use a higher temperature in battery rooms in practice. Heim has stated that the Hagen Company does not recommend this, as their experience is that accumulators which happen to work in warm stations are injured by the high temperature. Reference is made to an old paper by Gladstone and the writer, in which they said that while the capacity can be increased 40 or 50 per cent. by warming, yet "the increased temperature would increase local action, and the (direct) chemical action of the acid upon the spongy lead." Yet there is a possibility of getting some of the advantage due to higher temperature, as the increased action on both plates might be counteracted by a reduction in the strength of the acid. Each battery manufacturer should determine for his own type of cells at what temperature and with what strength the advantage is a maximum. "Till this and similar work has been done, the making and using of accumulators will stand on a different basis from that employed in the design of dynamos and engines."—Lond. *Elec. Rev.,* May 30.

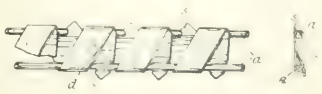
UNITS, MEASUREMENTS AND INSTRUMENTS.

British National Physical Laboratory.—CAMPBELL.—A description of the electrical equipment of this new laboratory. A supply of current is obtained from a steam turbine-driven 60-kw dynamo, a gas engine driven smaller dynamo and a motor-generator; there are also three storage batteries, one being reserved exclusively for electric heating in the thermometric department. Arrangemnts for supply of altrnating current at various frequencies are under consideration. There are three rooms devoted to purely electrical work; one is adapted for preserving constant temperature, it contains among other apparatus the Brit. Ass. standards of resistance and a Carey-Foster bridge for comparing resistances to a high degree of accuracy; the other two electrical rooms contain the primary and secondary standards, respectively, also the instruments devoted to capacity and inductance work, the latter including the magnetic testing of iron. There are two large air condensers, consisting of a large number of concentric brass cylinders supported in such a way that the alternate ones are insulated from the others, the dielectric substance being dry air; the capacity of each is about 0.02 microfarad. These condensers are said to be very trustworthy and convenient. Their absolute values have recently been redetermined by the following method: The condenser, with a suitable commutator, is made, one of the arms of a Wheatstone bridge, and the commutator is rotated at a uniform speed in such a way as to charge and discharge the condenser. The condenser arm of the bridge thus transmits a pulsating current and becomes equivalent to a resistance. If the moving part of the galvanometer has a sufficiently slow time of swing, a balance can be obtained in the ordinary way, and the capacity of the condenser calculated from the values of the resistances and the frequency of commutation. The speed of the commutator is regulated by the aid of a stroboscopic disc, which is viewed through the slits carried by an electrically-driven tuning fork, friction being applied by a cord to a pulley on the disc so as to keep the image, seen through the slits, steady. By means of Kelvin's method, commercial capacities are compared with the air standards. From the standard capacity can be obtained a standard inductance, or a standard of magnetic flux. There is also a Ewing permeability bridge of the latest pattern, with the additional apparatus necessary for the calibration of the standard bars. Commercial testing of transformer sheet has already been taken in hand. It is hoped that before long facilities will be available for testing incandescent lamps for candle-power, efficiency and life; the photometric standards at present used in Great Britain by different people vary very widely from one another, variations of 10 to 15 per cent. being not uncommon. The thermometric department has been equipped; resistance thermometers, thermojunctions and other pyrometers are tested up to 1,300 and 1,400 deg. C. For obtaining the necessary steady high temperature, two electric ovens have been set up. The electric equipment of the laboratory is only

in progress; before long there will be set up apparatus for supplying high voltages and for testing insulation resistance.—Lond. *Elec. Rev.*, June 6.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Telephone Cables.—J. H. WEST.—An illustrated description of a telephone cable, devised by him for the purpose of getting a low capacity and a high self-inductance. For this purpose it is necessary to make the distance between the two wires of a twin conductor as large as possible, and to use for insulation as much air as possible and as little paper or other solid dielectric as possible. He insulates two or four wires from another by means of a slotted strip of cardboard; this strip being wound in a spiral form, and the wires being placed in the slots. Several constructions of this form are shown diagrammatically; one construction for a two-wire conductor is shown in the adjoining Fig. 1, the cross-section in Fig. 2, the strip



FIGS. 1 AND 2.—TELEPHONE CABLE.

of cardboard in Fig. 3; *a* are the wires, *s* the teeth of the cardboard, and the lines *cc* and *dd* are indentures at which the cardboard is bent. He gives the results of measurements made by the Reichsan-



FIG. 3.—TELEPHONE CABLE.

stalt with a cable consisting of seven bundles, each of four wires, of which the bundles Nos. 1, 3, and 5 have wires of 1.5 mm., and bundles Nos. 2, 4, 6, 7 wires of 2 mm.; the capacity of a wire per km. in microfarad for bundles 2 to 7 is in microfarads 0.039, 0.033, 0.037, 0.032, 0.039, 0.037; the capacity of a loop per km. in microfarads for bundles 2 to 7 is 0.020, 0.017, 0.019, 0.017, 0.020, 0.020; the inductance of a loop per km in henrys for bundles 1 to 7 is 0.00108, 0.00100, 0.00106, 0.00113, 0.00109, 0.00101, 0.00101. The process of manufacturing is said to be very simple.—*Elek. Zeit.*, May 15.

New Books.

HIGH SCHOOL PHYSICS. By Henry S. Carhart, LL.D., and Horatio N. Chute, M.S. Boston: Allyn and Bacon. 433 pages, 322 illustrations.

The authors of the above work have succeded in writing a book which should be classed among the relatively few standard text-books. It is divided into the following principal divisions: Mechanics, Sound, Light, Heat and Electricity and Magnetism. "The authors hold firmly to the opinion that the class room and the laboratory should be provided with separate books." This class-room book is thoroughly up-to-date in point of view and treatment of the material; and the large experience of both of the authors in teaching physics, one in the university, and the other in the high school, has guided them to a discriminating choice as to the matter to be included, for it is quite out of the question to attempt to make any text-book encyclopedic in character. There are many figures illustrating the text, and the problems at the close of the chapters are well chosen. The workmanship of the book is excellent.

THE BALANCING OF ENGINES. By W. E. Dalby, M. A., B. Sc. New York: Longmans, Green & Company. 283 pages, 173 illustrations. Price, $3.75.

A few years ago the literature relating to the subject matter of this book consisted of an occasional paper to be found in the transactions of engineering societies. Since then this subject has forced itself upon the engineers to such an extent that at several recent annual meetings of engineering societies papers relating to it have far outnumbered those relating to any other one topic. During the past few years there has thus grown up a very extended literature of this subject and it has become of such importance as to justify an author of judgment and experience in preparing the present work devoted solely to this topic.

The book is divided into eight chapters of which the first relates simply to a discussion of the subject of "Vector Quantities." In the remaining chapters of the book the details of the subject are developed in a simple manner and yet sufficiently general in treatment to cover all practical requirements of the engineer. The problem of the balancing of a revolving mass is first treated, then follows the reciprocating mass with the infinite connecting rod, and then the reciprocating mass with the influence due to the angularity of a finite connecting rod. A special chapter is given to the subject of vibration of supports and of the frame work of the engine, at the same time including the question of turning effort and its uniformity.

The book is intended to be essentially practical in character and to give for the investigation of problems in balancing and for the computation of the forces developed, a semi-graphical method, which has proved itself suitable for the investigation of such problems in drawing office practice. The style of the author is simple and clear, and the illustrations are especially noteworthy for their clearness and simplicity, having in view the character of the questions under consideration. The book may be cordially recommended to all who are concerned with problems of this character.

AN ELEMENTARY TREATISE ON ALTERNATING CURRENTS. By W. G. Rhodes, M. Sc. London: Longmans, Green & Company. 211 pages, 83 illustrations. Price, $2.60.

In his preface the author announces that he has aimed to present his subject without that indulgence in mathematical gymnastics to which many of his colleagues have been prone. This intent is doubtless most commendable, but the reviewer cannot unreservedly congratulate Mr. Rhodes on the results; for, while it is true that this volume is not wholly a wilderness of figures and formulæ, brevity has frequently been attained by simply omitting intermediate steps in a development, which is hardly desirable in an elementary text-book. On the other hand, it cannot be denied that the arrangement of subject matter is most excellent and that the author's clean-cut and forcible English illuminates many an obscure path for the student. The practice so common abroad of emphasizing paragraph headings and important conclusions by using heavy type has been followed here, and while this is regarded with disfavor in many quarters in this country, it certainly enhances very materially the value of a book as a reference volume and must assist those readers who are taking up the subject for the first time.

Another excellent feature is the insertion of a brief chapter on the elements of vector algebra. The author states his belief that one should form a part of any volume on this subject and that vectors should be used as much as possible in solving problems, with both of which points we heartily concur.

The chapters on kicking coils, transformers and alternating-current machinery are, while of course elementary, good. That on the measurement of power in alternating-current circuits is very meagre and disappointing. No effort has been made to point out the almost prohibitive drawbacks of the antiquated three-voltmeter and three-ammeter methods, which have been dragged in, and they receive relatively the same amount of attention as the employment of a true watt-meter instead of being relegated to the limbo of the forgotten and impracticable that they deserve.

The presswork, paper and binding are all good and there are remarkably few typographical errors, even if the author is made to say at one point that "the practical unit of capacity is a Farad."

GRUNDRISS DER ELEKTROTECHNIK. Von Heinrich Kratzert. II thiel, 2, 3, 4 and 5 buch. Leipzig und Wein: Franz Deuticke. 436, 275, 208, 75 pages. Prices, respectively, 10, 6, 6 and 3 marks.

This is one of the best text-books of electrical engineering in the German language. It is essentially an engineering text-book, written by an engineer for engineers. The style is simple and clear, the illustrations numerous and well chosen, the diagrams in particular being admirable for their simplicity and directness.

Part 2 relates to electric lighting, with 436 pages and 439 illustrations, averaging over one illustration per page of text. The description is excellent and modern. It is curious to observe that in Austria the standard of light seems to be a "Munich Stearine Candle," burning 10.4 grammes per minute. Part 3 is devoted to power-transmission, electric railroads, electric automobiles, the costs of electric apparatus and the specifications for safe installation published by the Association of German Electrotechnists. It contains 275 pages and 149 illustrations.

Part 4 relates to electrochemistry and deals with primary and secondary batteries, electroplating, electrometallurgy, and short chapters on electrolytic products. 208 pages, 94 illustrations.

Part 5 treats of electric machinery in mines, farms, and on board ship. The description of electric mining and farming apparatus is the most complete we have seen in the German language. 75 pages and 44 illustrations.

Taken collectively the book is of great value to the electrical engineer, as representing Austrian and German practice in various directions, but particularly in electric lighting.

Das Elektrotechnische Institut Zu Carlsruhe. By Prof E. Arnold. Berlin: Julius Springer. 60 pages, 29 illustrations.

This is an elaborate pamphlet describing the equipment of the technical college above mentioned. The power plant is a 22-kw unit, comprising a gas engine, to one end of whose shaft is direct-coupled a direct-current generator, and to the other a polyphase machine. The capacity of the engine is such that only one of the two generators may be loaded up to its full capacity at any one time, but there is an elaborate equipment of storage batteries so that both high-tension low current and low-tension heavy direct-current experiments may be carried on while the alternator is being used for other purposes.

A 7-kw direct-current unit, also driven by a gas engine, is installed in the machine shop, and like the larger one has its dynamo provided with a permanently attached set of exploring brushes, so that the distribution of potential around the commutator may be plotted The distribution of current through the building is on the elaborate scale usual in such cases. Liberal use is made of gridiron interconnecting boards of the type employed in telegraph offices in this country, so that almost any variety of current may be plugged into a given line.

All wiring is exposed and on porcelain knobs, the conductors being transposed between each pair of adjacent knobs to avoid magnetic disturbances in the numerous testing rooms. The collection of measuring apparatus seems small but well selected. A very good photogravure of the building itself serves as a title page, and line drawings reduced from the architects' plans show the interior arrangements, the best feature of which is, perhaps, the large square inner court affording good illumination for all of the rooms.

BOOKS RECEIVED.

Dictionnaire Electrotechnique. French-German-English. By Paul Blaschke. Leipzig: S. Hirzel. 144 pages. Price, 5 marks.

Congré International D'Électr cité, Paris, 1900. Rapports et Procés-Verbaux. By E. Hospitalier. Paris: Gauthier-Villars. 525 pages, illustrated. Price, 20 francs.

Directory of Electrical Societies, Etc.

American Association for the Advancement of Science. Next meeting, Pittsburg, June 28 to July 3, 1902.

American Electochemical Society. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Toronto, Ont., 1903.

Electrical Contractor's Association of New York. Semi-Annual meeting, Hotel Ten Eyck, Albany, N. Y., July 15, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electrical Contractors' Association. Annual meeting, Hotel Walton, Philadelphia, July 16, 1902.

National Electric Light Association. Next meeting, Chicago, May, 1903.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Society for Promotion of Engineering Education. Next meeting, Pittsburg, June 28 to July 3, 1902.

The American Electro-Therapeutic Association. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

Multiple Arc Lighting System.

The Fort Wayne Electric Works has developed a street lighting system, the leading feature of which is the readiness whereby existing incandescent lighting systems by its use may be adapted to include an arc lighting system with a minimum expenditure for line material and equipment. The general plan of this multiple system of enclosed alternating arc street lighting is illustrated in Fig. 1. This diagram shows a complete installation, and illustrates the method of distribution by a three-wire system from which incandescent lights and arc lights may be operated from the same high potential mains. The particular application here illustrated is that of 2000-volt alternating-current incandescent

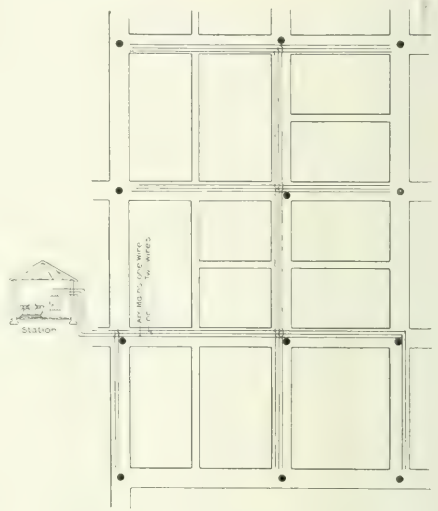


FIG. 1.—MULTIPLE ARC LIGHTING SYSTEM.

distribution system, having step-down transformers from which the secondary mains are supplied with current at standard incandescent lamp voltages.

Fig. 2 illustrates the only change in the equipment of the power station rendered necessary by the addition of such an arc lighting distribution system. By referring to same, it will be noticed that it has been necessary only to install one wire in addition to the incandescent mains, and a single pole, single throw switch, *A*, connecting this third wire with one side of the incandescent lighting circuit. The arc lamps are operated on small individual constant-current transformers—one transformer for each lamp—connected to the third wire and the opposite side of the incandescent circuit. By this means it is possible to use one side of the existing incandescent lighting circuit as a common wire for the arc lighting and incandescent lighting circuits. This plan can be followed in a great majority of cases. There are, however, a few instances where incandescent mains and arc circuits are widely separated, and it is here found necessary to extend one side of the incandescent mains to accommodate the arc lighting circuit.

In general, this system can be installed in any locality requiring street lighting, but the particular case where its application can be made most advantageously, is in small towns or suburban districts already supplied with an incandescent lighting system. In such cases the demand for light is not usually such as to warrant an outlay of capital sufficient to provide a separate set of arc light mains and the accompanying switchboard and other station

equipments. The usefulness and adaptability of the system is not limited to the cases just mentioned, but it may be extended to the full capacity of the station. In this way a much larger generating unit may be installed than is needed for incandescent lighting, thus obtaining the advantage of high efficiency generator, as well as saving in the original cost of installation.

The "Wood" transformer, used with this system, is designed to operate on 1000 or 2000-volt primary alternating current circuits, and develops practically constant energy in the secondary with wide variations of resistance in the secondary circuit. A short circuit of the secondary of one of these transformers affects only the one lamp to which it is connected and will not interfere with the operation of any other part of the system. The transformer can be adjusted for various secondary voltages and frequencies. Considerable variation in the primary voltage does not materially affect the value of the secondary current. The primary and secondary coils are wound entirely separate and never come in contact with each other when the various adjustments are made, thus reducing to a minimum the chances of cross connections between the coils. The "Wood"

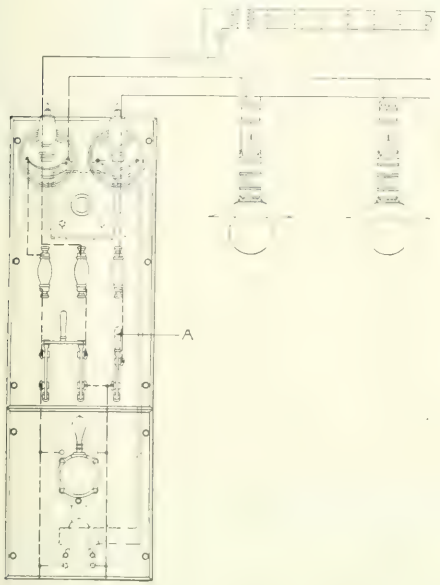


FIG. 2.—MULTIPLE ARC LIGHTING SYSTEM.

primary fuse box used with this system may be either double or single pole, according to the condition of installation.

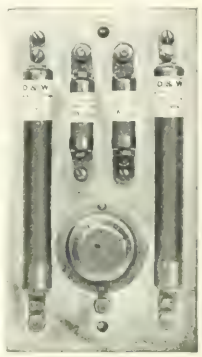
The "Wood" arc lamp used in connection with this system is a new enclosed form, recently developed by the Fort Wayne Electric Works and the general appearance resembles the enclosed series arc lamp, recently introduced. The interior construction and mechanism is practically the same as in the other lamps of this design and includes many of the valuable features of simplicity, interchangeability, cool operation and substantial construction. The lamp operates at 6.5 amperes with 75 volts at the arc and consumes 418 watts.

It is claimed that the efficiency of this system is very high and does not vary with the number of lamps in service, but remains constant for all loads—an advantage possessed by the multiple system which is lacking in other systems in which the efficiency diminishes rapidly as the load decreases. The same may be said of the power factor, which is high and the same with any number of lamps in operation; the system thus does not consume unnecessary generator capacity when operating at light loads. In a constant current system the apparent energy is the same for all loads, which means the same consumption of generator capacity whatever the number of lamps in operation, while in the multiple system it varies in direct proportion to the number of lamps in operation.

The great flexibility of this system is one of its leading features, since it permits the operation of arc lamps of various candlepower on the same circuit simply by the use of properly adjusted transformers. In a series system this cannot be done, as the line current is maintained at a constant value. In many instances it may be desirable to locate single arc lamps where arc circuits are not installed, particularly where municipalities require additional arc lamps at distant points or suburban districts. In such cases it is only necessary to obtain a single unit, consisting of arc lamp, transformer, and fuse boxes, connecting with the primary distribution mains in the same manner as extensions of the incandescent system are made. In this way the system obtains all the advantages of an incandescent lighting system and at the same time retains the valuable features of a multiple arc lighting system. Some of the more important points claimed for this system are its high efficiency and its extreme simplicity and flexibility.

Protectors for Telephone Circuits.

The desirability of "protection that will protect," in the matter of safeguarding telephone circuits and instruments against lightning, etc., is too well known to require much discussion, and, happily, telephone men have long since been aroused to a keen appreciation of securing as perfect appliances for this purpose as can be found. A protector for such use, exhibited at the Independent Telephone Convention, and which attracted much attention, while receiving favorable comment from managers and manufacturers who had used it, was the protector made specially for this class of work by the D. & W. Fuse Company, of Providence, R. I. Their "Combination Cut-out," for such it must be called, embodies the functions and elements of a high tension fuse, a sneak coil and a lightning arrester, and the type herewith illustrated is the complete double-pole form, but without the cap removed from the arrester. The high-tension fuse is connected with the sneak coil, the fuses being outside and the sneak coil inside, above the arrester; these being in series, and the two shunted to earth through the carbon plate of the arrester, which is normally open. The fuse will take care of any current up to a short circuit at 3,000 volts, and, of course, is free from any arc or flash. The little sneak coils operate on from one-tenth ampere up to half an ampere, and the two-tenth ampere form usually recommended for telephone work operates on three-tenth ampere is less than 15 seconds.



PROTECTORS

The lightning arrester part of this interesting apparatus consists of a carbon block separated from a ground plate by mica, or by an insulating waterproof film, an air-gap of .008 inch being provided with the mica, while .0025 inch with the film form separates the carbon from the ground plate. The entire arrester is enclosed in a metallic casing, which prevents the accumulation of dust, which has frequently been known to cause trouble, and also guards against any risk from the ignition of lint or flying particles during the instant when a discharge occurs across the plates. It is believed by the makers that the "film" possesses certain advantages over the air-gap, inasmuch as the device is practically continually grounded as far as all static discharges are concerned, although at the same time testing clear for all dynamic currents. It was ascertained that static discharges as low as 180 volts potential would readily pass through the film while at the same time this would successfully withstand over 500 volts dynamic current. Moreover, the film possesses the property of automatically grounding the device when the circuit becomes crossed with a high tension line in such a manner that only a small current could pass to earth. The current, which may be too small to cause the fuse to operate, is yet sufficiently great to cause disturbance and trouble on the line. It is then desirable to have the circuit grounded, and this is accomplished automatically under such [illegible] the line is cleared the film is easily and quickly replaced. This is considered a decided advantage over the air-gap arrester provided

by a mica separator, since a small discharge might continue across the air-gap for many hours, interfering with the satisfactory operation of the line, which would yet be too small to cause the fuse to operate.

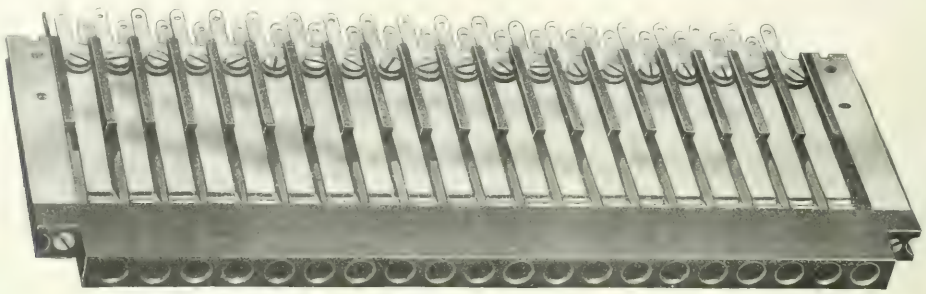
Under ordinary conditions the sneak coil alone would operate where the current was diverted through the instrument, and since trouble from these slight causes is more common than a dead cross, this, an inexpensive and readily renewable device, would alone have to be replaced as the fuse would be unaffectd by its opration. The diverter, or "arrester," only rarely needs attention, and then simply to free it from any carbon particles which may have accumulated within the air-gap where the mica is used, or to renew the films with the other type. The fuse, which is in reality a protector for the device itself, would be called upon to operate only in cases of emergency requiring prompt action without any of the flame or discharge which accompanies every other type of fuse.

A Small Multiple Spring-Jack.

A piece of apparatus, shown for the first time, and one that received a great deal of attention from prominent telephone men at the Interstate Telephone Convention, recently held in Chicago, was a 3-10 in. center multiple spring-jack, built by the Kellogg Switchboard and Supply Company. The accompanying illustration shows this jack, actual size (6¾ ins. long). The jack is known as a two-conductor jack, and is built of the best grade of hard rubber, brass and German silver. There being only one spring in the jack and two contacts in the plug, the 3-10 in. jack can be built substantially and have as high insulation resistance as most jacks on ⅜ in. centers.

This type of jack will be used in the 18,000-line switchboard, which this company is building for the Frontier Telephone Company, Buffalo, N. Y., and also in the 15,000-lin board being built for the Home Telephone Company, Los Angeles, Calif.

An illustration of the amount of work involved in building the multiple jacks alone for a 15,000-line board, may be gained by the following brief facts: The ultimate number of spring-jacks required for a board of this size is 645,000. The ultimate number of strips of multiple jacks is 32,350. The spring-jacks, for the ultimate equipment, placed one on the end of another, would reach 30½ miles.

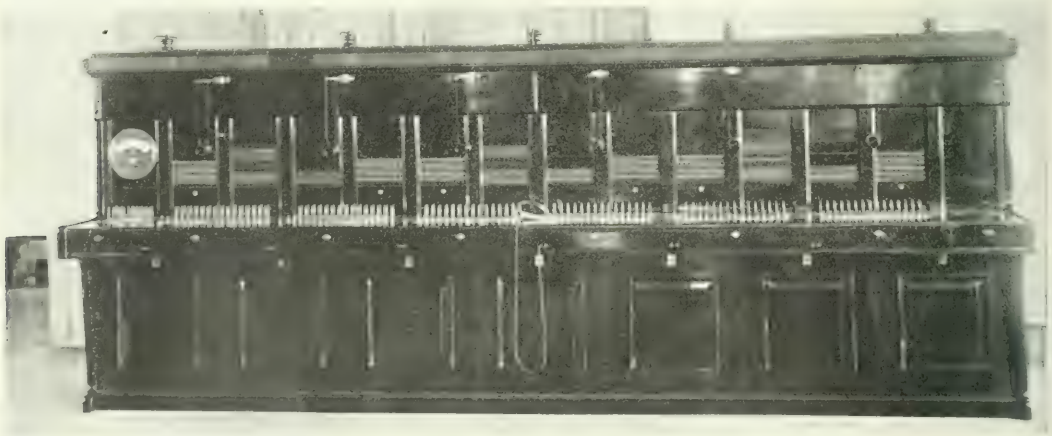


SMALL MULTIPLE SPRING-JACK.

The strips of multiple jacks, placed one on the end of another, would reach 3½ miles. The total number of strips (32,500), even though only 3-10 of an inch thick, piled one on top of the other, would make a column 812½ feet high.

Telephone Service for Manhattan System.

In connection with the many changes and improvements now being made in the Manhattan Railway system, of New York City, the company is installing a new telephone switchboard built by the Lambert Schmidt Telephone Mfg. Company, of New York. This board has a capacity of 500 lines and is complete in every respect. It has six operators' positions and is full multi-



MANHATTAN RAILWAY COMPANY'S TELEPHONE SWITCHBOARD.

a 3-10 in. center multiple spring-jack, built by the Kellogg Switchto get the maximum amount of speed in view of the fact that a majority of the instruments will practically be used continuously. The telephones will be located at each and all of the stations and offices throughout the system, and many of the instruments will be fully ten miles from "central." This is quite a severe test on a common battery circuit, and in other ways the system will probably be subjected to a more severe test than can come on any equivalent system in the country. It is a private plant doing an excessive duty as a central exchange.

Interior Telephone System for Westinghouse Factories.

Among the many interior systems installed for office and factory work, one of the most complete is that of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. This company purchased and installed some time ago a 500-line Stromberg-Carlson visual signal central energy switchboard, equipped also with sixty trunk lines connecting with branch exchanges located in the Westinghouse Machine Works and the Westinghouse Air Brake Company's factory. The operation of the system has been so successful that a duplicate of the outfit has been



SWITCHBOARD IN WESTINGHOUSE OFFICE.

purchased for the British Westinghouse Electric & Manufacturing Company, of Manchester, England.

These two switchboards are of the multiple type, with multiple jacks grouped in front of each operator up to 600 numbers, and multipled in the same manner in the toll and trunk line operator's position. The power and battery plant is modern and up-to-date in every way. This exchange is remarkable from another standpoint: The operators are called upon to answer 1,500 calls in eight hours. This is only an average record for the service the board is called upon to furnish. While equipped with 15 pairs of connecting cords to each position, with a double supervisory clearing-out system, there are many times during the day when the cords are all in service. This is quite remarkable when one stops to consider that the plant is used exclusively for the local work of the Westinghouse interests, but those interests employ many thousands of men in and around Pittsburg.

Alternating-Current Calculating Device.

Prof. F. G. Baum, of Leland Stanford University, has put in commercial form the alternating-current calculating device which was described in the issue of this journal dated May 18, 1901. The device consists of a series of curves on a piece of cardboard, over which is pivoted a movable piece of mica. The device enables determinations to be simply made of the regulation of a transformer, transmission line or generator, or any combination of these for any load and for any power factor. By its means the following determinations concerning a synchronous motor may also be immediately made:

The excitation to give any desired power factor at any given load; the excitation to give any percentage wattless current at any given load; the current and power factor for any given excitation at any given load; the angular swing of the motor for any given change in load; the maximum load that the motor will lag before falling out of step, and the percentage of compounding that must be given the field of a synchronous motor so that changes in load will not affect the pressure at the terminals.

A 22-page pamphlet accompanies the device, in which its principles are explained and instructions given for its use in making calculations. The calculator may be obtained from Prof. Baum, the cost being $1.00.

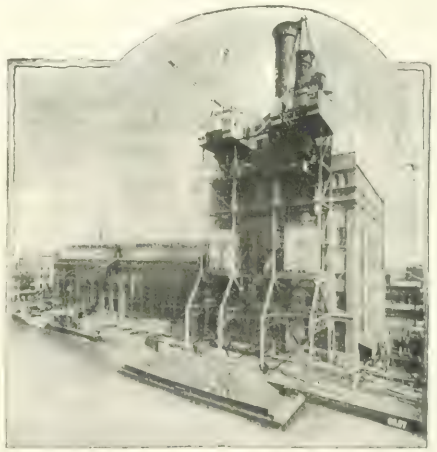
Electrical Equipment for Coal Hoisting Towers in Baltimore.

The great power stations in New York, Baltimore, and other large cities are far from the sources of fuel supply, and each of them consumes as much as a good sized coal mine can produce. The handling of this fuel is a problem of serious moment. It must be done with certainty and celerity, without excessive noise or dirt and at moderate cost. An excellent example of such work can be found in the new central power station of the United Railways & Electric Company, Baltimore.

In the new boiler house now building, thirty-two 500-hp. Babcock & Wilcox water tube boilers are to be located on two floors and in four sections. Four stacks, 200 feet in height and 13 feet inside diameter divide the entire building in two parts, with batteries on either side. Above the boilers are two coal storage bins with a capacity of 6,000 tons. Each bin is 32 feet wide, 34 feet deep and 128 feet long.

The arrangement of the plant necessitates raising the coal to a great height, which together with a large fuel consumption made the conditions most exacting. The coal hoisting towers and machinery were designed and constructed by the C. W. Hunt Co., New York, while the arrangement of the electrical apparatus in the tower is due to P. O. Keilholtz, consulting engineer of the United Railways & Electric Company. On the east side of the boiler house, two steel towers were built for hoisting the coal, one of which has been equipped throughout while work on a duplicate euipment is in progress. This plant has the double distinction of having the highest hoist of any power station and being the only one of its kind equipped throughout with electrically operated hoisting and conveying machinery. Each of the coal hoisting towers is 183 feet high, and the horizontal booms, 52 feet in length, extend over the water. The one-ton shovel is lowered by means of a cable, passing over a truck which runs back and forth on the booms to the shovel below. The shovel hoist and boom truck are driven by electric motors geared to the drums.

From the railway switchboard in the adjoining engine room



a 550-volt main extends into the coal hoisting towers. On the first floor of the tower is a motor generator set of standard General Electric type. From this motor shaft the coal crusher is also driven. The purpose of this generator is to supply a suitable voltage current to the hoisting motor on the fourth floor above.

As the turning effort is transmitted through gears to the hoisting drums, it is essential that the gears be not subjected to violent shocks by a sudden application of power. The mechanism is such that the rate acceleration is even, and dependent upon the will of the operator. The hoist motor has ample capacity to operate the shovel. When the shovel descends to the coal in the barge, the hoisting motor is started and closes the shovel, fills

it with coal, hoists it loaded 151 feet over the tower, and dumps the coal into a hopper at the front of the tower on the engine platform. The shovel is then lowered open to the coal and is ready for another trip. An engineer and assistant regulate the operation of the hoisting machinery from the second platform in the tower, the former controlling the hoisting drum motor, and regulating the speed and direction of rotation; the latter controls the motor hoist actuating the trolley on the boom. The shovel does not twist in hoisting or lowering, notwithstanding the great height of the hoist. The coal passes from the hopper through a coal cracker, where the large lumps are broken to the proper size for automatic stokers. By means of a double jawed cut-off valve, the coal is fed into an automatic railway car, then weighed. After the car is pushed off the scales, it passes to an inclined track over the bins, and is automatically discharged by a stop previously located at the point where the coal is needed. The inertia of the loaded car on the incline is stored in a counter-weigher which, when the load is dumped, returns the car to the scale for another load.

The tower was equipped by the C. W. Hunt Company and has a capacity of 50 tons of coal per hour. Recent records show that the hoist will deliver considerably more coal than the capacity given above. While the consumption of coal in a station of this size would probably be 100,000 tons per year, the coal handling plant has a capacity of ten times that quantity of fuel taken from the boat and delivered to the storage bins.

Under each of the boilers is an ash hopper with a cut-off valve. The Hunt noiseless gravity bucket conveyor receives the ashes which descend into, and are removed from, the hoppers by gravity. The ashes are carried over the coal pockets and dumped into a chute leading into ash bins in the tower; from thence they are removed by car or boat. This conveyor is 430 feet long, with a vertical lift of 86 feet and is motor driven. When carrying a load of ashes, it requires but 5 horse-power to keep it moving. No shoveling or manual labor of any kind is required in receiving, transporting or emitting coal or ashes from this plant, and the machinery is as nearly automatic in its operation as possible.

Electric Railway Development in Northern New York State.

The Hudson Valley Railway Company is a consolidation of the Stillwater and Mechanicsville, Greenwich and Schuylerville, Glens Falls, Sandy Hill & Fort Edward, and Warren County Railroads and the Saratoga Traction Company. The Company has now in operation over one hundred miles of electric road running north from Albany and Troy to Saratoga, Lake George and the Adirondacks. At the present time power for operating the road is derived from several independent power stations located at Stillwater, Saratoga, Middle Falls, Glens Falls and Caldwell. Ultimately, power for operating the entire system will be developed on the Hudson River near Waterford.

For the operation of the road until the Hudson River power station is completed, a somewhat unusual and interesting method will be used. The company has increased the capacity of the direct current power station at Glens Falls by installing a 250-kw. direct-current engine-type generator and has increased the capacity of the Caldwell station by installing a 270-kw., direct-current, belted generator. In the power station at Glens Falls there will be installed a 250-kw. rotary converter operating direct current to alternating current with raising transformers. Power will be transmitted by a three-phase, 11,000-volt transmission line to Caldwell, where lowering transformers and a second 250-kw. rotary converter operating alternating to direct current will be installed to supplement the power of the Caldwell direct-current generating plant.

At the company's power station in Saratoga there is to be installed a 400-hp. engine and 250-kw., 2200-volted, belted, alternating current generator with raising transformers. From this power station power will be transmitted by a three-phase, 11,000-volt transmission line to a substation at Round Lake where lowering transformers and a 250-kw. rotary converter operating alternating to direct-current are to be installed. This substation will supply power to the recently completed Saratoga Division of the system connecting the main line at Mechanicsville with the Saratoga-Ballston line at Ballston Spa. After the alternating current generating plant is installed next year on the Hudson River, the generating and substation apparatus now in use and in course of installation will be displaced by eight 300-kw., 600-volt direct-current rotary converters. All of the electrical apparatus for the temporary installations and also for the permanent equipment of substations is to be built and furnished by the Westinghouse Electric & Manufacturing Company.

Important Changes in the Gold Car Heating Company.

The Gold Car Heating and Lighting Company, which has just been incorporated under the laws of the State of New York, with a capital of $1,000,000, as announced by us last week, has purchased outright the entire business of the Gold Car Heating Company of New York, Chicago and London, and also the entire business of the Gold Street Car Heating Company. It takes possession July 1, 1902, of all of the property of both of these companies, and in addition to nearly one hundred patents already owned by them, has acquired a number of new and valuable patents covering electrical apparatus.

The business of the Gold Companies has increased enormously during the past few years, and now extends all over the world, wherever railway cars are operated by steam or electricity. The Gold Companies have a larger number of unfilled contracts on their books just now than ever before in the history of their business. At the present time they are engaged in equipping new cars or locomotives being built for the following railroads: New York Central, Lake Shore & Michigan Southern, Jersey Central, Delaware, Lackawana & Western, Lehigh Valley, Norfolk & Western, Philadelphia & Reading, New York, Ontario & Western, Chesapeake & Ohio, Southern, Atlantic Coast Line, Plant System, Alabama Great Southern, Waycross Air Line, Cincinnati Southern, Nashville, Chattanooga & St. Louis, Louisville & Nashville, Northern Pacific, Minneapolis, St. Paul & Sault Ste. Marie, Chicago, Burlington & Quincy, Missouri Pacific, Texas & Pacific, Denver & Rio Grande, Union Pacific, New Orleans & North Eastern, and many others.

The foreign business of the company is larger now than ever before, over two thousand sets of car heating apparatus being under construction for shipment abroad within the next three months.

Among the large electric heater contracts recently received is one from the Louisville Railway Company for over three hundred sets of car heating apparatus, and orders from the Jersey Street Railways for about one hundred equipments, as well as from the Boston & Maine, New York, New Haven & Hartford, Massachusetts Electric Companies and South Side Elevated Railroad of Chicago. A contract has recently been closed with the Metropolitan Street Railway of New York for electric heating apparatus which will be a departure from anything of this character hertofore undertaken.

In addition to all of the new work now under way, the Gold Companies have already equipped nearly forty thousand cars and locomotives on about five hundred railroads all over the world, and their apparatus is spoken of in the very highest terms wherever it has been used.

The capital of the Gold Car Heating and Lighting Company, which takes over all of this business, of $1,000,000, has been more than fully paid. There are no bonds on the new company and there is no preferred stock. Its capital is represented by ten thousand shares of common stock of the par value of one hundred dollars each, fully paid, and non-assessable, and the company has no other liabilities whatever. The net value of the property taken over by the new company is $1,090,000.

Mr. Edward E. Gold, of New York City, has already been elected president of the new company and made chairman of the executive committee. All of the stockholders of the old companies will be numbered among the stockholders of the new company, the plan having received the unanimous approval and consent of every shareholder in all of the properties purchased. The main office of the new company will be at Frankfort and Cliff Street, New York City.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4¼@4½ per cent. for 60 to 90 days and 4½ to 4⅝ for four to six months. There was greater strength and further activity in the stock market during the past week, the stocks of special interest being those of the southwestern, Pacific and Granger roads. The United States Steel stocks developed weakness and there was general selling, due to the decision against the preferred stock conversion and a possible entire abandonment of the scheme. There was much more public interest in the market and considerable buying of both bonds and stocks for investment purposes. At the close of the week the market was dull but firm. Industrials took a second place as compared with railroad shares. Amalgamated Copper shares seemed to be out of favor owing to the belief that improvement in the copper trade has not been maintained. The traction stocks were neglected and closed weak. Brooklyn Rapid Transit closed at 66½, after having reached 67½, being a net loss of ⅝-point. Metropolitan Street Railway closed with a net loss of ¼-point, the last quotation being 150½. This stock, like Brooklyn Rapid Transit, fluctuated within narrow limits, the highest price being 151⅞. General Electric reached 314 and fell at one time to 305, closing at 306, this being a net loss of 7¼ points. Westinghouse, both common and preferred, were firm, the former closing with a net gain of ½-point and the latter, 2¾; the closing prices were 210½ and 217, respectively. Western Union closed at 92½ ex-dividend. Other closing quotations were American Telegraph & Telephone, 177¼, being a net gain of 3⅛ points, and American District Telegraph, 36. In Boston, General Electric dropped off 12½ points and American Telegraph and Telephone advanced 1¼ points.

NEW YORK

	June 10.	June 17.		June 10.	June 17.
American Tel. & Cable..	—	87	Gen. Carriage (n. st'k)..	4¾	[illegible]
American Tel. & Tel....	177¼	175	Hudson River Tel.....	104	[illegible]
American Dist. Tel.....	—	31	Metropolitan St. Ry.....	[illegible]	148
Brooklyn Rapid Transit.	67⅛	66⅝	N. E. Elec. Veh. Trns..	—	[illegible]
Commercial Cable.....	[illegible]	—	N. Y. E. V. T. Co.....	13	[illegible]
Electric Boat.....	28	28	N. Y. & N. J. Tel.....	166	[illegible]
Electric Boat pfd.....	40	40	Tel. & Tel. Co. of Am...	—	[illegible]
Electric Load Regulator	[illegible]	3	Western Union Tel.....	92	[illegible]
Electric Vehicle.....	6½	7½	West. E. & M. Co.....	—	[illegible]
Electric Vehicle pfd....	[illegible]	15½	West. E. & M. Co. pfd..	217	[illegible]
General Electric.....	305	[illegible]			

BOSTON.

	Holiday.	June 17.		Holiday.	June 18.
American Tel. & Tel.....	—	[illegible]	Mexican Central.....	[illegible]	[illegible]
Cumberland Telephone..	—	[illegible]	North Butte Mining....	[illegible]	[illegible]
Edison Elec. Ill.	[illegible]	[illegible]	Westinghouse Elec.....	[illegible]	[illegible]
Erie Telephone.....	[illegible]	[illegible]	Westinghouse Elec. pfd..	—	[illegible]
General Electric.....	[illegible]	[illegible]			

PHILADELPHIA.

	June 17.	June 24.		June 17.	June 24.
American Railways.....	[illegible]	[illegible]	Phila. Traction.....	98	[illegible]
Elec. Storage Battery...	[illegible]	[illegible]	Phil. Electric.....	5⅜	[illegible]
Elec. Storage Bat'y pfd.	[illegible]	[illegible]	Phila. Rapid Transit....	[illegible]	[illegible]
Elec. Co. of America...	[illegible]	[illegible]	Pa. Elec. Vehicle pfd....	3	[illegible]

CHICAGO.

	June 17.	June 24		June 17.	June 24
Central Union Tel.....	90	[illegible]	National Carbon.....	[illegible]	[illegible]
Chicago Edison.....	179	[illegible]	Northwest Elev. com....	36⅝	[illegible]
Chicago City Ry.....	207¾	205	Union Traction.....	[illegible]	[illegible]
Chicago Teleph. Co....	170	160	Union Traction pfd.....	[illegible]	[illegible]
National Carbon.....	[illegible]	[illegible]			

* Asked.

NORTH AMERICAN ANNUAL shows total receipts for year ending May 31, 1902, of $2,103,188, and refers to its various changes and acquisitions during that time. In the last annual report the purchase of the Gas, Electric & Water Companies, in Covington, Newport, Dayton, Ludlow and Bellevue, and their consolidation into the Union Light, Heat & Power Co., in which the company has control, was announced. Since then a consolidation has been effected with the Cincinnati, Covington and Newport Railway Company and the North American has received preferred and common shares in the new company, namely, Cincinnati, Covington and Newport Light and Traction Company. The earnings, both gross and net, are rapidly increasing, the property is efficiently managed, the preferred shares are already on a dividend basis, and it seems assured that a surplus will be earned from the outset which will warrant dividends [illegible]. In the meantime negotiations were entered into with the Imperial Electric Light, Heat & Power Co., of St. Louis, which resulted in the purchase of the entire capital stock. Upon this sale a consolidation was effected with the Citizens' Electric Lighting & Power Co., under the corporate name of the Union Electric Light & Power Co. The Citizens' Company has a contract for public lighting in St. Louis, dated Sept. 1, 1900, upon favorable terms and for ten years. It is believed that the prospects in St. Louis are unusually favorable and that business will show a continuous and satisfactory growth. The consolidated company has been awarded by the Louisiana Purchase Exposition Company a contract for about one-half the current for the World's Fair in 1904, and all capital that may be required will be furnished by a syndicate. The North American retains ownership of the Milwaukee Electric Railway & Light Company, and the development of its earning capacity during the year has been even greater than expected.

NEW ENGLAND TELEPHONE.—The directors of the New England Telephone Co. have ordered that 36,047 shares of stock be offered to stockholders at par. Each stockholder of record July 1 will be entitled to subscribe for the new stock in the proportion of one new share for every five then held. The recent authorized increase of $10,000,000 in the capital stock will be sufficient to meet all new construction requirements for several years. The steady growth of the company's business, averaging about 15,000 new subscribers annually, requires over $2,000,000 new capital each year for new construction. The company has 44,969 subscribers in what is called Greater Boston, which compares with 30,809 a year ago. Last year the New England Telephone Co. expended $2,030,092 for new construction, and charged to operating expenses for repairs and maintenance $1,771,290, a total of $3,801,383, as against an expenditure for similar purposes the previous year of $3,153,501. This year it is estimated that $2,250,000 will be spent for new construction, and it is very possible that this sum will represent the new stock to be offered to stockholders next month at par. A year ago the company issued $2,577,400 new stock on the basis of one share for each six held.

DIVIDENDS.—The directors of the Brooklyn Union Elevated have declared a regular dividend of one per cent on the preferred stock, payable June 30. The last previous dividend paid by Brooklyn Union Elevated was two per cent on June 29, 1901. Philadelphia Company, of Pittsburg, directors have declared the regular quarterly dividend of one and one-half per cent. on the common stock, payable July 21. The directors of the United Traction & Electric Co., of New Jersey have declared the regular quarterly dividend of one per cent., payable July 1. Under provisions of the lease of the West End Street Railway Co., to the Boston Elevated Railway, a dividend rental of $2 per share will be paid to stock of record July 1. The directors of the Washburn-Moen Company have declared the regular quarterly dividend of one and three-quarters per cent upon the preferred stock, payable July 1. The Electric Company of America has declared an extra dividend of $1.50 per share, payable July 21. Directors of the Washington Water Power Company have declared the regular quarterly dividend of one and one-quarter per cent., payable July 1. The Columbus, O., Edison Co. has declared the regular semi-annual dividend of three per cent. on the preferred stock. A dividend of 75 cents per share has been declared on Reading Traction Stock.

A LONG ELECTRIC ROAD.—The organization of the New Orleans and Southwestern Electric Railway Company, with a capital stock of $2,000,000, has been effected at New Orleans. C. P. Shever was elected president; C. P. Young, general manager; H. L. Lancaster, treasurer, and Thomas A. Badeoux, secretary. It is the purpose of the company to build immediately an electric railway line from New Orleans through the Louisiana sugar and rice belt. The distance will be about 200 miles, and the road will be constructed with a view of handling the heaviest kind of freight. It is determined to begin the actual work of construction on July 10. A Boston syndicate is behind the enterprise.

A LARGE TELEPHONE SYNDICATE.—The Consolidated Telephone Co. has been formed at Buffalo, N. Y., with a capital [illegible] adjoining States.

STANLEY STOCK.—It is stated from Philadelphia that the Stanley Electric Mfg. Co., of Pittsfield, has increased its capital [illegible]

A PHILADELPHIA VIEW.—The "Wall Street Journal" has the following: An Electric Storage Battery Co. interest says: "The purchase of the Stanley Electric Mfg. Co. was a great stroke of business for the Electric Storage Battery Co. The Battery Company has never entered this field before, but the Stanley Company makes the same line of goods that the General Electric and Westinghouse companies do. The Stanley Company can be used as a 'club' by the Battery Company in competing with the other two companies for electrical plant equipment, much to its advantage. It will now be able to contract for the dynamos and motors of a plant as well as for the storage battery, and the company can show the consumer that he can put up a smaller plant than would be necessary without a storage battery. Although the Electric Storage Battery Co. may not directly take over the Stanley Mfg. Co., it will be controlled by the same people."

AMERICAN RAILWAYS COMPANY.—The gross earnings of the American Railways Company for the month of May, 1902, amount to $97,701, as against $73,406 for the corresponding month of the previous year, showing an increase of $24,295. These earnings include the full operation of the Chicago & Joliet Electric Railway Company, whose earnings increased from $12,905 in May, 1901, to $24,782 for the month of May, 1902, a change of almost one hundred per cent. The gross earnings for 11 months of this year and last compare as follows: In 1901-2, they were $908,550; in 1900-1 they were $763,959.

PENNSYLVANIA-NEW YORK TUNNEL.—For its right to enter New York City by an electric road under the Hudson, the Pennsylvania Railroad has agreed with the New York Board of Rapid Transit Commissioners to pay $75,535 per year for the first ten years for franchise, rights, etc., and $114,871 for each of the next fifteen years. The franchise allows five years for the completion of the work.

A BIG MORTGAGE.—The United States Illuminating Company and the United Electric Light & Power Company, which were merged some time ago, have mortgaged their property to the Union Trust Company. The mortgage is for $10,000,000 five per cent. gold bonds and runs for 30 years, and is subject to the United Electric Light & Power Company's prior mortgage.

COLUMBUS EDISON.—The Columbus, O., Edison Company is to issue $100,000 of preferred stock at par, to be allotted to the stockholders of both preferred and common stock in the proportion of one share of new stock for eight shares of stock held by the stockholder.

THE ELECTRIC COMPANY OF AMERICA has notified its stockholders that by resolution of the board of directors, duly authorized by the stockholders thereof, a final assessment, being the sum of $2.50 per share, has been levied and is now called for.

Commercial Intelligence.

THE WEEK IN TRADE.—In summarizing the situation in trade *Bradstreet's* states that the conditions governing present and future trade show very sharp contrasts, the immediately present situation being clouded by the rather less favorable industrial outlook and the prospect of an extension of the coal strike in the bituminous fields. The continued favorable progress made by all the leading crops lends assurance that once the present strained condition of industrial affairs is relieved, a large and prosperous fall and winter business is assured. The scarcity of pig iron is causing a noticeable stiffening in prices. Structural material and bar iron are strong, but wire and sheets are dragging. An order for 28,000 tons of steel rails for South Africa for delivery this year has been refused because of orders ahead preventing delivery. The business failures of the week, as reported by *Bradstreet's*, numbered 177 as against 165 the previous week and 188 the same week last year. The copper market remains dull and without feature. There was little business and little offering to sell. Lake is quoted at 12¼@12½c., electrolytic in cakes, wire bars and ingots, 12@12½c., in cathodes, at 11¾@12c. and casting stock 12c.

VARIOUS HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., reports having recently received several orders for their engines. The Gould Coupler Company for installation in its Depew, N. Y., plant, for both light and power use, has ordered a 300-hp. Harrisburg standard engine, which is to be direct connected to a 200-kw. generator to be built by the Bullock Electric Manufacturing Company, of Cincinnati, O. The Salts Textile Manufacturing Company, of Bridgeport, Conn., has called for a 120-hp. standard engine for direct connection to a 75-kw. generator of the Walker type built by the Westinghouse Electric and Manufacturing Company. These machines are to be used for light and power. J. E. Doane, of Thompson, Conn., has ordered a complete steam plant from the Harrisburg people for lighting his private estate. It will consist of a 120-hp. standard engine and a 75-kw. generator built by the Stanley Electric Manufacturing Company, of Pittsfield, Mass. The Thompson-Starrett Company, of New York, has ordered nine Harrisburg engines, aggregating 965 hp. One 225-hp., one 150-hp. and two engines, each of 120-hp. standard engines direct connected to 150-kw., 100-kw. and 75 kw. generators, built by the General Electric Company are to be installed for light and power use in a new apartment house at Sixty-seventh Street and Broadway, New York. In an apartment house on Thirty-fourth Street near Seventh Avenue, a 120-hp. standard engine and one 75-hp. are to be put in. These engines will be direct connected for light and power purposes to 75-kw. and 50-kw. General Electric generators. In the Pennsylvania Building, Philadelphia, three 75-hp. Harrisburg standard engines, direct connected to 50-kw. General Electric generators, are to be installed. These sets are intended for lighting use only. The People's Electric Light and Power Company, of Easton, Pa., has placed an additional order with the Harrisburg people for a 450-hp. tandem compound vertical engine for direct connection to a Northern generator of 300-kw. capacity, also for a 150-hp. belted engine to be used in connection with a 100-kw. Northern generator.

SOME FOREIGN AND DOMESTIC C & C ORDERS.—The C & C Electric Company, of Garwood, N. J., reports receipt within the last ten days of a number of contracts for the foreign and domestic markets. The Montezuma Lead Company of Mexico has placed an order—the third one—for a 65-kw. generator and switchboard for power purposes, and a cable order received from Chas. R. Heap, of London, S. W.—the C & C Company's representative in Great Britain—calls for the immediate shipment of five dynamos and motors of various sizes. Lyon & Healy, the big music publishers of Chicago, have sent a second order for a 150-kw. generator to be direct connected to a 225-hp. engine to be built by the Ames Iron Works, of Oswego, N. Y. This equipment will be used for light and power purposes in the new buildings of the Western concern. The Vulcanized Fibre Company, of Wilmington, Del., has also given a second order for a 40-kw. C & C generator for power use. Four motors varying from 10-hp to 25-hp have been ordered for installation in the Hanover National Bank Building, now under construction at Nassau and Cedar Streets, New York. These motors will be utilized for operating ventilating apparatus. The Monarch Silk Company, of York, Pa., is to be furnished with a 50-kw. engine type generator to be direct connected to a 75-hp. Harrisburg standard engine. This outfit is intended to furnish light. The Central Realty Company, of 907 Seventh Avenue, New York, has ordered two 50-kw. generators and one 30-kw. machine for installation in new apartment houses and the Seaboard Realty Company, of 127 West Forty-second Street, has called for six 75-kw. generators and four 60-kw. generators, also for apartment houses, where the machines are to be used for both light and power purposes.

WIRING AND CONDUIT ORDERS FOR PHILIPPINES CRUISERS.—F. W. Horrie, of Yokohama, the pioneer and largest handler of American machinery in the Far East, who, it will be recalled, is now in the United States placing large contracts—some particulars of which have already appeared in these columns—has given an order valued at nearly $10,000 to Joseph Barr, of New York, for the wiring requisite for ten of the fifteen cruisers now under construction in Japanese and Chinese shipbuilding yards for the Philippines Insular government. R. B. Corey, of New York, has been allotted an order by Mr. Horrie for loricated conduit for use in these vessels. Mr. Horrie will be in this country for some three weeks yet, and expects to close some further contracts in the interim. He is stopping at the Hotel Manhattan. Downtown he may be found at the offices in the Maritime Building, Bridge Street, of Alfred H. Post & Company.

EDDY PLANT SOLD.—The property of the Eddy Electric Company of Windsor, Conn., has been sold by order of the Superior Court of Connecticut for $35,000. The purchaser was Mr. Hinsdell Parsons, presumably for the General Electric Company.

ELECTRICAL EXPORTS FROM SAN FRANCISCO.—The exports of electrical material from the port of San Francisco, during the month of May reached a valuation of $10,658.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended June 21, 1902. Argentine Republic—117 pkgs. material, $3,914. Amsterdam—1 pkg. machinery, $119. Antwerp—12 pkgs. material, $257, 3 pkgs. machinery, $224. Berlin—3 pkgs. material, $65. British Australia—1 pkg. material, $44. Brazil—41 pkgs. material, $1,178; 11 pkgs. machinery, $3,346. British East Indies—1 pkg. material, $13. British West Indies—62 pkgs. material, $1,639. Cuba—11 pkgs. material, $235. Chile—4 pkgs. material, $932. Copenhagen—2 pkgs. machinery, $52. Dutch West Indies—5 pkgs. material, $43. Dutch Guiana—2 pkgs. material, $26. Ecuador—67 pkgs. material, $390. Glasgow—49 pkgs. machinery, $2,843; 32 pkgs. cable supplies, $14,040. Havre—19 pkgs. material, $355. Hamburg—37 pkgs. machinery, $2,403; 135 pkgs. goods, $8,492. Lisbon—1 pkg. material, $36. London—23 pkgs. machinery, $3,330; 181 pkgs. material, $2,987. Liverpool—262 pkgs. machinery, $16,018; 28 pkgs. material, $1,085. Mexico—122 pkgs. material, $3,229; 35 pkgs. machinery, $1,625. Manchester—26 pkgs. material, $1,261; 99 pkgs. machinery, $10,934. Marseilles—11 pkgs. material, $125. Newfoundland—7 pkgs. material, $180. New Castle—10 pkgs. machinery, $640. Novorossick—1 pkg. machinery, $36. Nova Scotia—4 pkgs. material, $229. Peru—13 pkgs. material, $170. Rotterdam—2 pkgs. machinery, $85. Southampton—2 pkgs. material, $136; 241 pkgs. machinery, $10,875. U. S. Colombia—24 pkgs. material, $928. Uruguay—3 pkgs. material, $45.

INDUCTION MOTORS AT THE CONTINENTAL IRON WORKS.—The Continental Iron Works, of Brooklyn, N. Y., the builders of the famous "Monitor," have recently purchased from the Westinghouse Electric and Manufacturing Company considerable additions to their electrical equipment. The purchase includes a 180-kw., 220-volt, 60-cycle, two-phase alternator, a five-panel switchboard, eleven induction motors of from 5 to 20-hp. each, with the accompanying auto-starters. The company some time ago installed alternators of 120-kw. and 45-kw. each, and of the same characteristics as the above. They also have quite a number of induction motors in use driving corrugating and bending rolls for making fire-boxes, also driving fans, shears, tools in the machine shop, etc. Some of the motors which have recently been purchased are to displace direct-current motors, the original installation at this particular plant having been of direct-current apparatus. Afterwards a 45-kw. alternator was put in to try alternating current distribution and subsequently the 120-kw. and 180-kw. alternators have been purchased. The direct-current motors are rapidly being replaced by alternating-current induction motors, and this is after a thorough and careful investigation of the subject and several years' trial of the induction motors. In fact, when the new 180-kw. alternator is installed, the old direct-current generator will be used as an exciter, also furnishing current to one or two small direct-current motors which will be used for a while until they are worn out.

THE ARNOLD MAGNETIC CLUTCH COMPANY.—A matter of more than usual interest in the electrical manufacturing field is the recent formation, in Milwaukee, of the Arnold Magnetic Clutch Company with $100,000 capital, to manufacture magnetic clutches of the design of B. J. Arnold as patented and used by Mr. Arnold in power station work; also magnetic clutches for other important purposes. The officers of the Company are well known in the electrical field and consist of F. R. Bacon, president; H. H. Cutler, vice-president; A. H. Berresford, secretary; F. L. Pierce, treasurer, and Bion J. Arnold, consulting engineer. Land has been purchased at Milwaukee, and a factory equipped with special tools suitable for this work will be in operation within the next three months. The company will not be in shape, however, to deliver clutches until its factory is completed. In the meantime a large number of designs will be developed for various purposes including, in addition to the Arnold clutches now in use, some new types upon which H. H. Cutler has been working. This will be the pioneer manufacturing company in a hitherto almost uncultivated field of magnetic clutch work, and the completion of the factory and the announcement of designs will be awaited with great interest.

WESTINGHOUSE CONTRACTS.—The Tom Boy Gold Mines, of Pandora, Colo., are being equipped throughout for electrical power distribution. A recent purchase from the Westinghouse Electric & Mfg. Co. includes a number of induction motors, reducing transformers, "low-equivalent" lightning arresters with choke coils and high-tension circuit breakers. The Riter-Conley Mfg. Co., of Pittsburg, Pa., has recently decided to adopt alternating-current motors exclusively for power distribution. It has purchased three 200-kw. engine-type Westinghouse generators which are to be direct connected to Westinghouse gas engines using natural gas. Alternating currents will be used for all work, including cranes, and a number of induction motors will be geared directly to straightening rolls. The Steubenville & Wheeling Traction Co. has just purchased two 500-kw Westinghouse railway generators, to be used in the operation of an electric railway running from Steubenville, Ohio, to Wheeling, W. Va., and, also, a line from Wellsburg to Wheeling.

THE ELECTRICAL EQUIPMENT COMPANY, Suite 939 Monadnock Block, Chicago, Ill., has been awarded a contract for the complete installation of a 2500-hp. electric transmission plant, located on the St. Joe River, at Constantine, Mich. The equipment includes six 400-hp. and two 60 hp. water wheels to operate under a twelve-foot head. The main drive will be divided into two sections, with three of the larger wheels geared to each shaft, which is direct connected to a 600-kw. revolving field, alternating current generator. Each of the small wheels will be direct connected to a 35-kw. direct-current generator to furnish exciting current for the alternators. In addition to furnishing power for manufacturing purposes, the commercial and city lighting of Constantine, Three Rivers, and White Pigeon will be operated from this plant. Several new industries, including a calcium carbide plant will be located at Constantine to utilize this power. The plant will be in operation December 1, 1902.

ELECTRICITY IN THE ORANGE GROVES.—The San Antonio Water Company of Ontario, Cal., Mr. W. H. Sanders, chief engineer, has just placed an order with the Abner Doble Company of San Francisco, for a third water wheel unit to be installed at its power plant which is now in course of construction in the Sierra Madre Mountains. These three wheel units are designed to develop 460-hp. each at 375-rpm. under a total head of water of 694 feet, and will be direct connected to 250-kw. General Electric generators. With the water wheel units will be furnished "Doble" needle regulating nozzles controlled by Lombard governors. The power developed will be transmitted to the orange groves in the vicinity of Ontario, Cal., and will be utilized for actuating motor-driven pumps for irrigating purposes. The stockholders of this company are the principal orange growers located in that section of the country.

A 2290-HORSE POWER WESTINGHOUSE GAS ENGINE PLANT.—The water works department of the city of Philadelphia has just placed a contract for what is said to be the largest of its description ever awarded in the United States for gas engines to be installed in a municipal plant. The contract, which was secured by W. C. Muckle, Jr., & Company, of Philadelphia, acting as agents for Westinghouse, Church, Kerr & Company, calls for a plant of 2290-hp. capacity. There are to be eight three-cylinder engines of 280-hp. each and two of 125-hp. They are intended to be direct-connected to pumps for the purpose of increasing the water service of the city fire protection system.

THE SAN GABRIEL ELECTRIC CO., of Los Angeles, Cal., has recently purchased a 750-kw., two-phase, engine-type Westinghouse generator which is to be installed in a substation of the Pacific Light & Power Co. The latter company has recently acquired the San Gabriel Company and the new alternator will be used in connection with its general system of lighting and power in Los Angeles and the vicinity.

STORAGE BATTERIES IN CUBA.—The Electric Storage Battery Company of Philadelphia announces that Mr. G. F. Greenwood, 34 Empedrado Street, Havana, Cuba, has been appointed agent for the sale of "the Chloride accumulator" in Cuba. All inquiries and business from that section should be forwarded to Mr. Greenwood and will receive from him prompt attention.

NEW TRACTION PROJECT IN BUENOS AYRES.—Varela Cuneo & Company, of Buenos Ayres, Argentine Republic, are expected to decide by July 31 as to the construction of a new electric traction system from Rivadavia, located on the outskirts of Buenos Ayres, going to the Tigra and passing through all the northern suburbs.

LIGHTING EQUIPMENT WANTED IN SOUTH AMERICA.—The River Plate Electric Light and Traction Company has closed a contract with the municipality of Rosario for the lighting of that South American city and will let contracts shortly for power house equipment, cables, etc.

MICA WORKS.—The General Electric Company has, it is stated, purchased property in the city of Ottawa, and has now a large force of men at work in improving the buildings and fitting them up for operation. Machinery is also being installed for the purpose of sorting and trimming mica.

THE SAN LUIS ELECTRIC COMPANY, of San Luis Potosi, Mexico, is about to considerably extend its operations. Chief Engineer Corbett and General Manager Waddell are now in the United States getting figures on equipment.

General News.

THE TELEPHONE.

ST. AUGUSTINE, FLA.—The Southern Bell Telephone Company has obtained the privilege of building long distance lines. A line to Jacksonville will be built and later a line to Palatka and other points connecting with the southern long-distance circuit.

TALLAPOOSA, GA.—The Gainsboro Telephone Company is installing a $2,000 exchange. The company has constructed some 200 miles of lines.

ATLANTA, GA.—C. J. Simmons, one of the receivers of the Standard Telephone Company, has filed his bond of $20,000 with the National Surety Company, of New York. The work of the telephone company will in no way be affected by the receivership.

TROWBRIDGE, ILL.—The Trowbridge Mutual Telephone Company has been incorporated, with a capital stock of $1,500. The incorporators are Henry C. McClory, John C. Quinn and Barnard Wilson.

HARDIN, ILL.—The Calhoun Telephone Company will lay a cable across the Illinois river at the Deer Plain Ferry, and connect with the Bell Telephone Company long-distance line at Grafton.

CHICAGO, ILL.—The Marissa Telephone Company, of Marissa, has been incorporated by J. A. Hamilton, Henry Finger and R. S. Coulter; capital, $2,500.

SPRINGPORT, IND.—The Springport Telephone Company has been organized with a capital of $4,000.

WINCHESTER, IND.—The Eastern Indiana Telephone Company has increased its capital stock to $5,000. New lines will be built and new cables installed.

VINCENNES, IND.—The Knox County Telephone Company has incorporated with a capital stock of $25,000; incorporators: W. H. Vallmer, Vincennes; D. A. Yoder, Cleveland, O.; Slinkard, Bloomfield, and J. E. Gardner, Bryan, O.

BLOOMINGTON, IND.—The Monroe County Telephone Company has filed articles of incorporation. The company's capital is placed at $5,000. The directors are A. F. and Arra McCormick, J. A. Luzzarder, F. P. Woodard and H. A. Leed.

BRAZIL, IND.—The Citizens' Telephone Company, of Clay County, has filed articles of incorporation. Capital stock, $50,000. The directors are J. G. H. Klingher; S. M. Siegter, M. J. Murphy, T. W. Englehart and H. D. Falls, all of Brazil.

ANDERSON, IND.—The county commissioners of this (Madison) county have granted a franchise to the Anderson Telephone and Telegraph Company, of Indiana, to construct and operate its lines throughout the county. The company is building a line from Indianapolis to Marion through this city. The terms of the franchise are that the company pay the county $360 and furnish the county offices free instruments. The commissioners at the same time caused the arrest of a crew of workmen for the American Telephone Company which had proceeded to distribute poles and wires along the public highways without right. The American Company had applied for a franchise, but refused to comply with some of the demands of the commissioners and the franchise was not granted.

MOVILLE, IA.—The Arlington Telephone Company has been organized with a capital of $5,000.

DES MOINES, IA.—Whitebreast Mutual Telephone Company of Lacona has been incorporated; capital, $1,000.

CARROLL, IA.—The Harris Jewell Telephone Company has been organized with A. C. Steel as president.

MARSHALLTOWN, IA.—The Cedar Valley Telephone Company has just completed the construction of a new line from Eagle Center to Hudson.

BARBOURVILLE, KY.—The Knox Telephone Company has been granted a franchise to operate a line to Corbin. Branch lines to various county points will also be built.

NEW ORLEANS, LA.—The Cumberland Telephone and Telegraph Company has been granted the privilege by the Railroad Commission to abolish its ten party lines, thus doing away with its cheaper service. There are about 500 subscribers to the ten party line service.

IRON MOUNTAIN, MICH.—At the recent annual meeting the Menominee Range Telephone Company re-elected old directors and declared a dividend of eight per cent. Despite the strong opposition of the Bell company the new company is exceedingly prosperous. Eight exchanges and two toll stations are maintained. A number of extensions are planned.

SEDALIA, MO.—The Queen City Telephone Company, of this city, has filed articles showing that it had increased its capital stock from $50,000 to $100,000.

ALEXANDRIA, MO.—The Illinois Western Telephone Company, of Illinois, has filed articles showing a capital stock of $200,000, of which $50,000 is to be used in Missouri, with an office at Alexandria.

ADRIAN, MO.—The telephone system recently completed here by the Austin Inland Telephone Company has been formally opened to the public. The company will soon connect this place with the neighboring towns of Austin, Altoona, Butler, Burdette and Harrisonville.

[illegible] is about to install in its plant a private telephone system of about 40 stations. There will be no control.

[illegible], N. J., capital, $100,000. Incorporators: Henry M. Black, New York City; M. Warner Hargrove, Brown's Mills, N. J., and William H. Reeves, New Lisbon, N. J.

ALBANY, N. Y.—The East Fishkill Telephone Co., of Hopewell Junction, Dutchess County; capital, $5,000, has been incorporated. Directors: H. D. White, Charles Underhill and John Rapelye, of Hopewell Junction.

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph Co. is rebuilding all its toll lines and is putting them on a copper metallic basis. The company has lines in nine counties and 1,200 miles of line will be rebuilt.

CHADBOWN, N. C.—The Columbus Telephone Company has been chartered with a capital of $5,000. The incorporators are T. G. Hyman, F. R. Hyman and C. B. Hyman.

GREENSBORO, N. C.—For the purpose of foreclosing a mortgage held by L. W. Floyd and G. A. Browning, the property of the Home Telephone Company will be sold by A. G. Furman, trustee, at public auction.

BEREA, OHIO.—The Citizens' Telephone Company will install an exchange at Royaltown.

OXFORD, OHIO.—The Oxford Telephone Company has secured a franchise in Oxford.

LONDON, OHIO.—The Madison-Clark Telephone Company will build an exchange at South Solon.

CADIZ, OHIO.—The Harrison County Telephone Company is installing an exchange at New Athens.

BARTLETT, OHIO.—The People's Telephone Company of Washington County has increased its capital stock from $2,000 to $5,000.

SPENCERVILLE, OHIO.—The Spencerville Telephone Company has increased its capital stock from $20,000 to $40,000 to provide for improvements. Albert C. Buss is president.

YOUNGSTOWN, OHIO.—On account of the recent increase in rates by the independent company, the Retail Grocers' Association is debating the advisability of adopting only one telephone system and all using it.

LONDON, OHIO.—Manager N. E. Liggett, of the Marysville Telephone Company, has bought out the Plain City Company operating the line between Marysville, New Dover and Watkins. The lines will be rebuilt.

FINDLAY, OHIO.—The Central Union Telephone Company has announced the second cut in rates within two months. The Findlay Home Telephone Company is making a strong bid for business, and the cut is the result.

YOUNGSTOWN, OHIO.—After July 1 the rates of the Youngstown Telephone Company will be increased from $18 to $24 for residences and from $25 to $36 for business. Business houses can secure service on a party line of two at $24.

VERMILLION, OHIO.—The Vermillion Telephone Company has organized with the following officers: E. L. Coen, president; R. F. Quigley, vice-president; C. C. Barnhart, secretary; Charles H. McGraw, treasurer. The company has secured 100 contracts and will commence operations as soon as possible.

CLEVELAND, OHIO.—Drake, Barnes & Company, of this city, have secured a perpetual franchise to operate telephone exchanges at Clearfield and Curwinsville, Pa. The franchise previously secured by the Bell company has been rescinded. The Clearfield Telephone Company will be incorporated to operate exchanges in both places.

CANTON, OHIO.—Strike of the linemen employed by the Stark County Telephone Company has been adjusted by concessions on both sides. In the future the men will receive $2.50 per day, regular foreman $3 and general foreman $3.50. Nine hours constitutes a day's work; time and a half for overtime and double time for holidays.

GALION, OHIO.—The Galion Telephone Company, which was recently sold by the Federal Telephone Company, has been reorganized with the following officers: Mark Cook, Mt. Gilead, president; U. A. Whitney, Mt. Gilead, vice-president; S. M. Wolf, Bellevue, treasurer; John W. Cupp, Galion, secretary; C. R. Callaghan, Bellevue, general manager.

CINCINNATI, OHIO.—The Cheviot, Mt. Airy & Groesbeck Telephone Company has been incorporated with $5,000 capital, to extend and operate a telephone line in Hamilton County. The principal office will be at Cheviot. The incorporators are: Robert R. Conger, Fred. C. Walhers, Avery Markland, Frank W. A. Bonner, Henry Frendorf, Nick Ruehel and George L. Ruehel. The company will operate an independent line from Mt. Airy to Groesbeck, to Cheviot, and eventually to Cleves. It is understood that in course of time the new company will take in the other telephone lines in that part of the county.

CLEVELAND, OHIO.—The Everett-Moore syndicate recently took under consideration a proposition made by leading independent telephone people of Columbus, Dayton and other large cities for the sale to the latter of the long distance lines of the United States Telephone Company, the total capital stock of which company is owned by the Federal Telephone Company. It is authoritatively announced that the deal has been declared off and that in all probability the United States long distance system will remain in the hands of the Everett-Moore people.

COLUMBIA, S. C.—Three new telephone companies have just been commissioned in South Carolina, viz.: The Lancaster Telephone Company, capital $5,000, J. T. Thompson being interested; the Bedford Telephone Company of Yorkville, capital $5,000, by W. B. Moore and W. W. Lewis, and the Blacksburg Telephone Company, capital $3,000, by W. B. Moore, of Yorkville, and A. M. Bridges, of Blacksburg.

KNOXVILLE, TENN. The Cumberland Telephone Company has begun a telephone line into Clear Fork Valley.

FORT WORTH, TEX.—Lancaster Telephone Company has been incorporated; capital stock, $10,000.

BARTLETT, TEX.—The Bartlett-Walberg Telephone Company has been chartered by W. P. Powell, O. H. Ward and J. T. Bartlett, capital, $2,000.

CHARLOTTESVILLE, VA.—The Bell Telephone Company has been refused a franchise to enter Charlottesville.

LYNCHBURG, VA.—The Council Committee has refused to renew the Bell Telephone Company franchise [illegible] rate for service. The Bell representative has refused to assent to this.

GOOCHLAND, VA.—The Goochland Telephone Company is pushing west to Silking and east to Oilville, a total distance of about 16 miles. A circuit from Goochland direct to Richmond will be commenced at once.

WARRENTON, VA.—The Upper Fauquier & Warrenton Telephone Company has been organized and the following officers elected: J. B. Beverly, president, R. W. Hilleary, vice-president, and R. A. McIntyre, secretary and treasurer.

RICHMOND, VA.—Four telephone companies have just filed charters to operate in Virginia, as follows: The Merchants' and Farmers' Telephone Company, of Hanover County, $1,000 to $10,000 capital, H. D. Kerr, of Ashland, is interested. The Farmers' Mutual Telephone System, of Shenandoah County, capital $500 to $5,000. The Buckingham Telephone Company, $500 to $5,000, R. S. Ellis, president. The Farmers' Mutual Telephone Company, of Prince William County, capital $50 to $5,000, C. T. Brower, president.

MADISON, WIS.—The Dane County Telephone Company, with a capital of $10,000, has been incorporated by J. C. Harper, H. C. Winter and H. J. Sutherland.

ASHLAND, WIS.—The Ashland Home Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are C. A. Lamoreaux, J. I. Levy and G. E. Bement.

ELECTRIC LIGHT AND POWER.

TALLADEGA, ALA.—The Talladega Company has secured a franchise for lighting and traction and will have a generating plant at Jackson's Shoals.

SAN FRANCISCO, CALIF.—The Princeton Mine at Mt. Bullion, Mariposa County, Calif., will install 20 additional stamps this summer and adopt electric power.

SAN DIEGO, CALIF.—The City Engineer of San Diego has been instructed by the City Council to make estimates as to the cost of a municipal electric lighting system.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company is building the dam for its new 12,000-hp. electric power plant in Butte County, Calif. Pipe lines will conduct the power water from the dam to the new generating station near Nimshew.

EUREKA, CALIF.—The Eureka Lighting Company's main electric generating station at the corner of First and C Streets, has been destroyed by fire. The estimated loss was $50,000. The town was left in darkness with the exception of a few incandescent lights.

SAN FRANCISCO, CALIF.—The contract for installing the electric motors and pumps for the new water system that is to supply the Salt Lake County farmers with irrigation water has been awarded to J. H. Gardner, superintendent of the Utah Sugar Company. Four pumps will be driven by four Westinghouse motors.

LOS ANGELES, CALIF.—The Western Power Company, of Los Angeles, has commenced work on its electric transmission system in Plumas County. Roads are being opened at several points under the supervision of J. M. Howells, manager and consulting engineer. The waters of the North Fork of Feather River will be diverted and stored. An electric transmission plant is to be installed that will in time be connected with San Francisco.

SAN FRANCISCO, CALIF.—The Supervisors' Committee on Lights recently rejected all proposals for public lighting except those of the San Francisco Gas & Electric Company and the Independent Electric Light & Power Company. The Independent Company offered to light 19 small buildings, including fire-houses, at $.039 cent per kw. hour and the Gas & Electric Company the remaining buildings at $.028. All of the street lighting bids were rejected as too high and also because the charter forbids the city paying any higher rates than the minimum allowed other consumers. At the rates bid it would cost annually $258,560 to keep the streets lighted every night in the year.

SAN FRANCISCO, CALIF.—The Stanislaus Water & Power Company, of San Francisco, will hold a stockholders' meeting on July 21st for the purpose of acting upon a proposition to create a bonded indebtedness to the amount of $2,500,000. The company will install a power plant and transmit current from the Stanislaus River to San Francisco. It will work in harmony with the Standard Electric Co. The Kern River Company, of Los Angeles, has closed contracts for the building of a 12-mile canal, which will convey 30,000 miner's inches of water to the site of the company's electric power plant. The generating station will have a capacity of 15,000 hp. Large grading and lumber contracts have been let and machinery will be ordered at once, but it will probably be nearly a year before the electric manufacturing companies can make deliveries. Electric power will be transmitted to Los Angeles for the use of the Huntington-Hellman syndicate on its electric car lines, to the Pacific Electric Power Company for light and power and to the Redondo Railroad Company for the operation of cars. Electricity will be transmitted also to Bakersfield, Randsburg and San Bernardino and other places. The San Bernardino line is now being constructed. A double pole line 110 miles in length will be built to Los Angeles. Auxiliary steam power plants will be established and kept in reserve.

AUGUSTA, GA.—The Augusta Railway and Electric Company is making great improvements at its plant in Augusta. A 650-hp. Green-Corliss engine has been installed and belted to a direct-current General Electric generator. At the west station twin horizontal turbines have been installed and connected with a 1000-hp. generator.

ATLANTA, GA.—An application for a charter for the Atlanta Manufacturing and Improvement Company, of Atlanta, Ga., capitalized at $300,000, has been filed. The privilege is asked in the charter for increasing the capital to $1,000,000 if necessary. The company proposes to furnish electric power for manufacturing concerns in and about the city.

VENICE, ILL.—Negotiations are under way by St. Louis investors to purchase the Electric Light and Power Company's plant in this city. The plant also furnishes power and light to Brooklyn.

SPRINGFIELD, ILL.—The Lamont Electric Light Company, of Lamont, has been incorporated; capital, $20,000. Incorporators: J. G. Bodenshatz, E. L. Huston and Hubert Sauber.

MUNCIE, IND.—The Muncie Electric Light Company has increased its capital stock from $25,000 to $1.5,000. H. C. Kimbrough is president of the company.

HARTFORD CITY, IND.—This city is in darkness, the electric light plant is fatherless, and consequently abandoned. The city denies the ownership of the plant and the American Light Company, which installed it, holds that it is the city's property. Litigation may result.

COVINGTON, KY.—The Union Light, Heat and Power Company has been refused an injunction to prevent the city of Covington from issuing municipal light bonds and the city clerk accordingly has advertised for bids for a bond issue of $75,000 par value.

HAGERSTOWN, MD.—It is proposed to dam the Potomac River about 15 miles from Hagerstown and build an electric power house, from which power will be transmitted to Martinsburg, Hagerstown, Williamsport and other places. It is the intention of the promoters to use the power for the operation of street railways and electric lighting in the various towns. Work on the power plant has already begun.

COHASSET, MASS.—The Cohasset Electric Co. is about to install a compound engine, built by the Ball Engine Co., Erie, Pa.

OCEAN SPRINGS, MISS.—John D. Gray has been granted a franchise to operate an electric light and ice plant.

OKOLONA, MISS.—Sealed proposals for the Okolona, Miss., $40,000 5 per cent. water works and electric lighting 20-year bonds will be received until June 30.

RATON, N. M.—The sum of $20,000 will be expended in increasing the capacity of the electric lighting system in Raton. A 200-hp. engine will be installed and an alternating current system will replace the direct.

ALBANY, N. Y.—The Easthampton Electric Light Company, Easthampton, Suffolk County, has been incorporated; capital, $48,000. Directors: Everett Herrick, New York; G. L. McAlpin, S. S. Quackenbush, Easthampton.

COLUMBUS, OHIO.—An electric lighting plant is to be installed in the Palace Hotel.

BUCYRUS, OHIO.—G. A. Myers of this place has secured lighting franchises at Navarre and Strasburg, Ohio. He will organize companies to build the plants.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway Company has secured lighting franchises in Georgetown, Mt. Washington, Amelia and Bethel.

MARYSVILLE, OHIO.—At a recent meeting of the Marysville Light & Water Company Howard Jones was elected to succeed G. M. McPeck as secretary of the company.

CALEDONIA, OHIO.—The C. D. Resler Electric Light & Power Company has been incorporated with $5,000 capital stock. Officers have been elected as follows: C. D. Resler, president; J. K. Rogers, vice-president; C. E. Kelley, secretary; E. S. Geddis, treasurer; C. D. Resler, general manager and superintendent.

GALLIPOLIS, OHIO.—The village clerk of Gallipolis will receive bids to July 15 on 100 arc lamps, 10 three-glower Nernst lamps and 50 16-cp. incandescents. The village will grant a franchise to 10 years for a company which will install a generating plant of 150-kw. or greater, capacity, and will assist in securing business.

SPRINGFIELD, OHIO.—The Citizens' Heating & Power Company has been granted a 25-year franchise for light, heat and power in Springfield. The company is required to pay one per cent of gross receipts from five to ten years, two per cent. from ten to fifteen years and three per cent. from fifteen to twenty-five years.

NILES, OHIO.—The Empire Iron & Steel Company is building a plant at Niles, consisting of six sheet mills, bar mill and squeezers, with scrap and puddling furnaces, waste heat boilers, steel buildings, trestle tracks for unloading, cranes, shears, machine shop and all small machines to operate by electricity. The power plant will comprise Allis engines and Sterling and Cahall boilers.

WINNSBORO, S. C.—The most interesting question at this time is that of issuing bonds to the amount of $10,000 for installing an electric light plant.

COLUMBIA, S. C.—The Cotton States Electric and Machine Company recently reorganized and dealing in electrical supplies, has increased its capital from $5,000 to $15,000. The company has on hand several lighting contracts.

AMARILLO, TEX.—The Amarillo Light & Water Company is erecting an electric light plant, equipped with two 45-kw. General Electric 220-volt dynamos, 12x13 Case automatic high-speed engine and two 125-hp. Morrison internal fired boilers, and water works system equipped with three Cook deep well pumps. The officers are John. W. Porter, president; H. B. Jones, vice-president and general manager; and E. L. Dohany, Jr., secretary and treasurer.

BRISTOL, VA.—The Ordway Manufacturing Company is erecting an electric power plant and proposes to furnish power to numerous industires.

MILWAUKEE, WIS.—The City is considering a site on Jones Island for the proposed city electric lighting plant.

[illegible] is taking steps towards utilizing the water power of the Kootenay River to obtain an increased supply of electrical energy for light and power.

OTTAWA, ONT.—It is learned that the Burleigh Falls Power Company, of Peterboro. Ont., has purchased the Buckhorn Falls power outright. The falls furnish 2,000 horse power. The Burleigh Falls supply 5,000 horse power, and the company, of which Mr. Alex. Culverwell is president, has a deal on whereby a syndicate of New York capitalists has been formed and will establish a plant on a big scale to furnish power to Peterboro, Port Hope, Coburg, and other towns in Central Ontario. The Buckhorn Falls are situated about 18 miles from Peterboro.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The franchise for an electric street railway line in Stockton, Calif., was recently sold to H. H. Griffith, the original applicant.

SAN FRANCISCO, CALIF.—It is reported that within a short time an electric railway will be commenced from San Diego to National City. John D. Spreckels, who controls the electric railway line in San Diego, is behind the new enterprise.

SAN FRANCISCO, CALIF.—The San Francisco, Oakland & San Jose Railway Company, which has been incorporated in Oakland, Calif., with capital stock of $5,000,000, by F. M. Smith, F. C. Havens and others, will take the place of the San Francisco & Piedmont and the Oakland & San Jose Railway companies. The new company purposes constructing a tunnel from Goat Island to Oakland. An electric railroad will extend through Emeryville, Piedmont and Haywards. There will be an extension to San Jose. From San Jose there will be three branches, one to Los Gatos, 15 miles; one to Santa Clara, three miles, and one to Saratoga, 15 miles. The main line and branches will have a total length of about 93 miles..

HARTFORD, CONN.—The organization of the Willimantic & Southbridge Street Railway Company has been effected. Contracts for the construction of the road were authorized to be given out, for which bonds will be issued.

WASHINGTON, D. C.—The Washington, Baltimore & Annapolis Railway Company has given out the contracts for grading its electric line between Baltimore and Washington.

RUSHVILLE, IND.—Representatives of an Eastern syndicate have bought the complete right of way across the gas belt from this city to New Castle, Muncie and to Alexandria for a new electric road.

EVANSVILLE, IND.—The Evansville & Henderson Electric Railway Company has been incorporated with $10,000 capital. The directors are C. F. H. Lavell, of Evansville; C. C. Tennis and C. H. Battan, Cincinnati; and H. E. Randall, Dayton, O.

INDIANAPOLIS, IND.—The Richmond & Northwestern Electric Railway Company has been incorporated, with a capital stock of $50,000. Among the incorporators are G. M. Hodges, of Dayton, Ohio; T. B. Millikan, of New Castle, Ind., and Milford Jesup, of Richmond.

INDIANAPOLIS, IND.—The Indianapolis Northern Traction Company has decided on the route for the proposed line to Logansport. The line will take in Noblesville, Tipton, Kokomo and Peru. A large substation will probably be erected at Carmel, between here and Noblesville.

NEW ORLEANS, LA.—The first interurban long-distance electric railway in the South will be built by Boston capital. It will be called the New Orleans and Southwestern Railroad. It will be 90 miles long, running from New Orleans through Hanlonville, Vacherie, Thibodeaux, Houma and other towns of the sugar district to a place on the Gulf coast where there is 18 feet of water.

WATERVILLE, ME.—A. F. Gerald, S. A. Nye and others of Fairfield are promoting an enterprise to build an electric railway between this city and Oakland.

PORTLAND, ME.—The White Mountain Paper Company has bought all the stock of the Fryeburg Street Railway Company, and purposes to construct an electric road to Stowe, Lovell and Chatham, N. H. E. E. Hastings, of Fryeburg, is clerk and treasurer of the new company. The directors are George B. James, Boston; A. C. Kennett, Conway; Col. E. C. Farrington, Augusta; E. E. Hastings and Henry Andrews, Fryeburg.

GREAT BARRINGTON, MASS.—The capital stock of the Berkshire (Mass.) Street Railway has been increased from $200,000 to $750,000, to complete the main line from Cheshire to Great Barrington and to build extensions in Pittsfield.

WORCESTER, MASS.—The Consolidated Street Railway Company has placed an order for four 300 hp water tube boilers with the Aultman-Taylor Company to replace a portion of the battery at the Worcester station. The price is about $20,000. The company has also placed a $60,000 order with the General Electric Company for 25 new closed cars.

PITTSFIELD, MASS.—A controlling interest in the stock of the Hoosac Valley Electric Railway, of North Adams, has been purchased by a syndicate, the members of which are stockholders of the Pittsfield Electric Street Railway. This purchase will bring about a consolidation of these two railways and there will be a continuous route from Pittsfield to Adams, North Adams and Williamstown.

UTICA, N. Y.—The double track trolley line from this city to Frankfort, ten miles to the east, was opened on June 14. This makes a through line from Herkimer to Utica. In ten days the line will be opened to Rome, and in about three months from Herkimer to Little Falls.

MASSILLON, OHIO.—The Massillon, Dalton & Wooster Railway Company also secured a 25-year franchise in Stark County.

CANTON, OHIO.—John Monett, of Canton, is promoting an electric railway touching Sandyville, Bolivar, Zoar and Dover.

LIMA, OHIO.—The Lima, Delphos, Van Wert & Ft. Wayne Traction Company has been granted a franchise to build its line into the center of Lima.

CLEVELAND, OHIO.—The Clevelaand, Elyria & Western Railway Company regular semi-annual dividend of two and one half per cent. on preferred stock on July 1.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company will allot pro rata among present stockholders $100,000 worth of stock which has been held in the treasury.

MT. VERNON, OHIO.—Fred Jones of this place is securing right of way and making surveys for a line from Mt. Vernon to Johnstown. The road would connect with the line from that place to Columbus.

CLEVELAND, OHIO.—Directors of the recently organized Cincinnati, Dayton & Toledo Traction Company have elected officers as follows: M. J. Mandelbaum, president; Will Christy, first vice-president; O. V. Parrish, Hamilton, O., second vice-president; F. T. Pomeroy, treasurer, and H. C. Lang, secretary.

CANTON, OHIO.—The Canton-Akron Railway Company and the Canton-Massillon Railway Company were merged on June 17 under the name of the former company. The capital stock will be increased from $600,000 to $1,600,000. The L. E. Myers Construction Company has been given the contract for building the extension from Navarre to New Philadelphia.

COLUMBUS, OHIO.—From reliable information it is learned that A. E. Appleyard of Boston, representing Tucker & Anthony of Boston, has purchased the Newark (O.) Traction Company line and the Interurban to Granville for the Columbus, Buckeye, Lake & Newark Traction Company. The price paid was several hundred thousand dollars. The road will be extended to Zanesville.

CLEVELAND, OHIO.—The Dayton & Northern Traction Company has given a contract to E. P. Roberts & Company, of Cleveland, for the engineering work for an extension of the road from Greenville to Muncie, Ind., by way of Union City and Winchester, a distance of 46 miles. When this is completed there will be a through line from Cincinnati to Ft. Wayne, Ind., as the Muncie, Hartford & Ft. Wayne Railway is now under construction. Plans are being prepared and actual construction work will start this fall.

PITTSBURG, PA.—The stockholders of the United Traction Company have ratified the action of the directors in the leasing of the Pittsburg & Charleroi Street Railway. The United Traction Company will pay a rental of $35,000 per year.

SKIPPACK, PA.—A company has been formed to build a trolley line between Souderton and Trooper. The directors of the company include E. S. Moser, Collegeville; H. W. Reiff, Lederachville, B. W. Dambly, Dr. J. N. Hunsberger, Skippack; John R. Cassel, Philadelphia; William S. Schultz, Dr. George K. Meschter, Worcester; Rev. W. S. Anders and D. M. Anders, Fairview Village.

DALLAS, TEX.—The Council has passed the Bonta franchise for the proposed Metropolitan Street Railway system. The franchise is estimated to involve an expenditure of over one million dollars in new construction. Mr. Bonta represents the United Electric Securities Company of Boston.

SHEBOYGAN, WIS.—The street car lines in the city have been practically tied up, due to a strike of the motormen and conductors who demand more pay. The company is not in favor of an advance such as asked for and is hiring other help.

TORONTO, ONT.—The employees of the street railway company in this city struck work recently. The strike continued for three days and was settled by the company granting the demands of its employees. During the continuation of the strike there was some rioting and the troops were called out in order to quell the disturbance.

THE AUTOMOBILE.

AUTOMOBILES FOR ELECTRIC LIGHT TRIMMERS.—The Syracuse Lighting Company has given orders to the Century Motor Vehicle Company for electric automobiles to be used by the repair and supply men. They will be equipped with a luggage box to carry 200 pounds and will be of special construction.

LARGE AUTOMOBILE.—A large automobile has just been completed by the White Steam Wagon Co. of Indianapolis, for a St. Louis firm. It is said to have a carrying capacity of 12,000 pounds, has 35 horse-power, with 225 pounds steam pressure, and is 25 feet long and 8 feet wide. The wheels are furnished with 12-inch tires. It is claimed that this is the largest automobile in the world.

NEW INDUSTRIAL COMPANIES

THE OREGON ELECTRICAL ASSOCIATION, of Portland, has been incorporated, with a capital of $1,000. The incorporators are Ed. Cannon, R. W. Willbur and H. W. Hogue.

AN AMERICAN ELECTRIC SECURITIES COMPANY has been incorporated at Jersey City; capital, $300,000. Incorporators: Gustav Levy, A. H. Vanderpool and Martin Nathan.

THE ELECTRIC RAILWAY SIGNAL COMPANY, Kittery, Me., has been incorporated; capital, $100,000. President, W. M. Chapman, Newton, Mass.; treasurer, O. E. Chapman, Boston, Mass.

THE MACHINE ELECTRIC SUPPLY COMPANY has been organized in Indianapolis, Ind. The company will manufacture and repair electrical apparatus. The capital is $10,000. George A. Coldwell is chief promoter.

THE STATES ELECTRIC COMPANY, of Manhattan, New York City, has been incorporated to deal in electric supplies; capital, $1,000. Directors: Sarah A. Miner, Harry L. Stamper, and Jacob H. Lubin, New York.

THE ELECTRICAL SPECIALTIES COMPANY, of Jersey City, has been incorporated to manufacture electrical specialties; capital, $50,000. Incorporators: Horace S. Gould, John J. Billings and K. K. McLaren.

THE AMERICAN ELECTRIC IMPROVEMENT COMPANY, capital, $1,000,000, has been incorporated at Trenton, to manufacture electrical appliances. Incorporators: H. G. Bleakly, E. G. C. Bleakly and H. E. Stockwell.

THE NORTHERN ALUMINUM COMPANY, LTD., has been incorporated at Quebec with a capital of $500,000. The incorporators are Arthur V. Davis, of Pittsburg; F. A. Stoughton, G. G. Foster, Samuel G. Archibald and S. F. Belnap, of Montreal. The company has its buildings all erected and is already at work.

THE MULTIPLEX TELEGRAPH MANUFACTURING & EQUIPMENT COMPANY, of Jersey City, has been incorporated to manufacture telegraph appliances; capital, $100,000. Incorporators: W. E. Athearn, W. A. Van Orden, L. B. Foley, A. Kline, F. L. Blendinger, J. C. Willever, E. P. Griffith, Herbert Smith and Robert H. Morris.

THE PEERLESS COMPANY, of Warren, Ohio, has been incorporated with $500,000 capital stock to manufacture electrical supplies. Incorporators: T. H. Gilmer, E. W. Gilmer, Jacob B. Perkins, William Wallace, W. C. Ward, E. E. Nash, and J. W. Holloway. Several of the gentlemen mentioned are identified with the Warren Electric & Specialty Company, but the new enterprise is entirely distinct from the latter. It is stated that a large plant will be erected at Warren.

OBITUARY.

OBITUARY—Mrs. C. F. Brush, wife of Mr. Charles F. Brush, the eminent electricain and inventor, died in Cleveland on June 25 as the result of an attack of malarial fever.

PERSONAL.

MR. JOHN C. ROBERTSON, president of the Richmond Telephone Company, has resigned and has been succeeded by Mr. A. Maupin.

MR. WALTER MUELLER, of the staff of Mr. Ray D. Lillibridge, New York, was married at Trenton, N. J., June 21st, to Miss Meta Hepworth Thomas.

MR. W. J. PHELPS, of the Phelps Company, Detroit, Mich., was a New York visitor last week. He went to Philadelphia to attend the Telephone Convention this week.

MR. JAMES ROWLAND BIBBINS has resigned as assistant electrical engineer of the Detroit United Railway to accept a position in the Westinghouse Companies' Publishing Department, Pittsburg and New York.

MR. A. A. SER[illegible], assistant sales manager of the Fort Wayne Electric Works, was in New York the early part of this week. He is visiting various branch offices throughout the country on behalf of his company.

MR. ELMER E. FARMER, the electrical engineer, has issued notice that the probate court of Berkshire County, Mass., has changed his name to Elmer E. F. Creighton, in accordance with the wish of his late maternal grandfather, David Creighton.

MR and MRS. A. M. YOUNG announce the wedding of their daughter, Miss Ella Shepardson Young, to Mr. John Henry Goss, on June 17, at the Anchorage, Pine Orchard, Conn. The happy pair are to make an extended tour and will be at home in Waterbury, Conn., next January.

MR. HUGH BONNER, ex-chief of the New York Fire Department, is now organizing the Manila Fire Department. He says the Philippine city is very combustible and that the growing use of electricity has added another fire peril to those which were already too numerous.

Trade Notes.

ASSIGNEE APPOINTED.—It is reported that the Sun Electric Manufacturing Company, of West Chester, Pa., has gone into the hands of an assignee.

THE DELAWARE HARD FIBRE CO., Wilmington, Del., is enlarging its plant to four times the present capacity. This indicates a large business.

THE ATLAS CEMENT CO., of Northampton, Pa., the largest cement works in the country, has just sent the Burt Mfg. Co., of Akron, Ohio, its fifth order for oil filters, making nine large Cross oil filters now in use in its different works.

THE BURT MFG. CO., of Akron, Ohio ,has recently made a large shipment of its oil filters to London, England. The question is suggested by the makers that if the Cross oil filter saves half on a manufacturer's oil bills, how long would it take it to pay for the Boer war?

THE READING GAS AND ELECTRIC FIXTURE COMPANY, Reading, Pa., describes and illustrates its complete lines of knife switches, panel boards, switchboards and electrical specialties in a catalogue of recent issue. A complete price list of these various devices, in all sizes, is also given.

VERTICAL MILLING MACHINES.—Catalogue No. 3 of the Garvin Machine Company, New York, is on the subject of vertical milling machines, profilers and duplex milling machines. Various styles of these machines are illustrated, each illustration being accompanied by appropriate descriptive matter.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., reports that the call for switches arranged for enclosed fuses has become so general that it now carries all its standard switches in stock arranged for this type of fuse, when only a few months ago the open link fuse was practically the only one thought of.

JEFFREY SCREENS.—The Jeffrey Manufacturing Company, Columbus, Ohio, has issued a very artistic 48-page pamphlet devoted entirely to the subject of screening machinery for coal, ores, sand, carbon, graphite and many other materials. The half-tone illustrations are printed in a dark brown ink, which greatly adds to the artistic effect.

ELECTRIC FANS.—Green is the dominant color of a neat pamphlet on electric motor fans issued by the Electrical Material Company, No. 221 North Calvert street, Baltimore, Md. Fans of all styles are illustrated, price lists of the various sizes and finishes of each style being given. The catalogue is printed in green and it has a greenish cover.

TIES AND RAILS.—A few days ago the Maltby Lumber Company, Bay City, Mich., sent out a full trainload of cedar ties to the street railway at Des Moines, Ia., and the same company has just made another large shipment of poles to Arkansas points. This shipment was handled in the same manner as the tie train, the whole train being kept intact throughout the run.

"HY-LO" HANDSHAKE.—Mr. W. J. Phelps, of Detroit, has been a frequent visitor to New York in the past ten days. Last week he brought his famous Convention-"Hy-lo" handshake from Cincinnati to New York and then, to emphasize this new departure in courtesy, he revisited New York the early part of this week. Mr. Phelps's method of greeting prospective buyers and some others is becoming as famous as his 16x1 incandescent lamp.

THE STERLING ELECTRICAL MFG. CO., Warren, Ohio, makers of the Sterling special lamp, has recently been distributing a very attractive aluminum ash tray containing the name of the lamp and the address of the company in embossed letters on the bed of the tray with a very fine illustration of the lamp itself. The slogan of the company, "equal light," appears as a caption for the cut. It makes a very neat desk ornament apart from its utility.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is just issuing its new general supply catalogue, No. 16, and has in press a general telephone and supply catalogue, No. 17, both of which are hereafter to be issued annually. The price lists accompanying the catalogues are so arranged that leaves may be inserted in place of out-of-date ones. Thus customers will be supplied with catalogues brought up to date from year to year and with price lists that are always correct.

ADIRONDACKS.—The lakes and streams in the Adirondack Mountains are full of fish; the woods are inviting, the air is filled with health, and the nights are cool and restful. If you visit this region once, you will go there again. An answer to almost any question in regard to the Adirondacks will be found in No. 20 of the "Four-Track Series," "The Adirondacks and How to Reach Them;" sent free on receipt of a two-cent stamp, by George H. Daniels, general passenger agent, Grand Central Station, New York.

MOTOR-DRIVEN AIR COMPRESSORS.—The line of electrically operated stationary and portable air compressors manufactured by the Christensen Engineering Company, Milwaukee, Wis., is described and illustrated in Catalogue No. 51, just issued by the company. The important parts of the compressors are separately illustrated, and tables give the dimensions, capacities and other data relating to the various sizes and styles of these machines. The catalogue contains interesting information on the general subject, and is artistically gotten up.

WESTON INSTRUMENTS.—Mr. J. P. Brown, 136 Liberty Street, New York, selling agent for the Weston Electrical Instrument Company, has issued an addition to the 1901 edition of the pocket price list of Weston instruments. The list includes switchboard and portable instruments, also the R. & T. combination volt-ammeters. The latter instruments are designed for use in situations where extreme vibration is met with, or where water or dampness is likely to affect the working of an instrument, the operative parts being fully protected by a waterproof aluminum case.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., has recently shipped coining machinery to Birmingham, England, where is located one of the largest coining firms in England, all the coinage for the British Government being done by private corporations under contract. Among other recent shipments of coining machinery may be mentioned the following: to the English Government in British India, the Bolivian government and the Peruvian government. The shipment to the Bolivian government includes a complete electric plant to be used in connection with the coining machinery, as well as for lighting and furnishing power to be used for other purposes.

THE BAIRD MANUFACTURING CO., Chicago, Ill., has for some time past been engaged in developing a rapid-service, single-coin machine and also a rapid-service meter for telephone lines, which promises to be successful. Feeling the need of an expert in switchboard and line conditions, the company has been fortunate to secure the services of Mr. David S. Hulfish, who until June 1 was switchboard engineer of the Central Union Telephone Co. Mr. Hulfish assumed the office of secretary and electrical engineer of the Baird Manufacturing Company on June 1 and has already designed some great improvements for the new rapid-service machines which insure complete success. The new machine is almost ready for the market and will shortly be placed before Bell telephone licensees.

[illegible] graduates of the American School of Correspondence, Boston, Mass., were Frank B. Fuller, of Swampscott, Mass., who completed the marine engineering course in sixteen months, and Ray O. Caukin, of Jackson, Cal., who completed the electrical engineering course in the same time. Mr. Fuller is employed by the Boston [illegible] of California. The record of another graduate, Mathias Knopf, of Newark, N. J., who completed the stationary engineering course while working as a fireman, shows what an ambitious man can do when he determines to gain a technical education. At the time he enrolled Mr. Knopf was not at all familiar with the English language. This delayed him somewhat on the earlier papers, yet he made better progress than many students not handicapped in this way. J. A. Gon-

stead, an engineer in the Minneapolis (Minn.) fire department, devoted spare time to the electrical engineering course, and completed it, also a course in mechanical drawing, in sixteen months. Another recent graduate in electrical engineering was George E. Higgins, superintendent of the Montreal agency of the [illegible] Company, who has already received their diplomas were Frank W. Burford, Timaru, N. Z., and Arthur E. Moss, Port Chambers, N. Z. It is interesting to note that the average of these men when they became students in the American School was thirty years, the youngest being twenty-three and the oldest thirty-five, and that they were regularly employed in some trade or profession while pursuing their studies.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED June [illegible], 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

702,392. CIRCUIT AND CUT OUT FOR ELECTRIC ARC LAMPS; M. H. Baker, Newark, N. J. App. filed June 10, 1901. For preventing excessive tension in the lamp circuit at the starting of the lamp, a low resistance starting circuit having an inductive restraining device applied to it, is used. The starting circuit is cut out when the lamp begins to burn.

702,403. VALISE, HAND-BAG OR SUIT CASE; S. D. Chapman, Kansas City, Mo. App. filed April 7, 1902. A bulls-eye light fixed in the end of a valise, is controlled by a circuit closer in the handle of the valise.

702,405. INCLOSED ARC LAMP; W. L. Cheney and G. R. Davison, Newark and E. W. Skinner, Arlington, N. J. App. filed Jan. 6, 1902. To create a mingling of the gases of combustion with the outer air, a tube extends from a point above the gas check to a point adjacent to the arc and is open at both ends.

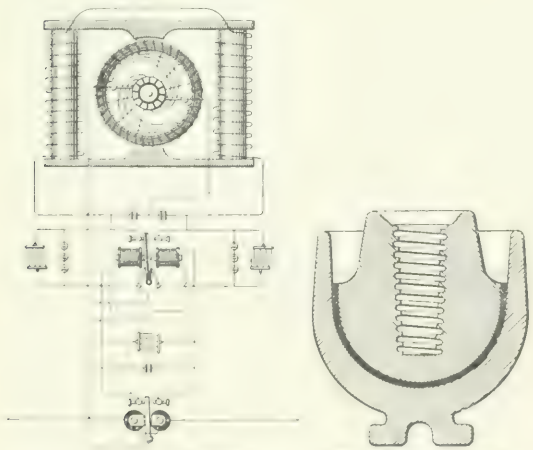
702,407. MOTOR GENERATOR; P. J. Collins, Scranton, Pa. App. filed Oct. 11, 1901. Several currents differing in character can be derived from the same machine and the electromotive force, frequency and volume of current can be readily regulated; the machine is intended for the use of physicians.

702,409. MULTIPLE SWITCH; H. H. Cutler, Milwaukee, Wis. App filed April 17, 1901. Multiple switches are arranged so that they can be closed only in a definite order and opened automatically at a desired time.

702,427. ELECTRIC RAILWAY; J. C. Henry, Denver, Colo. App. filed April 1, 1901. In a multiple unit system the step by step controllers are each operated by a solenoid and all solenoids are connected in series in a local circuit which is manipulated by a hand switch.

702,437. ELECTRIC CIGAR LIGHTER; W. F. Kessler, Auburn, Ind. App. filed Oct. 27, 1900. Details.

702,452. ELECTRIC SYNCHRONOUS APPARATUS; W. M. Miner, Plainfield, N. J. App. filed July 25, 1901. The vibrator which creates reversals of current to establish synchronism, is so connected with two batteries that their voltage cannot combine to establish an arc directly across the space from one vibrator contact to the other.



702,453. Electric Synch[illegible] Apparatus.

702,453. ELECTRIC SYNCHRONOUS APPARATUS; W. M. Miner, Plainfield, N. J. App. filed July 25, 1901. The object is to simplify the apparatus of the vibrator, a shunt for a source of current around the vibrator magnets is opened and closed by the synchronizing relay.

702,454. ELECTRIC SYNCHRONOUS APPARATUS; W. M. Miner, Plainfield, N. J. App. filed July 25, 1901. The object is to simplify the apparatus heretofore employed for keeping a motor running in synchronism with a distant machine; to diminish the number of separate generators which it is necessary to employ, to permit the use of motors having a large torque and operated by a heavy current.

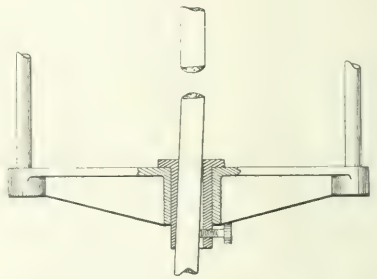
702,500. WATCH DEMAGNETIZER; P. Sorensen, Brooklyn, N. Y. App. filed Jan. 9, 1902. A crank handle by which the magnet is rotated, is [illegible] which [illegible] when the [illegible] is [illegible]

702,514. CARBON HOLDER; S. B. Whinery, Pittsburg, Pa. App. filed March 18, 1902. The lower carbon holder can be rotated in a socket for the purpose of aligning the carbon.

702,544. ELECTRIC BATTERY; P. DeLafon, Paris, France. App. filed April 3, 1900. A carbon-zinc battery of the dry type.

702,599. COLLECTOR RING FOR ELECTRICAL MACHINES; R. Siegfried, Pittsburg, Pa. App. filed Feb. 1, 1902. The collector rings have offset arms with cylindrical bosses at their extremities which can be arranged axially in line with each other to be secured together by a single bolt.

702,622. ELECTRIC TELEGRAPHY; S. G. Brown, Putney, England. App. filed Nov. 5, 1900. The receiving apparatus can be arranged to overcome the effect of "overlapping" signals by neutralizing the effect of the last part of each signal upon the receiver.



702,514, Carbon Holder.

702,656. BLOCK SIGNAL SYSTEM; P. O. Keilholtz, Baltimore, Md. App. filed March 6, 1902. A signal is given in a cab of the locomotive when it approaches within a predetermined distance of another train on the same track.

702,660. PROCESS OF MAKING INSULATORS; F. M. Locke, Victor, N. Y. App. filed March 12, 1902. The insulator is built up of shell secured together by applying liquid glaze between the parts and firing.

702,661. INSULATOR AND PROCESS OF MANUFACTURING SAME; F. M. Locke, Victor, N. Y. App. filed April 19, 1902. A modification of the preceding patent in which the molten glaze is applied to the shells after they are nested together and allowed to cool.

702,662. CONDUIT FOR ELECTRIC WIRES OR CABLES; R. W. Lyle, Perth Amboy, N. J. App. filed April 10, 1902. Details of the joint.

702,663. CONDUIT FOR ELECTRIC WIRES OR CABLES; R. W. Lyle, Perth Amboy, N. J. App. filed April 10, 1902. Spring clips enter grooves on the exterior of the conduit as the joint to hold the sections in line.

702,666. ELECTRIC CLOCK SYNCHRONIZER; C. F. Mears, Silver City, Iowa. App. filed May 16, 1901. Details.

702,695. SPARKING DEVICE; D. M. Bliss, Brookline, Mass. App. filed Nov. 7, 1901. An artificial load is introduced into the circuit when the spark gap is open, the introduction being controlled by the opening and closing of the gap.

702,725. ELECTRIC CONDUCTING WIRE; H. Hammesfahr and E. Hammesfahr, New York, N. Y. App. filed Feb. 23, 1902. The insulation is braided spun glass.

702,734. ELECTRIC WATER RECORDING DEVICE; W. H. Kelly and A. Tschinkel, New York, N. Y. App. filed March 15, 1901. Details.

702,751. TRANSMITTER; A. Von Wagenen, Sioux City, Iowa. App. filed March 27, 1901. An index is moved to the desired point on the dial and a push button then forced inward to send the signal.

702,752. ELECTROSURGICAL INSTRUMENT; R. H. Wappler, New York, N. Y. App. filed June 10, 1901. An arrangement of tubes in connection with an incandescent lamp for exploring certain organs of the body.

702,758. METHOD OF GRAPHITIZING ELECTRODES; E. G. Acheson, Buffalo, N.Y. App. filed Dec. 11, 1900. (See page 1155.)

702,760. ELECTROCHEMICAL GENERATOR; H. S. Amwake, Camden, N. J. App. filed March 13, 1902. A baffle plate is inserted between the electrodes of the cell to create a devious circulation of the electrolyte and prevent undue heating and consequent increase of resistance.

702,808. ELECTRIC PROGRAM CLOCK; J. O. Lyman, Waterbury, Conn. App. filed Aug. 16, 1901. Details of a circuit closing apparatus.

Sixth Annual Convention of the Independent Telephone Association of the United States.

THE sixth annual convention of the Independent Telephone Association of the United States was held on June 24, 25 and 26 at the Hotel Walton, Philadelphia, the meeting being called to order by President Thomas in the large ballroom at the top of the hotel. It had been supposed by some that the recent interstate meeting at Chicago would interfere with the attendance, but as a matter of fact this was not the case, the record number of 350 names being registered by Wednesday morning.

The address of welcome was delivered by Mayor Ashbridge, who defended his action in favoring independent telephony in Philadelphia and said: "I am a great believer in competition in all things, and in that belief, I signed the so-called 'Keystone Telephone Bill,' for which, in the parlance of the railroad man, I have had the 'red board' against me ever since. But it matters but little, if one feels that he is doing his duty and is benefitting the community, in giving better service, at cheaper rates; and anything that will materially benefit a community or a people or a business, I count it the duty of those in authority to carry out and execute. I, therefore, have no apologies to express, for signing a bill, giving to the people of this city a franchise, through a company that has become such a factor in the commercial life of the city.

"Telephones are no longer experimental, but are practically useful things that enter into the daily life of all people, in all conditions of life—the physician and the lawyer, the merchant and the manufacturer; and into the home life—our domestic world—it enters so largely, that we welcome all competition that has a tendency to extend its usefulness. I am glad, to-day, to be here to welcome you—men of the independent telephone business—who have had the moral courage and the intellectual development to chance your money in investments in a business in competition with a great monopoly.

"We are glad, indeed—let me repeat—to have you here in our midst, that you may commune and exchange thoughts and ideas with those connected with our organizations in this city, whether it be in telephony or other directions, and so increase the commercial benefit and the manufacturing genius of our nation. You are to be commended for your moral courage in entering into competition with what was one of the great monopolies and held this country by the throat, so that no one else dared to enter into the territory forbidden by its edicts. 'In union there is strength,' and by your combination and organization you have been able to successfully combat those people who tried to crush you out of existence. I am not antagonistic to the Bell company; on the other hand, I have warm personal relations with many of the officers of the company whom I esteem very highly as men. But this country is too great, and the interests of its people are too great for one man, or one interest or one concern, to monopolize all the good things."

Hon. S. P. Sheerin, of Indianapolis, on behalf of the Association, returned its thanks to the mayor for the welcome extended, and said that the Association represented the American average in most things, and rather more than the average in fighting qualities. They were anti-monopolists, and with them it was not merely a principle, but a business and a pursuit. Hence it was natural they should visit the "cradle of liberty" at least once for an inspiration.

Judge Thomas then delivered his annual presidential address, discussing chiefly the financial aspects of independent telephony. he said:

"In the Annual Report of the President of the American Telephone and Telegraph Company, under date of December 31, 1901, page 8, we find the following:

"Competition from telephone companies not associated with this company has existed for several years and is likely to continue in some places for some time to come. While it has in some places affected the licensees of this company disadvantageously, by reducing, for a time at least, the number of their subscribers and forcing them to meet competitive rates that are not based upon a proper recognition of the cost of doing business or an adequate appreciation of the amount that should be set aside from earnings for maintenance, reconstruction and depreciation, the consequences of the competition to the business as a whole, have not been of serious moment. The public in each community will determine for itself whether it is for its advantage that there should be two telephone exchanges serving one body of people. It would seem as if but one conclusion on this point was possible." We believe a little closer examination of the subject would have caused the report to say that these low rates are made in the hope of destroying competition. In almost every instance instead of meeting competitive rates they have offered ruinous rates, and so far have failed to destroy competition. So that the public so far has not determined whether there shall be two exchanges, except in some instances where the patronage has been withdrawn from the Bell exchange and the same has been closed. The public desires that competition exist in all lines of business, but we do not believe in ruinous competitive rates. And we do not believe as a general rule independent rates, as they have been established by the majority of companies, are too low. On the other hand, they show good business profit.

"We agree with Mr. Fish's statements that 'Competition has existed for several years and is likely to continue in some places for some time to come and has affected the licensee companies disadvantageously.' We also agree with his statement that the consequences of competition to the business as a whole have not been of serious moment. On the other hand we believe most sincerely that competition has done more for the telephone business than was accomplished in the entire period before competition entered the field, and cite you as a proof of that fact the last annual report of the president of the American Telephone and Telegraph Company. The growth of the business since that time has been marvelous, while the character of service has been greatly improved.

"Our object in this address shall be to frankly, fairly and broadly present the telephone business as it exists to-day, to insist upon rights, to discover wrongs, and, if possible, to be of some service to the many interests throughout the country; to point out a way of eliminating dangers to capital, which come through mistaken promotion and ruinous rates. We know that capital is needed to carry on this great enterprise which has been given such great impetus through competition. We desire to assure capital that with proper precautions there is no safer investment. We shall therefore begin with rules governing real estate investments and try to apply them to this business as a guide to safe, permanent investment." Judge Thomas then made an analogy or comparison with the work of the architect and builder, and continued as follows:

"The building of telephone properties has not been known to man very many years. It is fast passing out of the pioneer stage, though no telephone property has ever yet been completed. But now men who are giving close study to this great and important business believe that the time has come when we should look to the essentials, from the investment standpoint. This business requires more capital than is to-day at the command of the people who are at work in the building up of telephone properties, a stage that is always reached in the building up of great enterprises. Like all who work in a common business, we should in view of this fact, give earnest consideration to the best means of relieving the situation. We have in our meeting to-day enough men to invest during the present year more than was invested the first ten years of the use of the telephone. Local telephone investments are at present limited to the influence of the crowd which undertakes the enterprise, retarded by all other influences that are seeking money for investment in other enterprises, plus the influence of the Bell Company working through many of the financial institutions of the country.

"The general money markets have not yet been opened up to the business. Large enterprises have been compelled to pay heavy tribute to the underwriter. There are some instances where the underwriters' profits have very greatly embarrassed the enterprise, and others where this is sure to come in time.

If we have reached the period of building permanent investments, which we believe we have, then we must consider the best ways and means of building so as to be attractive to capital. Surely, no one who has studied the subject will deny that the prospect for the use of the telephone in the future is greater than it has been in the past; that the demand for its use exceeds the ability of the companies to supply it. The thing itself is necessary to the present methods of social and business economy. When men no longer talk, then the telephone will be placed in museums with the mummy and other dead things.

"If the thing itself is of a permanent nature, like good building ground, by employing the proper agent, architect, builder and operator, the telephone investor will have a desirable, permanent investment, such as is not only sought in local, but general money markets. The capitalist is always ready to invest in something sure and permanent, even though the returns are not very large. This being true, then somewhere in this field of investment there is something wrong, or else we could reach the money centers as well as local financial resources.

"The telephone was a mere toy and plaything at first, something that was novel and entertaining. The original investors did not risk very much. They used the usual methods of convincing the inventor that there was very little value to the thing, and he, in order to make some money, must sell cheap; they would take all the risk of perfecting and placing the thing in public use because they loved him so. That was in the days when men were selfish, before the millennium had dawned.

"Some very selfish contracts were made which aimed to be perpetual and exclusive. Through all the different stages of the growth of the American 'Bell' organization and the preceding organizations, we find the work of the skillful hand of monopoly. These contracts demand unreasonable tribute to the small capital which represented the parent company. It was the working out of a scheme which demanded for a small number of people with a small amount of capital unreasonable tribute from a large number of people representing a large amount of capital. In other words the very small amount of capital employed in purchasing the invention and bringing it to perfection was to always receive reward from the people themselves through these contracts after the right, under our patent laws, had expired—by always compelling the hundreds of millions of dollars invested in the manufacture of telephones and switchboards and the building of exchanges and systems throughout the land, to pay a royalty or rental. This is clearly against the principles of our moral and civil laws and cannot be justified and must fail in its purpose. We find here, perhaps, the greatest cause for the failure of capital to invest in this field so rapidly as it should.

"Broad minded men are at work on the solution of this problem and everything necessary to give to the people telephone service at a fair price and give adequate reward to capital and labor will soon be solved. The price through competition having in most instances been reduced to the minimum, something must be done to preserve the capital already invested and induce new capital to come into the enterprise.

"People should never uphold ruinous competition in anything any more than they should uphold ruinous monopoly. We must always be fair and just to both sides of a controversy. The user of the telephone must not be allowed to enjoy its great privileges at the expense of the man who has invested his money. We only want such competition as will cause the capitalist to be fair; and not a competition that will give advantage to the user.

"If the people are to be given the benefit of reasonable rates, and the capitalist of a fair return on his investment, the individual, the municipal, county and State organizations must not be selfish and unfair. The present tendency to hold the corporation up does not benefit the people, and is not pleasing to capital, and is a dangerous weed which seems just now to flourish. The public official should be confined to the reward contracted for when he agreed to accept its trust, and should have no superior right over his neighbor in dealing with corporations. Franchises and rights-of-way should be granted on fair and equitable lines and should be considered in accordance with the great benefit the new enterprise will bring the community. The telephone should always be considered as one of the most beneficial enterprises and should under proper police restrictions be welcomed to a city, county or State, without burdens which will affect the rights of the user or the capitalist. The United States, in consideration of its general usefulness, should do everything necessary to reduce the obstacles in the way of establishing full, complete service at reasonable prices. It should do more, perhaps, than to remove obstacles; but that we will not consider.

"We find upon a careful study of this proposition many difficulties. We believe no other business presents quite as many. We find throughout the slow stages of development a long period of pioneering that has cost a great deal of money, which practically has had to be replaced by installing more efficient apparatus and construction every few years. So that the capital invested has grown to very large proportions; where much more capital is necessary to be placed in the business in order to take care of the demand for service within the next year or so.

"While this, on first thought, seems discouraging to the promoter, we must remember that the same is true of every business of a general nature that has had to be developed through invention. We should bear in mind that through this pioneering we have educated the people to use the telephone, and that they are educated for all time in this method of communication. That while this has been accomplished, we have also been educating persons to handle the business more economically; while the inventors are constantly giving us new facilities for more economically handling the business. There is no excuse now for poor construction, inferior apparatus, ruinous rates, over-capitalization, incompetent employees, or any other thing that would bring danger to the investor. All we now need is to frankly confess our errors in the past, and proceed as business men in all lines proceed, to properly take care of the capital invested in the business, using modern methods and economies in working out the plan. Let us recognize one another's rights, and work in harmony to one common end, to place the business upon a firm financial footing.

"The Independent Telephone Association has from its birth taken a stand of recognizing every man's rights. And the work of the officers and committees of the association has always been free from preference or prejudice, and has been conducted upon broad and just principles. The banner of this association has never been trailed in the dust."

Judge Thomas then quoted in full with approval an editorial on the association meeting in ELECTRICAL WORLD AND ENGINEER, of June 14 as appropriate to be read on the occasion, and closed as follows: "We feel that on account of the standing that this association has gained as the representative of the independent telephone companies of the United States, that it must be the advanced thinker and the advanced worker in this field; that its policy should be ever onward to work out difficult telephone propositions on lines that will be both pleasing to capital and to the people. That its objects should not be to destroy, but to build up. That it should not be governed by prejudice or preference, but by justice and fair dealing. We hope and believe that this will be its future course."

After a little formal business the convention then adjourned till Wednesday at 10 A. M.

WEDNESDAY SESSION.

At the opening of the Wednesday morning session, Prof. W. E. Goldsborough, of Purdue University, Lafayette, Ind., on behalf of the Business Men's League of St. Louis and of the Exposition authorities, invited the Association to assist in making the Exposition a success and to enjoy the hospitalities of the city. He made a strong and effective statement as to the scope and opportunities of the St. Louis Fair in 1904, especially on its electrical side and in regard to the duty of all telephone men to educate the public up to the larger and fullest possible use of their apparatus. As to electricity, he stated that while 5,000 hp had been adequate at the beautiful Pan-American in Buffalo, St. Louis would need 25,000 to 40,000 hp of current. Electricity Building would be not less than 600 feet square, and architecturally one of the most imposing structures on the grounds.

Mr. Hugh Dougherty, of Bluffton, Ind., offered a resolution heartily favoring the support of the Exposition by the Association.

One of the manufacturers present opposed going to St. Louis,

in view of the poor results that had attended the meetings at the Pan-American, but after it had been pointed out that the resolution did not include fixing a convention in St. Louis, the resolution was adopted unanimously.

Mr. Lewis A Goudy, president and general manager of the Northeastern Telephone Company, of Portland, Me., read a paper on "The Telephone Situation in the Northeast." He stated that in the New England States a very small percentage of the people were subscribers to the telephone. In Maine less than one and one half per cent. were subscribers, and the proportion was even less in New Hampshire and Vermont. He held this to be due to the policy of the Bell Telephone Company in demanding high rates. This was now changing, on account of the movement fostered by the Dirigo Telephone Company of Maine, which had since become the Northeastern, although the Eastern Telephone Company of Portland had become associated with Bell interests. The Northeastern was therefore the only absolutely independent long distance competitive company in the territory, with liberal State charters for both Maine and New Hampshire, and owning trunk lines connecting between 60 and 70 exchanges and toll stations, with 200 miles of pole line construction terminating at present in Portland. "The Northeastern Company owns and controls the secret automatic system for the Northeast and has perfected its plans for the installation of that system in several cities in Maine and New Hampshire." The company has nearly 1,000 subscribers actual and immediately prospective, and Bangor, Skowhegan, Waterville, Augusta, Hallowell, Brunswick and Westbrook were all asking for competitive service. In substantially all these towns, licenses had been secured, and virtually capital was the only requirement for strong opposition. They would use the Strowger system for the larger exchanges in conjunction with the manual party line service for long distance connections and smaller exchanges, for which they had successfully tested a selective party line device making every line a private line.

Mr. Goudy then went on to refer to some of the incidents that had made independent work difficult in Maine, and referred to the law against common use of routes already occupied by one party unless consent were first obtained from the prior company or firm. He proceeded to indulge in some rather strong language as to the "devilish methods that have been used by the agents of the monopoly company, high and low, to defeat and destroy the possibility of competition;" and he referred darkly to proof which he had in his possession that would convince the most skeptical as to the debauchery of public men by which the great monopoly had entrenched itself in the East. He then proceeded to discuss the lowness of early Bell telephone rates in the Northeast, for example, as compared with the later ones prevalent, except where competition prevailed. In the city of Portland under the influence of competition, the New England Bell Company had, after installing its central energy system, advertised free telephones for several months, provided the subscriber would contract for a term of years at standard rates—to new subscribers only. He claimed that the New England Company and the parent Bell were unduly and unnaturally watered and inflated; hence the rates. The first capitalization of the American Bell was $200,000, of which $50,000 was cash and $150,000 patent rights. Six months later, the Bell Telephone Company was incorporated with a capital of $450,000, of which $400,000 represented patent rights and $50,000 only cash. Six months thereafter the two companies, he said, were combined as the National Bell Telephone Company, capitalized at $850,000, of which $650,000 was for patent rights and only $10,000 cash; the balance, $190,000, was represented by apparatus in use. As to the New England Telephone & Telegraph Company, operating in Maine, New Hampshire, Vermont and Massachusetts, the last annual report of March, 1902, etc., showed the capitalization to be $20,000,000 gross, or with reserve, profit and loss, etc., total capital liability of $24,630,753. This is offset by assets of real estate, $54,612; cash and debts receivable, $2,534,971; material, merchandise and stock, $705,650; miscellaneous, $052,666; patents and franchises, $20,952,844; to which is to be added $10,000,000 new stock, making a total of $35,000,000, representing less than 100,000 telephones in the four New England States. But its earnings for 1901 from exchange service—leaving out tolls—were only $3,769,844; its expenses account outside of dividends paid was $4,139,929. In the items of expense was $254,238 rental and royalty charges to the parent American Bell Company. Such conditions were certainly favorable to new competition.

A paper was then read by Mr. E. E. Webster, of the same company, for Mr. C. H. Judson, of the Twin City Telephone Company of Minneapolis, Minn., on "The Telephone Situation in the Northwest." This paper reviewed familiar conditions in the territory named, chiefly as to Bell sub-licenses.

The discussion on these two interesting communications was rather slim as to new data, but excessively verbose; but Fisher, of Grand Rapids, alleged that similar methods were being pursued by the Bell people elsewhere, in Ohio and the middle west, as to entangling alliances, and that the Central Union Company sought to secure all the independent companies it could as to sub-licensees. Messrs. Webster and Critchfield contributed to the discussion on parallel lines, while Mr. Goudy returned to the charge by making a series of astounding statements, supported by documentary proof in bulky envelopes, or by broad inuendo, as to the utter want of honesty and principle of about every public man and every lawyer—save one—in the State of Maine when it came to fighting the New England Bell Company. He had with him lists of high officials enjoying telephone franks in Maine and presented altogether such a distressful picture of affairs in a Republican State, that Mr. Sheerin, who is well known as a Democratic leader in Indiana, felt compelled to offer sympathy and relief that could hardly be said to carry real balm. Mr. Sheerin, in regard to the sub-licensee question, urged reasons and data against taking a Bell franchise or license in any form, and cited cases in Indiana where it had worked out very unsatisfactorily for the independents concerned.

The meeting then adjourned to Thursday at 10 A. M.

THURSDAY MORNING'S SESSION.

At the opening of the Thursday morning session a brief but pungent address was made by Mr. Thomas Martindale, who was at the head of the movement which after some years climaxed in the establishment of independent telephony in Philadelphia. He expressed the hope and belief that a newspaper system on the Buda Pest plan would be developed by the country exchanges, so that the newspaper once or twice a week would be supplemented by daily news service to each subscriber. It was easy still to put up pole lines in the country, but he doubted whether in cities space could be found for many more conduits for telephones; certainly not in Philadelphia.

Hon. L. J. Hackney, of Indianapolis, then presented a paper read by Mr. Sheerin, "Where We Were and Where We Are," reviewing the history of the independent movement. He claimed that now the independent industry had the smallest bonded indebtedness of any branch of business in the country. As to tendencies in Indiana he mentioned the fact that Evansville was discussing a municipal telephone plant. He rather ridiculed the idea that long distance toll line connections were necessary to independent success, and said that in Indiana only two and one-half per cent. of the toll line business went out of the State, while 89 per cent. of the messages at any center of population keeps within a radius of 35 miles. There were now 70,000 independent telephones in Indiana, and at the best ratios prevailing, that number could be brought up to 412,000.

Mrs. Annie McE. Brett of the independent company at El Paso, Tex., and president of the Brett Construction Company, then gave a brief but very interesting account of her successful work in Texas. At El Paso she now had 1,550 three-year contracts, and she was engaged in developing other exchanges as well as in long line work.

Mr. L. W. Stanton, chief of equipment of the Federal Telephone Company of Cleveland, O., then read a valuable paper on the great technical problems. It is given elsewhere in this supplement. Mr. Stanton had several diagrams with which to illustrate his remarks, and in support of measured service arguments used in the curve of growth recently shown in ELECTRICAL WORLD AND ENGINEER as to New York.

Mr. Breen, contract agent of the Keystone Company, an old Bell man, disputed the measured rate idea, and pointed to 12,000 five-year contracts as an evidence that people wanted unlimited service.

Mr. C. E. Wells, of Marion, Kan., then presented a paper through Mr. J. B. Ware, of Detroit, on "The Telephone Situa-

stance of independent failure he knew of in the State, and the movement had spread to every town down to 1,000 inhabitants, and even to those of four or five hundred. Lawrence and Kansas City were now coming in. The uniform success was remarkable. In Salina, there were now 560 subscribers, while the Bell people, even with free rates, had only some 30. The situation might be thus summed up: The Bell people outside Kansas City had perhaps half a dozen exchanges worthy the name, aggregating 4,000 subscribers, with 1,000 more at scattered points. The Kansas Independent Association, with some 60 companies, had in operation at last reports nearly 19,000 telephones, which was about 60 per cent. of the total in the whole State. As to long distance work, he then made incidental reference to the plans being carried through by Mr. Fred DeLand. Reference was also made to success in Oklahoma and Nebraska, and very emphatic endorsement was given to the good done by the Independent Telephone Association.

Prof. W. E. Goldsborough, of Purdue University, Lafayette, Ind., then gave a very interesting account of the special telephone course recently established there, the first in the country. He did not hesitate to express the opinion strongly held by himself, that many of the problems before the telephone engineer were more difficult to solve than those dealt with by engineers in the fields of light and power. As to the course itself, it had been laid out after careful consultation with the best men in the Bell and independent branches of the industry.

Hon. H. D. Critchfield, who was listed for a paper on "The Financial Status of the Independent Telephone Movement," begged off and was given permission to prepare it for the printed transactions.

Thanks were given to the Keystone Telephone Company and to others who had gone to great trouble and expense to make the visit of the association to Philadelphia enjoyable and memorable.

The meeting then adjourned, leaving election of officers for the afternoon, but not before passing unanimously the following resolution, presented by Mr. S. E. Wayland, of the Scranton Independent Telephone Company:

WHEREAS, it is generally believed and currently reported through the Press of the United States, and otherwise, that a combination exists among dealers in electrical supplies, the purpose and object of such combination among others being to unlawfully increase prices of such supplies from 25 to 50 per cent.; to limit the production of such material; to unlawfully discriminate in favor of certain purchasers of such supplies, and to boycott or cause to be boycotted buyers or dealers who are not affiliated with such association or combine; and

WHEREAS, such organization in effect amounts to a conspiracy which unlawfully and injuriously affects general trade in such supplies, and is especially injurious in its effects to purchasers of apparatus for Independent Telephone properties.

NOW, THEREFORE, BE IT RESOLVED, That the President and Secretary of this Association be and are hereby directed to advise the Attorney General of the United States of the nature and methods of doing business practiced by said organization or combine, and to request the Attorney General of the United States to cause an investigation to be made of the methods of said combination or association, and to tender the assistance of this Association, if desired, in making said investigation, and if found to be in violation of law to request the Attorney General of the United States to commence action and prosecute the same to a conclusion with a view of preventing and terminating such unlawful business methods.

AFTERNOON SESSION.

At the afternoon session the following ticket was elected unanimously; President, Jas. M. Thomas, Cleveland; First Vice-President, Hugh Dougherty, Bluffton, Ind; Second Vice-President, C. E. Stinson, Rochester, N. Y.; Third Vice-President, W. H. Durin, Cedar Rapids, Ia.; Secretary and Treasurer, J. B. Ware, Detroit, Mich.; First Assistant Secretary, C. E. Wilson, Philadelphia; Second Assistant Secretary, E. L. Barber, Wauseon, O.; Third Assistant Secretary, T. B. Lee, Pittsburg, Pa. The new Advisory Board is as follows: J. M. Thomas, S. P. Sheerin, H. Dougherty, H. D. Critchfield, E. B. Fisher, S. E. Wayland, W. B. Seaton, G. W. Beers, H. C. Young and E. E. Webster, the last two being the new members.

The convention then adjourned, in order to join in a trip given by the Keystone Telephone Company to all attending, to Atlantic City, for which a special train had been provided. This trip was of a specially attractive nature to many of the attendants from the West.

Needed Improvements in Independent Telephony.*

BY L. W. STANTON.

THERE are three giant problems: Tariff, Traffic and Equipment, which are deserving of as much sound consideration as any problem in the industrial field to-day. Public sentiment has been a very prominent factor in the independent field, but it is becoming more and more apparent that the company giving the best service and the most courteous treatment will secure the business.

The discriminating public have favored the home companies on account of their origin and the conditions under which they were brought into existence. This protection has extended over a number of years, but the time will arrive when the independent companies, even though they be owned locally, must demonstrate their ability to furnish as good or better service than their competitor. The writer is acquainted with several independent exchanges in which the service is inferior to that of the Bell Company, yet the public tolerate it, remembering the treatment they formerly received before the inauguration of the independent companies. This will not always exist. The public is prone to forget.

The company furnishing the best service to the greatest number at an equitable rate will, unquestionably, do the greater business. For the independent companies to bring about such conditions requires a far reaching revision in their present tariff system, a change in their engineering and equipment, and attention to details in traffic, the like of which they have never known before.

In our larger cities there are thousands of families and hundreds of small tradesmen that cannot afford to pay for flat rate individual service, neither can the telephone company, from a financial standpoint, afford to reduce its rate to meet these requirements. The inevitable result is party lines and measured service. He knew a great many are opposed to this class of service; some for reasons which are valid, and some for reasons which are thought to be valid, but which are not. There has been a great deal of prejudice against the party line, owing to poor apparatus and inferior traffic arrangements.

A great deal has been due to public sentiment, which is unjust to the telephone company and unjust to the subscriber who can not afford individual metallic service. By the use of the party line thousands of subscribers can be served that could not otherwise afford individual service. With a good system of four-party line selective, with the traffic details well worked out, this service for the small user is almost as good as individual service. You say that it works an injustice to the subscriber who has individual service. It is quite the reverse. It is optional with him whether he will use the party line or not, but in ninety-nine cases out of a hundred he is glad to have a chance to telephone to his party even though it be over a party line.

Let us now look into the financial aspects of the party line. We will assume the exchange from which we draw our figures to be one of 5,000 lines, built at an average cost of $100 per

COMPARATIVE DATA PARTY LINE SERVICE - 5,000 LINE EXCHANGE

No. of Phones per Line.	Average Cost per Line.	Rental per line per year.	Cost to Operate per Line	Interest on Int. Investment per Line	Depreciation 10 per cent. per Line	Total Cost Op. Int. & Depr. per Line	Net Earning per Line	Net Earning per Phone	Net per cent. Earned on Invest. per Line
1	$100	$48	$15	$5	$10	$30	$18	$18	$18
2	125	96	22.50	6.25	12.50	41.25	30.75	15.62	24
3	150	27-108	[illegible]	8 [illegible]	17.50	[illegible]	[illegible]	[illegible]	25.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32.25	8.03	18+
[illegible]	[illegible]	20-160	67.50	[illegible]	[illegible]	108.75	[illegible]	6.13	18.6
		18-144					35.25	4.40	13

line, and $25 extra for each additional party line telephone, including the phone, interior wiring, line drops, etc. We will

* Abstract.

assume the rate for individual service to be $48 per year; $15 per year for operating individual service telephones, and $7.50 per year to operate each additional party line telephone. Figuring interest at five per cent. and depreciation at ten per cent. on the amount invested, we find by referring to the chart that upon doubling the number of telephones on the line and decreasing the rate one-quarter we decrease the net revenue per telephone, and increase the net revenue per line; what is most noticeable is that the net per cent. earned on investment per line is greater for both two and four-party line than for either a greater or less number; a point that should not be lost sight of in establishing party line rates is that a dollar or two difference in the rate makes considerable difference in the net per cent earned on the amount invested as is shown by the two rates on the four and eight party lines; while the above table lays down no special rules to work by, it calls attention to facts that should not be lost sight of.

From the foregoing we see that the party line is a success from a financial standpoint, and a necessity from the view that the company serving the greatest number of people, renders a service the more valuable and will, therefore, secure the business, if the service is kept up to the standard.

We will now look at the party line from a traffic and tariff standpoint, which is an exceedingly complexed problem. There are three principal objections to the party line: First, the annoyance from the bells ringing when someone else is wanted, second, the frequent report of "line busy," third, service is not private. The first objection can be almost entirely eliminated on party lines of four or less, providing the equipment is of proper design and the operating is good. The second is a more difficult problem. If there are two or more parties on the line with unlimited service the line will frequently test "busy." To remedy this some form of measured service will be necessary. While it is admitted that measured service adds complications it is undoubtedly the most equitable method of charging. While there are several forms of measured service, there are none that entirely fill the requirements. Automatic apparatus either at the telephone or on the switchboard, is not satisfactory, for in the case the line called for should be busy there would be a call registered without the party securing the service. With either a meter or slot machine placed at the telephone it slows the service, for the operator must remain in on the line until the called for party is secured, and the calling party has registered or deposited the required coin. This also works a hardship on the party called for, as it is necessary to wait until the party calling deposits the coin or registers. The system of measured service where a meter is used is also more expensive, inasmuch as it requires a visit to each telephone to take the reading of the meter before a bill for service can be rendered.

The system in use in a number of the largest Bell exchanges and the one which gives the best general results is where the operator marks down the number of the telephone of the party calling, and in case the call is not completed she draws a line through that number. Each hour these sheets containing the record of the calls are collected and sent to the billing department.

Measured service handled in this way gives the subscriber very prompt and efficient service. This class of measured service used in connection with a four-party line will give excellent results. Suppose you allow each party line subscriber 600 or 1,000 outgoing calls per year on a four-party line or 1,200 to 1,500 on a two-party line, at a minimum charge with a fixed rate per message for all additional calls; all incoming calls free. Handled in this way the report "line busy" will be no more frequent than it is with individual unlimited service: in fact, the calls will probably average less per four-party line than with unlimited individual lines.

In a peg count which the writer examined where there were nearly 5,000 party line phones, all of which were either measured meter or nickel service, the average call per day, per telephone was 1.3.

In regard to secrecy or privacy of a properly designed party telephone, it is almost as private as an individual telephone. With a lamp signal board and selective ringing, the different parties on the line have no means of knowing when a party is calling or being called and if a line is in use they can readily hear another party come in on the line. With the three main objections just cited handled as above described, the party line gives a very desirable service and comes within the reach of a class of patrons or users that would otherwise be barred. From the foregoing it is plainly evident that the party line has a mission of importance to fulfill.

Up to the present time the call for the party line equipment has not been very great and the independent manufacturers who have done so well in furnishing equipment, have not given this subject the attention that it should receive in the future. One of the leading manufacturers is just placing on the market a four-party selective system which depends upon the number of frequencies to operate the bells. From the limited experiments the writer has had an opportunity to make, the system seems to possess valuable points over the pulsating bell type, which has been used by the Bell Company.

Before party line service can become thoroughly commercial among independent companies the manufacturers will have to revise their design of equipment. In the party line circuit of most of the manufacturers, either one or both sides of the line are permanently tied to the central battery, which is grounded. This makes four-party selective signaling very difficult ,if not impossible. While the independent companies are beginning to realize the value of the party line they need to equally realize the danger there is of very seriously impairing the efficiency of their present service. If inferior apparatus is used, or if the apparatus is not properly installed, or if the operating is not under proper discipline, the service will be such that the company will lose rather than gain by adopting party lines. One of the greatest needs of the independent telephone interests is either for this association or a kindred association to take up, in a technical way, the practical subjects of traffic engineering and equipment. The day for long distance telephony is just in its infancy, and for the independent companies to handle their share of the traffic and give the class of long distance service that will be demanded, they will be compelled to adopt a more standard form of equipment. The writer's experience on the United States Telephone Company's long distance lines is that where 20-volt to 40-volt common battery systems made by different manufacturers are connected the results are unsatisfactory. So much so in one case where a 40-volt system was installed, the former toll business at that place was almost lost for a period, owing to the inefficiency of the system for long distance work. Later a change was made that remedied the condition to some extent, but the system has never given the service it should. The trouble just cited was not due to the fact that it was a 40-volt system, which voltage is probably nearer correct, but due to the fact that the system was improperly designed, for receiving incoming toll business.

The above well illustrates why telephone apparatus should be standard. From the output on the various independent manufactures there could be selected a line of high class apparatus that would be worthy of standardization.

Attendants.

The following is a list of those registered as present from operating telephone companies:

HAVERHILL, MASS.—People's Tel. Co., N. N. Spofford.

JOHNSTOWN, PA.—Johnstown Tel. Co., E. D. Schade.

POCOMOKE, MD.—Poco. Tel. Co., W. H. Walters.

RUSH CITY, MINN.—North Eastern Tel. Co., A. J. Stowe, J. D. Markham.

CHICAGO, ILL.—United Tel. & Tel. Co., H. A. Harvey, W. T. Block.

DECATUR, IND.—Citizens' Tel. Co., F. W. Schirmeyer.

NEW IBERIA, LA.—Tel. Co. of Am., R. F. Broussard.

WASHINGTON, D. C.—Wash. Home Tel. Co., Jerome Penn.

BUFFALO, N. Y.—Frontier Tel. Co., C. E. Austin, C. L. Ingham.

ROCHESTER, N. Y.—Roch. Tel. Co., G. R. Fuller, C. E. Stinson.

MOBILE, ALA.—Home Tel. Co., W. H. Bryant.

TOPEKA, KAN.—Kan. Long-Dist. Tel. & Tel. Co., Fred. De Land.

YORK, PA.—York Tel. Co., G. B. Rudy, D. F. Lafean

KANSAS CITY, MO.—K. C. Home Tel. Co., O. C. Snider.

SAGINAW, MICH.—Valley Tel. Co., R. F. Johnson.

HOWELL, MICH.—Livingston Home Tel. Co., R. B. McPherson.

COLUMBIA, PA.—Col. Tel. Co., H. W. Johnson, H. C. Young.

MINNEAPOLIS, MINN.—Twin City Tel. Co., E. E. Webster.

Akron, Ohio.—People's Tel. Co., W. F. Lauback.
Coshocton, Ohio.—Citizens' Tel. Co., S. C. Kissner.
New York City.—Dutchess Co. Tel. Co., J. H. Scofield.
Philadelphia, Pa.—Keystone Tel. Co., R. H. Foederer, C. E. Wilson, W. H. Clark, W. W. Wharton, R. M. Eaton, J. Breen, J. M. Mack, M. Murphy, J. E. Ridgway, J. C. Perry, O. H. Larwill, R. A. Whittick, F. Herboth, Dr. L. Duncan, W. L. Hodges, C. K. Hagy.
Trenton, N. J.—Inter-State Tel. Co., A. M. Worstall, F. A. Demorest, J. J. Conner, J. C. Crawley.
Baltimore, Md.—Maryland Tel. & Tel. Co., H. W. Webb, E. H. Bouton, W. R. Whiting.
Cleveland, Ohio.—U. S. & Federal Tel. Cos., J. M. Thomas, H. D. Critchfield, H. H. Robinson, G. F. Du Perow, A. C. Morse; Consol Tel. Co., B. G. Hubbell.
Raleigh, N. C.—Raleigh Tel. Co., W. A. Wynne.
Morgantown, N. C.—Burke Co. Tel. Co., W. C. Ervin.
Cedar Rapids, Ia.—W. H. Durin.
Indianapolis, Ind.—New Long-Distance Tel. Co., S. P. Sheerin, H. W. Fox.
Bluffton, Ind.—H. Dougherty.
Camden, N. J.—Eastern Tel. & Tel. Co., E. A. Armstrong, W. W. Olheiser, J. J. Burleigh.
Fort Wayne, Ind.—Citizens' Tel Co., G. W. Beers.
Scranton, Pa.—S. E. Wayland.
Grand Rapids, Mich.—G. R. Tel. Co., E. B. Fisher.
El Paso, Tex.—Southern Ind. Tel. Co., Mrs. Annie McE. Brett.
Crawford, Ind.—Home Tel. Co., W. E. Nicholson.
Memphis, Tenn.—Mem. Tel. Co., H. Myers.
Zanesville, Ohio.—Zan. Tel. & Tel. Co., J. B. Rhodes, S. M. Granger.
Downington, Pa.—West Pa. Tel. Co., R. E. Russell.
Kent, Ohio.—Kent Home Tel. Co., W. H. Butler.
Hazleton, Pa.—Anthracite Tel. Co., C. A. Maus; People's Tel. Co., F. May, C. W. Kline.
Louisville, Ky.—Louisville Home Tel. Co., J. E. Zeluff.
St. Louis, Mo.—Kinloch Tel. Co., H. L. Reber.
Philadelphia, Pa.—United Tel. & Tel. Co., W. D. Barnard; Inter-State Tel. Co., C. E. Starr.
Syracuse, N. Y.—Syracuse Tel. Co., F. M. Potter, Jr.
Staunton, Va.—Staunton Tel. Co., N. C. Wetts.
New Britain, Conn.—Farmington Valley Tel. Co., R. L. Andrews, B. F. Case.
Mifflintown, Pa.—Consol. Tel. & Tel. Co.—A. G. Scholl.
Williamsport, Pa.—United Tel. & Tel. Co., N. E. Robb.
Jersey City, N. J.—State Tel. Co., G. H. Atkinson.
Columbus, Ohio.—Citizens' Tel. Co., F. L. Beam.
Binghamton, N. Y.—Binghamton Tel. & Tel. Co., E. Davis.
Portland, Me.—Northeastern Tel. Co., L. A. Goudy.
Munice, Ind.—Del. and Mad. Counties Tel. Co., W. E. Hitchcock, G. F. Trier.
Mobile, Ala.—Home Tel. Co., A. Glass.
Trenton, N. J.—Inter-State Tel. Co., B. C. Groh.
Pittsburg, Pa.—West. Penna. Tel. Co., T. B. Lee.
Grottoes, Va.—J. H. Livers.
Bristol, Conn.—A. R. Lamb.
Newton, N. J.—Sussex Tel. Co., J. M. Miller.
Lynchburg, Va.—Lynchburg Tel. Co., C. W. Scott.
Detroit, Mich.—People's Tel. Co., J. B. Ware.
Newtown, Pa.—Stand. Tel. & Tel. Co., H. H. Stevens, G. S. W. Brubacker.
Chrisman, Ill.—G. W. Fair.
Iowa City, Ia.—A. T. Pressen.
Crawfordsville, Ind.—E. A. Frazee.
Louisville, Ky.—J. A. Armstrong.
Thibodaux, La.—L. H. Lancaster.
Wellsburg, W. Va.—W. K. Cummings.
La Crosse, Wis.—I. H. Moulton.

Notes and Exhibits.

Standard Underground Cable Company entertained its many friends and patrons at Room 5 of the Manufacturers' Club, just across the way. It was duly represented by Messrs. T. E. Hughes, Philadelphia, manager; R. N. Hirst, G. L. Wiley, manager of eastern sales department; P. H. W. Smith, assistant general manager at Pittsburg; A. B. Saurman, manager for the northeastern department at Boston, while General Manager Marsh, vice president, though not much seen, had button 74 against his name as an attendant.

The Maybury-Holmes Party-Line was exhibited in operation in the Keystone Telephone Building. This system is selective. Subscribers not wanted are locked out and are warned that the line is busy. The exhibit was in charge of Messrs. F. E. Maybury and N. H. Holland. The company's address is West Medford, Mass. The basic principle is the engagement and release of a punctured disc by a vertical finger on the receiver lever.

The Russell-Tomlinson Electric Company, Danbury, Conn., was represented by Mr. W. E. Russell. It exhibited in the Keystone Telephone Building its three new types of desk instruments, also receivers and transmitters. Literature was distributed, illustrating its full line of instruments and apparatus.

Vallee Bros. Electrical Company, the prominent Philadelphia supply firm, was represented by its manager, Mr. Thomas L. Townsend.

Leon W. Pullen and R. S. Pullen, of The Leon W. Pullen Electric Company, Philadelphia, were at the convention.

Mr. A. Atwater Kent, of the Atwater Kent Mfg. Works, Philadelphia, was at the convention. This company manufacture the "Monoplex" telephone and popular priced telephone outfits.

H. C. Roberts & Co., Philadelphia, the well-known supply dealers, were represented at the convention by Messrs. H. C. Roberts and John Mustard.

The D. & W. Fuse Company, Providence, R. I., exhibited its admirable telephone protector in its improved form. The company was represented by Mr. W. S. Sisson, the secretary, Mr. W. J. Leggett and Mr. F. C. Jaeger.

New Haven Novelty Machine Company.—The exhibit of the New Haven (Conn.) Novelty Machine Company in the Keystone Telephone Building attracted a great deal of attention. Its main feature was the demonstration of the convenience, economy and waterproof qualities of the "Novelty Slideable Sleeve" and fittings for cable connections, as noted in these pages last week. The gentlemen in charge were Messrs. H. Grant Thompson, Franklin A Thompson and Charles Luke.

The Electric Storage Battery Company had headquarters in parlors at the Walton, where its many friends were welcomed by Mr. E. L. Reynolds, Pa., sales manager, assisted by Messrs. R. C. Hull and H. B. Coho. The company exhibited some of the many types of "Chloride" accumulators, designed especially for telephone work, and called particular attention to the fact that this accumulator has been adopted as the standard for many of the central energy systems of the country. The telephone men were deeply interested in the improvements which have made the use of storage batteries in central energy systems a commercial and operative success, and in some new smaller types of cell shown for exchanges of minor size now adopting this method of operation.

The Helios-Upton Company, Philadelphia, were represented by Chas. D. Meyers and Harry Huskey. While this company made no formal exhibit, circulars were distributed illustrating and describing the Helios-Upton lightning arresters, cable terminals, enclosed fuses, enclosed sneak current protectors and their telephone batteries.

The Viaduct Manufacturing Company, Baltimore, was represented at the convention by Mr. Wm. O. M. Le Bawer, the secretary of the company, and by Mr. Marion B. Davis, their electrician. A central energy switchboard and instruments were exhibited in operation at the offices of the United Telephone and Telegraph Company, in the Fidelity Mutual Building.

Stromberg-Carlson Telephone Manufacturing Company had a very neat exhibit of their famous telephone apparatus at the Keystone Building, illustrating their various types of boards and other parts of their system now in use in some of the largest and best independent telephone exchanges in the country. The headquarters were visited by the delegates in large numbers, and among those prepared to receive them were Messrs. J. J. Nate, whose work did so much to make the recent Interstate affair, at Chicago, such a success; A. J. Rousseau, C. W. Stiger, Eugene L. Brown and S. L. Reese.

Gordon Battery Company had a neat exhibit of their specialties at the Walton, and Mr. W. C. Banks, of Chicago, was on hand to represent their interests.

American Electric Telephone Company, of Chicago, occupied

Rooms 913 and 915 at the Walton, and there received the calls of hosts of friends, many of whom are using the well-known apparatus in their exchanges. The company were represented by Pres. P. C. Burns and by Messrs. H. P. Clausen, John H. Reid, S. J. Bear, J. G. Ihmsen, general manager.

The International Telephone Manufacturing Company, Chicago, were represented at the convention on Thursday by Pres. Henry Shafer, who was prevented from attending the opening by a trip through Canada, where he has just secured several large contracts for a complete central energy exchange equipment. Many of Mr. Shafer's warm personal friends in the independent telephone field complimented him on the many new features he has added to the durability and efficiency of telephone systems embodied in the construction of his company's lamp signal central energy double-supervisory, multiple and trunking switchboards and full line of telephones.

Manhattan Electrical Supply Company, of New York, was well represented by the veteran, I. M. Post.

Darlington Electric Supply Company, of Philadelphia, was represented by Mr. D. Scott Quintin.

U. S. Automatic Telephone Company, of New York, having mercury cup contact apparatus for the receiver, etc., was represented by Mr. E. E. Ries, the well-known inventor.

American Toll Telephone Company, of Cleveland, Ohio, was epresented by Messrs. W. A. Foss and J. R. McLean.

Ericsson Telephone Company, of New York, whose admirable apparatus has but recently been illustrated in these pages, had a neat exhibit at the Walton of their switchboards, models of neatness and finish, and were represented by Messrs. K. Weman and C. E. Monroe.

"Okonite" was ably, wholly and adequately represented by Mr. Geo. T. Manson, who bids fair to enjoy among the independents a well-deserved popularity long since won with a host of Bell friends, on personal grounds, and not forgetting the merits of the wire..

Vallee Electric Supply Company, of Philadelphia, were represented by Mr. G. A. Vallee.

A Wissahickon Drive, given on Tuesday by the Keystone Telephone Company, was a delight to many who had never taken the trip through Fairmount Park. Several tallyhos were in line, and a halt was made for refreshments at the Indian Inn, in the Park.

The Convention Meetings were held in the ball room of the Walton, at the top of the house—a fine hall, but wofully far from the big exhibits in the Keystone Telephone Building. The distance militated seriously against full attendance, while it made inspection of the exhibits not an easy matter. There was plenty of room for the exhibits around the hall antechambers.

D. S. M. Manufacturing Company, of Cleveland, were represented by Mr. G. S. Du Perow, who had an excellent little catalogue as to their telephone hardware specialties.

National India-Rubber Company sent Mr. H. Stanley as one who would probably know as many in the crowd as any other man present.

Electrical World and Engineer occupied Rooms 735-737 at the Walton, and was represented by Pres. J. M. Wakeman, Mr. G. W. Elliott, of the New York office; Mr. C. T. Walker, manager of the Philadelphia office, and Messrs. T. C. Martin and K. G. Martin, of the editorial staff.

Electrical Bureau of the City of Philadelphia was represented by Chief John C. Sager, E. Burk, manager, and F. Maize, first assistant manager.

Walker & Kepler, of Philadelphia, were represented by Mr. H. G. Kepler and Mr. L. J. Costa.

Novelty Electric Company, of Philadelphia, were represented by Secretary C. E. Trump.

American Electrical Works, of Providence, who do a large amount of independent telephone work, were represented by Mr. W. J. Watson, of New York.

S. B. Condit, Jr., & Co., Boston, Mass., was represented by Mr. S. B. Condit, Jr.

Hon. R. F. Broussard, M. C., vice-president of "The Telephone Company of America," Washington, D. C., was present.

G. H. Gharky, of Philadelphia, attended the meetings.

Mr. Geo. Breed, of Drake, Breed Company, Philadelphia, was in frequent attendance.

The American Contracting Company of New York was represented by J. H. Scofield.

Mr. B. S. Barnard looked after the interests of the American Vitrified Conduit Company of New York, and had a small exhibit in the convention room.

Gen. C. H. Barney, of the Monarch Fire Appliance Company, New York, greeted his many friends in the interests of Kilfyre, and distributed a very neat and useful match safe.

The F. Bissell Company, Toledo, Ohio, had an exhibit in their room in the Hotel Walton in charge of Mr. C. M. Hamilton. This exhibit included an assortment of their pole line specialties. Among these were pole seats, conduit rods, man-hole guards, cable distributing boards and trolleys for stringing cables.

Gray Telephone Pay Station, of Hartford, Conn., was ably represented by Mr. E. B. Baker, one of the best posted men going on telephony.

Illinois Electric Specialty Company, of Chicago, sent Mr. F. B. Patton and Mr. P. J. Hertz.

McRoy Clay Works might have been forgotten but for E. F. Kirkpatrick, but with "Kirk" present it was hard to think of anything else. Mr. A Bournonville, of Philadelphia, assisted him in his indefatigable efforts.

Varley Duplex Magnet Company, of New York, had Mr. J. M. Knox on the ground to speak in behalf of their excellent spools.

Rawson Electric Company, of Elyria, Ohio, were represented by Mr. S. B. Rawson himself.

Harrison Construction Company, of Cincinnati, were represented by Mr. P. J. Eubanks.

Waclark Wire Company, of New York, had an active spokesman in Mr. H. F. Sanville.

Smethhurst & Allen, of Philadelphia, were represented by W. A. Smethhurst and R. D. Allen.

Warner Electric Company, of Muncie, Ind., had a fitting and able exponent of their ingenious and excellent pole-changer in Mr. T. W. Warner himself, who showed the apparatus working in connection with the Kellogg exhibit. He distributed also some excellent literature as to this "ringer."

Edison Lamp Works of the General Electric Company were represented by Messrs. F. W. Willcox and H. Westberry, who had much sought-after souvenirs in the shape of miniature lamps as pins and watch charms. Their presence is readily understood in view of the enormous importance of the modern lamp-signal board, to which Mr. Willcox is applying much of the experience learned in other fields.

American Electric Fuse Company, of Chicago, had Mr. Frank C. Jones present to discuss the merits of their familiar apparatus.

Erner-Hopkins Company, of Columbus, Ohio, were represented by Mr. W. A. Hopkins, Jr.

Sterling Electric Company, of Lafayette, Ind., needed no better spokesman than the popular and ubiquitous W. E. Doolittle, the life of every group.

Williams-Abbott Company, of Cleveland, sent Mr. L. Sands and Mr. S. A. Duval.

Nungesser Electric Battery, of Cleveland, was very appropriately explained by Mr. B. P. Nungesser.

Hubbard & Co., of Pittsburg, were represented by Mr. C. Seyler, who distributed a fine catalogue of their pole-line material.

National Conduit and Cable Company, of New York, were represented by Messrs. J. P. McQuade, Eckert and Beylard.

Mr. C. A. Brown, the well-known patent attorney of Chicago, was in town on legal business and could not resist the temptation to drop in on a telephone convention. The art is one he is deeply familiar with these many years.

Mr. J. Allen Heany, of Philadelphia, the well-known inventor, attended the meetings, and took much interest in the exhibits.

The Sumter Telephone Manufacturing Company.—Sumter, S. C., had an impressive exhibit of instruments and parts in Room 900, Hotel Walton. Their new central energy instrument attracted a great deal of attention on account of its compact and convenient form. This company make their own woodwork, and pay special attention to variety and excellence of finish. The exhibit was in charge of Mr. F. C. Manning and Mr. L. G. LeBourveau.

John A. Roebling's Sons Company, Trenton, N. J., were ably represented at their headquarters in the Walton by Messrs. W. L. Doyle, U. G. Tingley, D. F. Ivins, C. B. Cushing and G. W. Swan.

Mr. J. R. Wilson, of the Crocker-Wheeler Electric Company, Ampere, N. J., was at the convention looking after the interests of that company, which has its dynamotor apparatus in a large number of telephone exchanges all over the country.

THE SWEDISH-AMERICAN COMPANY exhibited in the Walton, and its interests were represented by Mr. E. B. Overshiner, who distributed a very neat perfect miniature telephone.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY had a splendid auxiliary exhibit in the Keystone Building. They were represented by Kempster B. Miller, J. C. Belden, Paul W. Bossert, A. E. Barker, S. C. Platt, Arthur B. Kratz, F. J. Dommerque.

JAMES G. BIDDLE, of Philadelphia, made an impressive exhibit of electrical instruments at Room 933, Hotel Walton. It consisted chiefly of cable testing apparatus, a special feature being made of Fisher cable testing sets, which appeal strongly to telephone engineers. These sets are largely used by the U. S. Government as well as by cable manufacturers, telephone exchanges, etc. Mr. Biddle also exhibited a line of high-grade condensers for central energy systems.

LAMBERT SCHMIDT TELEPHONE MANUFACTURING COMPANY had an exhibit at the Keystone Telephone Building of a 200-line common battery switchboard, using automatic self-restoring line drops, supervisory lamps, combination listening and ringing cams, and a 10-drop bridging terminal switchboard, using cams instead of cords, plugs and jacks. They showed in addition to these handsome samples of their switchboard work, a full line of multiple strips, receivers, etc. This exhibit, which attracted much attention, was in charge of Messrs. Lambert Schmidt, Roach and Bostwick.

HOLTZER-CABOT ELECTRIC COMPANY, of Brookline, Mass., represented by Messrs. J. J. Estabrook and D. M. Bliss, in the Keystone Telephone Building, a variety of apparatus, including a Ness automatic desk set, their magneto signalling apparatus, a ringer-dynamotor, for giving alternating current for ringing, and a pulsating current for party-line signals; a small interior telephone for hotel and domestic use, equipped with a new self-contained hook, provided with a silver-pointed rubbing contact, and similar button.

NORTH ELECTRIC COMPANY, of Cleveland, got in on the ground floor at the Keystone Telephone Building, where they had a most artistically arranged room. They had several switchboards set up and in full working order, taking current from a set of chloride accumulators. They illustrated their common battery, target signal system, and magneto switchboards, all set up and running. Their No. 14 switchboard attracted a large amount of well-deserved attention, being available as an automatic target signal, a central calling battery, or a local talking battery, with full supervision, equipped for 100 supervisory lines and 10 toll lines. The North Company, somewhat along the lines of the Globe-Wernicke multiple bookcase people, have worked out a most ingenious, useful and economical system of "unitype" switchboards, which consist of single sections or units uniform in style and appearance, which can be placed side by side, making at once a continuous frame and an extensible exchange, so that as the system grows, the old smaller board need not be scrapped, but can be utilized with newer sections. they were shown as magneto call, target and lamp signal boards in units of 100 or 200 lines. The plan elicited universal admiration as the "Farthest North" in telephony. All the details of the North system were also shown on tables for close exmaination as to parts, durability, etc. The company were represented by Messrs. C. H. North, R. Hendrickson and F. F. Sapp.

ALFRED F. MOORE, E. B. Bartram and W. W. Pawling, of "Alfred F. Moore," Philadelphia, the well-known manufacturers of insulated wire, greeted their many friends among the telephone fraternity.

J. L. PUTNAM and Louis Stillings, of the Clark Automatic Telephone Switchboard Company, Providence, R. I., were very much in evidence at the convention.

CHASE SHAWMUT COMPANY, Boston, Mass., the well-known manufacturers of electrical specialties, were represented by Harry P. Moore. Literature illustrating and descriptive of their "Boston Cable Clip" was distributed freely.

THE WESTERN ELECTRIC COMPANY was represented by Messrs. H. G. Braynard and Fred C. Jaeger, of the Philadelphia store, and they seemed to find themselves very much at home among the independents.

PROF. W. E. GOLDSBOROUGH, of Purdue University, was not only able, as superintendent of its electrical exhibits, to address the convention very instructively as to the St. Louis Fair, but as conducting the only university telephone course in the country, had many opportunities to discuss the desirability of such a course, its prospects and the outlook for young telephone engineers.

THE KEYSTONE TELEPHONE COMPANY, whose exchange was naturally the greatest exhibit and feature of interest at the convention, has now in operation approximately 4,000 telephones connected to the two exchanges known as the Main Exchange, located at Second and Sansom Streets, and the Race Exchange, at Sixteenth and Summer Streets. These two exchanges have both been illustrated and described in the pages of ELECTRICAL WORLD AND ENGINEER. A third exchange, to be located on the corner of Preston and Filbert Streets, is now in the process of construction, and it is anticipated that the exchange will be in operation some time in July. All three of the above exchanges are equipped with complete exchange apparatus furnished by the Kellogg Switchboard and Supply Company. A peculiarity of the Kellogg system, as there seen, is, that all the jacks in the switchboard are disconnected from the lines with which they are associated at all times excepting when they are actually in use for conversation. This is managed by the cut-off relay in the line circuit which at the same time that the lamp signal circuit is disconnected, connects the jacks to the line. In the Kellogg system the worst that can happen when stray currents get in is the destruction of the relay upon the particular line which has come in contact with the wire carrying the foreign current. The relays being individually mounted on the mounting strip, and individually encased in a drawn metallic shell, the damage is confined to the part immediately concerned. Another point in connection with the Kellogg exchanges, is that the jacks on the line have but one spring, and but two metallic connections. The tip of the plug connects with the spring of the jack, and the sleeve of the plug connects to the sleeve of the jack. The sleeve of the jack is also used to furnish the click in the operator's ear, which acts as a busy test. The simplicity of the circuits connected with this system render its liability to trouble very small. Paired cable can be used in the multiple which renders the laying up of the multiple very neat and compact; at the same time, the jacks, having but two soldered connections, are not subject to the ordinary troubles which have heretofore been common in the multiples containing 3, 4, or 5 wires. On account of this feature, several new exchanges now being built by the Kellogg Company will be equipped with jacks which are mounted in strips on three-tenths each centers, notably the big exchanges for Buffalo and Los Angeles, Cal. By this means, it will be possible to place a very much larger number of multiple jacks within the reach of a single operator than has generally been possible. Another feature of the equipment in use in Philadelphia is the mechanical construction of all the relays which are used on the system. The armatures of the relays are bent around the end of the core at an angle which is slightly greater than 90 degrees; the end of the armature which is next to the end of the core, is drawn toward the magnet by the action of the current, and by so doing the opposite end of the armature which engages the springs is raised, thereby making or breaking the spring contacts as desired. This armature is mounted upon a knife edge, eliminating the possibility of sticking. In general the system used by the Keystone Company may be described as a complete central energy multiple system having a two-wire multiple, a line and cut-off relay on each line with lamp signals, the relays being mounted on a rack in a separate room adjacent to the exchange. Supervisory lamps are connected with each cord, the relays controlling the lamps being mounted in the rear of the section. A main distributing frame and intermediate distributing frame are used; incoming and outgoing trunks having lamp supervision and operated in connection with order wires are included in the equipment. All current necessary for the operation of the exchange is furnished from a central battery consisting of two sets of eleven cells each of chloride accumulator battery, which is charged by a special telephone wound charging set which is installed in duplicate. These charging sets are manufactured by the Holtzer-Cabot Company, and are made according to specifications of the engineering department of the Kellogg Switchboard and Supply Company. On the trunk lines "busy back and don't answer" signals are given by means of two different kinds of noise which is introduced on the line from an interrupter and transformer operating in connection with the ringing generators.

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Electrical world

Engineering

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